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Contents

Chapter 1
Summary of findings in the 2008 UK Renal Registry Report

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In 2007, all but one UK renal centre provided electronic data extracts to the UK Renal Registry. In the UK, the acceptance rate in 2007 was 109 per million population (pmp) compared to 111 pmp in 2006. Acceptance rates in England (107 pmp), Scotland (108 pmp) and Northern Ireland (105 pmp) have fallen slightly, whilst that in Wales (140 pmp) has risen. The median age of all incident patients was 64.1 yrs and for non-Whites 57.1 yrs. Diabetic renal disease remained the single most common cause of renal failure (21.9%). By 90 days, 67.4% of patients were on HD, 21.3% on PD, 5.2% were transplanted and 6.1% had died or stopped treatment. The incidence of late presentation (<3months) was 21%.

There were 45,484 adult patients receiving RRT on 31/12/2007. The population prevalence for adults was 746 per million population per year (pmp) with an annual increase in prevalence of approximately 5% per annum. The median age of prevalent RRT patients was 57 yrs (HD 65 yrs, PD 60 yrs, transplant 50 yrs). Median RRT vintage was 5.3 yrs (HD 2.8 yrs, PD 2.1 yrs, transplant 10.4 yrs). The prevalence rates for males peaked in the 75–79 year age band at 2,506 pmp and in females in the 70–74 year age band at 1,314 pmp. The most common treatment modality was transplantation (46.6%), closely followed by centre-based HD (42.1%) in either the primary centre (25.2%) or the satellite unit (16.9%). The HD population has continued to expand, and the PD population to contract.

Increasing live and non-heartbeating donors were responsible for the increasing transplant activity. Transplant waiting list numbers continued to rise by 8%. Graft failure occurred in 3.2% of prevalent transplant patients. Death rates remained stable at 2.3/100 patient years. Malignancy accounted for 21% of these deaths. Analysis of prevalent transplants by CKD stage showed 16% with eGFR <30 and 2.2% <15. Of those in stage 5T, 26% had Hb <10 g/dl, 27% phosphate >1.8 mmol/L and 50% an iPTH >32 pmol/L. These patients were less likely to achieve the UK Standards in comparison to CKD5 dialysis patients.

In the incident RRT cohort, 52% had one or more comorbidities. Diabetes mellitus and ischaemic heart disease were the most common conditions seen in 28.9% and 22.5% of patients respectively. Comorbidities were more common in Whites and were associated with a greater likelihood of starting on HD (rather than PD). In multivariable survival analysis, malignancy and ischaemic/neuropathic ulcers were the strongest predictors of poor survival.

The 2006 unadjusted 1 year after 90 day survival for patients starting RRT was 86%. In incident 18–64 year olds the unadjusted 1 year survival has risen from 85.9% in 1997 to 91.5% in 2006 and for those aged

>65 it has risen from 63.8% to 72.9%. The age adjusted survival of prevalent dialysis patients rose from 85% in 2000 to 89% in 2007. Diabetic patient survival rose from 76.6% in 2000 to 84.0% in 2007. The relative risk of death on RRT compared with the general population was 30 at age 30 years compared with 3 at age 80 years. In the prevalent RRT dialysis population, cardiovascular disease accounted for 34% of deaths, infection 20% and treatment withdrawal 14%.

81% of prevalent HD patients met the UK Clinical Practice Guideline for URR (>65%). This has increased from 56% in 1998 to 81% in 2007.

This year for the first time there has been a small fall (from 85.9% in 2006 to 85.6%) in the percentage of HD patients with a Hb of >10 g/dl. This contrasts with previous annual improvements in this figure and is related to implementation of the new Hb Standard which has a target range of 10.5–12.5 g/dl. The median Hb in prevalent HD patients was 11.6 g/dl with 86% having Hb $\geqslant$10.0 g/dl. The median Hb on PD was 11.9 g/dl with 91% having Hb $\geqslant$10.0 g/dl. In 2007 58% of patients commenced RRT with Hb $\geqslant$10.0 g/dl (median Hb 10.3 g/dl). Of incident patients 81% and 87% had Hb $\geqslant$10.0 g/dl by 3 and 6 months of dialysis treatment respectively. The median ferritin in HD patients was 417 µg/L and 95% had a ferritin $\geqslant$100 µg/L. The median ferritin in PD patients was 255 µg/L with 85% having a ferritin $\geqslant$100 µg/L. The mean ESA dose was higher for HD than PD patients (9,300 vs. 6,100 IU/week).

Serum phosphate was between 1.1–1.8 mmol/L in 53% of HD and 64% of PD patients. Since 2003 there has been annual improvement in phosphate control for both HD and PD patients, largely through a reduction in phosphate >1.8 mmol/L. PD patients this year also showed a reduction in the percentage with a low phosphate. Adjusted calcium was between 2.2–2.6 mmol/L in 73% of HD and 78% of PD patients. Parathyroid hormone was between 16–32 pmol/L in 25% of HD and 27% of PD patients.

Significantly more haemodialysis patients achieved the BP standard (44.6% pre-HD and 48.8% post-HD) than peritoneal dialysis (32.8%) or renal transplant patients (26.7%). Median BP fell significantly between 2000 and 2007 for each treatment modality. There was significant variability in BP control between renal centres ($p < 0.0001$) for haemodialysis and transplant patients. Hypertension was significantly more common in haemodialysis patients with vascular disorders such as diabetes and renovascular disease (56.8 %) than in glomerulonephritis (51.0%) or tubular disorders (45.1 %). The effect was less prominent in peritoneal dialysis and not evident in transplant patients where few achieve the BP standard.

From April 2007, all centres providing RRT in England were asked to provide additional data on patients with MRSA bacteraemia. From April 2007–March 2008, 188 discrete episodes of MRSA bacteraemia were reported in patients receiving dialysis. Over the same period 4,448 MRSA bacteraemias were reported in England, indicating that 4.2% of all cases occurred in dialysis patients. The relative risk of MRSA bacteraemia was about 8 fold higher for a patient using a catheter in comparison to a fistula. The mean rate using just HD patients as the denominator, was 1.14 ± 0.95 episodes/100 patients/year with a range of 0–3.93. Compared to previous registry reports, absolute numbers of reported MRSA bacteraemias has fallen by approximately 62% from 2004.

The UK paediatric RRT population in April 2008 was 875 patients with 74% transplanted. The proportion with grafts from living donors was 34%. For those on dialysis, 57% were on PD. The prevalence under age 16 yrs was 55 pmp and the incidence was 8 pmp. Children from ethnic minority groups were less likely to have an allograft and living donation was also less frequent. The rate of RRT for South Asians was 3 times that of the White and Black populations. Diseases with autosomal recessive inheritance were more common in patients from ethnic minority groups. Renal dysplasia was the most common diagnosis accounting for 33% of prevalent RRT patients. The incidence of cystinosis causing ERF has fallen, reflecting better early treatment. Overall 5 year survival for children with ERF was 91.8%. Five year survival of infants starting dialysis was just 62%.

Chapter 2
Introduction to the 2008 UK Renal Registry Report

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Key Words
UK Renal Registry

Introduction

The UK Renal Registry (UKRR) is part of the UK Renal Association and provides independent, professionally led, audit and analysis of renal replacement therapy (RRT) in the UK. The Registry is funded directly by participating renal centres through an annual capitation fee, currently £17 per patient per annum (2008).

The Registry receives quarterly electronic data extracts from information systems used for clinical and administrative purposes within each renal centre and has developed expertise in mapping data items from each local system to the UKRR database. All but one UK renal centre provided an electronic data extract in 2007; although this centre provided summary data on prevalent patients.

Renal centre populations

The Scottish Renal Registry provided demographic and also haematology and dialysis dose data from the whole of Scotland.

The populations listed below are extremely crude estimates of the population coverage of each renal centre (based on each individual renal centre's own estimate). Work is currently underway to redefine this using geographical mapping of patient populations.

For a list of the IT systems currently used by these centres refer to chapter 15.

Two renal centres were created in 2007 and one is planned for 2009.

1. Doncaster (until 2007 a satellite of Sheffield renal centre)
2. Colchester (new 2007)
3. Hereford (until 2009 a satellite of Birmingham, Queen Elizabeth Hospital)

In the 2007 Report, Chester was incorrectly reported as a new centre, it actually remained part of the Wirral renal centre.

Future coverage by the Registry

From the analyses presented here, it can be seen that the report on the 2007 data covers over 99% of the UK with Colchester the only renal centre unable to return an electronic data extract. This interface is currently being developed.

Table 2.1. Centres in the 2007 Registry Report

	Hospital	Estimated population (millions)
England		**51.1**
Basildon	Basildon Hospital	0.50
Birmingham	Heartlands Hospital	0.60
Birmingham	Queen Elizabeth Hospital	1.82
Bradford	St Luke's Hospital	0.60
Brighton	Royal Sussex County Hospital	0.98
Bristol	Southmead Hospital	1.50
Cambridge	Addenbrookes Hospital	1.42
*Canterbury	Kent & Canterbury Hospital	1.03
Carlisle	Cumberland Infirmary	0.36
Carshalton	St Helier Hospital	1.80
Chelmsford	Broomfield Hospital	0.50
Coventry	Walsgrave Hospital	0.85
Derby	Derby City Hospital	0.48
*Doncaster	Doncaster Royal Infirmary	0.29
Dorset	Dorchester Hospital	0.71
Dudley	Russell's Hall Hospital (previously Wordsley)	0.42
Exeter	Royal Devon and Exeter Hospital	0.75
Gloucester	Gloucester Royal Hospital	0.55
Hull	Hull Royal Infirmary	1.04
Ipswich	The Ipswich Hospital	0.33
Leeds	St James's Hospital & Leeds General Infirmary	2.20
Leicester	Leicester General Hospital	1.80
Liverpool	University Hospital Aintree	0.64
Liverpool	Royal Liverpool University Hospital	0.98
London	St Barts & The Royal London	1.79
*London	St Georges Hospital	0.60
London	Guys & St Thomas' Hospital	1.70
London	Hammersmith, Charing Cross & St Mary's	2.11
London	Kings College Hospital	1.01
London	Royal Free, Middlesex, UCL Hospitals	1.43
Manchester	Hope Hospital	0.94
*Manchester	Manchester Royal Infirmary	2.15
Middlesbrough	James Cook University Hospital	1.00
Newcastle	Freeman Hospital	1.31
Norwich	James Paget Hospital	0.84
Nottingham	Nottingham City Hospital	1.16
Oxford	Churchill Hospital	1.80
Plymouth	Derriford Hospital	0.55
Portsmouth	Queen Alexandra Hospital	2.00
Preston	Royal Preston Hospital	1.48
Reading	Royal Berkshire Hospital	0.60
Sheffield	Northern General Hospital	1.43
Shrewsbury	Royal Shrewsbury Hospital	0.40
Southend	Southend Hospital	0.35
Stevenage	Lister Hospital	1.25
Stoke	North Staffordshire Hospital	0.70
Sunderland	Sunderland Royal Hospital	0.34
Truro	Royal Cornwall Hospital	0.36
Wirral	Arrowe Park Hospital	0.55
Wolverhampton	New Cross Hospital	0.49
York	York District Hospital	0.39
Wales		**2.96**
Bangor	Ysbyty Gwynedd	0.18
Cardiff	University of Wales Hospital	1.30

Table 2.1. Continued

	Hospital	Estimated population (millions)
Clwyd	Ysbyty Clwyd	0.15
Swansea	Morriston Hospital	0.70
Wrexham	Maelor General Hospital	0.32
Northern Ireland		**1.80**
Antrim	Antrim Hospital	
Belfast	Belfast City Hospital	
Derry	Altnagelvin Hospital	
Newry	Daisy Hill Hospital	
Tyrone	Tyrone County Hospital	
Ulster	Ulster Hospital	
Scotland	(via the Scottish Registry)	**5.10**
Aberdeen	Aberdeen Royal Infirmary	
Airdrie	Monklands District General Hospital	
Dunfermline	Queen Margaret Hospital	
Dumfries	Dumfries & Galloway Royal Infirmary	
Dundee	Ninewells Hospital	
Edinburgh	Royal Infirmary	
Glasgow	Royal Infirmary, Western Infirmary & Stobhill General Hospital	
Kilmarnock	Crosshouse Hospital	
Inverness	Raigmore Hospital	

* Renal centre included in the report for the first time

Completeness of returns for four important data items

The Registry has again included a table of completeness for four of the important data items for which it has been trying to improve returns. Centres have been ranked on their average score (table 2.2). Ethnicity, date first seen by nephrologist and comorbidity are not mandatory items in the Scottish Renal Registry returns so these centres have been listed separately.

Software and links to the Registry

There are 13 systems in use by renal centres, some of them commercial and some developed in-house. The Registry has worked with the relevant companies to provide appropriate software links to the Registry. As new data items (e.g. those relating to vascular access) are defined and the need for collection by the Registry accepted, there will be a continuing requirement that these companies provide the necessary enhancements to their systems to permit collection of these items and maintenance of the interface with the Registry for transmission of the new items. The Standards Board of the NHS Information Centre has approved a National Renal Dataset, with the intention that collection of these data items within electronic care records provided by Local Service Providers under Connecting for Health will be mandatory (see chapter 15).

Paediatric Renal Registry links

In the UK at the start of 2008 there were 875 patients under 18 years old who were on renal replacement therapy at the 13 UK paediatric renal centres. In order to integrate with the adult Registry and also benefit from funded resources for data management, the BAPN is combining with the adult Registry and will implement similar automated electronic data capture systems.

Relationship with the Renal Association

The UK Renal Registry Chairman represents the UKRR on the Renal Association Clinical Practice Guidelines Committee. This committee has produced a modular,

Table 2.2. Percentage completeness of data returns

Centre	Ethnicity	Primary diagnosis	Date first seen	Comorbidity	Completeness	Country
Ulster	100.0	100.0	100.0	100.0	100.0	N Ireland
Dorset	94.8	96.6	98.3	94.8	96.1	England
Donc	83.3	100.0	100.0	100.0	95.8	England
Bradfd	92.0	96.6	95.4	98.9	95.7	England
Swanse	94.3	100.0	93.4	92.7	95.1	Wales
Oxford	95.0	98.6	97.8	86.3	94.4	England
Nottm	100.0	100.0	99.2	75.6	93.7	England
Basldn	97.4	100.0	100.0	74.4	92.9	England
York	100.0	77.1	88.2	74.3	84.9	England
Glouc	47.4	96.5	98.2	96.5	84.6	England
Wolve	95.6	100.0	95.5	47.1	84.5	England
Truro	57.8	88.9	93.2	93.3	83.3	England
Sheff	65.1	100.0	97.5	51.8	78.6	England
Derry	85.7	100.0	85.7	42.9	78.6	N Ireland
Ports	77.1	96.2	85.3	54.1	78.2	England
Leic	97.9	82.1	61.9	70.4	78.1	England
Bristol	93.5	83.8	55.6	73.4	76.6	England
Tyrone	86.4	100.0	86.4	31.8	76.1	N Ireland
L Kings	98.4	100.0	0.0	100.0	74.6	England
Newc	99.1	99.1	97.2	0.9	74.1	England
Chelms	63.5	100.0	75.0	53.9	73.1	England
Belfast	92.3	100.0	75.8	24.2	73.1	N Ireland
Sund	90.2	100.0	0.0	100.0	72.5	England
M Hope	96.0	96.0	78.8	9.1	70.0	England
Leeds	77.8	53.0	80.2	65.8	69.2	England
Carlis	96.0	100.0	0.0	80.0	69.0	England
L Barts	95.0	100.0	0.0	73.5	67.1	England
Newry	40.0	100.0	100.0	26.7	66.7	N Ireland
Antrim	97.2	100.0	52.8	13.9	66.0	N Ireland
Middlbr	80.6	99.0	77.6	0.0	64.3	England
Wirral	96.2	90.6	69.2	0.0	64.0	England
Bangor*	100.0	100.0	*0.0	44.4	61.1	Wales
Camb	81.1	99.2	63.8	0.0	61.0	England
Derby	33.3	96.7	0.0	95.0	56.3	England
Carsh	73.0	94.9	0.0	57.1	56.2	England
Sthend	17.6	100.0	0.0	94.1	52.9	England
L St.G	73.0	78.7	0.0	58.4	52.5	England
Redng	100.0	100.0	3.3	0.0	50.8	England
Hull	2.0	99.0	1.0	98.0	50.0	England
B Heart	97.9	100.0	0.0	1.1	49.7	England
B QEH	99.1	96.9	0.5	0.5	49.2	England
Wrexm*	96.3	100.0	*0.0	0.0	49.1	Wales
Plymth	28.9	98.7	1.3	67.1	49.0	England
Prestn	93.8	99.2	0.8	0.0	48.4	England
Shrew*	100.0	90.9	*0.0	1.8	48.2	England
Covnt	91.7	99.1	0.0	0.0	47.7	England
L Rfree	98.9	88.5	0.0	0.0	46.8	England
Dudley	91.4	94.3	0.0	0.0	46.4	England
L West*	58.1	73.4	*0.0	47.0	44.6	England
Liv RI	31.6	100.0	0.0	43.9	43.9	England
Cardff	70.0	99.0	0.5	0.5	42.5	Wales
L Guys	65.3	100.0	0.0	2.0	41.8	England
Norwch	49.1	100.0	12.0	5.6	41.7	England
Stevng	26.7	100.0	36.5	2.3	41.4	England
Ipswi*	42.5	92.5	*0.0	30.0	41.3	England

Table 2.2. Continued

Centre	Ethnicity	Primary diagnosis	Date first seen	Comorbidity	Completeness	Country
Stoke*	8.0	98.9	*0.0	43.7	37.6	England
Brightn	51.3	87.0	0.0	0.9	34.8	England
Liv Ain	35.3	100.0	0.0	2.9	34.6	England
M RI	93.7	32.7	11.3	0.0	34.4	England
Clwyd	4.3	95.7	0.0	0.0	25.0	Wales
Exeter	10.7	35.3	17.6	5.7	17.3	England
Edinb	1.1	100.0				Scotland
D & Gall	0.0	100.0				Scotland
Airdrie	0.0	98.0				Scotland
Inverns	4.0	96.0				Scotland
Glasgw	0.5	91.9				Scotland
Dunfn	0.0	91.9				Scotland
Dundee	1.7	91.7				Scotland
Klmarnk	0.0	59.4				Scotland
Abrdn	0.0	0.0				Scotland

* All first seen dates have been set to missing as at least 20% of the dates returned were the same as the treatment start date

4th edition set of audit measures relating to all aspects of care of patients with kidney disease (http://www.renal.org/pages/pages/guidelines/current.php). Where possible, the UKRR will adapt its data collection procedures so as to be able to report on performance against these audit measures. Some of the data items cannot be collected electronically from renal centre IT systems and for those measures, centres will have to develop local audits. The Chairman also represents the UKRR on the Clinical Affairs Board.

Links with other organisations

UK Transplant and the British Transplantation Society

Close collaboration has developed with UK Transplant (www.nhsbt.nhs.uk) and with the British Transplantation Society (www.bts.org.uk), to produce analyses utilising the coverage of both the NHS BT and Renal Registry databases. The 2007 Report included many new analyses and others have been accepted as papers for publication in peer reviewed journals. A pdf copy of the transplant chapter was distributed to all on the BTS membership list.

Departments of Health and predicting future RRT demand

Registry reports are sent to the Department of Health (DoH) or equivalent body in each UK country in the expectation that the analyses will inform policy relating to the care of patients with established renal failure. Such analyses were important in the development of the National Service Framework in England. The DoH for England is represented on the UKRR Committee.

The Registry is currently working closely with the DoH on producing a new model of predicting future RRT demand by modalities and Primary Care Trust (PCT), adjusting for factors such as age, ethnicity and social deprivation. The first model was produced by Roderick *et al.* and published in the 2002 Registry Report chapter 6, although the Registry data available at that time was insufficient to include adjustment for these demographic factors. The final model will be freely available to all commissioners and providers.

The Information Centre, Connecting for Health, and the Secondary Uses Service

The Registry, together with other professional organisations, provided input into a working party to define the scope of an audit of care of patients with kidney disease in England. The funding for the audit was awarded by the Healthcare Commission (now renamed as the Healthcare Quality Improvement Partnership) to the NHS Information Centre (NHS IC) in association with the Registry. The national audit of vascular access for haemodialysis is ongoing and the audit on patient transport was undertaken in 2008.

Detailed negotiation continues with the Information Centre on how data will flow to the UKRR as the work of Connecting for Health (CfH) evolves. The present model of data extraction from specialty-specific IT systems in each renal centre, would not be sustainable if such specialty-specific systems were no longer supported or used. CfH has now taken the view that specialty-specific systems, fully inter-operable with the main electronic care record, will continue to be necessary to support the care of patients within different medical specialties.

The Registry is keen, to be able to use data from the NHS IC on hospitalisation, surgical procedures and discharge diagnoses and is investigating obtaining the required approval from the Secretary of State to obtain this data linkage.

The Health Protection Agency

Web-based collection of an extended dataset by the Health Protection Agency (HPA) on patients on RRT with methicillin resistant Staphylococcus Aureus (MRSA) bacteraemia was piloted in eight renal centres in 2006–7. This programme is now being extended to the whole of England. The Registry has collaborated with the HPA and the Cleaner Hospitals Team of the Department of Health for England in providing details of main centres and satellite units, to ensure that all patients on RRT developing MRSA bacteraemia can be accurately identified. Together with the HPA, the first joint report on bacteraemias in renal patients in England, is included in chapter 12.

EDTA-ERA Registry

The UKRR sends fully anonymised data to the European Renal Association Registry. Several representatives have participated in discussions regarding the ERA nephroQUEST programme for European countries, which intends to initiate quality initiatives, similar to many of those already undertaken by the UKRR. The nephroQUEST initiative has been granted funding by the European Union and will involve the specification and development of a standardised renal IT data interface for electronic exchange of data (HL7v3). The nephroQUEST group is also investigating the feasibility of funding and co-ordinating pan-European collaboration in anaemia, mineral metabolism and cardiovascular risk studies.

The ERA Registry will finalise a new, more comprehensive, primary renal diagnosis coding system in May 2009.

Commissioning of renal services and Primary Care Trusts/Health Authorities

An Executive summary of the Annual Report is published (as a pdf file) and distributed to all specialised commissioners in the UK. Feedback has been positive.

The East Midlands Public Health Observatory (www.empho.org.uk) has a statutory responsibility on reporting to the Department of Health for England on renal services. The UKRR is working with them to provide a web based geographical output (by PCT for England and Health Authority for other UK countries) of much of the Registry output.

The Registry and clinical governance

This is reported on in chapter 15.

Anonymity and confidentiality

This is reported on in chapter 15.

Data security and confidentiality

Data encryption systems and data security are described in chapter 15.

The National Health Service Act 2006 section 251 and the Health and Social Care Act 2001: section 60 exemption

This is reported on in chapter 15.

New data items and analyses

Pre-RRT care

In order to provide some description of the care prior to start of RRT, the Registry is extending the dataset to include retrospective data from prior to starting RRT (time points 1, 2, 3, 6, 9 and 12 months). This has now been tested at 8 centres and some preliminary analyses have been made available.

Vascular access and PD access

As part of the testing of the National Renal Dataset, UK nephrologists have supported the Registry in developing definitions of data items to describe the construction and use of both vascular access for haemodialysis and PD access. Implementation of the HQIP vascular access audit will result in these data fields becoming available on all renal IT systems. Additionally the pre-specified data items for PD access and complications may also be installed on renal IT systems at the same time as the vascular access software upgrades.

Non-RRT care of patients with stage 5 CKD

The Registry has been awarded funding from Kidney Research UK and the Edith Murphy Foundation to run a pilot project in 8 renal centres, involving collection of data on patients with stage 5 CKD who are not currently receiving RRT. Data will include laboratory variables, comorbidity, the patient's decision about future RRT (if possible), any form of RRT subsequently initiated and the date and cause of death. If successful, these data will allow analysis of the outcomes of 'conservative', 'palliative' or 'supportive' care as well as an estimate of how many patients enter this pathway.

New data items

The Registry has previously produced analyses on phosphate control, lipid control and blood pressure achievement. These analyses are now limited due to the absence of information on medications. The Registry is expanding the dataset to collect this information.

One of the other missing factors is the date on which these measurements were taken (for analyses on HD patients, relating the data to the day of the week). The dataset extraction is being altered to incorporate this. At the same time the quarterly data extraction process will be modified to include monthly laboratory items where available (e.g. up to 3 results per data item per quarter). This additional modification will also be important to the incorporation of CKD 5 patients who are not on RRT.

Peritoneal dialysis

The Registry Committee is acutely aware of the limitations of its analyses on the outcomes of peritoneal dialysis. The Registry is unable to report on membrane function, peritonitis rates, residual renal function, prescription of peritoneal dialysis, net ultrafiltration or delivered peritoneal dialysis dose. Other registries have reported on these, for instance the ANZDATA Registry has reported on the association between peritoneal transport status and outcome (Rumpsfeld M, McDonald SP, Johnson DW). Higher peritoneal transport status is associated with higher mortality and technique failure in the Australian and New Zealand peritoneal dialysis patient populations (J Am Soc Nephrol 2006;17:271–278) and the outcome of peritoneal dialysis after failed kidney transplantation (Badve SV, Hawley CM, McDonald SP, Mudge DW, Rosman JB, Brown FG, Johnson DW: Effect of previously failed kidney transplantation on peritoneal dialysis outcomes in the Australian and New Zealand patient populations. *Nephrol Dial Transplant* 9:9, 2005). With the publication of revised peritoneal dialysis clinical practice guidelines by the Renal Association (http://www.renal.org/guidelines/module3b.html), it is time to put this right.

The problem is not due to a lack of willingness of the Registry to report on these data items – the relevant fields have been defined in the Registry dataset for years. The Registry has written software within Proton to support the calculation of PD KT/V and PET testing. Uptake to use this software by PD teams at Proton sites rather than their commercial standalone PC based systems has been poor. Other non-Proton based renal system IT suppliers have also not integrated such a product into their software having focused, at least initially, on haemodialysis rather than peritoneal dialysis. The calculations required are also more complex in peritoneal dialysis than in haemodialysis; whereas urea reduction ratio can be calculated simply from the pre-dialysis and post-dialysis urea concentration, calculation of peritoneal dialysis dose requires 13 pieces of information, including the results of biochemical tests on each exchange, drain volumes, plasma biochemistry, height, weight and residual renal function. Consistent practice between centres is also required in measurement of dialysis dose in APD patients, accounting for overfill in the calculation of ultrafiltration in CAPD patients and the correction for glucose interference in the measurement of dialysate creatinine concentration. Reliance on commercially provided software for calculation of dialysis dose is not a solution, since different software packages use different approaches to this calculation.

The UK Peritoneal Dialysis Research Network was formed to study encapsulating peritoneal sclerosis, but is now developing a clinical tool, derived from the

GLOBAL fluid study (http://medweb.uwcm.ac.uk/globalfluid/), which accommodates different clinical practices and which will use methods of calculation recommended by the Renal Association Clinical Practice Guidelines committee. It is anticipated that this network will provide a series of recommendations for the uniform collection of relevant data items in each centre, which will lead rapidly to the development of an agreed dataset in a uniform electronic format suitable for extraction and analysis by the Registry.

Support for renal systems managers and informatics staff

For the last 3 years the Registry has provided a forum for a renal informatics meeting supporting development of renal IS & IT staff. Topics included a discussion on current informatics, health informatics professionalism (e.g. UKCHIP), agenda for change and informatics related job profiles, ways to enhance the role of IS managers within the multi-disciplinary team, an update from the NHS Information Centre on the national IT programme, provision by the UKRR of centre specific reports and examples of local renal audits. Encouraged by the feedback from those who attended, the Registry is planning a further meeting for September 2009.

Interpretation of the data within the report

It is important to re-emphasise that for the reasons outlined below, caution must be used in interpretation of any apparent differences between centres.

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 70 centres and then centre Y with the other 69 centres. Thus, 139 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 71 centres were compared with each other, 2,484 such individual comparisons would be made and one would expect to find 124 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 Registry has therefore not tested for 'significant difference' between the highest achiever of a standard and the lowest achiever, as these centres were not identified in advance of looking at the data.

The most appropriate way of testing for significance between individual centres, to see where the differences lie, is not clear. The commonly used Bonferroni test is not applicable to these data, since the individual comparisons are not independent. In several chapters, funnel plots are used to identify significant outliers outside 2 and 3 standard deviations (see chapters 3, 4, 8, 9 and 11).

In chapters 3 and 4, charts are presented to allow PCTs and other organisations representing relatively small populations to assess whether their incidence and prevalence rates for renal failure are significantly different from that expected from the age and ethnic mix of the population they serve.

Future potential

Support for renal specialist registrars undertaking a non-clinical secondment

Through links with the Universities of Southampton and Bristol, training is available in both Epidemiology and Statistics. The Renal Registry now has the funding for 3 registrar positions. Dr Daniel Ford started in August 2007 and Dr Alex Hodsman and Dr Udaya Udayaraj are just completing 3 years working with the Registry both studying for higher degrees. In 2009 their positions will be taken by Dr Clare Castledine and Dr Lynsey Webb.

Dr Raman Rao, Dr Az Ahmad, Dr Alison Armitage, Dr Catherine Byrne and Dr J Rajamahesh have previously completed two years working as a Registry registrar. It is hoped that their positive experiences and publication record will encourage other registrars who are interested in undertaking epidemiological work to consider working with the Registry.

Recent UK Renal Registry peer reviewed publications

1 Udayaraj UP, Steenkamp R, Caskey FJ, Rogers C, Nitsch D, Ansell D, Tomson CR. Blood pressure and mortality risk on peritoneal dialysis. Am J Kidney Dis. 2009 Jan;53(1):70–8. Epub 2008 Nov 22.

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3 Tomson C, Ford D, Ansell D. The UK Renal Registry: an overview. Br J Hosp Med (Lond). 2008 Oct;69(10):548–9.

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11 Caskey FJ, Schober-Halstenberg HJ, Roderick PJ, Edenharter G, Ansell D, Frei U, *et al.* Exploring the differences in epidemiology of treated ESRD between Germany and England and Wales. Am J Kidney Dis. 2006;47(3):445–54.

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13 Roderick P, Nicholson T, Armitage A, Mehta R, Mullee M, Gerard K, *et al.* An evaluation of the costs, effectiveness and quality of renal replacement therapy provision in renal satellite units in England and Wales. Health Technol Assess 2005;9:1–178.

14 Blank L, Peters J, Lumsdon A, O'Donoghue DJ, Feest TG, Scoble J, Wight JP, Bradley J. Regional differences in the provision of adult renal dialysis services in the UK. Quarterly Journal of Medicine 2005;98:183–190.

15 Feest TG, Rajamahesh J, Byrne C, Ahmad A, Ansell A, Burden R, Roderick R. Trends in adult renal replacement therapy in the UK: 1982–2002. Quarterly Journal of Medicine 2005;98:21–28.

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18 Roderick P, Nicholson T, Mehta R, Gerard K, Mullee M, Drey N, Armitage A, Feest T, Greenwood R, Lamping D, Townsend J. A clinical and cost evaluation of hemodialysis in renal satellite units in England and Wales. Am J Kidney Dis. 2004;44:121–31.

19 Roderick P, Davies R, Jones C, Feest T, Smith S, Farrington K. Simulation model of renal replacement therapy: predicting future demand in England. Nephrol Dial Transplant. 2004;19:692–701.

20 Burton C, Ansell D, Taylor H, Dunn E, Feest TG. Management of anaemia in United Kingdom renal units: a report from the UK Renal Registry. Nephrology, Dialysis, Transplantation 2000;15:1022–1028.

The following have been submitted for publication:

1 A V R Rao, D Ansell, J A Gilg, S J Davies, E J Lamb, C R V Tomson. Effect of change in renal replacement therapy modality on laboratory variables: a cohort study from the UK Renal Registry.

2 D Nitsch, L Kadala, P Mangtani, R Steenkamp, D Ansell, C Tomson, I dos Santos Silva, P Roderick. Validation and utility of a computerized South Asian Names and Group Recognition Algorithm (SANGRA) in ascertaining South Asian ethnicity in the national renal registry.

3 I Macdougall, C Tomson, David Ansell. Relative risk of death in UK haemodialysis patients in relation to achieved haemoglobin from 1999 to 2005: an observational study using UK Renal Registry data incorporating 33,373 patient-years of follow-up.

4 U Udayaraj, Y Ben-Shlomo, P Roderick, A Casula, D Ansell, C Tomson, F Caskey. Socioeconomic status, ethnicity and geographical variations in incidence of renal replacement therapy in England and Wales – an ecological study.

5 L Karamadoukis, D Ansell, R Foley, S McDonald, C Tomson, L Trpeski, F Caskey. Towards casemix-adjusted international renal registry comparisons: how can we improve data collection practice?

Commissioned research and reports

1 Feest T, Rajamahesh J, Taylor H, Roderick P. The Provision of Renal Replacement Therapy for adults in the UK 1998. 1998 National Renal Survey, Report for Department of Health.

2 Roderick P, Armitage A, Feest TG, *et al.* An evaluation of the effectiveness, acceptability, accessibility and costs of renal replacement therapy in renal satellite units in England and Wales. Report for Department of Health, 2003.

3 Roderick P, Davies R, Jones C, Feest T, Smith S, Farrington K. Simulation model of renal replacement therapy: predicting future demand in England. HTA report 2003.

4 Feest TG, Byrne C, Ahmad A, Roderick P, Webber S, Dawson P. The Provision of Renal Replacement Therapy in the UK 2002. Report for the Department of Health, 2004.

5 Ansell D, Benoy-Deeney F, Dawson P, Doxford H, Will E. Welsh data validation exercise project report. Report for the Welsh Assembly 2005.

Distribution of the Registry Report

This report will also be distributed to Strategic Health Authorities and all PCTs in England and Commissioners throughout the UK.

Further copies of the report will be sent to individuals or organisations on request: a donation towards the £15 cost of printing and postage will be requested. CDs will also be available. The full report may be downloaded from the Registry website, www.renalreg.org.

Conflict of interest: none

Chapter 3
ESRD incident rates in 2007 in the UK: national and centre-specific analyses

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Key Words
Acceptance rate · Comorbidity · Diabetes · Dialysis · End Stage Renal Disease · End Stage Renal Failure · Ethnicity · Incidence · Late referral · Haemodialysis · Peritoneal dialysis · Primary Care Trust · Renal replacement therapy · Transplantation · Treatment modality

Abstract
Introduction: This chapter describes the characteristics of adult patients starting renal replacement therapy (RRT) in the UK in 2007 and the acceptance rate for RRT in Primary Care Trusts (PCT) or equivalent Health Authority (HA) areas in the UK. ***Methods:*** The basic demographics are reported for all UK centres and clinical characteristics of patients starting RRT from all except 1 centre in the UK. Late presentation, 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 PCTs or equivalent HAs were calculated. ***Results:*** In 2007, the acceptance rate in the UK was 109 per million population (pmp) compared to 111 pmp in 2006. Acceptance rates in England (107 pmp), Scotland (108 pmp) and Northern Ireland (105 pmp) have fallen slightly, whilst that in Wales (140 pmp) has risen. There were wide variations between PCTs/HAs with respect to the standardised ratios which were lower in more PCTs in the North West and South East of England and higher in London, the West Midlands and Wales. The median age of all incident patients was 64.1 years and for non-Whites 57.1 years. There was an excess of males in all age groups starting RRT and nearly 80% of patients were reported to be White. Diabetic renal disease remained the single most common cause of renal failure (21.9%). By 90 days, 67.4% of patients were on haemodialysis, 21.3% on peritoneal dialysis, 5.2% had had a transplant and 6.1% had died or had stopped treatment. The incidence of late presentation in those centres supplying adequate data was 21%. ***Conclusions:*** The acceptance rate has fallen in England, Northern Ireland and Scotland but continues to rise in Wales with wide variations in acceptance rate between PCTs/HAs.

Introduction

This chapter includes analyses regarding adult patients starting renal replacement therapy (RRT) in the UK in 2007. It is divided into 3 sections: regional and national variations in acceptance rate onto RRT in the UK; the demographics and clinical characteristics of all patients starting RRT in the UK; and late presentation to a renal centre for initiation of RRT. The methodology and the results for these analyses are discussed for the 3 sections separately.

The term Established Renal Failure (ERF) used within this chapter is synonymous with the terms of 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.

UK Renal Registry coverage

In 2007, the UK Renal Registry (UKRR) received returns from all 5 renal centres in Wales, all 6 in Northern Ireland and 51 of the 52 in England. Data from all 9 centres in Scotland were obtained from the Scottish Renal Registry. In addition, summary data were obtained separately from Colchester, to enable calculation of whole UK acceptance rates. A degree of caution must still be exercised in view of this extrapolation, although with almost full coverage the reliability of estimates must now be high. The proportion of the population aged over 65 years was similar in the fully covered population (based on PCT/HA areas whose population was thought to be fully covered by participating renal centres) compared with the UK general population. The proportion from ethnic minority groups was 8.1% in the fully covered population compared with 8.0% in the total population. For comparisons between renal centres and between local areas fully covered by the Renal Registry, the data from the Registry are fully valid. Data on children and young adults can be found in chapter 13.

1 Geographical variation in acceptance rates

Equity of access to RRT is an important aim. Need for RRT depends on many factors 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 profile 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 were used to calculate overall age and gender specific acceptance rates. The age and gender breakdown of the population in each PCT area in England or equivalent areas in Scotland, Northern Ireland and Wales were obtained from the 2001 Census data from the Office for National Statistics (ONS) [2]. This population breakdown was extrapolated by the ONS from the 2001 census data to mid-2006 estimates. The population breakdown and the overall acceptance rates were used to calculate the expected age and gender specific acceptance numbers for each PCT or HA area. 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 done 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 or HA area was obtained from the ONS.

Results

In 2007, the number of adult patients starting RRT in the whole UK was 6,644. This equated to an acceptance rate of 109 pmp (table 3.1), slightly less than the 111 pmp in 2006. Acceptance rates in England (107 pmp), Scotland (108 pmp) and Northern Ireland (105 pmp) have fallen slightly, whilst that in Wales remained highest in the UK and increased to 140 pmp (figure 3.1). There continued to be very marked gender differences in take-on rates, 137 pmp (95% CI 132–141) in males and 82 pmp (95% CI 79–86) in females.

Acceptance rates and standardised ratios are shown in table 3.2 for PCTs and HAs with complete coverage by the Registry. The 95% confidence intervals are given for the standardised ratios from the combined years' analysis and ratios which are significantly different from 1 are highlighted provided that the area has been covered for at least three years. 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

Table 3.1. Number of new adult patients starting RRT in the UK in 2007

	England	Wales	Scotland	N Ireland	UK
Centres contributing to UKRR (71)	5,456	416	556	185	**6,613**
All UK centres (71 + 1 = 72)	5,487	416	556	185	**6,644**
*Total estimated population mid 2007 (millions)	51.1	3.0	5.1	1.8	**61.0**
Acceptance rate (pmp)	107	140	108	105	**109**
(95% CI)	(105–110)	(126–153)	(99–117)	(90–120)	**(106–112)**

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

different from national norms the observed acceptance rate for a population of 80,000 would have to be outside the limits of 37 to 181 pmp per year, whilst for a population of 1 million, the limits are from 89 to 129 pmp per year. The plot begins at population 80,000 because below this the number of expected cases is small and the statistical assumptions needed to produce the plot are not valid. Although the largest PCT has about 1.3 million population, the plot extends to 4 million. This is because for the combined years' analysis the population on the x-axis is the area's population multiplied by the number of years that the area has been covered (up to 6). The plot has been curtailed at 4 million, even though a few areas have 'combined populations' above 4 million, as the confidence intervals are relatively consistent above this size.

The crude acceptance rates in 2007 for adults varied from 18 pmp in Armagh (population 56,400) to 302 pmp in Carrickfergus (population 39,800) (table 3.2) but this merely reflected a change in 1 or 2 patients in both these populations. There were similar wide variations in the standardised ratios for acceptance from 0.17 in the Isle of Wight (population 138,200) to 2.95 in Carrickfergus. Changes over the 6 years between 2002 and 2007 showed the wide variations in annual standardised acceptance ratios in areas with small populations. Over the period 2002–2007, of those PCT or HA areas with data for a minimum of 3 years, 39 had significantly low ratios, 51 had high ratios and 118 normal ratios. There were significant differences between regions ($p < 0.0001$), with acceptance rates being lower in more PCTs in North West England and South East England and higher in London, the West Midlands and Wales (table 3.3).

In those PCT/HA areas with significantly high ratios the median percentage of population who were non-

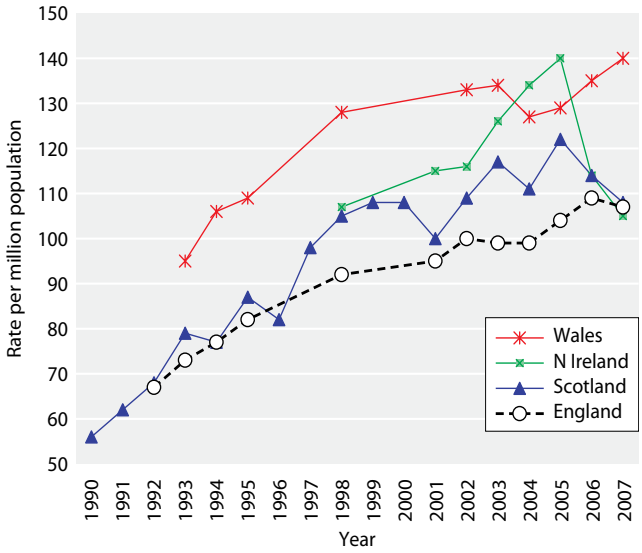

Fig. 3.1. RRT incident rates in the countries of the UK 1990–2007

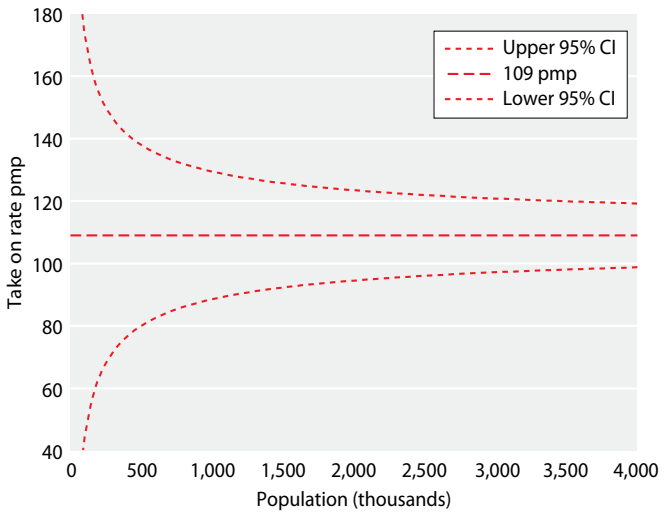

Fig. 3.2. 95% confidence limits for take on rate of 109 pmp for population size 80,000–4 million

Table 3.2. Crude adult annual acceptance rates (pmp [a]) and standardised ratios 2002–2007

[a] per million population
[b] for those areas not covered by the Registry for the entire period 2002–2007, the standardised acceptance ratio and the acceptance rates are averages for the years covered by the Registry
O/E = standardised acceptance ratio
Blank cells – no data returned to the Registry for that year
Areas with data for a minimum 3 years and with significantly high acceptance ratios are bold in darker grey cells, areas with significantly low acceptance ratios are italicised in lighter grey cells
% non-White = the sum of % South Asian and Black from the 2001 UK census

			2002	2003	2004	2005	2006	2007		2002–2007[b]				% non-
UK area	PCT or HA	Tot pop	O/E	O/E	O/E	O/E	O/E	O/E	pmp[a]	O/E	LCL	UCL	pmp	White
North	*County Durham*	*500,400*	*1.01*	*0.79*	*0.88*	*0.94*	*0.85*	*0.70*	*80*	*0.86*	*0.76*	*0.96*	*93*	*1.0*
East	Darlington	99,100	0.93	0.99	0.79	0.46	0.70	1.17	131	0.84	0.64	1.10	89	2.1
	Redcar and Cleveland	139,200	1.85	1.15	1.08	0.76	0.90	0.99	115	1.11	0.91	1.34	122	1.1
	Hartlepool	91,100	0.69	1.32	0.88	0.83	1.37	0.50	55	0.93	0.71	1.22	97	1.1
	Middlesbrough	138,500	1.14	1.16	0.92	1.16	1.44	1.20	123	1.17	0.96	1.44	114	6.3
	North Tees	189,200	0.98	0.88	1.09	0.82	0.83	0.70	74	0.88	0.72	1.07	88	2.7
	Gateshead	190,500	1.16	0.86	1.00	0.90	0.85	0.87	100	0.93	0.78	1.12	101	1.6
	Newcastle	270,400	0.92	0.87	1.11	1.12	0.85	1.27	129	1.03	0.88	1.20	99	6.9
	North Tyneside	195,100	1.03	0.64	0.93	0.83	0.78	0.85	97	0.84	0.69	1.01	91	1.9
	Northumberland	*309,900*	*0.73*	*0.85*	*0.93*	*0.60*	*0.74*	*0.74*	*90*	*0.76*	*0.65*	*0.89*	*88*	*1.0*
	South Tyneside	151,000	0.80	0.70	1.01	0.95	1.01	1.04	119	0.92	0.75	1.13	100	2.7
	Sunderland Teaching	280,600	1.01	1.20	0.64	0.76	0.72	1.07	118	0.90	0.77	1.05	94	1.9
North	Wirral	311,100	0.83	1.04	1.24	1.20	0.73	0.72	84	0.95	0.83	1.10	105	1.7
West	Liverpool	436,200	1.07	0.81	1.11	1.32	1.23	1.08	110	1.11	0.98	1.24	107	5.7
	Central and Eastern Cheshire	451,200						0.67	78	0.67	0.48	0.94	78	1.6
	Western Cheshire	235,100	1.05	0.68	1.07	0.56	0.95	0.80	94	0.85	0.72	1.01	94	1.6
	Knowsley	151,500	0.95	1.32	0.98	0.65	0.74	1.02	106	0.94	0.76	1.16	92	1.6
	Sefton	*277,500*	*1.03*	*0.69*	*0.56*	*0.92*	*0.78*	*0.54*	*65*	*0.75*	*0.64*	*0.89*	*86*	*1.6*
	Halton and St Helens	297,000	0.94	0.79	0.82	1.22	1.19	1.06	114	1.01	0.87	1.17	103	1.2
	Warrington	*194,300*	*1.00*	*0.63*	*0.94*	*0.74*	*0.79*	*0.62*	*67*	*0.78*	*0.64*	*0.96*	*80*	*2.1*
	Blackburn with Darwen	**141,200**	**1.58**	**1.33**	**1.00**	**1.41**	**1.40**	**1.29**	**120**	**1.33**	**1.10**	**1.62**	**118**	**22.0**
	Blackpool	*142,800*	*1.09*	*0.32*	*0.38*	*0.73*	*0.57*	*0.88*	*105*	*0.66*	*0.52*	*0.84*	*75*	*1.6*
	North Lancashire	*329,000*	*0.60*	*0.63*	*0.35*	*0.41*	*0.46*	*0.60*	*73*	*0.51*	*0.42*	*0.61*	*59*	*1.7*
	Cumbria	*496,000*	*0.74*	*0.74*	*0.61*	*0.85*	*0.64*	*0.63*	*77*	*0.70*	*0.62*	*0.80*	*81*	*0.7*
	Central Lancashire	*451,600*	*0.44*	*0.49*	*0.66*	*0.67*	*0.59*	*0.75*	*82*	*0.61*	*0.52*	*0.70*	*63*	*5.6*
	East Lancashire	*384,500*	*0.81*	*0.70*	*0.66*	*0.73*	*0.90*	*0.73*	*78*	*0.76*	*0.65*	*0.88*	*77*	*8.1*
	Ashton, Leigh and Wigan	*305,500*		*0.86*	*0.79*	*0.94*	*0.71*	*0.67*	*72*	*0.79*	*0.66*	*0.94*	*82*	*1.3*
	Bolton	262,500		1.03	0.79	0.71	0.88	0.87	91	0.86	0.71	1.03	87	11.0
	Bury	*182,900*		*0.57*	*0.85*	*0.80*	*0.50*	*0.62*	*66*	*0.67*	*0.52*	*0.85*	*68*	*6.1*
	Manchester	451,900						1.21	104	1.21	0.91	1.61	104	19.0
	Heywood, Middleton and Rochdale	206,400						0.95	97	0.95	0.61	1.47	97	11.4
	Oldham	*219,800*		*0.79*	*0.69*	*0.56*	*0.83*	*0.86*	*86*	*0.75*	*0.60*	*0.93*	*73*	*13.9*
	Salford	*217,800*		*1.36*	*0.53*	*0.41*	*0.90*	*0.49*	*51*	*0.73*	*0.59*	*0.91*	*73*	*3.9*
	Stockport	280,800						0.79	89	0.79	0.53	1.17	89	4.3
	Tameside and Glossop	247,700						1.38	145	1.38	1.00	1.92	145	4.9
	Trafford	212,100						0.96	104	0.96	0.63	1.46	104	8.4

Table 3.2. Continued

UK area	PCT or HA	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 pmp[a]	2002–2007[b] O/E	2002–2007[b] LCL	2002–2007[b] UCL	2002–2007[b] pmp	% non-White
Yorkshire and the Humber	*East Riding of Yorkshire*	*331,100*	*0.84*	*1.02*	*0.69*	*1.03*	*0.59*	*0.68*	*85*	*0.80*	*0.70*	*0.93*	*95*	*1.2*
	Hull	256,200	1.08	0.98	1.19	1.28	0.76	1.01	101	1.04	0.89	1.22	100	2.3
	North East Lincolnshire	159,900	1.16	0.68	1.04	1.21	1.03	1.12	125	1.04	0.86	1.26	110	1.4
	North Lincolnshire	155,200	0.96	0.67	1.39	0.97	0.97	0.78	90	0.95	0.78	1.16	105	2.5
	North Yorkshire and York	783,200	1.29	1.10	1.01	0.89	0.85	0.73	86	0.97	0.89	1.06	108	1.4
	Barnsley	223,700	1.11	0.71	0.88	0.75	0.94	0.84	94	0.87	0.73	1.04	92	0.9
	Doncaster	*290,400*	*0.92*	*1.02*	*0.87*	*0.73*	*0.81*	*0.58*	*65*	*0.82*	*0.70*	*0.96*	*87*	*2.3*
	Rotherham	253,000	0.87	0.95	1.18	1.11	0.91	1.04	115	1.01	0.86	1.18	105	3.1
	Sheffield	526,100	1.02	0.97	1.20	1.08	1.11	1.18	124	1.10	0.99	1.22	109	8.8
	Bradford and Airedale	**493,000**	**1.34**	**1.55**	**1.27**	**1.35**	**0.84**	**1.56**	**150**	**1.31**	**1.18**	**1.46**	**120**	**21.7**
	Calderdale	198,600	0.76	1.35	0.93	0.78	0.92	0.75	81	0.91	0.76	1.10	92	7.0
	Wakefield District	*321,000*	*0.82*	*0.88*	*1.06*	*0.64*	*0.99*	*0.57*	*62*	*0.82*	*0.71*	*0.96*	*86*	*2.3*
	Kirklees	398,400	1.24	1.26	1.31	0.76	1.21	0.68	70	1.07	0.94	1.21	104	14.4
	Leeds	750,300	0.89	1.06	0.99	1.18	0.95	0.80	80	0.98	0.89	1.07	93	8.1
East Midlands	**Leicester City**	**289,700**	**1.63**	**1.71**	**1.34**	**1.49**	**1.60**	**1.86**	**169**	**1.61**	**1.42**	**1.82**	**138**	**36.1**
	Leicestershire County and Rutland	*673,600*	*0.81*	*0.80*	*0.71*	*0.79*	*0.83*	*0.87*	*98*	*0.80*	*0.72*	*0.89*	*86*	*5.1*
	Northamptonshire	*669,200*	*0.92*	*0.74*	*0.72*	*0.83*	*0.87*	*0.98*	*103*	*0.85*	*0.76*	*0.94*	*84*	*4.9*
	Nottinghamshire County	657,500	0.86	1.07	1.02	1.21	1.17	1.09	125	1.08	0.98	1.18	116	2.8
	Bassetlaw	111,000	0.72	0.94	0.60	1.04	0.60	1.63	189	0.93	0.73	1.18	102	1.4
	Derby City	236,400		0.93	1.05	1.16	1.17	0.89	93	1.04	0.87	1.24	106	12.6
	Derbyshire County	*720,800*	*0.45*	*0.85*	*0.70*	*0.69*	*0.66*	*0.77*	*90*	*0.69*	*0.62*	*0.77*	*76*	*1.5*
	Lincolnshire	*688,700*	*0.61*	*0.58*	*0.74*	*1.02*	*0.84*	*0.82*	*102*	*0.77*	*0.70*	*0.86*	*91*	*1.4*
	Nottingham City	286,400	0.72	0.93	1.19	1.43	1.29	0.93	84	1.09	0.93	1.27	93	15.1
West Midlands	Dudley	305,200	0.62	0.81	1.18	1.00	0.91	0.86	98	0.90	0.78	1.04	98	6.4
	Birmingham East and North	**395,900**			**1.58**	**1.86**	**1.81**	**1.32**	**131**	**1.64**	**1.45**	**1.86**	**160**	**22.3**
	Heart of Birmingham Teaching	**271,400**			**2.24**	**2.11**	**2.37**	**2.62**	**206**	**2.34**	**2.03**	**2.69**	**181**	**59.9**
	South Birmingham	**339,400**			**1.62**	**1.19**	**1.07**	**1.33**	**133**	**1.30**	**1.12**	**1.51**	**126**	**15.1**
	Sandwell	**287,700**			**1.91**	**1.49**	**1.31**	**1.55**	**163**	**1.56**	**1.35**	**1.80**	**161**	**20.3**
	Solihull	203,000	0.74	1.56	1.22	1.11	1.25	0.81	94	1.12	0.95	1.31	122	5.4
	Walsall Teaching	**254,700**	**1.35**	**1.25**	**1.55**	**1.13**	**1.45**	**1.18**	**130**	**1.32**	**1.15**	**1.51**	**138**	**13.6**
	Wolverhampton City	**236,900**	**1.78**	**1.70**	**1.65**	**1.63**	**1.24**	**1.01**	**110**	**1.49**	**1.30**	**1.70**	**154**	**22.2**
	Coventry Teaching	**306,600**	**1.58**	**1.21**	**0.89**	**0.97**	**1.14**	**1.30**	**130**	**1.17**	**1.02**	**1.35**	**112**	**16.0**
	Herefordshire	178,000			0.92	0.77	0.73	0.80	101	0.80	0.64	1.01	100	0.9
	Warwickshire	522,300	0.97	0.72	0.88	0.97	1.04	1.02	117	0.94	0.84	1.04	101	4.4
	Worcestershire	*553,000*			*0.93*	*0.80*	*0.65*	*0.83*	*98*	*0.80*	*0.70*	*0.92*	*91*	*2.4*
	North Staffordshire	211,400						0.56	66	0.56	0.33	0.95	66	1.5
	South Staffordshire	603,500						0.96	109	0.96	0.76	1.22	109	2.7
	Shropshire County	289,500			1.10	0.83	0.98	0.64	79	0.88	0.74	1.05	107	1.2
	Stoke on Trent	247,600						1.22	133	1.22	0.87	1.72	133	5.1
	Telford and Wrekin	161,800			1.34	0.82	1.13	1.59	161	1.22	0.98	1.52	121	5.2
East of England	*Bedfordshire*	*403,600*	*0.93*	*0.93*	*0.83*	*0.68*	*1.10*	*0.59*	*62*	*0.84*	*0.73*	*0.97*	*84*	*6.7*
	Luton	**187,200**	**0.92**	**1.74**	**0.87**	**1.58**	**1.05**	**1.42**	**134**	**1.27**	**1.07**	**1.51**	**113**	**28.1**
	West Hertfordshire	*530,600*	*0.64*	*0.63*	*0.62*	*0.74*	*1.00*	*0.89*	*94*	*0.76*	*0.67*	*0.86*	*76*	*7.6*
	East and North Hertfordshire	*527,800*	*0.85*	*0.95*	*0.71*	*0.76*	*0.89*	*0.66*	*70*	*0.80*	*0.71*	*0.90*	*80*	*5.0*
	Mid Essex	361,400			1.13	0.86	0.98	0.96	105	0.98	0.84	1.15	105	2.4
	North East Essex													2.6
	South East Essex	329,900			1.21	0.90	1.15	1.03	121	1.07	0.92	1.25	124	3.0

Table 3.2. Continued

UK area	PCT or HA	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 pmp[a]	2002–2007[b] O/E	2002–2007[b] LCL	2002–2007[b] UCL	2002–2007[b] pmp	% non-White
East of	South West Essex	388,300			1.27	0.81	1.10	0.96	100	1.03	0.89	1.20	106	3.8
England	*West Essex*	*274,700*			*1.01*	*0.71*	*0.77*	*0.72*	*80*	*0.80*	*0.65*	*0.98*	*86*	*4.2*
	Cambridgeshire	*589,600*	*0.66*	*0.82*	*0.90*	*0.92*	*1.10*	*0.91*	*97*	*0.89*	*0.80*	*1.00*	*90*	*4.1*
	Peterborough	163,400	1.19	1.14	0.93	1.26	1.19	1.03	104	1.12	0.93	1.36	107	10.3
	Norfolk	738,900			0.89	1.19	1.01	1.05	133	1.04	0.94	1.15	128	1.5
	Suffolk	585,300			0.80	0.99	0.80	0.95	111	0.88	0.78	1.00	101	3.1
	Great Yarmouth and Waveney	**210,600**			**1.46**	**1.26**	**1.26**	**1.15**	**147**	**1.28**	**1.08**	**1.52**	**160**	**1.3**
London	**Barnet**	**328,400**				**0.80**	**1.48**	**1.77**	**174**	**1.36**	**1.14**	**1.61**	**133**	**26.0**
	Camden	227,200				0.77	1.31	1.28	106	1.12	0.88	1.44	92	26.8
	Enfield	**285,400**				**1.04**	**1.58**	**1.09**	**105**	**1.24**	**1.02**	**1.51**	**120**	**22.9**
	Haringey Teaching	**225,600**				**1.44**	**1.36**	**1.24**	**102**	**1.35**	**1.07**	**1.69**	**111**	**34.4**
	Islington	**185,500**				**1.74**	**1.66**	**1.44**	**119**	**1.61**	**1.28**	**2.03**	**133**	**24.6**
	Barking and Dagenham	165,400			1.24	0.76	0.78	0.87	79	0.90	0.69	1.18	80	14.8
	City and Hackney Teaching	216,200					1.31	1.34	106	1.32	0.99	1.76	106	39.7
	Havering	227,500					0.97	0.77	88	0.87	0.65	1.17	101	4.8
	Newham	**248,300**			**2.01**	**2.39**	**2.42**	**1.83**	**137**	**2.17**	**1.85**	**2.53**	**158**	**60.6**
	Redbridge	251,800			1.42	0.99	0.97	1.33	127	1.17	0.97	1.41	109	36.5
	Tower Hamlets	**212,500**			**1.32**	**1.43**	**1.50**	**1.72**	**127**	**1.50**	**1.22**	**1.84**	**108**	**48.6**
	Waltham Forest	222,100					1.82	2.43	212	2.12	1.71	2.63	187	35.5
	Brent Teaching	271,400					1.72	2.66	243	2.18	1.81	2.63	203	54.7
	Ealing	**306,400**	**1.99**	**1.96**	**2.37**	**1.60**	**1.51**	**2.48**	**225**	**1.98**	**1.77**	**2.21**	**170**	**41.3**
	Hammersmith and Fulham	**171,400**	**1.71**	**1.98**	**1.78**	**1.05**	**1.07**	**1.22**	**105**	**1.45**	**1.22**	**1.74**	**119**	**22.2**
	Harrow	214,600					1.44	1.39	140	1.41	1.10	1.81	144	41.2
	Hillingdon	**250,100**			**1.44**	**1.10**	**1.48**	**1.19**	**116**	**1.30**	**1.09**	**1.56**	**124**	**20.9**
	Hounslow	**218,600**			**2.24**	**1.58**	**1.69**	**1.73**	**156**	**1.80**	**1.52**	**2.13**	**158**	**35.1**
	Kensington and Chelsea	178,000					0.80	0.76	73	0.78	0.53	1.14	76	21.4
	Westminster	231,700					1.39	1.18	108	1.29	0.99	1.68	119	26.8
	Bexley	221,600	1.26	1.06	0.78	0.95	1.06	1.14	122	1.04	0.88	1.23	106	8.6
	Bromley	299,400	0.91	0.97	1.00	1.04	0.86	0.70	77	0.91	0.78	1.06	95	8.4
	Greenwich Teaching	**222,600**	**1.57**	**1.43**	**0.55**	**2.13**	**0.98**	**1.56**	**139**	**1.37**	**1.17**	**1.60**	**116**	**22.9**
	Lambeth	**272,200**	**1.63**	**1.38**	**1.50**	**1.83**	**1.48**	**2.01**	**162**	**1.64**	**1.43**	**1.88**	**126**	**37.6**
	Lewisham	**255,600**	**1.87**	**1.01**	**1.94**	**1.86**	**1.63**	**2.13**	**180**	**1.74**	**1.52**	**1.99**	**140**	**34.1**
	Southwark	**269,000**	**1.77**	**1.42**	**1.19**	**1.82**	**1.50**	**2.35**	**193**	**1.68**	**1.47**	**1.93**	**131**	**37.0**
	Croydon	**337,000**	**1.57**	**1.29**	**1.18**	**1.62**	**1.02**	**1.66**	**160**	**1.39**	**1.23**	**1.57**	**127**	**29.8**
	Kingston	156,000						0.95	90	0.95	0.56	1.61	90	15.5
	Richmond and Twickenham	179,500						0.85	84	0.85	0.51	1.41	84	9.0
	Sutton and Merton	382,000						1.36	131	1.36	1.03	1.80	131	18.1
	Wandsworth	279,200						1.90	158	1.90	1.41	2.55	158	22.0
South	*Isle of Wight*	*138,200*	*0.70*	*0.67*	*0.66*	*0.40*	*0.53*	*0.17*	*22*	*0.51*	*0.39*	*0.67*	*64*	*1.3*
East	*Hampshire*	*1,265,900*	*0.75*	*0.70*	*0.61*	*0.69*	*0.81*	*0.80*	*91*	*0.73*	*0.68*	*0.79*	*79*	*2.2*
	Portsmouth City Teaching	*196,300*	*0.67*	*0.92*	*0.58*	*0.70*	*0.77*	*0.95*	*92*	*0.77*	*0.62*	*0.95*	*70*	*5.3*
	Southampton City	*229,100*	*0.80*	*0.85*	*0.65*	*0.71*	*0.76*	*0.87*	*83*	*0.78*	*0.64*	*0.95*	*70*	*7.6*
	West Kent													3.9
	Medway													5.4
	Eastern and Coastal Kent													2.4
	Hastings and Rother	176,200			1.05	0.72	1.06	0.57	74	0.85	0.68	1.06	108	2.4
	Brighton and Hove City	251,500			1.04	0.85	0.88	0.87	87	0.91	0.74	1.12	89	5.7
	East Sussex Downs and Weald	330,200			1.18	0.68	0.93	0.78	100	0.89	0.76	1.04	112	2.3

Table 3.2. Continued

UK area	PCT or HA	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 pmp[a]	2002–2007[b] O/E	2002–2007[b] LCL	2002–2007[b] UCL	2002–2007[b] pmp	% non-White
South East	*Surrey*	*1,073,400*			*0.77*	*0.61*	*0.80*	*0.81*	*89*	*0.75*	*0.67*	*0.83*	*81*	*4.9*
	West Sussex	*770,600*			*0.59*	*0.81*	*0.87*	*0.82*	*100*	*0.78*	*0.69*	*0.87*	*93*	*3.4*
	Milton Keynes	230,100	0.88	1.25	0.99	0.79	0.83	1.18	109	0.98	0.82	1.18	85	9.1
	Berkshire East	382,200	0.69	0.98	0.92	1.22	1.23	1.32	128	1.07	0.94	1.22	99	16.0
	Berkshire West	445,400	0.63	1.04	0.94	1.00	0.94	0.97	97	0.93	0.81	1.05	87	7.3
	Oxfordshire	*607,400*	*0.88*	*1.10*	*0.73*	*0.89*	*0.85*	*0.70*	*72*	*0.86*	*0.77*	*0.96*	*84*	*5.0*
	Buckinghamshire	*500,700*	*0.77*	*0.78*	*0.81*	*0.63*	*0.68*	*0.78*	*84*	*0.74*	*0.65*	*0.84*	*76*	*7.7*
South West	Bath and North East Somerset	175,600	0.65	0.73	1.34	1.00	0.84	1.02	114	0.93	0.77	1.13	99	2.8
	Bristol	**410,700**	**0.97**	**1.39**	**1.25**	**1.20**	**1.36**	**1.01**	**97**	**1.20**	**1.07**	**1.35**	**109**	**8.2**
	Gloucestershire	*578,500*	*0.84*	*0.86*	*0.91*	*0.85*	*1.01*	*0.89*	*104*	*0.90*	*0.81*	*1.00*	*99*	*2.9*
	Swindon	192,600	1.06	1.00	1.17	0.84	0.79	0.51	52	0.88	0.73	1.08	86	4.8
	South Gloucestershire	254,200	1.21	0.99	0.99	1.12	1.02	0.90	98	1.04	0.89	1.21	107	2.4
	Wiltshire	*448,600*	*0.45*	*0.61*	*0.54*	*0.81*	*0.68*	*0.67*	*76*	*0.63*	*0.55*	*0.73*	*68*	*1.6*
	Bournemouth and Poole	*297,900*			*0.70*	*0.66*	*0.68*	*0.61*	*74*	*0.66*	*0.54*	*0.81*	*78*	*2.6*
	Dorset	*403,100*			*0.73*	*0.56*	*0.53*	*0.69*	*94*	*0.62*	*0.53*	*0.74*	*84*	*1.2*
	North Somerset	201,200	0.85	1.31	1.20	1.14	0.91	0.82	99	1.03	0.88	1.22	119	1.4
	Somerset	*518,800*	*0.92*	*0.81*	*0.87*	*0.63*	*0.76*	*0.67*	*83*	*0.77*	*0.69*	*0.87*	*90*	*1.2*
	Devon	740,600	0.82	0.85	1.02	1.01	0.90	1.01	128	0.94	0.86	1.03	113	1.1
	Plymouth Teaching	**247,900**	**1.54**	**1.46**	**1.12**	**1.06**	**1.86**	**1.75**	**186**	**1.47**	**1.29**	**1.68**	**148**	**1.6**
	Torbay	133,000	0.47	1.09	1.32	1.01	0.79	0.93	120	0.94	0.76	1.15	115	1.2
	Cornwall and Isles of Scilly	526,200	1.48	1.20	1.35	0.71	1.02	0.92	116	1.10	1.00	1.21	132	1.0
Wales	**Cardiff**	**317,500**	**1.71**	**1.65**	**1.39**	**1.35**	**1.34**	**1.50**	**145**	**1.48**	**1.31**	**1.68**	**135**	**8.4**
	Merthyr Tydfil	**55,800**	**1.87**	**1.78**	**2.47**	**1.83**	**2.83**	**1.78**	**197**	**2.10**	**1.68**	**2.64**	**221**	**1.0**
	Rhondda, Cynon, Taff	**234,100**	**1.57**	**1.11**	**1.66**	**1.41**	**1.36**	**1.48**	**162**	**1.43**	**1.25**	**1.64**	**149**	**1.2**
	Vale of Glamorgan	123,200	1.16	0.95	1.26	0.74	1.40	1.01	114	1.09	0.88	1.34	116	2.2
	Carmarthenshire	**177,800**	**1.10**	**1.41**	**1.14**	**1.12**	**1.02**	**1.32**	**163**	**1.18**	**1.01**	**1.39**	**139**	**0.9**
	Ceredigion	77,100	1.36	0.59	1.05	0.66	0.41	0.85	104	0.81	0.60	1.09	93	1.4
	Pembrokeshire	116,800	0.87	1.21	0.75	1.13	0.93	0.82	103	0.95	0.76	1.18	113	0.9
	Powys	130,900	0.68	0.33	0.96	1.21	0.80	1.06	138	0.85	0.68	1.05	104	0.9
	Blaenau Gwent	69,500	1.32	0.14	1.11	1.18	0.99	1.02	115	0.96	0.71	1.29	103	0.8
	Caerphilly	**171,300**	**1.62**	**1.07**	**1.06**	**1.61**	**1.31**	**1.73**	**187**	**1.40**	**1.19**	**1.65**	**144**	**0.9**
	Monmouthshire	87,800	1.18	0.72	1.01	1.15	0.90	0.65	80	0.93	0.72	1.20	108	1.1
	Newport	140,500	1.07	1.46	0.94	0.96	1.09	1.26	135	1.13	0.93	1.38	115	4.8
	Torfaen	91,000	1.45	1.17	0.95	0.90	0.94	1.35	154	1.12	0.88	1.43	121	0.9
	Bridgend	**132,600**	**1.16**	**1.69**	**1.31**	**1.10**	**1.49**	**1.74**	**196**	**1.42**	**1.19**	**1.70**	**152**	**1.4**
	Neath Port Talbot	**137,100**	**1.44**	**1.51**	**1.29**	**0.90**	**1.33**	**1.68**	**197**	**1.36**	**1.14**	**1.62**	**151**	**1.1**
	Swansea	**227,000**	**1.46**	**1.72**	**1.21**	**1.06**	**1.34**	**1.15**	**132**	**1.32**	**1.14**	**1.51**	**144**	**2.2**
	Conwy	111,300	1.24	0.52	1.17	0.76	1.05	1.21	162	0.99	0.80	1.23	126	1.0
	Denbighshire	95,900	0.68	0.37	1.01	1.82	0.57	0.67	83	0.86	0.66	1.11	101	1.2
	Flintshire	150,000	1.17	1.25	1.04	1.29	1.10	1.13	127	1.17	0.97	1.40	123	0.8
	Gwynedd	**118,200**	**1.54**	**1.39**	**1.22**	**1.52**	**1.71**	**1.54**	**186**	**1.49**	**1.25**	**1.78**	**171**	**1.2**
	Isle of Anglesey	**68,800**	**0.94**	**1.42**	**1.15**	**1.69**	**1.25**	**1.64**	**203**	**1.36**	**1.07**	**1.73**	**160**	**0.7**
	Wrexham	131,000	1.03	1.29	0.83	1.14	0.87	0.89	99	1.00	0.81	1.25	106	1.1
Scotland	Aberdeen City	207,000	1.14	1.03	1.77	1.11	0.79	0.72	77	1.08	0.91	1.28	110	2.9
	Aberdeenshire	236,300	1.10	0.76	0.88	0.98	0.74	1.21	135	0.94	0.80	1.11	99	0.7
	Angus	109,500	2.16	0.91	1.31	1.08	0.80	1.05	128	1.20	0.98	1.48	139	0.8
	Argyll & Bute	91,200	0.70	1.44	0.95	0.81	0.76	1.05	132	0.95	0.74	1.22	113	0.8
	Scottish Borders	110,300	0.93	0.73	1.36	0.76	0.93	1.25	154	0.99	0.79	1.24	116	0.6

Table 3.2. Continued

UK area	PCT or HA	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 pmp[a]	2002–2007[b] O/E	2002–2007[b] LCL	2002–2007[b] UCL	2002–2007[b] pmp	% non-White
Scotland	Clackmannanshire	48,800	0.87	1.45	1.03	1.16	0.73	1.50	164	1.12	0.80	1.57	116	0.8
	West Dunbartonshire	91,100	0.59	0.67	1.45	0.42	1.38	0.71	77	0.87	0.66	1.16	90	0.7
	Dumfries & Galloway	148,000	1.32	1.38	1.03	1.24	1.06	0.84	108	1.14	0.95	1.36	140	0.7
	Dundee City	**142,100**	**1.51**	**1.99**	**1.36**	**2.31**	**1.46**	**1.69**	**190**	**1.72**	**1.47**	**2.01**	**184**	**3.7**
	East Ayrshire	119,300	0.77	1.22	0.73	1.22	1.65	0.81	92	1.08	0.87	1.34	116	0.7
	East Dunbartonshire	105,700	0.75	1.35	0.71	0.67	1.27	0.65	76	0.90	0.71	1.16	99	3.1
	East Lothian	92,600	0.97	0.31	0.82	1.06	0.73	1.50	173	0.90	0.69	1.18	99	0.7
	East Renfrewshire	89,000	0.46	0.99	0.88	1.24	0.97	1.10	124	0.95	0.73	1.24	101	3.8
	Edinburgh, City of	463,300	0.78	1.11	1.07	1.03	1.03	0.72	73	0.96	0.85	1.08	92	4.1
	Falkirk	149,500	0.64	0.67	0.60	1.14	0.89	1.47	161	0.92	0.74	1.13	95	1.0
	Fife	359,200	1.12	0.96	1.01	1.38	1.04	0.94	106	1.07	0.95	1.22	114	1.3
	Glasgow City	**580,600**	**1.38**	**1.85**	**1.50**	**1.33**	**1.20**	**1.07**	**107**	**1.38**	**1.26**	**1.51**	**130**	**5.5**
	Highland	**215,400**	**1.30**	**1.37**	**1.24**	**1.81**	**0.91**	**0.86**	**102**	**1.24**	**1.07**	**1.43**	**140**	**0.8**
	Inverclyde	81,300	2.38	1.19	1.07	1.01	0.84	1.09	123	1.24	0.97	1.58	133	0.9
	Midlothian	**79,000**	**1.06**	**1.77**	**2.14**	**1.07**	**1.56**	**0.92**	**101**	**1.41**	**1.12**	**1.79**	**148**	**0.9**
	Moray	86,700	0.91	1.30	0.97	1.32	1.34	0.59	69	1.07	0.84	1.38	119	0.9
	North Ayrshire	**135,300**	**1.41**	**1.20**	**1.27**	**1.26**	**1.57**	**0.64**	**74**	**1.22**	**1.01**	**1.48**	**133**	**0.7**
	North Lanarkshire	323,700	1.20	1.27	0.98	0.80	0.92	1.04	108	1.03	0.89	1.18	101	1.3
	Orkney Islands	20,000	1.44	1.83	0.45	1.29	0.81	0.42	50	1.02	0.61	1.73	117	0.4
	Perth & Kinross	140,200	1.21	1.28	1.27	0.84	0.68	0.99	121	1.03	0.85	1.26	120	1.0
	Renfrewshire	**169,300**	**1.79**	**1.23**	**1.23**	**1.27**	**0.93**	**0.96**	**106**	**1.22**	**1.03**	**1.45**	**128**	**1.2**
	Shetland Islands	22,000	0.00	0.45	1.33	0.42	0.00	1.62	182	0.64	0.33	1.24	68	1.1
	South Ayrshire	111,900	0.66	1.18	0.70	1.03	0.69	0.86	107	0.85	0.67	1.08	101	0.7
	South Lanarkshire	307,700	1.23	0.94	0.97	0.86	1.01	0.89	97	0.98	0.85	1.13	102	1.1
	Stirling	87,600	0.73	0.69	0.69	0.32	1.02	1.05	114	0.76	0.56	1.03	78	1.5
	West Lothian	165,700	0.92	0.53	0.60	1.13	1.07	0.73	72	0.84	0.67	1.04	78	1.3
	Eilean Siar	25,900	0.71	1.01	1.34	0.00	0.89	1.83	232	0.97	0.61	1.54	116	0.6
N Ireland	**Antrim**	**51,500**				**2.40**	**1.64**	**1.26**	**117**	**1.76**	**1.19**	**2.60**	**162**	**0.5**
	Ards	76,000				1.02	0.84	0.86	92	0.90	0.59	1.37	96	0.9
	Armagh	56,400				1.91	0.72	0.19	18	0.93	0.56	1.54	89	0.5
	Ballymena	61,400				1.27	1.05	1.55	163	1.29	0.87	1.91	136	1.3
	Ballymoney	29,300				1.81	0.68	1.76	171	1.41	0.80	2.48	137	0.6
	Banbridge	45,400				0.96	1.35	0.69	66	1.01	0.58	1.73	95	0.4
	Belfast	**267,600**				**1.24**	**1.40**	**1.48**	**146**	**1.38**	**1.14**	**1.66**	**136**	**0.4**
	Carrickfergus	**39,800**				**2.53**	**2.15**	**2.95**	**302**	**2.54**	**1.78**	**3.61**	**260**	**0.3**
	Castlereagh	**65,600**				**2.39**	**1.33**	**0.69**	**76**	**1.46**	**1.03**	**2.06**	**163**	**0.4**
	Coleraine	**56,900**				**2.56**	**0.97**	**1.49**	**158**	**1.66**	**1.16**	**2.37**	**176**	**0.3**
	Cookstown	34,600				2.67	0.95	1.29	116	1.62	0.98	2.68	145	1.3
	Craigavon	86,800				1.62	0.47	0.97	92	1.01	0.68	1.49	96	0.6
	Derry	107,800				1.01	1.58	0.76	65	1.12	0.79	1.60	96	0.8
	Down	**68,400**				**1.71**	**1.91**	**0.75**	**73**	**1.46**	**1.01**	**2.10**	**141**	**0.7**
	Dungannon	52,700				1.27	0.40	0.62	57	0.75	0.42	1.36	70	0.7
	Fermanagh	60,600				1.01	1.43	0.98	99	1.15	0.75	1.76	116	0.8
	Larne	31,400				0.89	1.12	0.87	96	0.96	0.52	1.79	106	0.4
	Limavady	33,900				1.73	1.31	1.34	118	1.45	0.84	2.50	128	0.6
	Lisburn	113,300				1.54	0.73	0.93	88	1.06	0.76	1.48	100	0.7
	Magherafelt	42,900				1.05	0.99	0.25	23	0.76	0.40	1.47	70	0.7
	Moyle	17,000				0.00	1.62	0.56	59	0.74	0.28	1.98	78	0.3

Table 3.2. Continued

UK area	PCT or HA	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 pmp[a]	2002–2007[b] O/E	2002–2007[b] LCL	2002–2007[b] UCL	2002–2007[b] pmp	% non-White
N Ireland	Newry & Mourne	93,600				0.85	0.69	0.59	53	0.71	0.44	1.12	64	0.4
	Newtownabbey	81,400				1.09	1.14	1.17	123	1.13	0.79	1.63	119	0.3
	North Down	79,000				1.29	0.88	1.02	114	1.06	0.73	1.53	118	1.0
	Omagh	51,200				0.66	1.25	1.07	98	1.00	0.59	1.69	91	0.4
	Strabane	39,200				0.55	0.78	1.60	153	0.98	0.54	1.76	94	0.8

White was 13.6% which was significantly higher (Wilcoxon rank sum test $p < 0.001$) than in those areas with low (2.6%) or normal (1.4%) ratios (figure 3.3).

Of the 208 PCTs and HAs with coverage for at least three years, 36 had relatively high non-White percentages (>10%). Twenty-six of these had high standardised acceptance ratios (51% of all areas with high ratios), 15 of these were in London and 7 in the West Midlands. Nine had normal ratios (8% of all areas with normal ratios), and one (Oldham) had a low ratio (3% of all areas with low ratios).

The number of patients accepted by each renal centre in the years 2002 to 2007 is shown in table 3.4, along with the percentage difference between the 2002 and 2007 numbers for each of those 48 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 127.5% in Reading to a reduction of 44.4% 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.

Although the overall number of accepted patients in the UK increased from 6,446 to 6,644 between 2006 and 2007, in those centres with complete reporting during the period 2002 to 2007, accepted numbers fell in the past year (4,867 to 4,676). Hence the increase in the number of UK patients accepted between 2002 and 2007 at 9.2% was less than the 12% increase between 2002 and 2006 which was reported last year. The increase between 2002 and 2007 was greater in England (10.8%) than in Wales (8.1%). There was no change in Scotland.

2 Demographics and clinical characteristics of patients accepted onto RRT

Methods

The proportion of patients starting RRT was examined by age group, gender, primary renal disease, ethnic origin and first modality of 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.

Table 3.3. Number of PCTs or HAs with low, normal and high standardised acceptance rate ratios (2002–2007)

Region	Standardised acceptance rate ratio			Total
	Low	Normal	High	
NE England	2	10	0	12
NW England	11	6	1	18
Yorkshire & Humber	3	10	1	14
East Midlands	4	4	1	9
West Midlands	1	6	7	14
East of England	5	6	2	13
London	0	5	15	20
SE England	8	6	0	14
SW England	5	7	2	14
England	**39**	**60**	**29**	**128**
Wales	**0**	**12**	**10**	**22**
Scotland	**0**	**26**	**6**	**32**
N Ireland	**0**	**20**	**6**	**26**
Total	**39**	**118**	**51**	**208**

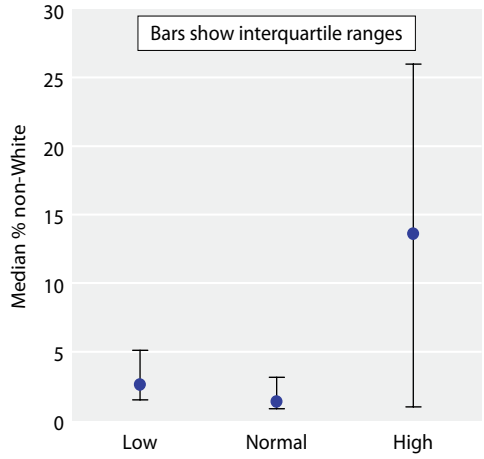

Fig. 3.3. Percentage non-Whites in PCT/HA areas with low, normal and high age-gender standardised ratios (2002–2007)

Estimated glomerular filtration rate (eGFR) at 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 on possible data extraction errors. Patients starting RRT between 2001 and 2005 from one centre (London West) were also excluded due to errors in the data extraction process for this item. This extraction process had been rectified in 2006 and patients starting RRT in this centre in 2006–2007 have been included.

Table 3.4. Number of new patients accepted by individual renal centres reporting to the UK Renal Registry 2002–2007

Country	Centre	Year						% change since 2002
		2002	2003	2004	2005	2006	2007	
England	B Heart	66	103	102	116	115	95	43.9
	B QEH			194	196	186	222	
	Basldn		53	46	28	45	39	
	Bradfd	62	74	61	66	50	87	40.3
	Brightn			118	109	131	115	
	Bristol	124	163	164	175	177	154	24.2
	Camb	74	96	110	111	157	127	71.6
	Carlis	26	31	29	31	27	25	−3.8
	Carsh	172	198	165	180	184	196	14.0
	Chelms			52	38	49	52	
	Colchr						*31*	
	Covnt	94	75	76	83	102	109	16.0
	Derby		59	67	71	69	72	
	Donc						18	
	Dorset		65	59	45	53	58	
	Dudley	25	41	54	38	44	35	40.0
	Exeter	82	97	110	110	104	122	48.8
	Glouc	54	53	53	60	73	57	5.6
	Hull	105	81	109	126	98	99	−5.7
	Ipswi	43	38	45	59	42	40	−7.0
	Kent				*104*	*124*	163	
	L Barts			185	184	187	200	
	L Guys	141	93	104	132	134	150	6.4
	L Kings	115	108	114	136	113	128	11.3
	L Rfree				132	209	182	
	L St.G						89	
	L West	250	254	295	290	283	334	33.6
	Leeds	152	185	175	164	181	117	−23.0
	Leic	153	167	162	223	241	240	56.9
	Liv Ain			3	29	34	34	
	Liv RI	152	114	130	139	140	114	−25.0
	M Hope		143	111	112	129	99	
	M RI						159	

Table 3.4. Continued

Country	Centre	Year						% change since 2002
		2002	2003	2004	2005	2006	2007	
England	Middlbr	111	103	102	84	105	98	−11.7
	Newc	102	94	109	113	110	111	8.8
	Norwch			95	119	109	108	
	Nottm	87	115	107	145	135	127	46.0
	Oxford	170	188	171	156	162	139	−18.2
	Plymth	79	64	62	58	91	76	−3.8
	Ports	145	141	118	151	173	157	8.3
	Prestn	110	98	79	118	121	128	16.4
	Redng	40	63	59	74	77	91	127.5
	Sheff	156	159	168	157	168	166	6.4
	Shrew			55	42	54	55	
	Stevng	100	122	84	91	118	86	−14.0
	Sthend	34	42	40	34	47	34	0.0
	Stoke						87	
	Sund	56	55	50	58	56	61	8.9
	Truro	59	53	67	32	50	45	−23.7
	Wirral	43	53	66	58	55	53	23.3
	Wolve	98	88	105	92	87	68	−30.6
	York	63	57	48	43	47	35	−44.4
N Ireland	Antrim				42	33	36	
	Belfast				131	112	91	
	Derry					3	7	
	Newry				28	14	15	
	Tyrone				23	30	22	
	Ulster				9	8	14	
Scotland	Abrdn	60	52	69	64	53	56	−6.7
	Airdrie	60	51	51	39	56	50	−16.7
	D & Gall	22	22	16	21	21	17	−22.7
	Dundee	68	64	62	76	52	60	−11.8
	Dunfn	29	27	29	44	37	37	27.6
	Edinb	81	90	98	99	105	94	16.0
	Glasgw	175	221	188	202	189	185	5.7
	Inverns	29	34	33	44	26	25	−13.8
	Klmarnk	32	40	29	43	56	32	0.0
Wales	Bangor	29	33	36	40	41	36	24.1
	Cardff	181	166	186	182	207	207	14.4
	Clwyd	20	12	14	27	18	23	15.0
	Swanse	113	125	93	98	113	123	8.8
	Wrexm	42	32	29	40	26	27	−35.7
England		**3,343**	**3,786**	**4,478**	**4,912**	**5,246**	**5,487**	
N Ireland					**233**	**200**	**185**	
Scotland		**556**	**601**	**575**	**632**	**595**	**556**	
Wales		**385**	**368**	**358**	**387**	**405**	**416**	
UK		**4,284**	**4,755**	**5,411**	**6,164**	**6,446**	**6,644**	
Including only centres reporting continuously 2002–2007								
England		**3,343**	**3,466**	**3,493**	**3,703**	**3,867**	**3,704**	**10.8**
Scotland		**556**	**601**	**575**	**632**	**595**	**556**	**0.0**
Wales		**385**	**368**	**358**	**387**	**405**	**416**	**8.1**
UK		**4,284**	**4,435**	**4,426**	**4,722**	**4,867**	**4,676**	**9.2**

Blank cells – no data returned to the UKRR for that year
Renal centres in italics are those providing summary data only

Results

Age

In 2007, the median age of patients starting renal replacement therapy was 64.1 years, a little lower than previously reported (table 3.5). The differences between the four countries of the United Kingdom were more marked than those detailed in previous reports. In Northern Ireland the median age of incident patients was 68.2 years, slightly higher than in Wales (67.6 years) and considerably higher than in England (63.8 years) and Scotland (61.8 years). The median age of incident UK non-White patients was considerably lower at 57.1 years. This may reflect 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].

Acceptance rates of patients over the age of 80 were much higher in Northern Ireland and Wales, being approximately twice those in England and Scotland (table 3.6). In the latter two countries, the acceptance rate peaked in the 75–79 age band (at 414 and 446 pmp respectively). In Wales the peak was in the 80–84 age band (at 619 pmp). In Northern Ireland the acceptance rate reached a plateau between the ages of 70 and 85.

There were large differences between centres with respect to the median age of their incident patients (figure 3.4). In 10 centres, the median age was <60 years and in 8 it was over 70 years. Possible explanations include chance fluctuations due to low take-on rates, 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 was slightly but significantly lower than that in non-transplant centres (63.0 vs 65.5 years: $p < 0.0001$). Five of the 10 centres whose incident cohort had a median age <60 years were transplanting centres. Four of the 8 centres whose incident cohort had a median age >70 years accepted less than 40 patients during 2007.

Table 3.6 Acceptance rate pmp by age band and country in 2007

	Pmp			
Age	England	Wales	Scotland	N Ireland
20–24	27	15	41	8
25–29	42	61	29	36
30–34	47	53	54	34
35–39	63	74	65	39
40–44	73	92	67	77
45–49	105	121	146	59
50–54	141	107	146	69
55–59	156	202	145	144
60–64	207	282	207	241
65–69	288	389	238	313
70–74	353	446	311	589
75–79	414	584	446	534
80–84	360	619	295	576
85+	132	225	137	229

Gender

As in previous UKRR reports there was an excess of males starting RRT in all age groups (figure 3.5). Peak acceptance rate was in the 75–79 year age band in both males and females. The proportion of males increased progressively with age from the 25–34 year age band (figure 3.6).

In the whole UK, 61.8% of the 2007 incident cohort was male. All reporting centres reported an excess of incident males, the male:female ratio varying from 1.0 to 3.3 (excluding Derry with only 7 incident patients) (figure 3.7). Higher ratios are likely to be an effect of small numbers. Ten of the 19 centres with a ratio greater than 2 in 2007 took on less than 50 patients in that year. There was no significant difference between the ratio in transplanting and non-transplanting centres.

Table 3.5. Median age of patients starting renal replacement therapy 2002–2007

	Year					
Country	2002	2003	2004	2005	2006	2007
England	65.3	64.6	64.8	65.1	64.5	63.8
N Ireland				67.9	68.2	68.2
Scotland	65.3	66.4	65.5	65.9	65.8	61.8
Wales	67.0	66.5	68.7	67.4	67.3	67.6
UK	**65.5**	**65.0**	**65.2**	**65.4**	**64.9**	**64.1**

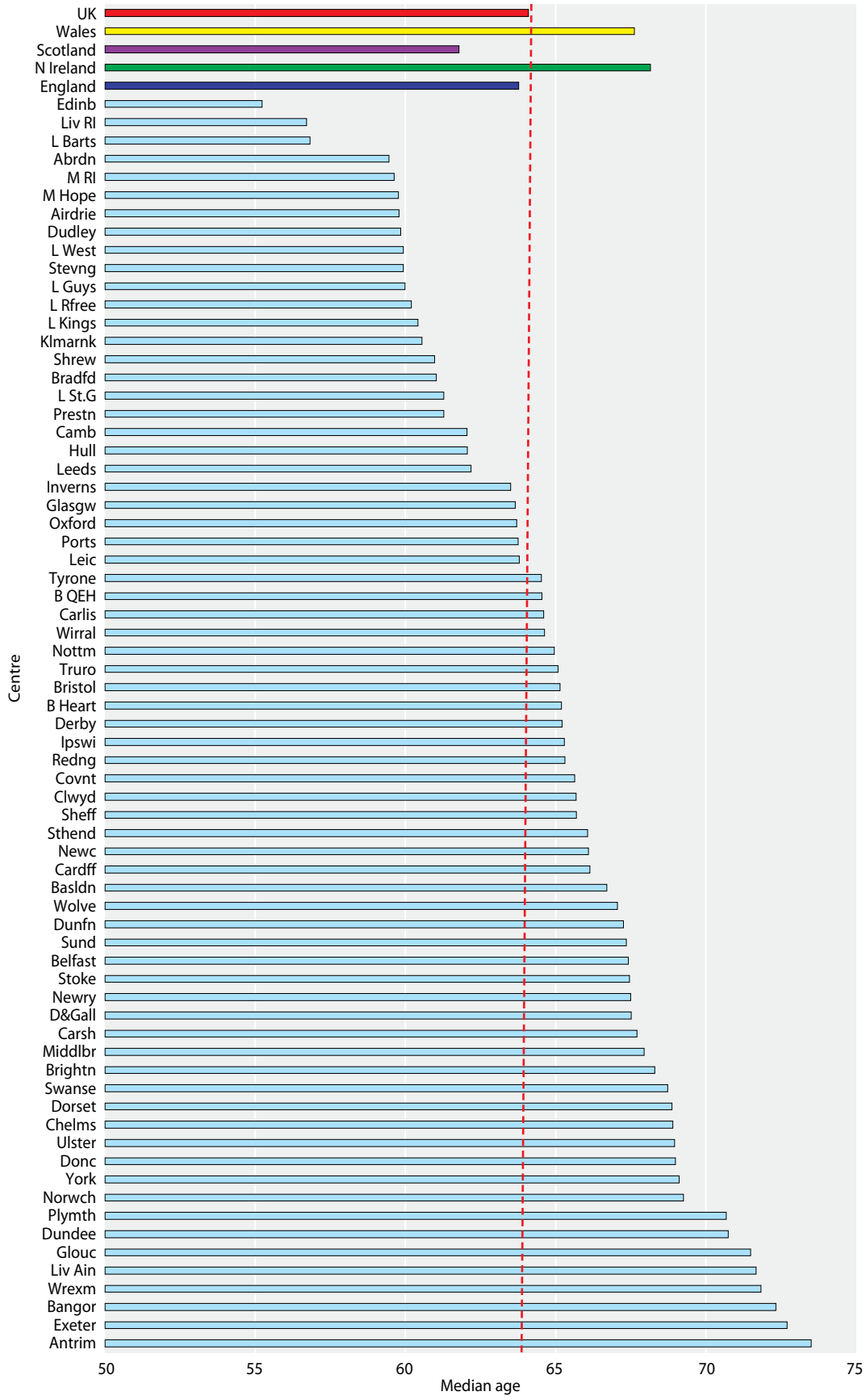

Fig. 3.4. Median age of new patients in each centre in 2007

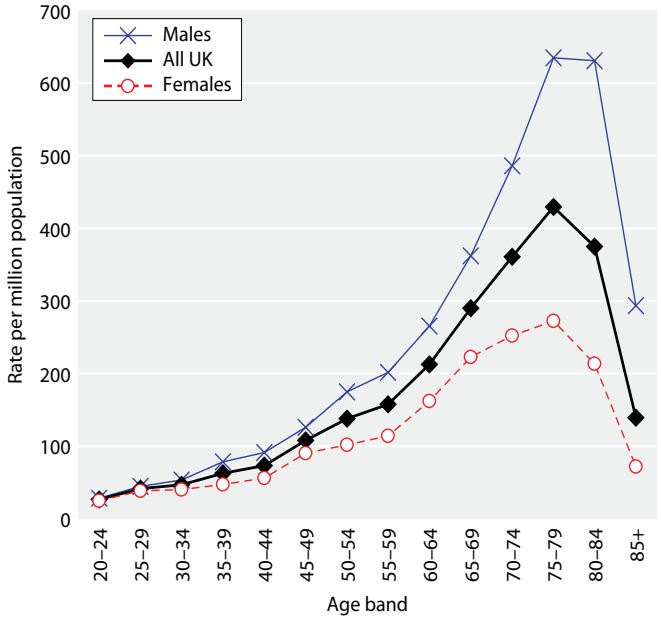

Fig. 3.5. Incident rates by age and gender in 2007

Ethnicity

Only 46 of the 70 centres (65.7%) returned ethnicity data that was 50% or more complete (table 3.7). This is similar to last year. In view of this lack of completeness, the results of analysis of ethnicity data should be interpreted cautiously. There was great variation between centres with respect to the ethnic mix of incident patients. This ranged from 0% for ethnic minorities in York, Doncaster, Truro, Ulster, Antrim and Tyrone to over 50% in London St Georges, London Barts and London West. All the latter centres cover areas with high standardised acceptance ratios.

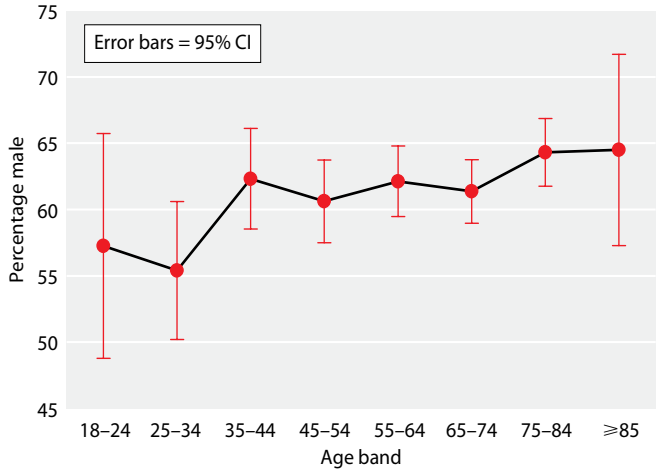

Fig. 3.6. Percentage of total starting RRT who are male, by age band in 2007

Primary renal diagnosis

The distribution of incident patients by age, gender and cause of renal failure is shown in table 3.8. The proportion of null returns for primary renal diagnosis at 9.7% has decreased from a UK mean of 14.4% in 2006. In table 3.8 distributions are shown as a proportion of all patients reported to the UKRR, and as a proportion of all those returned with data on primary renal disease excluding those with missing diagnoses. Proportions in the latter category are slightly higher, but relative proportions are the same using both methods.

In the following analysis the proportions were calculated after excluding missing diagnoses. Diabetes was the most common specific diagnosis accounting for 21.9% of incident diagnoses. This was the case irrespective of age, though the proportion was slightly higher in those aged <65 years. Biopsy proven glomerulonephritis (13.9% vs 7.1%) and adult polycystic kidney disease (10.9% vs 2.8%) were much more common in the younger incident cohort, whilst renal vascular disease was much more common in older incident patients (12.8% vs 2.5%). It was perhaps not surprising that uncertainty about the underlying diagnosis was also more common in the older cohort (30.2% vs 20.3%). For most primary renal diagnoses, the male to female ratio was greater than 1.5. The 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 (APKD) is a major exception, the ratio approximating unity in this condition.

There are marked disparities between centres (table 3.9) with respect to missing data relating to primary renal disease. Twenty-eight centres had full returns, whilst 3 centres (Aberdeen, Manchester Royal Infirmary and Exeter) had less than 50% returns. There has been a further slight reduction in the UK as a whole with respect to uncertain aetiology, although there is great variation between centres. Some of this variation is likely to reflect the lack of 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 were significant negative correlations between the frequency of uncertain diagnosis and all other diagnostic categories.

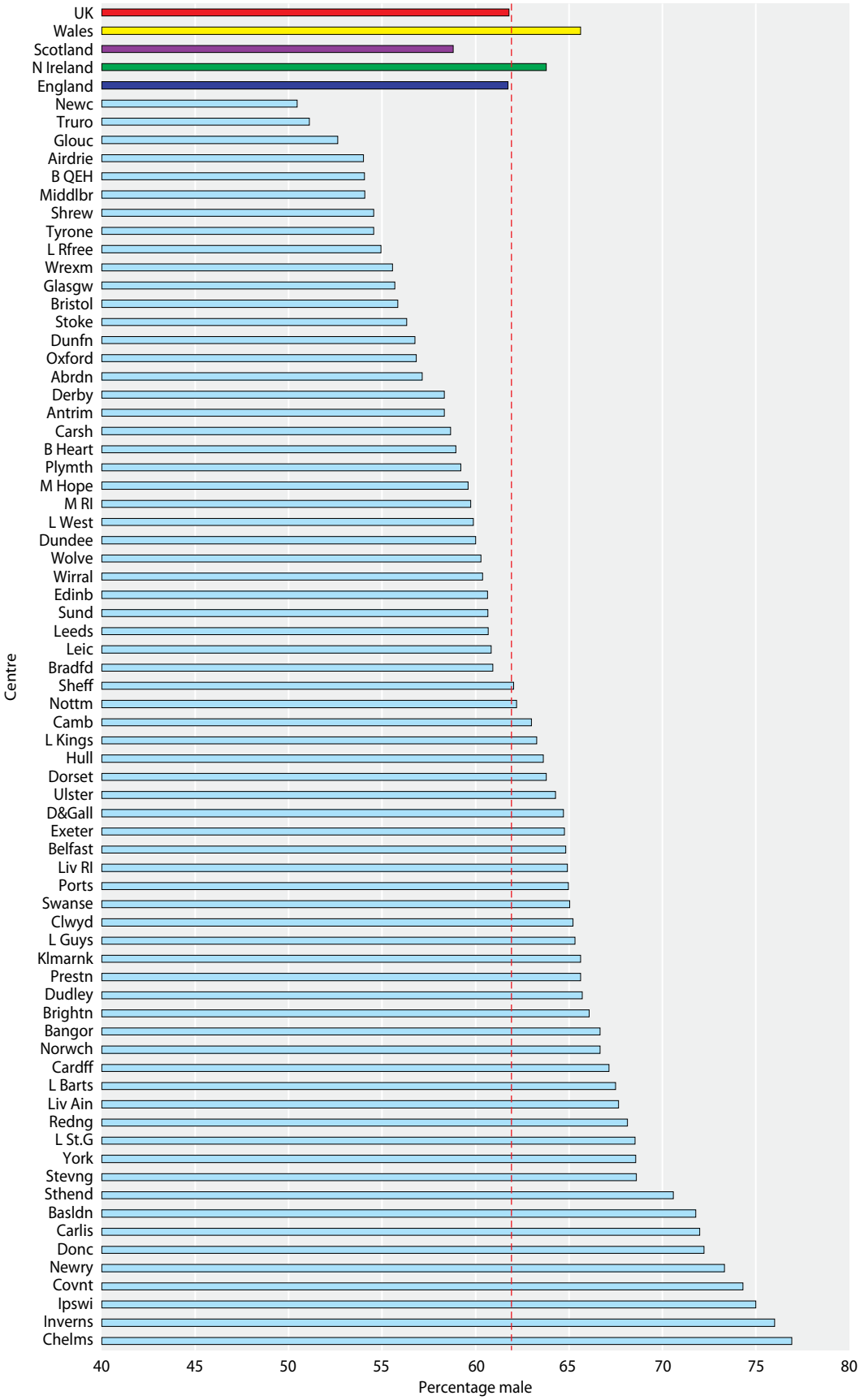

Fig. 3.7. Percentage of new patients who are male in renal centres reporting to the UKRR in 2007

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

Country	Centre	Completion %	Percentage				
			White	Black	South Asian	Chinese	Other
England	York	100.0	100.0				
	Shrew	100.0	96.4		3.6		
	Nottm	100.0	89.8	4.7	5.5		
	Redng	100.0	76.9	4.4	16.5	2.2	
	Newc	99.1	91.8		6.4	0.9	0.9
	B QEH	99.1	68.2	9.1	17.7		5.0
	L Rfree	98.9	57.2	21.7	13.9	0.6	6.7
	L Kings	98.4	51.6	36.5	8.7	3.2	
	Leic	97.9	76.6	3.8	17.4	0.4	1.7
	B Heart	97.9	62.4	10.8	26.9		
	Basldn	97.4	89.5	2.6	5.3	2.6	
	Wirral	96.2	92.2		2.0	3.9	2.0
	Carlis	96.0	95.8		4.2		
	M Hope	96.0	80.0	3.2	15.8		1.1
	Wolve	95.6	75.4	9.2	13.8	1.5	
	L Barts	95.0	45.3	10.5	26.3	1.6	16.3
	Oxford	95.0	84.8	4.5	6.8	0.8	3.0
	Dorset	94.8	92.7	3.6	1.8		1.8
	Prestn	93.8	87.5	0.8	11.7		
	M RI	93.7	81.9	8.1	8.7	1.3	
	Bristol	93.5	94.4	2.8	2.1	0.7	
	Bradfd	92.0	57.5	2.5	38.8		1.3
	Covnt	91.7	91.0		9.0		
	Dudley	91.4	90.6		9.4		
	Sund	90.2	98.2		1.8		
	Donc	83.3	100.0				
	Camb	81.1	95.1	1.0	2.9	1.0	
	Middlbr	80.6	96.2		3.8		
	Leeds	77.8	79.1	6.6	13.2		1.1
	Ports	77.1	91.7	2.5	3.3	0.8	1.7
	L St.G	73.0	40.0	40.0	15.4	1.5	3.1
	Carsh	73.0	76.2	6.3	12.6	1.4	3.5
	L Guys	65.3	57.1	38.8	4.1		
	Sheff	65.1	97.2	1.9	0.9		
	Chelms	63.5	97.0	3.0			
	L West	58.1	45.4	20.1	22.7		11.9
	Truro	57.8	100.0				
	Brightn	51.3	96.6	1.7			1.7
N Ireland	Ulster	100.0	100.0				
	Antrim	97.2	100.0				
	Belfast	92.3	98.8	1.2			
	Tyrone	86.4	100.0				
Wales	Bangor	100.0	97.2		2.8		
	Wrexm	96.3	92.3		3.8		3.8
	Swanse	94.3	96.6	2.6	0.9		
	Cardff	70.0	96.6	0.7	2.8		
England		**75.3**	**77.7**	**8.1**	**11.0**	**0.7**	**2.6**
N Ireland		**88.6**	**99.4**	**0.6**			
Scotland		**0.7**	**75.0**		**25.0**		
Wales		**77.9**	**96.3**	**1.2**	**2.2**		**0.3**
UK		**69.4**	**79.8**	**7.3**	**10.0**	**0.6**	**2.3**

Centres with less than 10 patients and those with less than 50% returns are not shown
The country and overall averages include all centres

Table 3.8. Percentage distribution of primary renal diagnosis by age and gender ratio, in 2007 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*	18.5	*20.3*	27.0	*30.2*	22.6	*25.0*	1.6
Glomerulonephritis	12.7	*13.9*	6.3	*7.1*	9.6	*10.6*	2.3
Pyelonephritis	6.8	*7.4*	6.0	*6.7*	6.4	*7.1*	1.5
Diabetes	21.2	*23.2*	18.3	*20.5*	19.8	*21.9*	1.6
Renal vascular disease	2.3	*2.5*	11.4	*12.8*	6.7	*7.4*	2.1
Hypertension	5.5	*6.0*	4.9	*5.5*	5.2	*5.8*	2.0
Polycystic kidney	10.0	*10.9*	2.5	*2.8*	6.4	*7.1*	1.1
Other	14.4	*15.7*	12.7	*14.3*	13.6	*15.1*	1.3
Data not available	8.7	–	10.8	–	9.7	–	1.6

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

Table 3.9. Percentage distribution of primary renal diagnosis by centre in 2007 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	0.0	25.3	32.6	11.6	3.2	10.5	5.3	7.4	4.2
	B QEH	3.2	16.3	28.8	10.2	7.4	13.0	4.2	8.4	11.6
	Basldn	0.0	10.3	20.5	15.4	5.1	18.0	5.1	15.4	10.3
	Bradfd	3.5	15.5	36.9	11.9	9.5	11.9	2.4	7.1	4.8
	Brightn	13.0	25.0	21.0	15.0	3.0	14.0	4.0	8.0	10.0
	Bristol	16.2	16.3	16.3	13.2	14.0	16.3	8.5	11.6	3.9
	Camb	0.8	65.9	2.4	4.8	2.4	16.7	4.8	1.6	1.6
	Carlis	0.0	0.0	12.0	8.0	0.0	24.0	20.0	4.0	32.0
	Carsh	5.1	31.7	19.9	8.6	5.9	14.0	7.0	7.0	5.9
	Chelms	0.0	38.5	25.0	7.7	3.9	11.5	3.9	0.0	9.6
	Covnt	0.9	15.7	25.0	8.3	11.1	14.8	5.6	8.3	11.1
	Derby	3.3	29.3	24.1	17.2	0.0	10.3	6.9	10.3	1.7
	Donc	0.0	38.9	16.7	16.7	0.0	5.6	5.6	5.6	11.1
	Dorset	3.5	12.5	23.2	14.3	1.8	14.3	12.5	8.9	12.5
	Dudley	5.7	21.2	21.2	6.1	6.1	15.2	6.1	12.1	12.1
	Exeter	64.8								
	Glouc	3.5	29.1	20.0	14.6	3.6	16.4	7.3	5.5	3.6
	Hull	1.0	22.5	18.4	21.4	5.1	14.3	11.2	4.1	3.1
	Ipswi	7.5	24.3	18.9	10.8	5.4	27.0	2.7	2.7	8.1
	L Barts	0.0	17.0	34.5	11.0	8.0	14.0	6.0	7.5	2.0
	L Guys	0.0	10.0	32.7	16.7	10.7	10.7	6.0	8.7	4.7
	L Kings	0.0	0.8	23.4	9.4	8.6	39.1	1.6	8.6	8.6
	L Rfree	11.5	13.7	23.0	9.9	13.0	29.8	6.2	1.9	2.5
	L St.G	21.4	18.6	22.9	14.3	4.3	20.0	12.9	1.4	5.7
	L West	26.7								
	Leeds	47.0								
	Leic	17.9	27.9	18.8	11.7	1.0	15.2	6.6	12.2	6.6
	Liv Ain	0.0	97.1	2.9	0.0	0.0	0.0	0.0	0.0	0.0
	Liv RI	0.0	56.1	9.7	7.9	3.5	9.7	7.0	3.5	2.6
	M Hope	4.0	97.9	1.1	0.0	0.0	0.0	1.1	0.0	0.0
	M RI	67.3								
	Middlbr	1.0	40.2	17.5	5.2	2.1	9.3	6.2	7.2	12.4

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	0.9	19.1	22.7	12.7	2.7	17.3	10.9	7.3	7.3
	Norwch	0.0	42.6	10.2	13.0	2.8	8.3	7.4	7.4	8.3
	Nottm	0.0	22.1	29.9	7.1	2.4	16.5	7.9	8.7	5.5
	Oxford	1.4	19.7	20.4	14.6	4.4	14.6	8.0	8.8	9.5
	Plymth	1.3	22.7	9.3	5.3	0.0	25.3	10.7	2.7	24.0
	Ports	3.8	15.9	19.9	12.6	12.6	13.9	9.3	10.6	5.3
	Prestn	0.8	17.3	19.7	9.5	6.3	17.3	9.5	8.7	11.8
	Redng	0.0	19.8	26.4	12.1	3.3	16.5	7.7	6.6	7.7
	Sheff	0.0	39.8	15.1	6.0	1.8	11.5	6.6	10.8	8.4
	Shrew	9.1	22.0	32.0	6.0	10.0	12.0	12.0	2.0	4.0
	Stevng	0.0	19.8	20.9	5.8	0.0	39.5	5.8	3.5	4.7
	Sthend	0.0	8.8	23.5	14.7	2.9	14.7	5.9	8.8	20.6
	Stoke	1.2	31.4	16.3	8.1	10.5	12.8	5.8	7.0	8.1
	Sund	0.0	18.0	26.2	11.5	11.5	18.0	4.9	6.6	3.3
	Truro	11.1	7.5	35.0	15.0	5.0	20.0	5.0	5.0	7.5
	Wirral	9.4	97.9	0.0	0.0	2.1	0.0	0.0	0.0	0.0
	Wolve	0.0	22.1	26.5	14.7	5.9	22.1	1.5	4.4	2.9
	York	22.9	22.2	18.5	3.7	14.8	11.1	3.7	7.4	18.5
N Ireland	Antrim	0.0	27.8	38.9	5.6	0.0	11.1	5.6	2.8	8.3
	Belfast	0.0	13.2	20.9	7.7	6.6	14.3	12.1	15.4	9.9
	Newry	0.0	0.0	13.3	6.7	13.3	13.3	13.3	0.0	40.0
	Tyrone	0.0	13.6	4.6	9.1	18.2	27.3	18.2	9.1	0.0
	Ulster	0.0	28.6	28.6	14.3	0.0	14.3	0.0	14.3	0.0
Scotland	Abrdn	100.0								
	Airdrie	2.0	12.2	16.3	6.1	6.1	18.4	6.1	16.3	18.4
	D & Gall	0.0	23.5	17.7	0.0	0.0	5.9	29.4	5.9	17.7
	Dundee	8.3	10.9	20.0	7.3	5.5	12.7	7.3	7.3	29.1
	Dunfn	8.1	14.7	26.5	11.8	2.9	14.7	17.7	5.9	5.9
	Edinb	0.0	14.9	19.2	16.0	3.2	18.1	9.6	9.6	9.6
	Glasgw	8.1	19.4	19.4	12.4	1.2	15.9	11.2	11.2	9.4
	Inverns	4.0	25.0	33.3	12.5	4.2	8.3	8.3	0.0	8.3
	Klmarnk	40.6								
Wales	Bangor	0.0	22.2	8.3	16.7	11.1	30.6	2.8	8.3	0.0
	Clwyd	4.4	59.1	31.8	9.1	0.0	0.0	0.0	0.0	0.0
	Cardff	1.0	33.7	29.3	14.6	5.4	6.8	5.9	2.0	2.4
	Swanse	0.0	17.1	21.1	8.1	4.1	12.2	5.7	9.8	22.0
	Wrexm	0.0	33.3	22.2	11.1	3.7	11.1	7.4	11.1	0.0
England		**10.0**	**25.9**	**21.8**	**10.5**	**6.1**	**15.4**	**6.7**	**6.9**	**6.7**
N Ireland		**0.0**	**16.2**	**22.7**	**8.1**	**7.0**	**15.1**	**10.3**	**10.3**	**10.3**
Scotland		**16.9**	**16.5**	**20.1**	**11.5**	**3.0**	**15.2**	**11.5**	**9.5**	**12.8**
Wales		**0.7**	**29.1**	**24.7**	**12.4**	**5.1**	**10.4**	**5.3**	**5.3**	**7.8**
UK		**9.7**	**25.0**	**21.9**	**10.7**	**5.8**	**15.1**	**7.1**	**7.1**	**7.4**

* 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 a high percentage of missing primary diagnoses, the percentages in the other diagnostic categories has not been calculated

The proportion of incident patients whose primary renal disease was recorded as diabetes varied between centres from 0% to 38.9%. Much of this variation is artefactual; 5 of the 8 centres submitting returns reporting <10% of their incident patients with diabetes as the primary renal disease reported that >50% of their incident population had uncertain diagnoses. Some may relate to chance fluctuations due to low take-on numbers. The ethnic mix of the incident population also has a major role. Of the 9 centres reporting that

Table 3.10. Primary renal diagnosis incidence rates per million population (unadjusted) 2007

	England		Northern Ireland		Scotland		Wales		UK	
Diagnosis	Pmp	%	Pmp	%	Pmp	%	Pmp	%	Pmp	%
Uncertain aetiology*	25.2	23.3	17.1	16.2	14.8	13.7	40.3	28.8	24.8	22.6
Glomerulonephritis	10.2	9.5	8.5	8.1	10.3	9.5	17.1	12.3	10.5	9.6
Pyelonephritis	6.7	6.2	10.8	10.3	8.6	7.9	7.4	5.3	7.0	6.4
Diabetes	21.3	19.7	23.9	22.7	18.1	16.7	34.2	24.5	21.7	19.8
Polycystic kidney	6.5	6.0	10.8	10.3	10.3	9.5	7.4	5.3	7.0	6.4
Hypertension	5.9	5.5	7.4	7.0	2.7	2.5	7.0	5.0	5.7	5.2
Renal vascular disease	6.6	6.1	10.8	10.3	11.5	10.6	10.7	7.7	7.3	6.7
Other	15.0	13.9	15.9	15.1	13.6	12.6	14.4	10.3	14.9	13.6
Data not available	10.8	10.0	0.0	0.0	18.3	16.9	1.0	0.7	10.6	9.7
All	**108**	**100.0**	**105**	**100.0**	**108**	**100.0**	**140**	**100.0**	**110**	**100.0**

* includes presumed glomerulonephritis not biopsy proven

greater than 30% of their incident cohort had diabetes as the primary renal disease, 4 reported a high proportion of non-Whites in the incident population (38–55%) and the remaining 5 took on 55 patients or less in 2007. These factors undoubtedly contributed 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.

There were national variations in the distributions of primary renal disease in the incident cohort (table 3.10). The incidence rate of uncertain diagnoses was higher in England (25.2 pmp) and Wales (40.3 pmp) than in Scotland (14.8 pmp) and Northern Ireland (17.1 pmp). The incidence of diabetes was higher in Wales (34.2 pmp) than in England (21.3 pmp), Northern Ireland (23.9 pmp) and Scotland (18.1 pmp). Likewise, the incidence rate of glomerulonephritis was higher in Wales (17.1 pmp) than in England (10.2 pmp), Scotland (10.3 pmp) and Northern Ireland (8.5 pmp). In addition, the incidence rate of hypertension was lower in Scotland (2.7 pmp) than in Northern Ireland (7.4 pmp), Wales (7.0 pmp) and England (5.9 pmp), whilst that of renal vascular disease was lower in England (6.6 pmp) than in Scotland (11.5 pmp), Northern Ireland (10.8 pmp) and Wales (10.7 pmp).

First established treatment modality

In the whole UK in 2007, haemodialysis (HD) was the first modality of RRT (defined as first treatment recorded irrespective of any later change) in 74.9% of patients, peritoneal dialysis (PD) in 20.6% and pre-emptive transplant in 4.5%. After increasing successively over a number of years, the frequency of HD as the first treatment modality has decreased slightly from last year's 76.6%. Many patients, especially those presenting late, undergo a brief period of HD, before switches to other modalities can be considered. Hence, the established modality at 90 days is more representative of the elective first modality. By 90 days in the 2007 UK cohort, 5.7% of incident patients had died, a further 0.5% had stopped treatment, leaving 93.8% of the original cohort remaining on RRT (table 3.11). Expressed as a percentage of the whole 2007 UK incident cohort, 67.4% were on HD, 21.3% on PD and 5.2% had had a transplant. Expressed as a percentage of those still receiving RRT at 90 days, 71.8% were on HD, 22.7% on PD and 5.5% had received a transplant (figure 3.8). Of those still on RRT at 90 days, only 0.2% were receiving home haemodialysis, with the vast majority of HD patients on centre-based treatment either in main hospital centres (50.3% of total) or satellite units (19.3%). Around 30% of patients on PD are on automated treatments. The major national difference in modality distribution at 90 days, was the lower percentage of PD patients in the incident cohort in Northern Ireland (9.1% of the total incident cohort). The percentages in the 3 other countries all exceeded 20%.

Ninety day mortality in the incident cohort ranged between centres from 0 to 28.6% (table 3.11). Small numbers were likely to be a major factor in this variation. Nine of the 10 centres with zero deaths took on fewer than 40 patients, as did the centre with the highest 90 day mortality. Many other factors may be important particularly selection policies, including those relating to conservative management and to variations in the practice of offering a 'trial of dialysis', in cases for

Table 3.11. RRT modality at 90 days by centre in the 2007 cohort

		Percentage of patients				
Country	Centre	HD	PD	Tx	Stopped treatment	Died
England	B Heart	81.3	10.4	0.0	0.0	8.3
	B QEH	75.5	17.1	1.4	0.0	6.0
	Basldn	69.2	12.8	0.0	10.3	7.7
	Bradfd	73.1	15.4	2.6	0.0	9.0
	Brightn	62.6	27.8	2.6	0.0	7.0
	Bristol	62.9	21.4	3.8	0.0	11.9
	Camb	64.1	11.1	15.7	0.0	9.2
	Carlis	69.6	21.7	4.3	0.0	4.3
	Carsh	74.8	17.9	2.3	0.0	5.0
	Chelms	67.4	23.9	0.0	2.2	6.5
	Covnt	61.4	25.7	3.0	1.0	8.9
	Derby	56.9	32.8	0.0	1.7	8.6
	Donc	25.0	75.0	0.0	0.0	0.0
	Dorset	57.4	37.0	1.9	1.9	1.9
	Dudley	52.9	47.1	0.0	0.0	0.0
	Exeter	71.6	23.3	0.0	0.0	5.2
	Glouc	75.0	20.3	0.0	0.0	4.7
	Hull	66.4	28.4	1.7	0.9	2.6
	Ipswi	56.3	37.5	6.3	0.0	0.0
	L Barts	55.0	39.5	3.5	0.0	2.0
	L Guys	70.5	14.1	13.5	0.0	1.9
	L Kings	63.2	28.9	4.4	0.0	3.5
	L Rfree	67.0	16.2	13.2	0.0	3.6
	L St.G	55.0	26.7	18.3	0.0	0.0
	L West	74.8	6.2	16.8	0.0	2.2
	Leeds	69.5	19.8	6.9	0.0	3.8
	Leic	64.0	23.6	7.8	0.0	4.7
	Liv Ain	93.8	0.0	0.0	0.0	6.3
	Liv RI	71.8	17.9	4.3	0.0	6.0
	M Hope	68.3	26.9	1.0	0.0	3.8
	M RI	54.1	19.7	23.0	0.0	3.3
	Middlbr	72.3	14.9	3.2	0.0	9.6
	Newc	60.4	19.8	9.4	0.0	10.4
	Norwch	59.5	22.4	0.0	2.6	15.5
	Nottm	63.9	26.4	3.5	0.0	6.3
	Oxford	56.2	29.5	9.6	0.0	4.8
	Plymth	60.5	22.2	6.2	2.5	8.6
	Ports	60.2	20.5	9.3	0.0	9.9
	Prestn	77.4	19.4	0.0	0.0	3.2
	Redng	61.5	37.4	0.0	0.0	1.1
	Sheff	73.7	16.7	4.5	0.6	4.5
	Shrew	69.2	21.2	1.9	1.9	5.8
	Stevng	73.7	18.9	0.0	0.0	7.4
	Sthend	78.8	15.2	3.0	0.0	3.0
	Stoke	62.0	29.6	0.0	0.0	8.5
	Sund	85.7	8.2	0.0	0.0	6.1
	Truro	70.8	25.0	0.0	0.0	4.2
	Wirral	75.5	17.0	0.0	1.9	5.7
	Wolve	55.2	35.8	0.0	1.5	7.5
	York	65.7	34.3	0.0	0.0	0.0
N Ireland	Antrim	90.5	2.4	0.0	7.1	0.0
	Belfast	77.0	11.0	5.0	2.0	5.0
	Newry	62.5	31.3	0.0	6.3	0.0
	Tyrone	94.4	0.0	0.0	0.0	5.6
	Ulster	85.7	0.0	0.0	7.1	7.1

Table 3.11. Continued

Country	Centre	Percentage of patients				
		HD	PD	Tx	Stopped treatment	Died
Scotland	Abrdn	80.4	15.7	0.0	0.0	3.9
	Airdrie	86.3	11.8	0.0	0.0	2.0
	D & Gall	70.0	30.0	0.0	0.0	0.0
	Dundee	76.7	18.3	0.0	0.0	5.0
	Dunfn	66.7	30.3	0.0	0.0	3.0
	Edinb	61.0	29.5	5.7	0.0	3.8
	Glasgw	69.3	15.6	3.6	0.0	11.5
	Inverns	48.3	44.8	0.0	0.0	6.9
	Klmarnk	78.8	21.2	0.0	0.0	0.0
Wales	Bangor	45.7	17.1	0.0	8.6	28.6
	Clwyd	70.0	30.0	0.0	0.0	0.0
	Cardff	64.5	24.6	6.6	0.0	4.3
	Swanse	68.1	23.3	0.0	0.0	8.6
	Wrexm	53.6	35.7	3.6	0.0	7.1
England		**66.9**	**21.5**	**5.7**	**0.3**	**5.5**
N Ireland		**80.8**	**9.1**	**2.5**	**4.0**	**3.5**
Scotland		**70.4**	**21.3**	**2.3**	**0.0**	**6.1**
Wales		**63.4**	**24.6**	**3.7**	**0.7**	**7.6**
UK		**67.4**	**21.3**	**5.2**	**0.5**	**5.7**

which the benefits of long-term dialysis may be uncertain. This may also account for some of the variation in the proportions stopping treatment during the first 90 days. The range in the proportion of incident patients who had a functioning transplant at 90 days was 0 to 23%. Fifteen of the 16 centres in which more than 5% of their incident cohort had received a transplant by 90 days 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 (7.8 vs 2.2%: $p < 0.0001$).

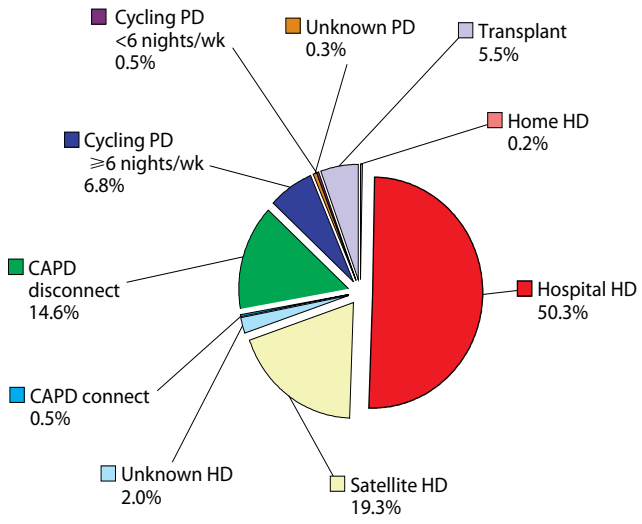

Fig. 3.8. RRT modality at day 90 in the 2007 incident cohort

This suggests variation in organ allocation or more likely that patients transplanted pre-emptively or early were attributed to the incident cohort of the transplanting centre rather than that of the referring centre.

There were also major differences between individual centres in the percentage of new dialysis patients established on haemodialysis at 90 days (range 25–100%) (figure 3.9). Three centres had all their dialysis patients on haemodialysis (Tyrone, Ulster and Liverpool Aintree), although this may reflect that PD provision is provided through one of the larger local renal centres. Twenty-five centres had 80% or more of their dialysis patients on haemodialysis at 90 days and only one (Doncaster with 25%) had less than 50%. Six centres had 40% or more of their incident dialysis patients on PD at day 90. Apart from London Barts, these all took on 40 or less patients during 2007.

Older patients were more likely to be on HD rather than PD at 90 days. In the whole UK, 69.4% of incident patients aged less than 65 years were on HD at this stage compared with 82.7% of patients aged over 65 ($p < 0.001$) (table 3.12). Equivalently, the percentage of patients on PD at 90 days was almost twice as high in patients aged <65 years as in older patients (30.6% vs 17.3%). In only 7 centres (Wirral, London St. Georges, London Kings, Basildon, Exeter, Stoke, Doncaster) was this trend reversed; these centres had a higher proportion of older than younger patients on PD.

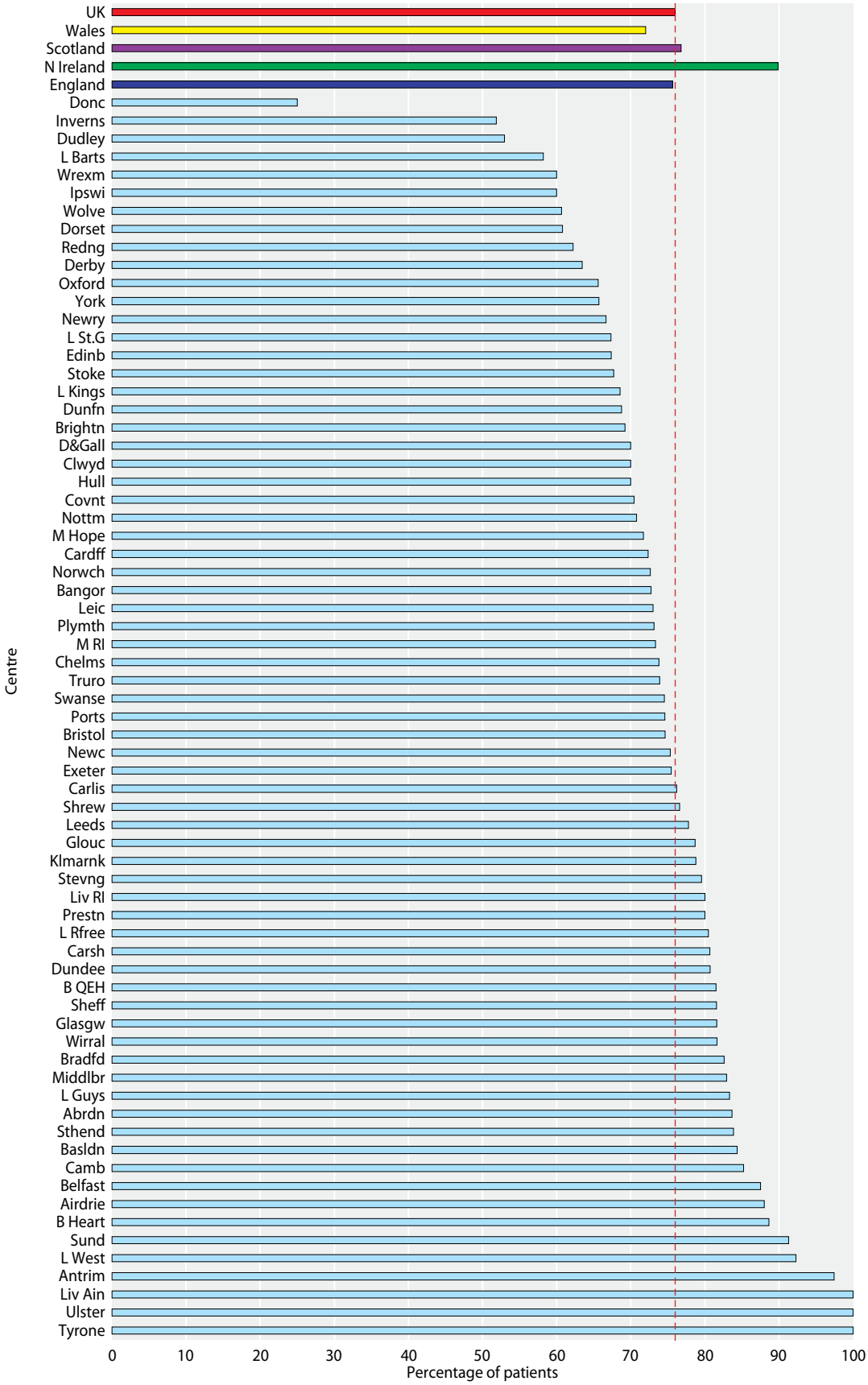

Fig. 3.9. Percentage of incident dialysis patients in each centre on HD on day 90 (2007)

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

	Age <65 (%)		Age ⩾ 65 (%)	
Centre	HD	PD	HD	PD
Abrdn	75.0	25.0	95.2	4.8
Airdrie	82.8	17.2	95.2	4.8
Antrim	90.9	9.1	100.0	–
B Heart	81.1	18.9	94.1	5.9
B QEH	73.1	26.9	88.8	11.2
Bangor	70.0	30.0	75.0	25.0
Basldn	86.7	13.3	82.4	17.6
Belfast	82.1	17.9	91.8	8.2
Bradfd	78.4	21.6	87.5	12.5
Brightn	55.6	44.4	79.7	20.3
Bristol	67.2	32.8	81.4	18.6
Camb	79.1	20.9	93.8	6.3
Cardff	55.7	44.3	87.0	13.0
Carlis	63.6	36.4	90.0	10.0
Carsh	73.6	26.4	86.5	13.5
Chelms	63.6	36.4	77.4	22.6
Clwyd	62.5	37.5	75.0	25.0
Covnt	60.9	39.1	81.0	19.0
D & Gall	54.5	45.5	88.9	11.1
Derby	55.6	44.4	72.0	28.0
Donc	40.0	60.0	14.3	85.7
Dorset	59.1	40.9	62.1	37.9
Dudley	35.3	64.7	70.6	29.4
Dundee	64.0	36.0	93.8	6.3
Dunfn	66.7	33.3	71.4	28.6
Edinb	66.2	33.8	70.0	30.0
Exeter	79.1	20.9	73.1	26.9
Glasgw	77.4	22.6	86.1	13.9
Glouc	64.0	36.0	88.9	11.1
Hull	60.9	39.1	82.6	17.4
Inverns	50.0	50.0	58.3	41.7
Ipswi	54.5	45.5	63.2	36.8
Klmarnk	62.5	37.5	94.1	5.9
L Barts	55.8	44.2	63.3	36.7
L Guys	76.3	23.7	92.9	7.1
L Kings	70.3	29.7	65.9	34.1
L Rfree	73.8	26.2	87.5	12.5
L St.G	69.2	30.8	65.2	34.8
L West	91.0	9.0	93.7	6.3
Leeds	67.2	32.8	89.3	10.7
Leic	71.9	28.1	74.3	25.7
Liv Ain	100.0	–	100.0	–
Liv RI	72.1	27.9	94.6	5.4
M Hope	66.7	33.3	81.8	18.2
M RI	70.0	30.0	77.5	22.5
Middlbr	80.0	20.0	85.7	14.3
Newc	65.9	34.1	85.7	14.3
Newry	25.0	75.0	81.8	18.2
Norwch	64.7	35.3	77.0	23.0
Nottm	61.3	38.7	79.4	20.6
Oxford	52.4	47.6	79.0	21.0
Plymth	68.2	31.8	75.6	24.4
Ports	66.1	33.9	82.4	17.6
Prestn	78.5	21.5	81.8	18.2
Redng	51.1	48.9	74.4	25.6
Sheff	77.8	22.2	84.6	15.4
Shrew	69.2	30.8	85.7	14.3
Stevng	78.3	21.7	81.0	19.0
Sthend	80.0	20.0	87.5	12.5
Stoke	72.4	27.6	63.9	36.1
Sund	85.7	14.3	96.0	4.0
Swanse	56.5	43.5	88.3	11.7
Truro	54.2	45.8	95.5	4.5
Tyrone	100.0	–	100.0	–
Ulster	100.0	–	100.0	–
Wirral	82.6	17.4	80.8	19.2
Wolve	52.0	48.0	66.7	33.3
Wrexm	55.6	44.4	62.5	37.5
York	43.8	56.3	84.2	15.8
England	**69.7**	**30.3**	**81.8**	**18.2**
N Ireland	**83.1**	**16.9**	**94.4**	**5.6**
Scotland	**70.3**	**29.7**	**85.1**	**14.9**
Wales	**57.1**	**42.9**	**84.0**	**16.0**
UK	**69.4**	**30.6**	**82.7**	**17.3**

Between centres there was great variation between the male:female ratio of patients on HD and PD (figure 3.10). Overall, in the UK there was no significant difference between the male:female ratio of incident patients on HD (1.6) and PD (1.7).

Renal function at the time of starting RRT

In the 2007 cohort, older patient groups had a higher geometric mean eGFR at start of dialysis than younger groups (figure 3.11). The geometric mean eGFR at start of dialysis progressively increased from the 25–34 age-group onwards.

Analysis of serial data derived only from centres reporting continuously to the UKRR since 1998 indicated that over the last decade there has been a progressive tendency to initiate dialysis, both HD and PD, at a higher median eGFR (figure 3.12).

3 Late presentation (referral) of incident patients

Methods

It is recognised that the clinical event usually called 'late referral' is a complex phenomenon with a range of possible causes.

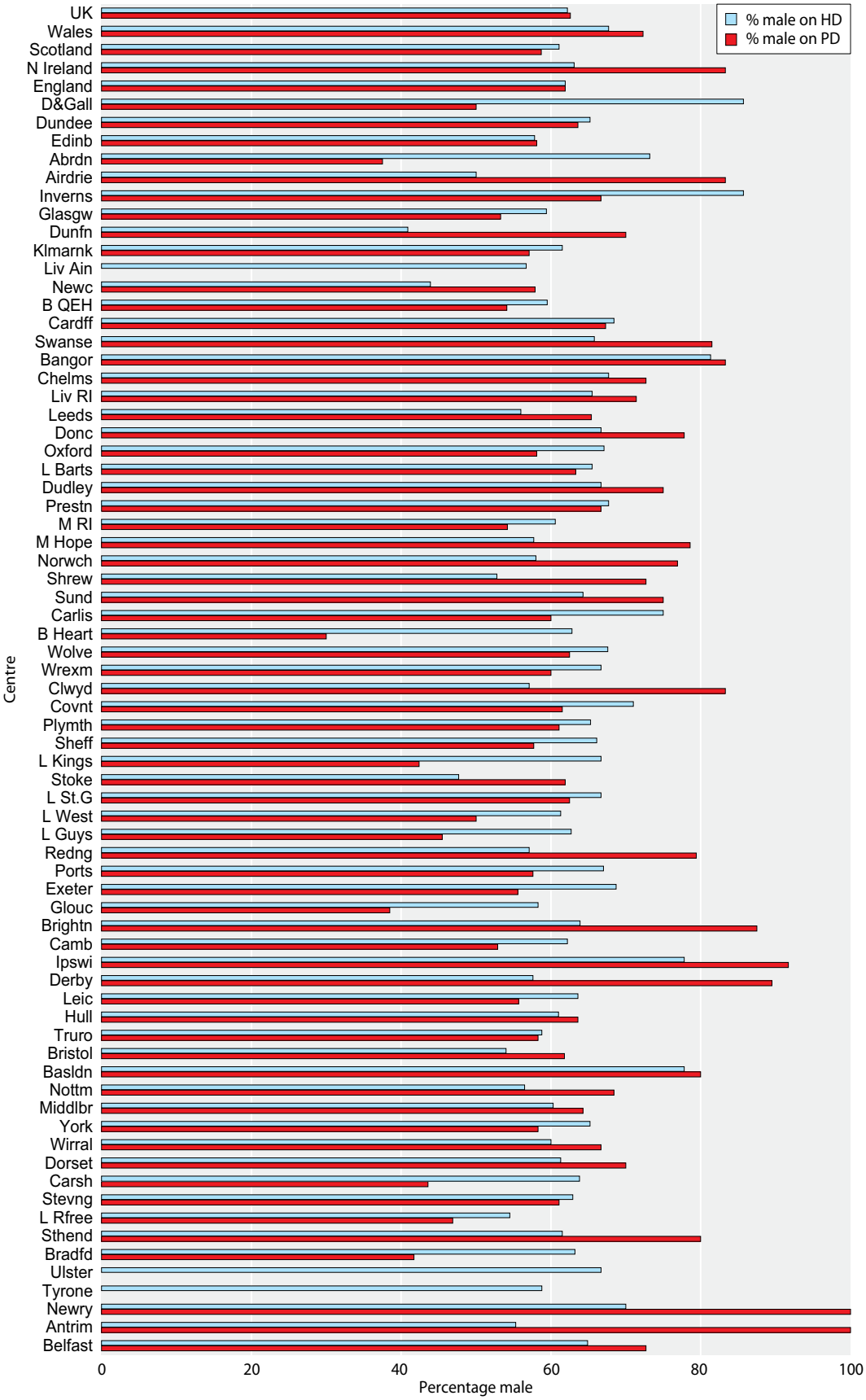

Fig. 3.10. Percentage of male patients by dialysis modality in incident cohort 2007

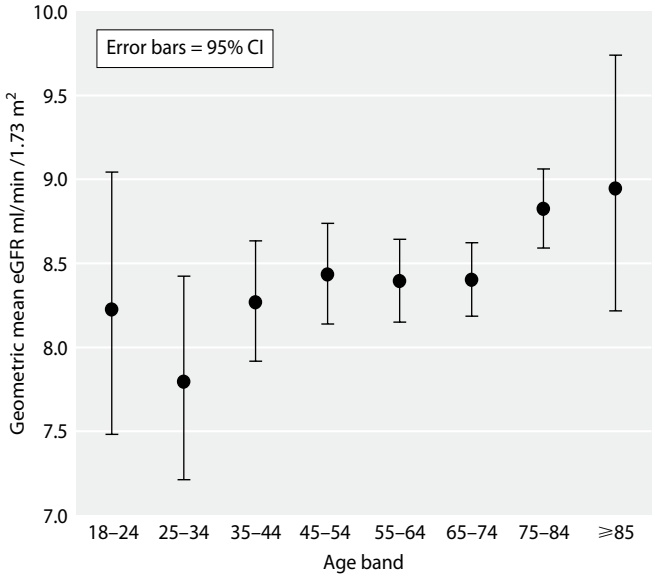

Fig. 3.11. Geometric mean eGFR at start of RRT by age band
p value from an ANOVA to test for differences between these age groups is 0.01

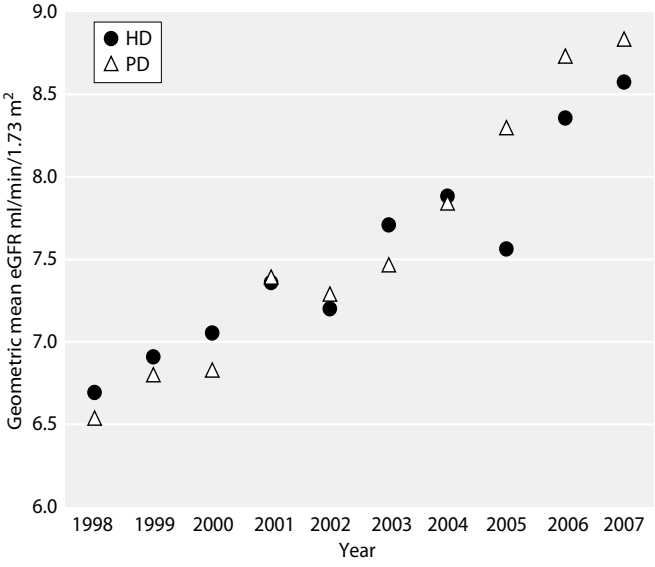

Fig. 3.12. eGFR on starting RRT 1998–2007; PD and HD

Renal disease may be asymptomatic until very advanced and therefore may present late to primary or secondary care services before referral onto renal services. 'Late referral' in this setting might be more appropriately labelled 'late presentation'. Alternatively patients may have been under follow-up in primary or secondary care with known renal failure and referral onto nephrological services may have been delayed. This is appropriately labelled 'late referral'. The data presented here encompasses both these moieties and are grouped under a single category of late presentation to the nephrologist.

Data were included from all incident patients in the years 2002–2007 with the following exceptions:

1. All patients under 18 years of age at the start of RRT.
2. All Scottish data since the date first seen in the renal centre was only available for a handful of patients.
3. The small number of patients who recovered sufficient renal function to allow discontinuation of dialysis.

The date of starting RRT and the date first seen in a renal centre 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/years with 75% or more completeness were used. Centres/years where 10% or more of the referral times were zero were excluded. After these exclusions, data on 8,514 patients were available for analysis. Referral times of 90 days or more were defined as early referrals. Referral times of less than 90 days were defined as late referrals. Forty-seven people were calculated to have negative referral times (−1 to −14 days) probably related to an error in recording the exact RRT start date and these were attributed as zero. This accounted for only 0.6% of the cohort.

Results

Table 3.13 shows the percentage completeness of data from centres between 2002 and 2007.

Late presentation by centre and year

The percentage of patients presenting to a nephrologist less than 90 days before RRT initiation in the included centres in the period 2002–2007 are shown in table 3.14. The incidence of late presentation ranged from 3.8–29.2% in 2007, giving a mean incidence of 21%, which was lower for the second consecutive year.

Time referred before dialysis initiation in the 2007 incident cohort

In 2007, 63.6% of incident patients had been referred over a year before they needed to start dialysis. There were 10.4% of patients referred within 6–12 months, 5.1% within 3–6 months and 21% within 3 months. Table 3.15 shows data relating to time referred before dialysis initiation from those 4 centres supplying data for each of the last 6 years with >75% completeness (Nottingham, Oxford, Portsmouth and Sheffield). There has been a sustained reduction in late referral over that period, more marked over the last 2 years. There has also been an increase in the percentage of patients referred over 12 months before dialysis initiation.

Table 3.13. Percentage completeness of late presentation data (2002 to 2007) by centre

	Year					
Centre	2002	2003	2004	2005	2006	2007
Antrim				0.0	39.4	52.8
B Heart	0.0	0.0	0.0	0.0	0.0	0.0
B QEH			0.0	0.0	0.0	0.5
Bangor	64.3	0.0	97.1	89.7	0.0	0.0
Basldn		96.2	97.8	89.3	100.0	100.0
Belfast				53.4	63.1	75.8
Bradfd	0.0	0.0	95.1	98.5	98.0	95.4
Brightn			0.0	0.0	0.0	0.0
Bristol	72.1	72.2	75.0	80.8	85.7	55.6
Camb	1.4	0.0	63.3	66.1	50.3	63.8
Cardff	0.0	2.4	1.6	0.5	0.5	0.5
Carlis	0.0	0.0	3.4	0.0	0.0	0.0
Carsh	0.0	0.5	0.0	0.6	0.0	0.0
Chelms			76.9	47.4	87.8	75.0
Clwyd	0.0	0.0	0.0	0.0	0.0	0.0
Covnt	0.0	0.0	0.0	0.0	1.0	0.0
Derby		0.0	1.5	1.4	0.0	0.0
Donc						100.0
Dorset		98.5	100.0	97.8	100.0	98.3
Dudley	8.0	14.6	0.0	0.0	0.0	0.0
Exeter	78.8	54.6	64.5	49.5	54.4	17.6
Glouc	2.0	0.0	13.5	93.3	82.2	98.2
Hull	0.0	2.5	0.9	2.4	0.0	1.0
Ipswi	90.7	0.0	0.0	96.5	92.9	0.0
L Barts			0.5	0.0	19.8	0.0
L Guys	0.0	0.0	0.0	0.0	0.0	0.0
L Kings	15.7	23.4	16.8	10.3	0.0	0.0
L Rfree				0.0	0.0	0.0
L St.G						0.0
L West	0.0	0.0	0.0	0.0	0.0	0.0
Leeds	65.1	76.6	88.5	88.3	85.9	80.2
Leic	86.9	93.8	92.5	62.4	54.4	61.9
Liv Ain			0.0	0.0	0.0	0.0
Liv RI	0.7	0.0	0.8	0.0	0.7	0.0
M Hope		52.4	59.5	75.9	86.0	78.8
M RI						11.3
Middlbr	91.0	91.3	87.3	89.3	73.3	77.6
Newc	0.0	0.0	0.0	0.0	98.2	97.2
Newry				78.6	0.0	100.0
Norwch			50.5	29.4	19.3	12.0
Nottm	94.2	99.1	98.0	98.6	97.7	99.2
Oxford	95.1	88.6	88.2	87.7	88.5	97.8
Plymth	0.0	0.0	0.0	0.0	1.1	1.3
Ports	95.8	95.0	94.8	91.9	94.2	85.3
Prestn	71.6	0.0	0.0	0.0	0.8	0.8
Redng	7.5	3.2	11.9	6.8	7.8	3.3
Sheff	97.4	98.7	98.8	97.4	95.8	97.5
Shrew			0.0	0.0	0.0	0.0
Stevng	0.0	95.8	85.4	59.3	42.2	36.5
Sthend	0.0	0.0	0.0	0.0	0.0	0.0
Stoke						0.0
Sund	0.0	0.0	0.0	0.0	0.0	0.0
Swanse	40.2	54.8	61.5	92.9	99.1	93.4
Truro	57.6	75.5	58.2	71.0	52.0	93.2
Tyrone				95.7	96.6	86.4

Table 3.13. Continued

Centre	Year					
	2002	2003	2004	2005	2006	2007
Ulster				0.0	100.0	100.0
Wirral	34.9	37.7	48.5	75.9	71.7	69.2
Wolve	69.1	79.1	97.1	98.9	97.5	95.5
Wrexm	0.0	0.0	0.0	0.0	0.0	0.0
York	87.1	85.7	93.8	0.0	95.7	88.2
Total	**37.7**	**41.8**	**39.9**	**38.0**	**40.2**	**34.7**

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Age and late presentation

In the whole cohort 2002–2007, patients who were referred late (<90 days before dialysis initiation) were significantly older than patients referred earlier (median age 67.5 vs 64.9 years: $p < 0.001$). Furthermore, the median duration of pre-dialysis care diminished progressively with increasing age beyond the 45–54 age group (figure 3.13).

Gender and late presentation

In the whole cohort 2002–2007, the male:female ratio was slightly, but not significantly, higher in those referred

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

Centre	Year					
	2002	2003	2004	2005	2006	2007
Bangor			36.4	40.0		
Basldn		39.2	35.6	20.0	26.7	20.5
Belfast						29.0
Bradfd			15.5	32.8	16.3	20.5
Bristol			26.7	24.5	14.7	
Chelms			22.5		30.2	28.2
Donc						27.8
Dorset		26.6	19.0	36.4	17.0	22.8
Exeter	17.5					
Glouc				19.6	21.7	21.4
Ipswi	38.5			50.9	33.3	
Leeds		36.2	29.9	32.9	31.6	24.7
Leic	27.8	21.1	23.0			
M Hope				20.0	13.5	3.8
Middlbr	32.7	26.6	31.5	22.7		17.1
Newc					22.4	18.9
Newry				22.7		20.0
Nottm	38.3	29.5	34.0	33.6	24.0	17.9
Oxford	30.1	27.4	27.3	28.9	26.6	21.1
Ports	34.8	25.8	31.2	27.2	29.8	21.8
Sheff	22.8	27.9	22.0	22.4	22.0	19.5
Stevng		30.4	20.0			
Swanse				42.9	38.2	29.2
Truro		15.0				17.1
Tyrone				22.7	10.7	10.5
Ulster					12.5	28.6
Wirral				31.8		
Wolve		26.5	30.3	30.0	25.3	26.6
York	22.2	22.9	26.7		27.3	26.7
Total	**29.3**	**27.7**	**26.9**	**29.4**	**24.3**	**21.0**

Blank cells – data not available or high incompleteness

Table 3.15. Referral times in 4 groups by year restricted to 4 centres contributing continuous data 2002–2007

Year	% <3 months	% 3–6 months	% 6–12 months	% >12 months
2002	30.5	10.5	11.8	47.1
2003	27.6	6.2	11.7	54.4
2004	27.7	7.1	9.4	55.8
2005	27.9	5.5	11.8	54.8
2006	25.7	7.7	10.9	55.8
2007	20.1	5.7	11.3	63.0

late (<90 days) than in those referred earlier (1.72 vs 1.61).

Ethnicity, social deprivation and late presentation

In this analysis of the whole cohort 2002–2007, only patients from centres with >70% ethnicity and >75% referral time data were included. Patients from the Chinese ethnic minority and others were excluded due to the small numbers with referral data. The percentage of non-Whites (South Asian and Black) referred late (<90 days) was significantly lower than in Whites (21.3% vs 25.9%: $p = 0.014$). 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.

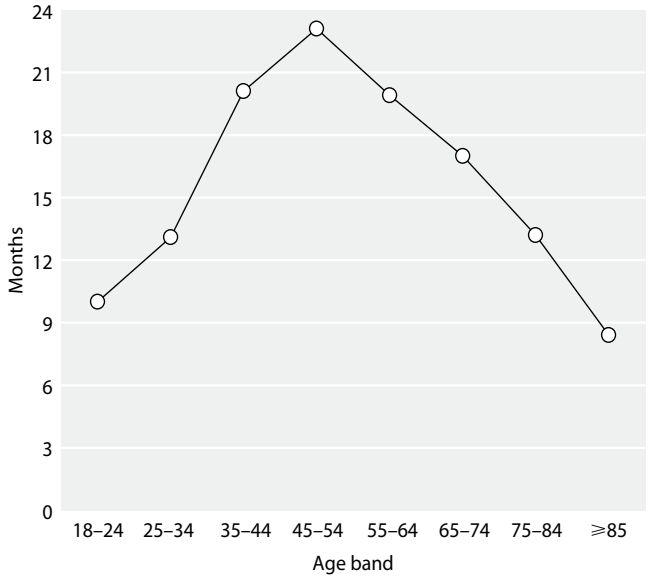

Fig. 3.13. Median duration of pre-dialysis care by age

Table 3.16. Late presentation by primary renal diagnosis

Diagnosis	Late presentation	
	N	%
Uncertain aetiology*	596	29
Diabetes	239	15
Glomerulonephritis	174	20
Other identified category	596	47
Polycystic kidney	44	8
Pyelonephritis	135	21
Renal vascular disease	305	28
Data not available	138	40

* includes presumed glomerulonephritis not biopsy proven

Primary renal disease and late presentation

In the 2002–2007 cohort, late referral (<3 months prior to dialysis initiation) differed significantly between primary renal diagnoses ($p < 0.001$) (table 3.16). Patients with a diagnosis of 'other identified category', 'data not available', and the aetiology uncertain/glomerulonephritis unproven groups appeared to have higher rates of late referral. Those with diabetes and particularly those with adult polycystic kidney disease had lower rates (table 3.16).

Modality and late presentation

In the whole 2002–2007 cohort, late presentation had a clear effect on the choice of modality. The percentage of patients whose first modality was PD was significantly less in the late referral group compared to those referred earlier (11.7% vs 28.5%: $p < 0.0001$). By 90 days after dialysis initiation the difference was less, though still highly significant (18.6% vs 30.9%: $p < 0.0001$).

Comorbidity and late presentation

In the whole 2002–2007 cohort, significantly fewer patients who had presented late (<90 days) were assessed as having no comorbidity when compared with the group who presented earlier (41% vs 44.9%: $p = 0.01$). Peripheral vascular disease was significantly less common in the group referred late. On the other hand, malignancies were significantly more common in those presenting late, perhaps because of the potential for rapid decompensation in renal function in this setting (table 3.17).

Haemoglobin and late presentation

In the whole 2002–2007 cohort, patients presenting late had a significantly lower haemoglobin concentration at dialysis initiation than patients presenting earlier

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

Comorbidity	0–89 days	⩾90 days	p-value
Cerebrovascular disease	11	10	0.9
COPD	7	7	0.3
Diabetes (not a cause of ERF)	8	9	0.4
Ischaemic heart disease	23	24	0.4
Liver disease	2	2	0.3
Malignancy	18	10	<0.0001
Peripheral vascular disease	10	13	0.001
Smoking	16	16	0.8

(9.5 vs 10.4 g/dl: $p < 0.001$), presumably because of inadequate pre-dialysis care and the lack of opportunity to optimise anaemia management.

eGFR at start of RRT and late presentation

In the whole data set 2002–2007, eGFR was lower in patients who presented late compared to earlier presentation (7.6 vs 8.1 ml/min/1.73 m^2: $p < 0.0001$), both in males (7.8 vs 8.4: $p < 0.0001$) and females (7.2 vs 7.7: $p = 0.0006$). The same relationship held in older patients (>65 years) (7.8 vs 8.4: $p < 0.0001$) and in younger patients (18–44 years) (6.8 vs 7.9: $p < 0.0001$), but not in those in the intermediate age range (45–64 years (7.6 vs 7.8: NS). The relationship held in Whites (7.5 vs 8.1: $p < 0.0001$) but not in Blacks (8.5 vs 7.8: NS) or Asians (7.3 vs 7.7: NS), though the numbers were small in these groups. There were no clear differences with respect to the Townsend score of social deprivation. eGFR was significantly lower in late referrals with renal disease of uncertain aetiology (6.9 vs 7.9: $p < 0.0001$)) and 'other diagnoses' (7.5 vs 8.1: $p = 0.005$). When stratifying by comorbidity, eGFR was significantly lower in patients who presented late compared to earlier presentation in all comorbid groups except cerebrovascular and peripheral vascular disease and diabetes. For example, amongst patients with malignancy, the eGFR at start of RRT was 8.2 in those who presented early compared to 7.4 in those who presented late ($p = 0.007$).

Survival of incident patients

This analysis is to be found in chapter 7 Survival of incident and prevalent patients.

Conflict of interest: none

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Chapter 4
ESRD prevalent rates in 2007 in the UK: 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 demographics of UK RRT patients in 2007. ***Methods:*** Complete data were electronically collected from 71 UK centres with the remaining 1 centre submitting summary data. A series of cross-sectional and longitudinal analyses were performed to describe the demographics of prevalent UK RRT patients in 2007 at a centre and a national level. ***Results:*** There were 45,484 adult patients receiving RRT on 31/12/2007. The population prevalence for adults was 746 per million population per year (pmp) with an annual increase in prevalence of approximately 5% per annum. There was substantial variation in standardised prevalence ratios between Primary Care Trust (PCT)/Health Authority (HA) areas which were associated with geographical factors and differences in ethnicity with mean standardised prevalence ratios (SPR) significantly higher in PCTs/HAs with a high proportion of ethnic minorities. The median age of prevalent RRT patients was 57 years (HD 65 years, PD 60 years, transplant 50 years). Median RRT vintage was 5.3 years (HD 2.8 years, PD 2.1 years, transplant 10.4 years). For all ages, crude prevalence rates in males exceeded those in females, peaking in the 75–79 year age band for males at 2,506 pmp and in females in the 70–74 year age band at 1,314 pmp. The most common identifiable diagnosis was glomerulonephritis (15.3%) but in those over 65 it was diabetes (15.1%). The most common treatment modality was transplantation (46.6%), closely followed by centre-based HD (42.1%) in either the primary centre (25.2%) or the satellite unit (16.9%). The HD population has continued to expand, and the PD population to contract. HD was increasingly prominent with increasing age at the expense of transplantation. ***Conclusions:*** There were national, area and dialysis centre level variation in the prevalent UK RRT population. This has implications for service planning and ensuring equity of care for RRT patients.

Introduction

The UK Renal Registry collected data from 72 (100%) UK renal centres. Seventy one centres submitted an electronic dataset and one centre submitted summary data including prevalent patient numbers.

These analyses of prevalent RRT patients are performed annually in conjunction with a similar analysis of incident patients 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 of 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 2007 (chapter 15 and appendix B). The cohort was defined as all adult patients prevalent on RRT on the UK Registry database on 31/12/2007. Population estimates were obtained from the UK Office of National Statistics (ONS) [1].

Total numbers of prevalent RRT patients were calculated for the UK as a whole and by UK countries using UK Renal Registry (UKRR) data where possible but also including summary data from the centre not currently submitting data electronically. This was analysed with ONS data to calculate the prevalence of RRT pmp with 95% confidence intervals. The numbers of prevalent patients split by dialysis modality was calculated for each centre and compared to previous years both for all centres (including percentage change from 2006 to 2007) and centres continuously reporting to the Registry since 2000 (including percentage change from 2000 to 2007). To explore the effect of centre size on modality distribution, centres were also divided into quartiles by total number of RRT patients and the proportion of patients for each modality was calculated for each quartile.

The prevalence of RRT by PCT and standardised prevalence ratios (SPR) were calculated (2008 Report appendix D www.renalreg.org). Age and gender specific prevalence was first calculated using the available Registry data on the number of prevalent patients for the covered area in England, Wales, Scotland and Northern Ireland. The data on the age and gender breakdown of the population of each PCT area was obtained from the ONS mid 2006 estimates which were derived from the 2001 census data. The age and gender specific prevalence was then used to calculate the expected prevalence for each PCT area. The age and gender standardised ratio is therefore equal to (observed prevalence)/(expected prevalence). A ratio of 1 indicates that the PCT area's prevalence was as expected if the age/gender rates found in the total covered population applied to the PCT area's population structure; a level above 1 indicates that the observed prevalence was greater than expected given the PCT area's population structure; if the lower confidence limit was above one this is statistically significant at the 5% level. The converse applies to standardised prevalence rate ratios under one. Prevalence estimates of RRT in relatively small populations such as those covered by individual Primary Care Trusts incur wide confidence intervals for any observed frequency.

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. PCTs in each region were then classified as having a low (below 95% CI), normal or high (above 95% CI) SPR.

ONS data were used to calculate the mean proportion of non-White people in each region weighted by PCT size. Ethnicity data were also obtained from the ONS (2001 census).

A series of analyses were performed to explore case mix differences between prevalent RRT patients. These included RRT vintage, age, gender, ethnicity, primary renal diagnosis and diabetic status (2008 Report appendix G). Patients were excluded from these analyses if the treatment modality was not known. RRT vintage was defined as median time on treatment and was calculated from the most recent start date. Vintage was calculated for each modality and the whole RRT cohort. Patients were excluded from this analysis if an accurate start date was unknown e.g. patients transferring centres. The distribution of RRT patients was analysed by age, gender, ethnicity, primary renal disease and diabetes and where appropriate split by dialysis modality. Centre level differences in age and ethnicity were also calculated.

The distribution of prevalent patients by RRT treatment modality was analysed both by centre and country. A longitudinal analysis was performed to analyse changes in use of modality for prevalent patients over time.

The data were analysed using SAS 9.1.3. A number of statistical tests were used to test for significant differences between groups. Parametric data were analysed using t-tests and Pearson correlation coefficients. Non-parametric data were analysed using Wilcoxon rank sum test and Spearman correlation coefficients.

Results

Prevalent patients numbers and changes in prevalence

The numbers 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 areas by their individual post codes, as some centres treat patients across national boundaries.

Prevalent patient numbers

The analysis includes summary statistics from the one centre not contributing data to the UKRR, and excludes those without a treatment modality code. There were 45,484 adult patients receiving RRT in the UK at the end of 2007, giving a UK population prevalence for adults of 746 pmp (table 4.1), an increase from 724 pmp in 2006 [2]. Prevalence increased in each of the four UK countries and remained lower in England (736 pmp) than in Wales (798 pmp), Scotland (797 pmp)

Table 4.1. Prevalence of RRT therapy in adults in the UK 31/12/07

	England	Wales	Scotland	N Ireland	UK
All UK centres	37,614	2,377	4,101	1,392	45,484
Total population, mid-2007(millions)*	51.1	3.0	5.1	1.8	61.0
Prevalence pmp HD	318	339	346	393	323
Prevalence pmp PD	74	109	77	60	76
Prevalence pmp dialysis	392	448	423	453	399
Prevalence pmp transplant	344	350	374	338	347
Prevalence pmp total	736	798	797	791	746
Confidence intervals total	729–744	766–830	773–822	750–833	739–753

* estimates from ONS web site

and Northern Ireland (791 pmp). Figure 4.1 shows the distribution of treatment modalities in relation to the number of prevalent RRT patients. The prevalence rate for each of the UK countries is shown in figure 4.2.

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 contributed to this including geography, local population density, age distribution, ethnic composition and social deprivation index of that population. Local facilities, preferences and centre transplanting status also played a role in determining the modality distribution. 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 (1.26 vs. 0.53: $p < 0.001$). The wide variability in this ratio both in transplanting (0.78–2.03) and non-transplanting (0–1.08) centres suggests considerable variation in transplant follow-up policies.

The distribution of treatment modalities was also dependent on centre size, in terms of the number of RRT patients. As centre size increased the proportion of transplant patients increased at the expense of the proportion of haemodialysis patients. The proportion of transplanting centres increased through the size 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 was a transplanting centre up to 2003).

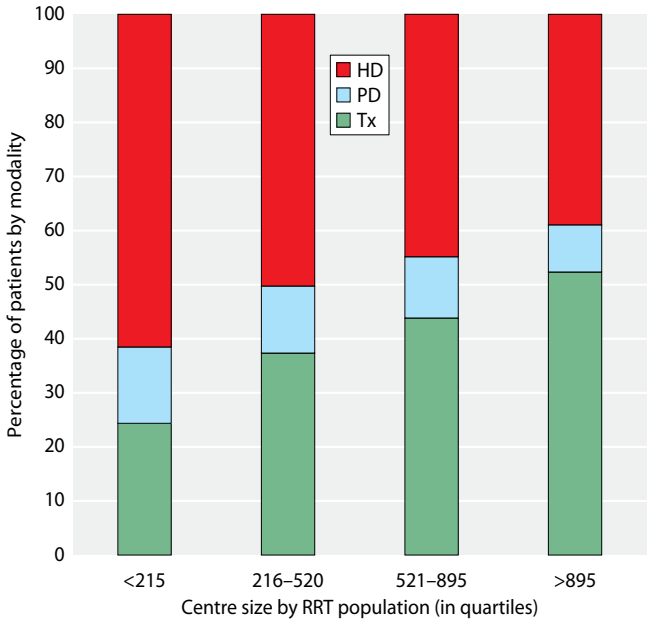

Fig. 4.1. Distribution of treatment modalities in relation to the number of prevalent RRT patients (displayed in quartiles)

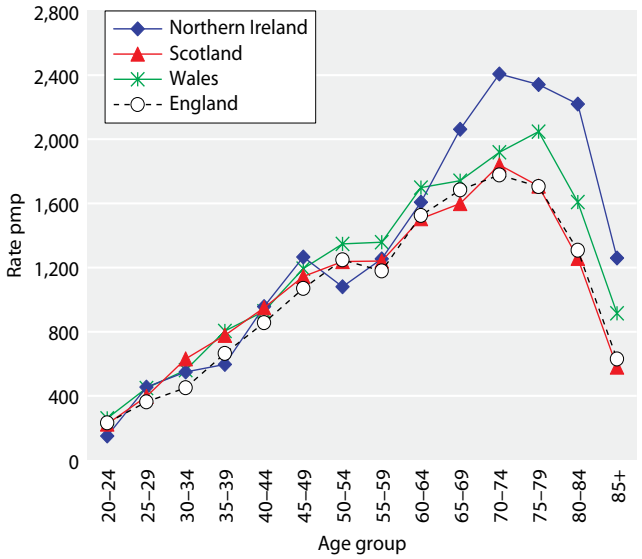

Fig. 4.2. Prevalent rate per million population by age band and UK country

Table 4.2. Number of prevalent patients per treatment modality by centre on 31/12/07

Country	Centre	HD	PD	Dialysis	Transplant	RRT
England	B Heart	387	34	421	157	578
	B QEH*	764	132	896	730	1,626
	Basldn	132	31	163	42	205
	Bradfd	178	43	221	174	395
	Brightn	333	87	420	265	685
	Bristol*	463	81	544	690	1,234
	Camb*	356	50	406	529	935
	Carlis	86	13	99	103	202
	Carsh	561	128	689	476	1,165
	Chelms	108	42	150	38	188
	Colchester	100	0	100	0	100
	Covnt*	308	77	385	332	717
	Derby	204	78	282	19	301
	Donc	58	38	96	11	107
	Dorset	159	55	214	238	452
	Dudley	114	61	175	80	255
	Exeter	300	82	382	282	664
	Glouc	176	34	210	116	326
	Hull	310	90	400	272	672
	Ipswi	101	50	151	132	283
	Kent	289	98	387	240	627
	L Barts*	583	240	823	650	1,473
	L Guys*	481	64	545	850	1,395
	L Kings	344	86	430	282	712
	L RFree*	610	125	735	702	1,437
	L St.G*	204	53	257	310	567
	L West*	1,056	67	1,123	1,039	2,162
	Leeds*	506	105	611	768	1,379
	Leic*	675	203	878	716	1,594
	Liv Ain	115	0	115	0	115
	Liv RI*	421	90	511	763	1,274
	M Hope	321	135	456	303	759
	Man RI*	402	123	525	877	1,402
	Middlbr	291	29	320	367	687
	Newc*	250	54	304	534	838
	Norwch	260	64	324	171	495
	Nottm*	369	147	516	455	971
	Oxford*	342	147	489	839	1,328
	Plymth*	131	44	175	246	421
	Ports*	403	102	505	677	1,182
	Prestn	418	82	500	355	855
	Redng	230	98	328	217	545
	Sheff*	566	93	659	513	1,172
	Shrew	162	41	203	82	285
	Stevng	329	43	372	176	548
	Sthend	122	20	142	53	195
	Stoke	256	96	352	236	588
	Sund	165	15	180	164	344
	Truro	156	27	183	103	286
	Wirral	182	34	216	0	216
	Wolve	275	62	337	104	441
	York	115	26	141	90	231
Wales	Bangor	65	33	98	0	98
	Cardff*	494	159	653	785	1,438
	Clwyd	71	19	90	65	155
	Swanse	301	82	383	161	544
	Wrexm	79	33	112	30	142

Table 4.2. Continued

Country	Centre	HD	PD	Dialysis	Transplant	RRT
Scotland	Abrdn	212	35	247	205	452
	Airdrie	148	23	171	59	230
	D & Gall	50	16	66	11	77
	Dundee	170	29	199	177	376
	Dunfn	112	25	137	83	220
	Edinb*	272	77	349	371	720
	Glasgw*	599	104	703	902	1,605
	Inverns	85	40	125	82	207
	Klmarnk	130	47	177	37	214
Northern Ireland	Antrim	129	16	145	55	200
	Belfast*	262	63	325	423	748
	Derry	52	4	56	6	62
	Newry	86	14	100	47	147
	Tyrone	83	5	88	61	149
	Ulster	79	3	82	4	86
Totals	**England**	**16,227**	**3,819**	**20,046**	**17,568**	**37,614**
	N Ireland	**691**	**105**	**796**	**596**	**1,392**
	Scotland	**1,778**	**396**	**2,174**	**1,927**	**4,101**
	Wales	**1,010**	**326**	**1,336**	**1,041**	**2,377**
	UK	**19,706**	**4,646**	**24,352**	**21,132**	**45,484**

* Transplanting centres
Italics, centre returned summary data

Changes in prevalence

Overall growth in the prevalent UK RRT population between 2006 and 2007 was 11.8% (table 4.3). The growth in England (13.1%) and Wales (10.8%) outstripped that in Scotland (5.0%) and Northern Ireland (2.9%). There were large variations between centres. Growth increased by 96.2% in Clwyd, 82.4% in Derry and 30.6% in London West and decreased by

Table 4.3. Number of patients on RRT by centre 2004–2007

	Date				
Centre	31/12/2004	31/12/2005	31/12/2006	31/12/2007	% change 2006–2007
Abrdn	388	415	428	452	5.6
Airdrie	181	171	233	230	−1.3
Antrim		188	200	200	0.0
B Heart	503	538	578	578	0.0
B QEH	1,420	1,514	1,555	1,626	4.6
Bangor	93	101	103	98	−4.9
Basldn	161	168	186	205	10.2
Belfast		738	750	748	−0.3
Bradfd	324	361	365	395	8.2
Brightn	591	615	647	685	5.9
Bristol	1,089	1,158	1,200	1,234	2.8
Camb	766	816	905	935	3.3
Cardff	1,218	1,267	1,334	1,438	7.8
Carlis	179	183	188	202	7.4
Carsh	957	994	1,101	1,165	5.8
Chelms	138	134	155	188	21.3
Clwyd	70	83	79	155	96.2
Covnt	602	636	675	717	6.2
D & Gall	61	69	76	77	1.3
Derby	274	279	301	301	0.0
Derry			34	62	82.4

Table 4.3. Continued

Centre	Date				% change 2006–2007
	31/12/2004	31/12/2005	31/12/2006	31/12/2007	
Donc				107	0.0
Dorset	368	382	395	452	14.4
Dudley	254	257	261	255	−2.3
Dundee	319	355	362	376	3.9
Dunfn	136	150	156	220	41.0
Edinb	649	669	701	720	2.7
Exeter	570	580	621	664	6.9
Glasgw	1,517	1,583	1,541	1,605	4.2
Glouc	258	280	319	326	2.2
Hull	549	585	610	672	10.2
Inverns	178	198	199	207	4.0
Ipswi	281	290	283	283	0.0
Klmarnk	158	180	211	214	1.4
L Barts	1,293	1,332	1,415	1,473	4.1
L Guys	1,214	1,220	1,315	1,395	6.1
L Kings	593	633	669	712	6.4
L Rfree		1,310	1,382	1,437	4.0
L St.G				567	0.0
L West	1,142	1,145	1,656	2,162	30.6
Leeds	1,255	1,300	1,366	1,379	1.0
Leic	1,269	1,427	1,497	1,594	6.5
Liv Ain	34	81	98	115	17.3
Liv RI	1,251	1,293	1,360	1,274	−6.3
M Hope	575	612	714	759	6.3
M RI				1,402	0.0
Middlbr	577	589	639	687	7.5
Newc	800	863	898	838	−6.7
Newry		155	148	147	−0.7
Norwch	360	408	436	495	13.5
Nottm	830	887	922	971	5.3
Oxford	1,197	1,192	1,286	1,328	3.3
Plymth	349	367	411	421	2.4
Ports	1,051	1,085	1,144	1,182	3.3
Prestn	744	765	828	855	3.3
Redng	377	410	530	545	2.8
Sheff	1,146	1,164	1,230	1,172	−4.7
Shrew	225	235	260	285	9.6
Stevng	544	557	604	548	−9.3
Sthend	181	181	188	195	3.7
Stoke				588	0.0
Sund	267	277	269	344	27.9
Swanse	444	462	499	544	9.0
Truro	277	269	289	286	−1.0
Tyrone		165	160	149	−6.9
Ulster		44	61	86	41.0
Wirral	185	191	199	216	8.5
Wolve	422	438	448	441	−1.6
Wrexm	183	137	130	142	9.2
York	183	200	223	231	3.6
England	**27,625**	**30,201**	**32,621**	**36,887**	**13.1**
N Ireland		**1,290**	**1,353**	**1,392**	**2.9**
Scotland	**3,587**	**3,790**	**3,907**	**4,101**	**5.0**
Wales	**2,008**	**2,050**	**2,145**	**2,377**	**10.8**
UK	**33,220**	**37,331**	**40,026**	**44,757**	**11.8**

Table 4.4. Prevalent patient numbers in renal centres reporting continuously 2000–2007

Centre	2000	2001	2002	2003	2004	2005	2006	2007	% change 2000–2007
Abrdn	302	316	355	349	388	415	428	452	49.7
Airdrie	98	143	171	172	181	171	233	230	134.7
B Heart	422	452	444	497	503	538	578	578	37.0
Bristol	905	945	991	1,050	1,089	1,158	1,200	1,234	36.4
Cardff	1,028	1,055	1,092	1,156	1,218	1,267	1,334	1,438	39.9
Carlis	156	159	161	170	179	183	188	202	29.5
Carsh	671	697	785	886	957	994	1,101	1,165	73.6
Covnt	514	545	563	575	602	636	675	717	39.5
D & Gall	54	72	73	79	61	69	76	77	42.6
Derby	121	160		259	274	279	301	301	148.8
Dudley	244	235	231	241	254	257	261	255	4.5
Dundee	236	244	288	299	319	355	362	376	59.3
Dunfn	90	112	119	127	136	150	156	162	80.0
Edinb	558	574	597	619	649	669	701	720	29.0
Exeter	407	433	509	520	570	580	621	664	63.1
Glasgw	1,393	1,414	1,430	1,487	1,517	1,583	1,541	1,605	15.2
Glouc	235	195	210	243	258	280	319	326	38.7
Hull	420	443	506	514	549	585	610	672	60.0
Inverns	92	120	147	159	178	198	199	207	125.0
Klmarnk	136	143	157	168	158	180	211	214	57.4
L Guys	1,124	1,145	1,185	1,183	1,214	1,220	1,315	1,395	24.1
Leeds	1,167	1,162	1,181	1,203	1,255	1,300	1,366	1,379	18.2
Leic	973	1,028	1,079	1,120	1,269	1,427	1,497	1,594	63.8
Middlbr	415	422	520	550	577	589	639	667	60.7
Nottm	760	817	789	809	830	887	922	971	27.8
Oxford	1,241	1,316	1,359	1,397	1,197	1,192	1,286	1,328	7.0
Plymth	408	393	385	345	349	367	411	421	3.2
Prestn	458	503	567	712	744	765	828	855	86.7
Redng	174	200	199	228	377	410	449	545	213.2
Sheff	866	943	1,022	1,083	1,146	1,164	1,230	1,172	35.3
Stevng	451	451	528	565	544	557	604	548	21.5
Sthend	141	142	151	168	181	181	188	195	38.3
Sund	228	218	236	236	267	277	269	282	23.7
Swanse	226	383	383	415	444	462	499	544	140.7
Wolve	316	335	366	399	422	438	448	441	39.6
Wrexm	221	202	201	199	183	137	130	142	−35.7
York	92	124	160	186	183	200	223	231	151.1
England	**12,909**	**13,463**	**14,127**	**15,139**	**15,790**	**16,464**	**17,529**	**18,138**	**40.5**
Scotland	**2,959**	**3,138**	**3,337**	**3,459**	**3,587**	**3,790**	**3,907**	**4,043**	**36.6**
Wales	**1,475**	**1,640**	**1,676**	**1,770**	**1,845**	**1,866**	**1,963**	**2,124**	**44.0**
UK	**17,343**	**18,241**	**19,140**	**20,368**	**21,222**	**22,120**	**23,399**	**24,305**	**40.1**

9.3% in Stevenage. In Clwyd, the major growth was in transplant numbers, due to transfer from Liverpool of a cohort of established post-transplant patients for local follow-up. This was also true for Dunfermline where patients were transferred from Glasgow. In Derry, a new growing centre, the major growth was in the haemodialysis population. The growth in London West reflected the recent amalgamation of centres and now includes data from the transplant patients previously at London St Mary's.

In the longer term, for those 37 centres contributing data to the Registry across the 8 years between 2000 and 2007, growth in the prevalent RRT population increased by 40.1% (table 4.4), giving an average annual growth rate of around 5%. This was fairly stable across the three UK countries whose centres submitted data over that period, ranging from 4.8% in Scotland, through 5.1% in England to 5.4% in Wales. The absolute increase of RRT patients was highest in those centres in the highest quartile (Q4) in terms of RRT

population at baseline in 2000 (median increase Q1 = 115, Q2 = 125, Q3 = 203, Q4 = 288 patients), whilst the growth in percentage terms was the inverse of this (median increase Q1 = 125%, Q2 = 50%, Q3 = 40%, Q4 = 32%).

The long-term (1982–2007) UK prevalence pattern in relation to RRT modality is shown in figure 4.3. The steady growth in transplant numbers was maintained but haemodialysis numbers continued to increase more rapidly. The slow contraction in home-based therapies, evident over the past decade, persisted.

Prevalence of RRT in Primary Care Trusts (PCT) in England and Health Authorities (HA) in N Ireland, Scotland and Wales

For the first time in 2007, prevalence rates were reported in relation to the catchment area populations of Primary Care Trusts in England. Data by HA for the other UK countries continued to be reported. There were substantial variations in the crude PCT/HA area prevalence from 399 pmp (Great Yarmouth and Waveney, population 210,600) to 1,487 pmp (Merthyr Tydfil, population 55,800). There were similar variations in SPR from 0.48 (Great Yarmouth and Waveney) to 2.44 (Heart of Birmingham) (table 4.5).

PCTs/HAs with small populations have wide confidence limits for SPR (figures 4.4 and 4.5), such that the interpretation of data from a single year may be difficult. The annual standardised prevalence rate was inherently more stable than the annual standardised acceptance rate (chapter 3), and there was a high degree of correlation between the SPR's obtained for 2007 and those calculated for the period 2002 to 2007 ($r^2 = 0.889$: $p < 0.001$).

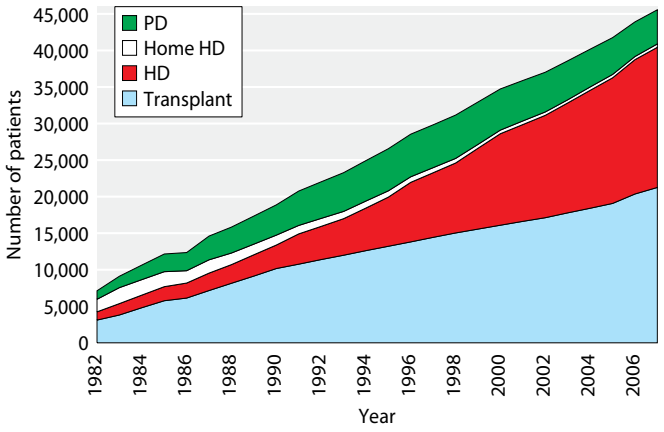

Fig. 4.3. Growth in prevalent patients, by treatment modality at the end of each year 1982–2007

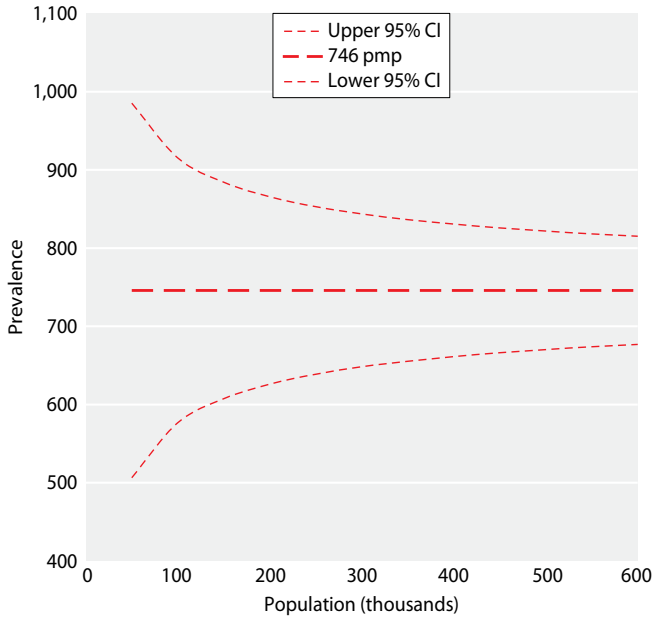

Fig. 4.4. 95% confidence limits for prevalence of 746 pmp for population sizes 50,000–600,000

Factors associated with variation in standardised prevalence ratios in PCTs in England and HAs in Northern Ireland, Scotland and Wales

Geographical considerations and ethnicity were the major factors underlying the variation in SPR (table 4.5). In 2007, for the PCTs/HAs with available data, there were 48 PCTs/HAs with a significantly low SPR, 129 with a normal SPR and 51 with a significantly high

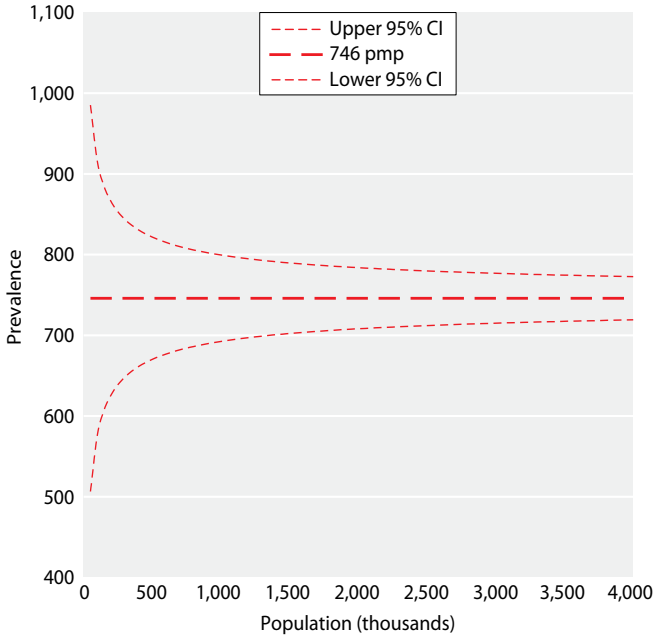

Fig. 4.5. 95% confidence limits for prevalence of 746 pmp for population sizes 50,000–4 million

Table 4.5. Prevalence of RRT and standardised prevalence ratios in Primary Care Trusts and Health Authorities with complete coverage

[a] per million population
O/E = standardised prevalence ratio
Blank cells – no data returned to the Registry for that year
Areas with significantly high prevalence ratios are bold in darker grey cells, areas with significantly low prevalence ratios are italicised in lighter grey cells
% non-White = the sum of % South Asian and Black from the 2001 UK census

			2002	2003	2004	2005	2006	2007				All	% non-
Region	**PCT**	**Tot pop**	**O/E**	**O/E**	**O/E**	**O/E**	**O/E**	**O/E**	**LCL**	**UCL**	**pmp[a]**	**O/E**	**White**
NE	County Durham	500,400	1.02	0.95	0.97	0.99	0.95	0.91	0.82	1.01	715	0.96	1.0
England	Darlington	99,100	0.95	0.97	0.98	0.96	0.83	0.83	0.64	1.06	636	0.91	2.1
	Redcar and Cleveland	139,200	1.07	1.03	1.03	0.97	0.98	0.98	0.81	1.19	776	1.01	1.1
	Hartlepool	91,100	0.94	0.97	1.02	0.93	1.00	0.89	0.69	1.14	670	0.96	1.1
	Middlesbrough	138,500	1.21	1.22	1.09	1.03	1.06	1.07	0.88	1.29	758	1.11	6.3
	North Tees	189,200	0.79	0.81	0.88	0.88	0.92	0.86	0.72	1.02	634	0.86	2.7
	Gateshead	190,500	1.15	1.07	1.04	1.00	0.95	0.90	0.76	1.06	698	1.01	1.6
	Newcastle	270,400	1.01	0.93	0.88	0.92	0.90	0.93	0.80	1.08	655	0.93	6.9
	North Tyneside	195,100	1.05	1.02	1.00	1.02	0.99	0.94	0.80	1.10	733	1.00	1.9
	Northumberland	*309,900*	*0.96*	*0.93*	*0.93*	*0.89*	*0.83*	*0.81*	*0.71*	*0.93*	*671*	*0.89*	*1.0*
	South Tyneside	151,000	0.88	0.90	0.92	0.95	0.96	0.94	0.78	1.13	728	0.93	2.7
	Sunderland Teaching	280,600	1.01	1.03	1.03	0.97	0.90	0.89	0.77	1.03	677	0.97	1.9
NW	Wirral	311,100	1.09	1.09	1.07	1.04	1.00	0.93	0.82	1.06	726	1.03	1.7
England	Liverpool	436,200	1.21	1.18	1.19	1.13	1.14	1.08	0.97	1.20	766	1.15	5.7
	Central and Eastern Cheshire	*451,200*						*0.78*	*0.69*	*0.88*	*618*	*0.78*	*1.6*
	Western Cheshire	235,100	0.99	0.96	1.01	0.94	0.91	0.91	0.78	1.06	723	0.95	1.6
	Knowsley	151,500	1.20	1.24	1.23	1.15	1.08	1.04	0.87	1.26	752	1.15	1.6
	Sefton	*277,500*	*0.93*	*0.92*	*0.86*	*0.88*	*0.87*	*0.83*	*0.72*	*0.96*	*663*	*0.88*	*1.6*
	Halton and St Helens	297,000	0.87	0.89	0.87	0.89	0.95	0.98	0.85	1.11	734	0.91	1.2
	Warrington	194,300	0.81	0.90	0.90	0.83	0.81	0.86	0.73	1.03	654	0.85	2.1
	Blackburn with Darwen	**141,200**	**0.86**	**1.07**	**1.14**	**1.15**	**1.20**	**1.38**	**1.16**	**1.64**	**914**	**1.15**	**22.0**
	Blackpool	*142,800*	*0.66*	*0.76*	*0.73*	*0.70*	*0.63*	*0.76*	*0.62*	*0.94*	*609*	*0.71*	*1.6*
	North Lancashire	*329,000*	*0.63*	*0.81*	*0.77*	*0.68*	*0.67*	*0.72*	*0.62*	*0.83*	*581*	*0.71*	*1.7*
	Cumbria	*496,000*	*0.77*	*0.81*	*0.78*	*0.76*	*0.76*	*0.75*	*0.67*	*0.84*	*619*	*0.77*	*0.7*
	Central Lancashire	*451,600*	*0.65*	*0.71*	*0.74*	*0.74*	*0.72*	*0.78*	*0.69*	*0.88*	*591*	*0.73*	*5.6*
	East Lancashire	384,500	0.67	0.88	0.94	0.89	0.93	1.05	0.94	1.18	783	0.90	8.1
	Ashton, Leigh and Wigan	305,500		0.61	0.64	0.66	0.69	0.91	0.80	1.05	694	0.71	1.3
	Bolton	262,500		0.75	0.75	0.81	0.83	1.08	0.94	1.23	789	0.85	11.0
	Bury	182,900		0.36	0.42	0.45	0.45	0.89	0.74	1.06	656	0.53	6.1
	Manchester	451,900						1.07	0.95	1.19	659	1.07	19.0
	Heywood, Middleton and Rochdale	206,400						0.99	0.84	1.16	707	0.99	11.4
	Oldham	219,800		0.49	0.54	0.50	0.60	0.91	0.77	1.07	641	0.62	13.9
	Salford	*217,800*		*0.71*	*0.64*	*0.62*	*0.66*	*0.78*	*0.66*	*0.94*	*565*	*0.69*	*3.9*
	Stockport	*280,800*						*0.84*	*0.72*	*0.97*	*648*	*0.84*	*4.3*
	Tameside and Glossop	247,700						0.97	0.83	1.12	715	0.97	4.9
	Trafford	*212,100*						*0.78*	*0.65*	*0.93*	*585*	*0.78*	*8.4*
Yorkshire	*East Riding of Yorkshire*	*331,100*	*0.84*	*0.84*	*0.81*	*0.82*	*0.78*	*0.78*	*0.68*	*0.89*	*649*	*0.81*	*1.2*
& Humber	Hull	256,200	1.04	0.98	1.02	1.02	0.97	1.00	0.86	1.16	703	1.00	2.3
	North East Lincolnshire	159,900	0.93	0.94	1.00	1.00	0.97	0.99	0.83	1.18	750	0.97	1.4
	North Lincolnshire	155,200	1.01	0.98	0.96	0.91	0.94	0.92	0.76	1.10	728	0.95	2.5
	North Yorkshire and York	*783,200*	*0.84*	*0.84*	*0.85*	*0.83*	*0.82*	*0.82*	*0.75*	*0.89*	*650*	*0.83*	*1.4*
	Barnsley	223,700	1.17	1.19	1.21	1.11	1.08	1.02	0.88	1.18	782	1.12	0.9
	Doncaster	290,400	1.04	1.12	1.10	1.01	1.02	0.93	0.82	1.07	716	1.03	2.3

Table 4.5. Continued

Region	PCT	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 LCL	2007 UCL	2007 pmp[a]	All O/E	% non-White
Yorkshire & Humber	Rotherham	253,000	1.19	1.19	1.23	1.16	1.07	1.06	0.92	1.21	806	1.14	3.1
	Sheffield	526,100	1.08	1.06	1.11	1.06	1.09	1.08	0.98	1.19	779	1.08	8.8
	Bradford and Airedale	**493,000**	**1.22**	**1.28**	**1.27**	**1.27**	**1.17**	**1.18**	**1.07**	**1.30**	**799**	**1.23**	**21.7**
	Calderdale	198,600	0.94	1.03	1.05	1.05	1.06	1.06	0.91	1.24	796	1.04	7.0
	Wakefield District	*321,000*	*0.88*	*0.85*	*0.86*	*0.86*	*0.88*	*0.85*	*0.74*	*0.97*	*648*	*0.86*	*2.3*
	Kirklees	398,400	1.16	1.21	1.21	1.15	1.18	1.11	1.00	1.24	803	1.17	14.4
	Leeds	750,300	1.06	1.02	1.00	1.01	1.02	0.96	0.88	1.05	668	1.01	8.1
East Midlands	**Leicester City**	**289,700**	**1.84**	**1.81**	**1.80**	**1.76**	**1.71**	**1.73**	**1.55**	**1.93**	**1118**	**1.77**	**36.1**
	Leicestershire County and Rutland	*673,600*	*0.92*	*0.93*	*0.95*	*0.90*	*0.90*	*0.89*	*0.81*	*0.97*	*692*	*0.91*	*5.1*
	Northamptonshire	*669,200*	*0.92*	*0.89*	*0.71*	*0.88*	*0.87*	*0.88*	*0.80*	*0.97*	*653*	*0.86*	*4.9*
	Nottinghamshire County	657,500	1.06	1.04	1.04	1.02	0.99	0.98	0.90	1.07	771	1.02	2.8
	Bassetlaw	111,000	0.70	0.74	0.78	0.81	0.79	0.94	0.76	1.16	748	0.80	1.4
	Derby City	236,400		1.18	1.20	1.12	1.11	1.03	0.89	1.19	740	1.12	12.6
	Derbyshire County	*720,800*	*0.67*	*0.90*	*0.86*	*0.84*	*0.84*	*0.85*	*0.78*	*0.93*	*681*	*0.83*	*1.5*
	Lincolnshire	*688,700*	*0.81*	*0.77*	*0.79*	*0.80*	*0.77*	*0.77*	*0.70*	*0.85*	*636*	*0.78*	*1.4*
	Nottingham City	**286,400**	**1.37**	**1.29**	**1.29**	**1.24**	**1.21**	**1.16**	**1.01**	**1.32**	**733**	**1.25**	**15.1**
West Midlands	*Dudley*	*305,200*	*0.78*	*0.78*	*0.99*	*0.96*	*0.92*	*0.87*	*0.76*	*1.00*	*682*	*0.89*	*6.4*
	Birmingham East and North	**395,900**			**1.51**	**1.54**	**1.57**	**1.47**	**1.33**	**1.62**	**1003**	**1.52**	**22.3**
	Heart of Birmingham Teaching	**271,400**			**2.44**	**2.43**	**2.43**	**2.44**	**2.21**	**2.70**	**1389**	**2.43**	**59.9**
	South Birmingham	**339,400**			**1.42**	**1.40**	**1.32**	**1.26**	**1.13**	**1.41**	**872**	**1.34**	**15.1**
	Sandwell	**287,700**			**1.48**	**1.45**	**1.44**	**1.41**	**1.26**	**1.58**	**1018**	**1.44**	**20.3**
	Solihull	203,000	0.76	0.88	1.04	0.99	1.04	0.94	0.80	1.10	729	0.94	5.4
	Walsall Teaching	**254,700**	**0.88**	**0.86**	**1.33**	**1.32**	**1.28**	**1.26**	**1.11**	**1.43**	**942**	**1.17**	**13.6**
	Wolverhampton City	**236,900**	**1.24**	**1.28**	**1.37**	**1.35**	**1.29**	**1.23**	**1.07**	**1.40**	**908**	**1.29**	**22.2**
	Coventry Teaching	**306,600**	**1.37**	**1.38**	**1.32**	**1.23**	**1.19**	**1.18**	**1.05**	**1.34**	**822**	**1.27**	**16.0**
	Herefordshire	*178,000*			*0.88*	*0.87*	*0.84*	*0.81*	*0.67*	*0.96*	*680*	*0.85*	*0.9*
	Warwickshire	522,300	1.06	1.03	1.10	1.08	1.03	1.02	0.93	1.13	806	1.05	4.4
	Worcestershire	*553,000*			*0.85*	*0.86*	*0.82*	*0.81*	*0.73*	*0.89*	*644*	*0.83*	*2.4*
	North Staffordshire	*211,400*						*0.83*	*0.71*	*0.98*	*667*	*0.83*	*1.5*
	South Staffordshire	*603,500*						*0.89*	*0.81*	*0.98*	*699*	*0.89*	*2.7*
	Shropshire County	*289,500*			*0.85*	*0.87*	*0.85*	*0.83*	*0.72*	*0.96*	*687*	*0.85*	*1.2*
	Stoke on Trent	247,600						1.10	0.96	1.26	820	1.10	5.1
	Telford and Wrekin	161,800			0.88	0.82	0.86	1.02	0.85	1.22	735	0.90	5.2
East of England	*Bedfordshire*	*403,600*	*0.88*	*0.88*	*0.89*	*0.86*	*0.89*	*0.84*	*0.74*	*0.95*	*627*	*0.87*	*6.7*
	Luton	**187,200**	**1.16**	**1.21**	**1.16**	**1.27**	**1.30**	**1.29**	**1.10**	**1.50**	**860**	**1.24**	**28.1**
	West Hertfordshire	*530,600*	*0.45*	*0.43*	*0.41*	*0.58*	*0.78*	*0.86*	*0.78*	*0.96*	*641*	*0.60*	*7.6*
	East and North Hertfordshire	*527,800*	*0.77*	*0.80*	*0.81*	*0.91*	*0.89*	*0.84*	*0.75*	*0.94*	*621*	*0.84*	*5.0*
	Mid Essex	*361,400*			*0.82*	*0.81*	*0.84*	*0.86*	*0.76*	*0.98*	*661*	*0.83*	*2.4*
	North East Essex												2.6
	South East Essex	329,900			0.98	0.94	0.96	0.95	0.84	1.08	752	0.96	3.0
	South West Essex	388,300			0.88	0.90	0.92	0.93	0.83	1.05	682	0.91	3.8
	West Essex	*274,700*			*0.80*	*0.84*	*0.80*	*0.74*	*0.64*	*0.87*	*568*	*0.79*	*4.2*
	Cambridgeshire	*589,600*	*0.85*	*0.84*	*0.88*	*0.90*	*0.90*	*0.87*	*0.79*	*0.96*	*650*	*0.87*	*4.1*
	Peterborough	163,400	0.84	0.93	0.98	0.98	1.03	1.01	0.84	1.21	716	0.97	10.3
	Norfolk	*738,900*			*0.90*	*0.91*	*0.92*	*0.91*	*0.84*	*0.99*	*754*	*0.91*	*1.5*
	Suffolk	*585,300*			*0.81*	*0.81*	*0.81*	*0.82*	*0.74*	*0.90*	*644*	*0.81*	*3.1*
	Great Yarmouth and Waveney	*210,600*			*0.39*	*0.37*	*0.40*	*0.48*	*0.39*	*0.59*	*399*	*0.41*	*1.3*
London	**Barnet**	**328,400**				**1.13**	**1.24**	**1.43**	**1.29**	**1.60**	**996**	**1.27**	**26.0**
	Camden	227,200				0.93	1.04	1.13	0.97	1.32	709	1.04	26.8

Table 4.5. Continued

Region	PCT	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 LCL	2007 UCL	2007 pmp[a]	All O/E	% non-White
London	**Enfield**	**285,400**				**1.46**	**1.46**	**1.41**	**1.25**	**1.58**	**978**	**1.44**	**22.9**
	Haringey Teaching	**225,600**				**1.50**	**1.53**	**1.54**	**1.35**	**1.76**	**971**	**1.52**	**34.4**
	Islington	**185,500**				**1.33**	**1.45**	**1.38**	**1.18**	**1.61**	**868**	**1.39**	**24.6**
	Barking and Dagenham	165,400			1.11	1.14	1.14	1.12	0.93	1.34	719	1.13	14.8
	City and Hackney Teaching	**216,200**					**1.44**	**1.44**	**1.25**	**1.66**	**874**	**1.44**	**39.7**
	Havering	*227,500*						*0.77*	*0.65*	*0.92*	*598*	*0.77*	*4.8*
	Newham	**248,300**			**1.41**	**1.60**	**1.74**	**1.78**	**1.57**	**2.01**	**1019**	**1.64**	**60.6**
	Redbridge	**251,800**			**1.16**	**1.25**	**1.22**	**1.23**	**1.07**	**1.41**	**838**	**1.22**	**36.5**
	Tower Hamlets	**212,500**			**1.12**	**1.14**	**1.22**	**1.29**	**1.10**	**1.51**	**729**	**1.20**	**48.6**
	Waltham Forest	**222,100**					**1.34**	**1.51**	**1.32**	**1.73**	**977**	**1.43**	**35.5**
	Brent Teaching	**271,400**					**1.37**	**2.03**	**1.83**	**2.24**	**1360**	**1.71**	**54.7**
	Ealing	**306,400**	**1.50**	**1.44**	**1.53**	**1.49**	**1.61**	**1.67**	**1.50**	**1.85**	**1119**	**1.55**	**41.3**
	Hammersmith and Fulham	**171,400**	**1.41**	**1.45**	**1.51**	**1.37**	**1.33**	**1.25**	**1.06**	**1.47**	**805**	**1.38**	**22.2**
	Harrow	**214,600**						**1.71**	**1.51**	**1.93**	**1216**	**1.71**	**41.2**
	Hillingdon	250,100			0.89	0.99	1.07	0.95	0.82	1.11	660	0.98	20.9
	Hounslow	**218,600**			**1.68**	**1.62**	**1.51**	**1.42**	**1.24**	**1.63**	**947**	**1.55**	**35.1**
	Kensington and Chelsea	*178,000*						*0.75*	*0.61*	*0.92*	*528*	*0.75*	*21.4*
	Westminster	231,700						1.00	0.85	1.17	673	1.00	26.8
	Bexley	221,600	1.19	1.21	1.14	1.10	1.14	1.14	0.99	1.32	848	1.15	8.6
	Bromley	299,400	1.00	1.00	1.00	0.99	0.99	0.94	0.82	1.07	708	0.98	8.4
	Greenwich Teaching	**222,600**	**1.06**	**1.03**	**0.92**	**1.12**	**1.12**	**1.17**	**1.01**	**1.36**	**764**	**1.08**	**22.9**
	Lambeth	**272,200**	**1.33**	**1.33**	**1.36**	**1.36**	**1.37**	**1.66**	**1.48**	**1.87**	**1032**	**1.41**	**37.6**
	Lewisham	**255,600**	**1.59**	**1.53**	**1.63**	**1.65**	**1.67**	**1.72**	**1.53**	**1.93**	**1103**	**1.64**	**34.1**
	Southwark	**269,000**	**1.55**	**1.58**	**1.57**	**1.61**	**1.60**	**1.72**	**1.53**	**1.93**	**1078**	**1.61**	**37.0**
	Croydon	**337,000**	**1.00**	**1.09**	**1.13**	**1.18**	**1.17**	**1.32**	**1.18**	**1.48**	**920**	**1.16**	**29.8**
	Kingston	156,000						1.06	0.89	1.28	731	1.06	15.5
	Richmond and Twickenham	*179,500*						*0.70*	*0.57*	*0.86*	*501*	*0.70*	*9.0*
	Sutton and Merton	**382,000**						**1.20**	**1.07**	**1.34**	**832**	**1.20**	**18.1**
	Wandsworth	**279,200**						**1.38**	**1.22**	**1.57**	**867**	**1.38**	**22.0**
SE England	*Isle of Wight National Health Service*	*138,200*	*0.71*	*0.75*	*0.73*	*0.63*	*0.63*	*0.58*	*0.46*	*0.74*	*499*	*0.67*	*1.3*
	Hampshire	*1,265,900*	*0.76*	*0.78*	*0.78*	*0.76*	*0.78*	*0.76*	*0.71*	*0.82*	*593*	*0.77*	*2.2*
	Portsmouth City Teaching	196,300	1.16	1.12	1.09	1.05	0.99	0.98	0.83	1.17	667	1.06	5.3
	Southampton City	229,100	0.90	0.92	0.95	0.92	0.90	0.90	0.77	1.07	602	0.91	7.6
	West Kent												3.9
	Medway												5.4
	Eastern and Coastal Kent												2.4
	Hastings and Rother	*176,200*			*0.85*	*0.79*	*0.78*	*0.72*	*0.60*	*0.88*	*607*	*0.78*	*2.4*
	Brighton and Hove City	251,500			0.85	0.84	0.87	0.86	0.73	1.00	608	0.85	5.7
	East Sussex Downs and Weald	*330,200*			*0.84*	*0.81*	*0.77*	*0.80*	*0.70*	*0.91*	*666*	*0.80*	*2.3*
	Surrey	*1,073,400*			*0.76*	*0.76*	*0.78*	*0.86*	*0.80*	*0.93*	*661*	*0.79*	*4.9*
	West Sussex	*770,600*			*0.77*	*0.76*	*0.76*	*0.80*	*0.73*	*0.87*	*644*	*0.77*	*3.4*
	Milton Keynes	230,100	0.90	0.97	0.97	0.95	0.90	0.96	0.81	1.12	656	0.94	9.1
	Berkshire East	**382,200**	**1.04**	**1.06**	**1.10**	**1.07**	**1.11**	**1.24**	**1.11**	**1.38**	**866**	**1.11**	**16.0**
	Berkshire West	**445,400**	**0.98**	**1.01**	**1.05**	**0.99**	**1.03**	**1.13**	**1.02**	**1.25**	**806**	**1.04**	**7.3**
	Oxfordshire	607,400	1.09	1.12	1.10	1.04	1.04	0.96	0.87	1.05	693	1.05	5.0
	Buckinghamshire	500,700	1.03	1.02	1.00	0.99	0.98	0.96	0.87	1.07	727	1.00	7.7
SW England	Bath and North East Somerset	175,600	0.68	0.70	0.82	0.86	0.84	0.85	0.71	1.03	644	0.80	2.8
	Bristol	**410,700**	**1.34**	**1.36**	**1.35**	**1.30**	**1.30**	**1.22**	**1.10**	**1.36**	**825**	**1.31**	**8.2**

Table 4.5. Continued

Region	PCT	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 LCL	2007 UCL	2007 pmp[a]	All O/E	% non-White
SW England	*Gloucestershire*	*578,500*	*0.86*	*0.88*	*0.91*	*0.91*	*0.93*	*0.90*	*0.81*	*0.99*	*705*	*0.90*	*2.9*
	Swindon	192,600	0.90	0.91	0.99	0.95	0.96	0.90	0.75	1.07	649	0.93	4.8
	South Gloucestershire	254,200	1.13	1.07	1.07	1.03	1.03	0.96	0.84	1.11	732	1.04	2.4
	Wiltshire	*448,600*	*0.69*	*0.68*	*0.64*	*0.68*	*0.69*	*0.70*	*0.62*	*0.80*	*548*	*0.68*	*1.6*
	Bournemouth and Poole	*297,900*			*0.86*	*0.82*	*0.82*	*0.83*	*0.72*	*0.96*	*658*	*0.83*	*2.6*
	Dorset	*403,100*			*0.82*	*0.81*	*0.76*	*0.77*	*0.68*	*0.87*	*672*	*0.79*	*1.2*
	North Somerset	201,200	1.00	1.08	1.12	1.03	0.98	0.91	0.77	1.07	741	1.01	1.4
	Somerset	*518,800*	*0.91*	*0.91*	*0.89*	*0.87*	*0.85*	*0.81*	*0.73*	*0.90*	*661*	*0.87*	*1.2*
	Devon	*740,600*	*0.86*	*0.86*	*0.88*	*0.84*	*0.85*	*0.84*	*0.77*	*0.92*	*701*	*0.85*	*1.1*
	Plymouth Teaching	247,900	1.22	1.16	1.09	1.03	1.16	1.13	0.98	1.29	823	1.13	1.6
	Torbay	133,000	0.92	0.92	1.04	0.96	0.94	0.88	0.72	1.07	737	0.94	1.2
	Cornwall and Isles of Scilly	526,200	1.01	1.02	1.11	1.02	1.01	0.95	0.87	1.05	798	1.02	1.0
Wales	**Cardiff**	**317,500**	**1.25**	**1.27**	**1.30**	**1.22**	**1.22**	**1.22**	**1.08**	**1.38**	**822**	**1.25**	**8.4**
	Merthyr Tydfil	**55,800**	**1.30**	**1.45**	**1.64**	**1.59**	**1.84**	**1.96**	**1.58**	**2.43**	**1487**	**1.65**	**1.0**
	Rhondda, Cynon, Taff	**234,100**	**1.38**	**1.25**	**1.37**	**1.34**	**1.34**	**1.38**	**1.21**	**1.56**	**1034**	**1.34**	**1.2**
	Vale of Glamorgan	123,200	0.99	1.02	1.11	0.97	1.02	0.97	0.79	1.19	747	1.01	2.2
	Carmarthenshire	177,800	1.08	1.12	1.14	1.12	1.11	1.04	0.88	1.21	849	1.10	0.9
	Ceredigion	77,100	0.90	0.86	0.98	0.89	0.81	0.79	0.60	1.05	636	0.87	1.4
	Pembrokeshire	116,800	0.83	0.94	0.92	1.01	0.95	0.92	0.75	1.13	762	0.93	0.9
	Powys	130,900	0.47	0.45	0.88	0.91	0.88	0.86	0.70	1.05	733	0.76	0.9
	Blaenau Gwent	69,500	1.40	1.27	1.21	1.21	1.14	1.16	0.90	1.48	892	1.22	0.8
	Caerphilly	171,300	1.26	1.15	1.15	1.15	1.16	1.17	1.00	1.37	876	1.17	0.9
	Monmouthshire	87,800	1.27	1.19	1.17	1.20	1.06	0.99	0.79	1.25	820	1.14	1.1
	Newport	**140,500**	**1.22**	**1.31**	**1.26**	**1.20**	**1.16**	**1.21**	**1.01**	**1.44**	**890**	**1.22**	**4.8**
	Torfaen	91,000	1.24	1.26	1.24	1.17	1.13	1.18	0.95	1.46	912	1.20	0.9
	Bridgend	**132,600**	**1.07**	**1.15**	**1.18**	**1.18**	**1.25**	**1.33**	**1.12**	**1.57**	**1026**	**1.20**	**1.4**
	Neath Port Talbot	**137,100**	**1.05**	**1.16**	**1.15**	**1.11**	**1.15**	**1.20**	**1.01**	**1.42**	**948**	**1.14**	**1.1**
	Swansea	**227,000**	**1.27**	**1.34**	**1.33**	**1.29**	**1.28**	**1.26**	**1.11**	**1.44**	**974**	**1.29**	**2.2**
	Conwy	111,300	0.93	1.00	1.00	0.92	0.92	0.93	0.76	1.15	800	0.95	1.0
	Denbighshire	95,900	0.88	0.94	0.94	1.02	0.87	0.88	0.69	1.11	719	0.92	1.2
	Flintshire	150,000	1.04	1.09	1.07	1.02	1.02	1.01	0.84	1.20	780	1.04	0.8
	Gwynedd	118,200	1.16	1.21	1.02	1.00	0.97	0.98	0.80	1.20	778	1.05	1.2
	Isle of Anglesey	68,800	0.85	0.95	0.93	1.03	1.00	0.90	0.68	1.18	741	0.94	0.7
	Wrexham	131,000	1.40	1.41	1.30	1.19	1.17	1.08	0.89	1.30	824	1.25	1.1
Scotland	Aberdeen City	207,000	1.16	1.11	1.27	1.24	1.16	1.13	0.98	1.31	850	1.18	2.9
	Aberdeenshire	236,300	1.05	0.98	0.98	1.01	0.96	0.99	0.86	1.15	783	0.99	0.7
	Angus	109,500	1.35	1.20	1.30	1.25	1.14	1.10	0.90	1.34	904	1.22	0.8
	Argyll & Bute	91,200	1.01	1.00	0.99	0.89	0.92	0.93	0.74	1.18	789	0.95	0.8
	Scottish Borders	110,300	0.79	0.73	0.80	0.82	0.81	0.91	0.74	1.13	762	0.82	0.6
	Clackmannanshire	48,800	0.60	0.82	0.81	0.88	0.77	0.83	0.58	1.18	635	0.79	0.8
	West Dunbartonshire	91,100	1.09	0.96	0.97	0.91	0.93	0.86	0.66	1.10	648	0.95	0.7
	Dumfries & Galloway	148,000	1.15	1.17	1.04	1.04	0.98	0.90	0.75	1.08	777	1.03	0.7
	Dundee City	**142,100**	**1.35**	**1.44**	**1.41**	**1.49**	**1.47**	**1.40**	**1.20**	**1.64**	**1063**	**1.43**	**3.7**
	East Ayrshire	119,300	1.04	1.01	0.98	1.05	1.11	1.06	0.87	1.29	830	1.04	0.7
	East Dunbartonshire	105,700	1.19	1.29	1.18	1.07	1.07	0.99	0.80	1.22	785	1.12	3.1
	East Lothian	92,600	1.12	1.03	1.04	0.95	0.92	0.97	0.77	1.22	767	1.00	0.7
	East Renfrewshire	89,000	1.06	1.10	1.09	1.15	1.11	1.05	0.83	1.32	809	1.09	3.8
	Edinburgh, City of	463,300	1.01	1.02	1.04	0.99	0.97	0.94	0.84	1.05	673	0.99	4.1
	Falkirk	149,500	1.07	1.06	0.99	1.02	0.96	1.05	0.88	1.26	803	1.02	1.0

Table 4.5. Continued

Region	PCT	Tot pop	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2007 LCL	2007 UCL	2007 pmp[a]	All O/E	% non-White
Scotland	Fife	359,200	1.02	0.98	0.99	1.01	0.98	0.94	0.83	1.06	727	0.98	1.3
	Glasgow City	**580,600**	**1.44**	**1.44**	**1.37**	**1.34**	**1.30**	**1.26**	**1.16**	**1.38**	**890**	**1.35**	**5.5**
	Highland	215,400	1.06	1.09	1.17	1.25	1.15	1.11	0.97	1.28	910	1.14	0.8
	Inverclyde	81,300	1.48	1.41	1.37	1.33	1.22	1.13	0.90	1.43	886	1.31	0.9
	Midlothian	79,000	1.10	1.18	1.29	1.20	1.29	1.17	0.92	1.47	899	1.21	0.9
	Moray	86,700	1.06	0.99	1.00	1.11	1.14	0.99	0.78	1.25	796	1.05	0.9
	North Ayrshire	**135,300**	**1.25**	**1.25**	**1.29**	**1.24**	**1.34**	**1.24**	**1.04**	**1.47**	**976**	**1.27**	**0.7**
	North Lanarkshire	323,700	1.28	1.25	1.21	1.13	1.08	1.03	0.91	1.16	757	1.15	1.3
	Orkney Islands	20,000	0.98	1.10	1.12	1.18	1.11	0.97	0.60	1.59	800	1.08	0.4
	Perth & Kinross	140,200	0.97	1.05	1.03	0.95	0.91	0.86	0.70	1.04	706	0.96	1.0
	Renfrewshire	169,300	1.25	1.23	1.21	1.21	1.14	1.07	0.91	1.26	827	1.18	1.2
	Shetland Islands	22,000	0.70	0.67	0.78	0.60	0.50	0.69	0.39	1.22	545	0.65	1.1
	South Ayrshire	111,900	1.05	1.14	1.00	1.06	1.03	0.98	0.80	1.20	822	1.04	0.7
	South Lanarkshire	307,700	1.25	1.22	1.20	1.10	1.03	0.97	0.85	1.10	744	1.12	1.1
	Stirling	*87,600*	*0.95*	*0.93*	*0.90*	*0.83*	*0.79*	*0.75*	*0.57*	*1.00*	*571*	*0.85*	*1.5*
	West Lothian	165,700	1.08	1.06	1.00	1.02	0.96	0.92	0.76	1.11	664	1.00	1.3
	Eilean Siar	25,900	0.67	0.64	0.84	0.52	0.54	0.82	0.52	1.30	695	0.67	0.6
N Ireland	**Antrim**	**51,500**				**1.44**	**1.51**	**1.47**	**1.12**	**1.94**	**990**	**1.48**	**0.5**
	Ards	76,000				1.35	1.27	0.98	0.75	1.27	737	1.19	0.9
	Armagh	56,400				1.40	1.28	1.12	0.83	1.51	762	1.26	0.5
	Ballymena	61,400				1.12	1.12	1.05	0.79	1.39	765	1.09	1.3
	Ballymoney	29,300				0.90	0.89	1.08	0.71	1.64	751	0.96	0.6
	Banbridge	45,400				0.95	1.09	1.06	0.75	1.49	727	1.03	0.4
	Belfast	**267,600**				**1.22**	**1.22**	**1.25**	**1.10**	**1.42**	**848**	**1.23**	**0.4**
	Carrickfergus	**39,800**				**1.78**	**1.71**	**1.77**	**1.34**	**2.33**	**1281**	**1.75**	**0.3**
	Castlereagh	**65,600**				**1.46**	**1.50**	**1.30**	**1.02**	**1.66**	**991**	**1.42**	**0.4**
	Coleraine	56,900				1.01	0.98	0.98	0.72	1.34	721	0.99	0.3
	Cookstown	34,600				0.81	0.81	0.76	0.47	1.22	491	0.79	1.3
	Craigavon	86,800				1.23	1.10	1.12	0.88	1.42	760	1.15	0.6
	Derry	**107,800**				**1.20**	**1.31**	**1.27**	**1.03**	**1.56**	**798**	**1.26**	**0.8**
	Down	68,400				1.11	1.16	1.17	0.90	1.52	804	1.15	0.7
	Dungannon	52,700				0.78	0.74	0.75	0.51	1.10	493	0.76	0.7
	Fermanagh	60,600				0.87	1.04	1.00	0.74	1.35	710	0.97	0.8
	Larne	31,400				1.57	1.43	1.33	0.94	1.89	1019	1.44	0.4
	Limavady	33,900				1.13	1.11	1.13	0.77	1.68	737	1.13	0.6
	Lisburn	113,300				1.14	1.08	1.05	0.85	1.31	715	1.09	0.7
	Magherafelt	42,900				1.29	1.37	1.07	0.75	1.53	699	1.24	0.7
	Moyle	17,000				0.82	0.94	0.80	0.43	1.48	588	0.85	0.3
	Newry & Mourne	93,600				1.34	1.16	1.00	0.78	1.28	652	1.16	0.4
	Newtownabbey	81,400				1.19	1.24	1.16	0.92	1.47	848	1.20	0.3
	North Down	79,000				1.11	1.04	1.09	0.85	1.38	835	1.08	1.0
	Omagh	51,200				1.27	1.20	1.15	0.84	1.58	762	1.21	0.4
	Strabane	39,200				1.07	1.12	1.16	0.82	1.66	791	1.12	0.8
Country	**England**	**48,812,300**	**0.96**	**0.97**	**0.97**	**0.97**	**0.98**	**0.98**			**735**	**0.97**	
	Scotland	**5,115,200**	**1.14**	**1.13**	**1.12**	**1.10**	**1.07**	**1.03**			**793**	**1.10**	
	Wales	**2,965,200**	**1.12**	**1.14**	**1.16**	**1.13**	**1.12**	**1.12**			**866**	**1.13**	
	N Ireland	**1,743,700**				**1.20**	**1.18**	**1.14**			**787**	**1.17**	
	Total	**58,636,400**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**			**748**	**1.00**	

Table 4.6. Summary regional distribution of PCTs and HAs with significantly low, normal or significantly high values of SPR and mean (weighted by PCT size) % non-Whites per region on 31/12/07

Region	Prevalence group			Total	Mean % non-White	Weighted mean % non-White
	Low	Normal	High			
NE England	1	11	0	12	2.5	2.4
NW England	9	14	1	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	6	4	7	17	12.0	11.4
East of England	9	3	1	13	6.2	5.0
London	3	7	21	31	28.5	28.9
SE England	6	6	2	14	5.7	5.3
SW England	6	7	1	14	2.4	2.3
England	**47**	**65**	**36**	**148**	**10.9**	**9.4**
Wales	**0**	**15**	**7**	**22**	**1.6**	**2.1**
Scotland	**1**	**28**	**3**	**32**	**1.4**	**2.0**
N Ireland	**0**	**21**	**5**	**26**	**0.6**	**0.6**
UK	**48**	**129**	**51**	**228**	**7.5**	**8.1**

SPR. The geographical distribution of these is summarised in table 4.6. East of England ($p < 0.001$), the South East and South West of England ($p < 0.08$) had a higher proportion of areas with a low SPR compared with the UK as a whole, whilst in London ($p < 0.001$) there was a significantly higher proportion of areas with a high SPR. The West Midlands (41%) and Wales (32%) had a relatively higher percentage of PCTs/HAs with high SPRs compared to the rest of the UK (22%) but not significantly so. In Wales ($p < 0.01$), Scotland ($p < 0.001$) and Northern Ireland ($p < 0.01$) there were significantly fewer PCTs/HAs that had low values than in the rest of the UK.

PCTs/HAs with a high SPR had significantly higher ethnic minority populations than those with significantly low or normal SPRs ($p < 0.0001$) (figures 4.6, 4.7a and b). Mean SPR was significantly higher in the 47 PCTs/HAs with an ethnic minority population greater than 10% than in those with lower ethnic minority populations (1.33 vs. 0.97: $p < 0.001$). The SPR ($r = 0.257$, $p < 0.001$) was highly correlated with ethnicity. For each 10% increase in ethnic minority population the age standardised prevalence ratio increased by 0.2.

The relationship between the ethnic composition of a PCT/HA area and its SPR is further demonstrated in figure 4.7a, which shows the relationship for all PCTs/HAs and in figure 4.7b where those with <1% ethnic minority populations have been excluded.

Only 1 (Kensington & Chelsea, an area of low social deprivation) of the 47 PCT/HA areas with ethnic minority populations greater than 10% had a low SPR, whereas 34 had high SPRs. In contrast only 17 of the 181 PCT/HA areas with ethnic minority populations less than 10% had high SPRs. Seven of these were in Wales (Cardiff, Methyr Tydfil, Rhondda-Cynon-Taff, Newport, Bridgend, Neath and Port Talbot), 3 in Scotland (Dundee City, Glasgow City, North Ayrshire) and 5 in Northern Ireland (Antrim, Belfast, Carrickfergus, Castlereagh and Derry). The only centres in England were Bristol and Berkshire West. The factors contributing to these regional disparities remained unclear but social deprivation was likely to be an important factor.

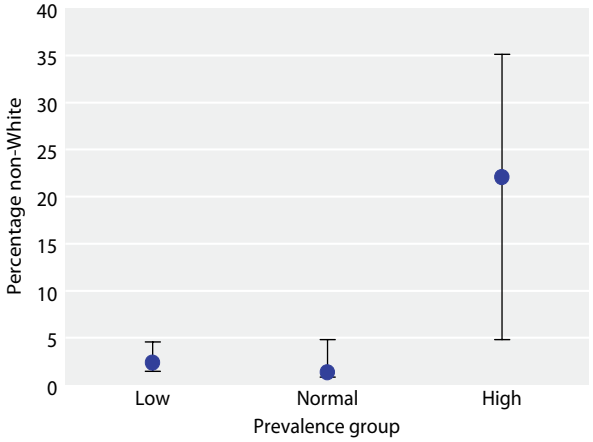

Fig. 4.6. Percentage non-Whites in PCTs and HAs with significantly low, normal and significantly high SPR values (median and quartiles)

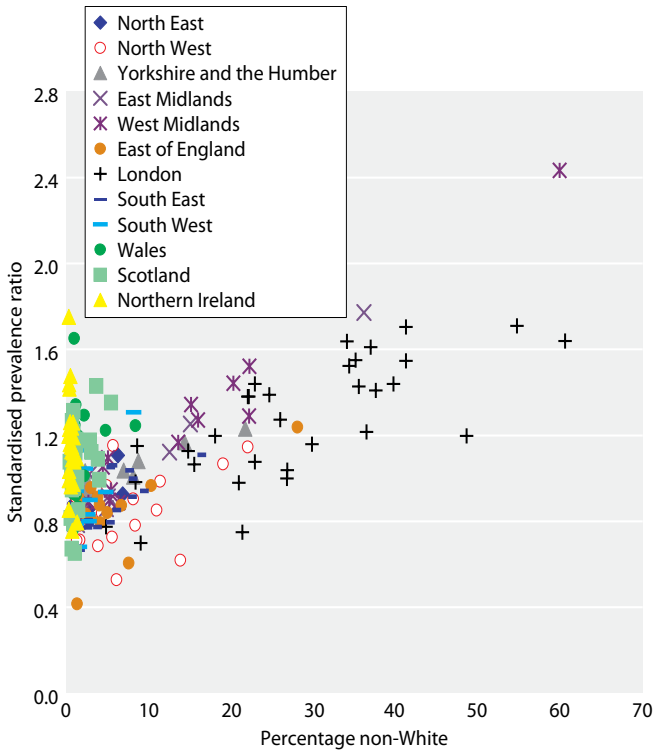

Fig. 4.7a. Ethnicity and standardised prevalence ratios for all PCTs and HAs by percentage non-White with available data

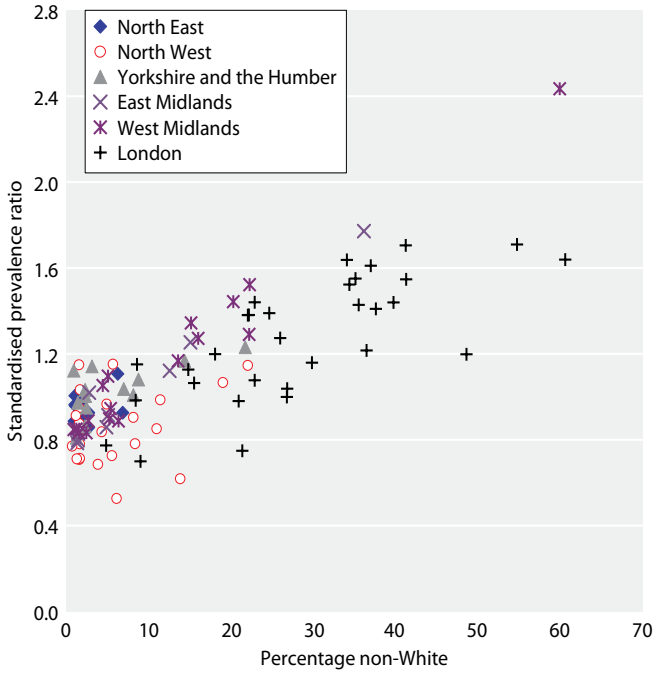

Fig. 4.7b. Ethnicity and standardised prevalence ratios for all PCTs and HAs by percentage non-White (excluding low percentage ethnic minority areas)

Case mix in prevalent RRT patients

Vintage

For patients who recover for >90 days and then restart RRT, median time from the start of RRT was calculated from the most recent start date. table 4.7 shows the median vintage (years since starting RRT) of prevalent RRT patients in 2007. Median vintage of the whole RRT cohort was 5.3 years. Patients with functioning transplants had survived a median 10.4 years on RRT whilst the median vintage of HD and PD patients was much less (2.8 and 2.1 years respectively). There was no significant change from 2006 [2].

Age

The median age of prevalent UK patients on RRT in 2007 was unchanged compared to 2006 at 57 years (table 4.8) [2]. The age profile varied markedly with modality. The median age of patients on HD (65.2 yrs) was greater than those on PD (60.3 yrs) and substantially higher than that of transplanted patients (50.2 yrs). These were all minimally higher than those reported in 2006. HD patients in Wales and Northern Ireland 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 their RRT population (51.5 to 70.8 yrs), the median age being less in transplanting than in non-transplanting centres (55.5 vs. 60.8 yrs: $p < 0.001$). The median age of HD patients was slightly less in transplanting than in non-transplanting centres (62.2 vs. 64.2: $p < 0.05$), but there was no difference in the median ages of PD and transplant patients. This implies that the major factor accounting for the lower median age of RRT patients in transplanting centres was the higher number of transplant patients under follow-up in transplant centres. The differing age distributions of the transplant and dialysis populations are illustrated in figure 4.8, demonstrating that patient age at peak dialysis prevalence was around three decades higher than patient age at peak transplant prevalence.

Table 4.7. Median vintage of prevalent RRT patients on 31/12/07

Modality	N	Median time treated (years)
Haemodialysis	18,825	2.8
Peritoneal dialysis	4,495	2.1
Transplant	19,443	10.4
All RRT	**42,763**	**5.3**

Table 4.8. Median age of prevalent RRT patients by treatment modality by renal centre on 31/12/07

Centre	Median age HD	Median age PD	Median age transplant	Median age all
Abrdn	65.6	52.9	51.6	56.7
Airdrie	59.9	48.3	44.8	54.3
Antrim	70.9	67.4	47.9	65.5
B Heart	66.2	64.5	50.6	62.6
B QEH	65.3	56.5	49.7	56.2
Bangor	67.7	64.0	n/a	67.5
Basldn	65.4	67.7	47.3	62.7
Belfast	63.7	53.7	48.4	53.4
Bradfd	66.0	50.5	48.8	55.7
Brightn	69.0	62.5	51.7	61.7
Bristol	69.0	60.8	51.6	58.5
Camb	65.3	60.0	49.4	55.0
Cardff	67.3	62.7	50.1	57.0
Carlis	66.8	59.8	51.4	58.6
Carsh	68.0	61.9	49.0	59.9
Chelms	70.0	65.3	57.0	65.6
Clwyd	64.2	56.0	52.4	58.6
Covnt	64.6	63.9	48.2	55.7
D & Gall	69.1	63.8	46.2	65.3
Derby	63.9	62.9	54.2	62.8
Derry	67.2	60.7	50.0	63.2
Donc	64.9	61.0	55.8	61.5
Dorset	66.1	70.3	56.3	60.3
Dudley	62.0	63.1	57.4	59.6
Dundee	68.8	59.4	55.1	60.0
Dunfn	64.5	57.9	54.3	61.4
Edinb	60.5	53.9	52.2	54.8
Exeter	71.2	67.6	49.8	60.9
Glasgw	64.1	57.2	49.5	54.6
Glouc	72.5	63.2	51.9	63.3
Hull	66.0	55.0	49.1	58.1
Inverns	64.6	65.0	47.4	56.6
Ipswi	60.7	61.5	51.8	56.8
Klmarnk	65.1	60.6	48.7	61.4
L Barts	57.0	58.1	49.9	53.8
L Guys	62.3	57.2	49.0	52.2
L Kings	61.1	59.2	50.1	55.8
L Rfree	64.1	57.4	48.4	55.0
L St.G	67.2	63.3	52.4	57.7
L West	64.0	63.0	51.9	56.9
Leeds	65.9	59.2	50.2	54.9
Leic	63.4	62.9	50.0	57.4
Liv Ain	61.4	n/a	n/a	61.4
Liv RI	60.0	54.9	49.7	52.8
M Hope	60.9	57.7	47.1	54.7
M RI	58.9	57.2	49.4	51.5
Middlbr	67.0	56.1	49.4	57.7
Newc	63.1	56.2	51.6	55.5
Newry	65.5	54.3	55.2	62.7
Norwch	67.8	63.2	50.3	61.9
Nottm	65.2	59.9	48.1	55.7
Oxford	64.7	59.7	50.1	54.9
Plymth	71.0	68.2	51.0	59.3
Ports	66.6	60.0	50.1	56.1
Prestn	62.9	58.1	50.6	57.2
Redng	69.9	59.4	53.7	60.2
Sheff	64.6	59.9	50.0	57.3
Shrew	65.3	57.8	50.7	59.9
Stevng	65.4	62.1	50.9	59.7
Sthend	67.1	60.8	56.8	63.0
Stoke	62.3	60.0	48.7	56.0
Sund	63.3	60.2	51.0	56.9
Swanse	69.6	63.7	54.7	63.1
Truro	71.6	63.6	53.8	64.3
Tyrone	64.3	62.4	45.9	59.5
Ulster	71.7	49.4	43.4	70.8
Wirral	65.9	61.1	n/a	65.3
Wolve	65.6	58.1	45.0	60.5
Wrexm	67.4	65.6	47.3	64.3
York	69.1	64.0	45.8	60.8
England	**65.0**	**60.4**	**50.2**	**56.9**
N Ireland	**67.1**	**57.4**	**48.6**	**58.6**
Scotland	**64.5**	**57.7**	**50.0**	**56.2**
Wales	**67.9**	**63.0**	**50.6**	**59.2**
UK	**65.2**	**60.3**	**50.1**	**57.0**

n/a not applicable

Gender

In the UK in 2007, age at peak absolute RRT prevalence was in the 55–65 year age-band in males and females (figure 4.9).

Correcting this for the age and gender distribution of the UK population calculated from PCT/ HA populations covered by the Registry using 2001 census data allowed estimation of crude prevalence rates by age and gender (figure 4.10).

The overall UK peak crude prevalence rate occurred in the age band 70–74 at 1,808 pmp. For all ages, crude prevalence rates in males exceeded those in females, peaking in the 75–79 year age band for males at 2,506 pmp and in females in the 70–74 year age band at 1,314 pmp.

The male:female ratio of the crude prevalence rate remained stable at around 1.5 until the 60–65 age band, then increased markedly to 1.8 in the 65–74 age

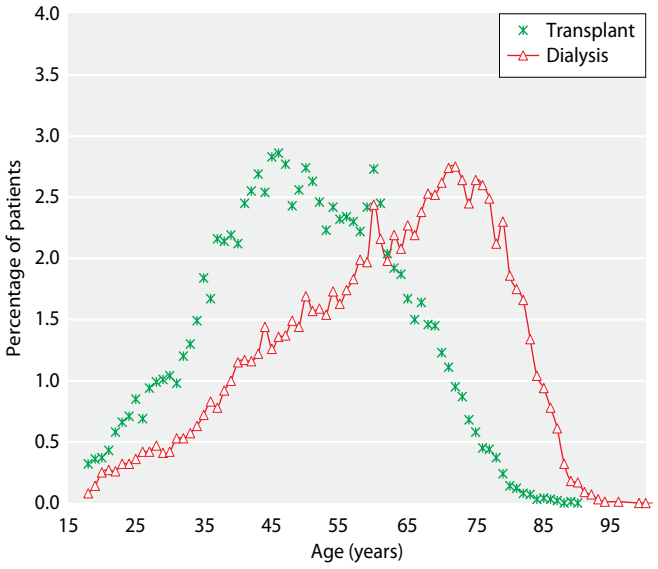

Fig. 4.8. Age profile of prevalent RRT patients on 31/12/07

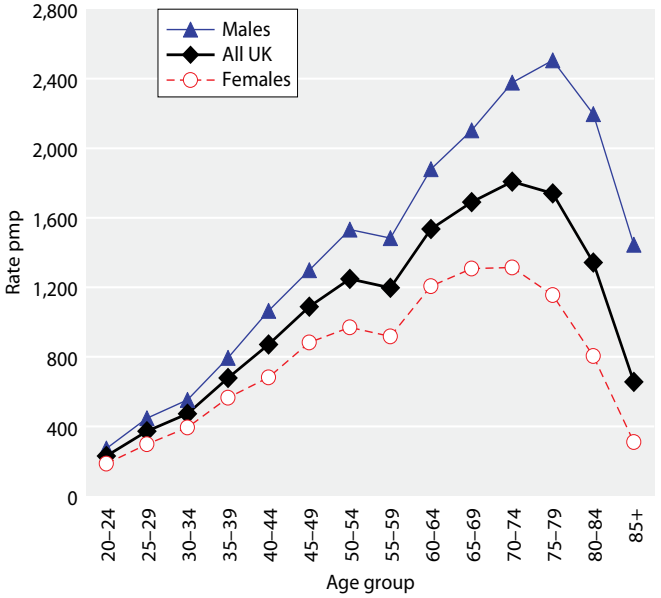

Fig. 4.10. Prevalence rate of RRT patients per million population by age and gender on 31/12/07

band, 2.2 at 75–79 years, 2.7 at 80–84 years and 4.7 in those over 85 years (figure 4.11).

Ethnicity

Thirty-seven of the 71 centres submitting electronic data to the UKRR in 2007 provided ethnicity data that were at least 90% complete (table 4.9), slightly worse than in 2006 [2]. Data from 60 centres had greater than 50% returns. In the whole UK, 18.6% of the prevalent RRT population were from an ethnic minority, similar to the proportion in England. The proportions in Wales, Scotland and Northern Ireland were very small, though there was a high level of missing data in Scotland (where ethnicity is not a mandated item).

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 4 centres (Antrim, Newry, Tyrone and Ulster) to over 50% in London West and London

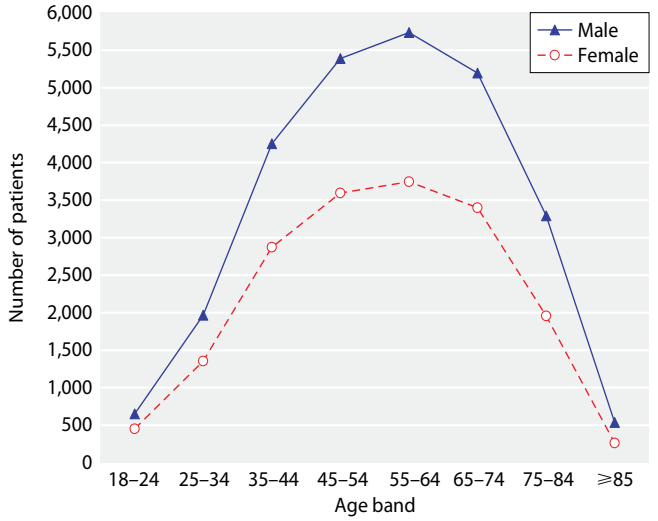

Fig. 4.9. Age profile of prevalent RRT patients by gender on 31/12/07

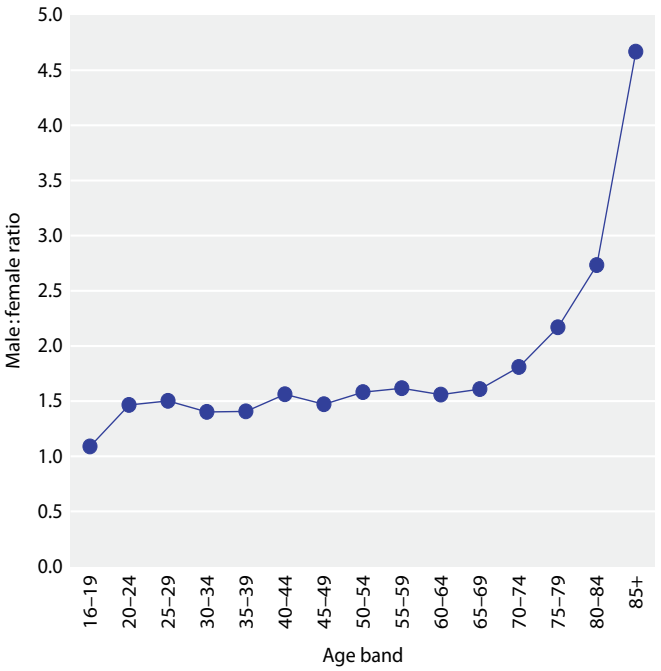

Fig. 4.11. Male:female ratio in UK RRT patients by age-band on 31/12/07

Table 4.9. Ethnicity* of prevalent RRT patients by renal centre on 31/12/07

Centre	% White	% Black	% Asian	% Chinese	% Other	% Missing
Abrdn	61.5	0.0	0.0	0.4	0.2	37.8
Airdrie	57.4	0.0	0.9	0.0	0.0	41.7
Antrim	100.0	0.0	0.0	0.0	0.0	0.0
B Heart	64.4	7.8	26.0	0.3	0.9	0.7
B QEH	68.2	9.7	19.2	1.0	1.7	0.2
Bangor	99.0	1.0	0.0	0.0	0.0	0.0
Basldn	91.7	2.9	3.9	0.5	0.5	0.5
Belfast	99.3	0.0	0.3	0.3	0.1	0.0
Bradfd	45.6	2.5	31.6	0.0	1.0	19.2
Brightn	45.1	1.0	0.4	0.0	0.6	52.8
Bristol	91.3	3.2	2.7	0.2	0.6	1.9
Camb	82.8	1.2	3.6	0.5	0.6	11.2
Cardff	44.2	0.4	1.2	0.0	0.0	54.2
Carlis	96.5	0.0	0.5	0.0	0.0	3.0
Carsh	66.6	8.2	10.4	1.4	3.1	10.3
Chelms	59.0	1.6	1.1	0.5	0.0	37.8
Clwyd	48.4	0.0	0.0	0.6	0.0	51.0
Covnt	80.3	2.6	13.4	0.6	0.1	2.9
D & Gall	11.7	0.0	0.0	0.0	0.0	88.3
Derby	65.8	1.3	5.6	1.0	1.3	24.9
Derry	95.2	0.0	0.0	0.0	0.0	3.2
Donc	93.5	0.0	0.9	0.0	0.0	5.6
Dorset	95.5	0.9	0.9	0.9	0.9	0.9
Dudley	85.1	2.7	10.6	0.8	0.0	0.8
Dundee	71.0	0.0	0.8	0.0	0.5	27.7
Dunfn	24.1	0.0	0.6	0.0	0.0	75.3
Edinb	9.3	0.0	0.8	0.1	0.0	89.7
Exeter	57.8	0.5	0.2	0.2	0.2	41.3
Glasgw	8.7	0.0	1.3	0.2	0.0	89.7
Glouc	90.2	0.3	0.3	0.0	0.0	9.2
Hull	47.2	0.1	0.1	0.3	0.4	51.8
Inverns	57.0	0.0	0.5	0.0	0.0	42.5
Ipswi	87.3	2.1	2.1	0.0	0.4	8.1
Klmarnk	5.6	0.0	0.0	0.0	0.0	94.4
L Barts	45.1	11.9	23.2	1.6	14.5	3.6
L Guys	56.7	20.6	2.6	1.2	0.1	18.9
L Kings	52.9	30.6	11.4	2.1	0.0	2.9
L Rfree	52.4	18.9	18.0	2.0	7.9	0.8
L St.G	38.8	18.9	8.6	1.1	5.6	27.0
L West	36.7	12.3	19.7	0.6	11.2	19.5
Leeds	61.3	3.0	10.3	0.0	0.8	24.6
Leic	74.8	2.7	15.7	0.1	0.9	5.7
Liv Ain	67.0	0.0	0.9	0.9	0.9	30.4
Liv RI	82.9	1.0	0.9	0.9	0.6	13.8
M Hope	81.3	1.1	12.9	0.4	0.9	3.4
M RI	78.0	4.5	9.2	0.6	0.1	7.7
Middlbr	88.3	0.0	3.0	0.4	0.1	8.1
Newc	95.1	0.3	2.9	0.5	0.7	0.4
Newry	87.8	0.0	0.0	0.0	0.0	12.2
Norwch	69.9	0.6	1.0	0.2	0.2	28.1
Nottm	86.8	4.7	5.6	0.0	0.7	2.2
Oxford	49.4	2.2	4.7	0.4	0.8	42.5
Plymth	65.8	1.7	0.0	0.7	0.5	31.4
Ports	91.6	0.8	2.4	0.4	0.5	4.3
Prestn	82.5	1.1	12.3	0.0	0.6	3.6
Redng	76.5	5.1	14.1	1.3	2.9	0.0

Table 4.9. Continued

Centre	% White	% Black	% Asian	% Chinese	% Other	% Missing
Sheff	83.4	1.8	3.7	0.7	0.7	9.8
Shrew	95.4	1.4	3.2	0.0	0.0	0.0
Stevng	71.0	6.2	11.7	0.4	1.1	9.7
Sthend	58.5	1.0	0.5	1.5	0.0	38.5
Stoke	39.6	0.2	2.2	0.3	0.5	57.1
Sund	86.9	0.7	0.4	0.7	0.7	10.6
Swanse	96.9	0.9	0.7	0.0	0.2	1.3
Truro	60.1	2.1	0.0	0.0	0.0	37.8
Tyrone	98.0	0.0	0.0	0.0	0.0	2.0
Ulster	98.8	0.0	0.0	0.0	0.0	1.2
Wirral	90.3	0.5	0.9	1.4	1.9	5.1
Wolve	74.6	7.7	15.4	0.7	0.5	1.1
Wrexm	95.8	0.0	1.4	0.0	0.7	2.1
York	89.2	0.0	0.4	0.0	0.9	9.5
England	**68.6**	**5.8**	**9.1**	**0.7**	**2.3**	**13.6**
N Ireland	**97.8**	**0.0**	**0.1**	**0.2**	**0.1**	**1.7**
Scotland	**26.3**	**0.0**	**0.8**	**0.2**	**0.1**	**72.6**
Wales	**61.9**	**0.5**	**1.0**	**0.0**	**0.1**	**36.5**
UK	**65.3**	**4.8**	**7.6**	**0.6**	**1.9**	**19.8**

* appendix G ethnicity coding

Barts. Larger centres (quartiles by RRT population) had a larger proportion of patients from ethnic minorities (Q1 1.0%, Q2 3.7%, Q3 14.4%, Q4 18.7%). In addition centres with an ethnic minority population greater than 10% had higher numbers of patients on RRT (median 855 vs. 285: $p < 0.001$), on dialysis (489 vs. 180: $p < 0.001$), and with functioning transplants (839 vs. 116: $p < 0.001$). Sixty percent of transplanting centres had an ethnic minority population greater than 10% compared with 28% of non-transplanting centres ($p = 0.015$).

Primary renal disease

Biopsy-proven glomerulonephritis (15.3% of patients) remained the most common specific primary renal diagnosis in the 2007 prevalent cohort (table 4.10). The proportion with diabetes (13.2%) was similar to 2006 [2]. The pattern was similar when the analysis was restricted to younger patients (age <65 years). However, in older patients the order was reversed (diabetes 15.1% vs. glomerulonephritis 8.3%). There were other age-related differences, notably higher prevalence of the aetiology uncertain/glomerulonephritis – not biopsy proven category (26.6% vs. 19.2%) and renovascular disease (8.2 vs. 1.1%) in the older age group.

The male:female ratio was significantly greater than unity for most primary renal diseases. The gender imbalance may be influenced by the presence of factors, such as hypertension, atheroma and renovascular disease, which were more common in males, more

Table 4.10. Primary renal disease in prevalent RRT patients by age and gender on 31/12/07

Primary diagnosis*	% all patients	Inter-centre range %	% age <65	% age ⩾65	M:F ratio
Aetiology uncertain/GN (not biopsy proven)**	21.6	2.1–84.3	19.2	26.6	1.6
GN (biopsy proven)**	15.3	2.3–22.4	17.8	10.0	2.2
Pyelonephritis	11.9	3.2–19.4	13.6	8.3	1.1
Diabetes	13.2	2.8–26.0	12.3	15.1	1.6
Polycystic kidney	9.2	2.0–15.8	9.6	8.3	1.1
Hypertension	5.4	1.0–16.0	4.6	6.9	2.4
Renal vascular disease	3.5	0.3–16.1	1.1	8.2	2.0
Other	14.5	1.9–36.1	16.0	11.3	1.3
Not sent	5.5	0.1–46.2	5.7	5.2	1.5

* appendix G ERA-EDTA coding
** GN = Glomerulonephritis

Table 4.11. Transplant:dialysis ratios by age and primary renal disease in the prevalent RRT population on 31/12/07

	Transplant:dialysis ratio	
Primary diagnosis	<65	⩾65
Aetiology uncertain/GN (not biopsy proven)*	1.4	0.3
GN (biopsy proven)*	1.8	0.5
Pyelonephritis	2.1	0.3
Diabetes	0.7	0.1
Polycystic kidney	1.7	1.1
Hypertension	1.1	0.3
Renal vascular disease	0.6	0.1
Other	1.4	0.3
Not sent	1.6	0.3

* GN = Glomerulonephritis

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. In pyelonephritis the ratio also approximated to unity, but whilst in APKD, the ratio also approximated unity in the incident cohort, in pyelonephritis the ratio was somewhat lower in the prevalent cohort than in the incident cohort (1.5). This possibly reflects poorer survival on RRT of males with this diagnosis.

Primary renal diagnosis also influenced the distribution of patients between the modalities (table 4.11), particularly the likelihood of having a functioning renal transplant. In younger patients (aged less than 65), the ratios of prevalent patients with functioning transplants to those on dialysis were higher in the groups with pyelonephritis (2.1), polycystic kidney disease (1.7) and glomerulonephritis (1.8) than in the groups with diabetes (0.7) and renovascular disease (0.6), suggesting a much higher transplant rate in the former groups. In older patients the transplant rate was generally much lower. This was reflected in the lower transplant:dialysis ratios in this group, especially those for diabetes (0.1) and renovascular disease (0.1). The exception was APKD with a ratio of 1.1.

Table 4.12. Median age, gender ratio and treatment modality in diabetic and non-diabetic prevalent RRT patients

	All diabetes	Non-diabetics
Number	5,906	36,279
M:F ratio	1.58	1.52
Median age on 31/12/07	60	57
Median age at start of RRT	55	47
Median years on RRT	2.8	6.1
% HD	59	41
% PD	13	10
% transplant	28	49

Diabetes

Again in 2007 there was no differentiation between Type 1 and Type 2 diabetes, since the distinction was not made in data submitted by centres in Scotland and some in Northern Ireland. The number of patients with diabetes in the 2007 prevalent cohort has increased to 5,906, representing 14% of all patients (table 4.12). The median age at dialysis initiation was much higher in diabetics (55 vs. 47 years), though the disparity was much less in the prevalent diabetic population (60 vs. 57 years), suggestive of reduced survival in patients with diabetes. Consistent with this, the RRT vintage of prevalent patients with diabetes (2.8 years) was much less than that of prevalent without (6.1 years). The percentage of patients with a functioning transplant was much lower in prevalent diabetics than in prevalent non-diabetics (28.1% vs. 49.4%). The contrasts were even more stark in older age patients (table 4.13), with only 6.6% of prevalent patients with diabetes having a functioning transplant compared to 24.5% of non-diabetic peers.

Modalities of treatment

The most common treatment modality in the 2007 UK prevalent cohort was transplantation (46.6%),

Table 4.13. Age relationships by type of diabetes and modality in prevalent RRT patients 31/12/07

	<65		⩾65	
	Diabetics	Non-diabetics	Diabetics	Non-diabetics
Number	3,694	24,615	2,212	11,664
% HD	46.4	29.8	81.0	63.6
% PD	12.6	8.9	12.4	11.9
% transplant	41.0	61.3	6.6	24.5

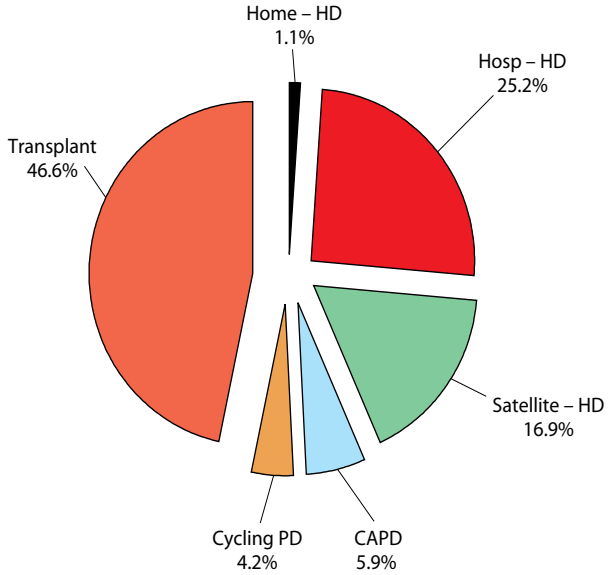

Fig. 4.12. Treatment modality in prevalent RRT patients on 31/12/07

closely followed by centre-based HD (42.1%) in either primary centre (25.2%) or satellite centre (16.9%) as depicted in figure 4.11. PD modalities made up 10.1% of the prevalent cohort, with CAPD accounting for 5.9% and cycling PD (automated PD) for 4.2%. The proportion of patients recorded as receiving CAPD using non-disconnect systems was very small, so in this analysis, has not been distinguished from those using disconnect systems. The term CAPD has been used to cover both.

Figure 4.12 shows the treatment modality in prevalent RRT patients on 31/12/2007. Transplantation (58.8%) was also the principal modality in patients aged less than 65, though HD (66.4%) predominated in older patients (tables 4.14 and 4.15). A slightly higher proportion of prevalent patients over 65 were on PD compared with the younger cohort (11.9% vs. 9.4%). There were differences among the 4 UK countries with respect to the proportion of patients on PD according to age group. In England and Wales, PD prevalence was higher in older patients, whilst in Northern Ireland, the reverse was the case. PD prevalence in both age groups was higher in Wales.

Table 4.15. Percentage of prevalent dialysis patients on haemodialysis by age and UK country on 31/12/07

	<65 years	⩾65 years	All
England	78	84	81
N Ireland	80	93	87
Scotland	77	88	82
Wales	70	81	76
UK	**77**	**85**	**81**

In general in the prevalent RRT population, age was a major factor in modality distribution (figure 4.13). With increasing age, transplant prevalence reduced, certainly beyond the age of 60 or so, whilst HD prevalence increased. The proportion of each age group treated by PD remained fairly stable across the age spectrum.

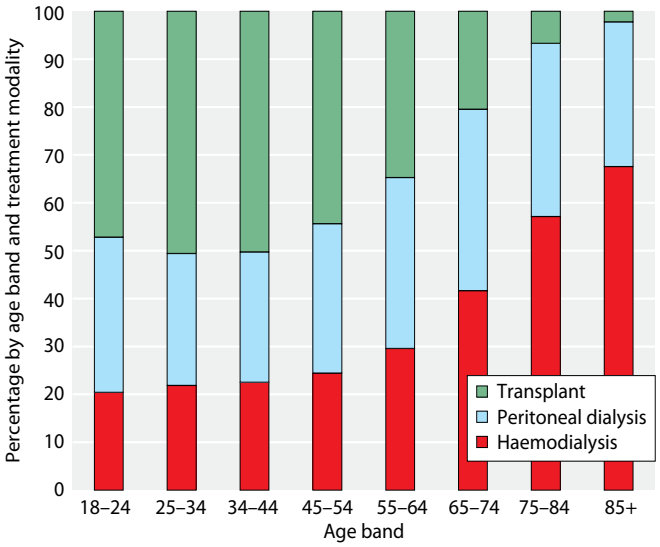

Fig. 4.13. Treatment modality distribution by age in prevalent RRT patients on 31/12/07

Table 4.14. Treatment modalities by age in UK countries on 31/12/07

	<65 years			⩾65 years		
UK country	% HD	% PD	% transplant	% HD	% PD	% transplant
England	31.7	9.2	59.1	65.9	12.2	21.9
N Ireland	35.0	8.7	56.3	74.5	5.6	19.9
Scotland	32.8	9.9	57.3	68.4	9.6	21.9
Wales	29.1	12.5	58.4	65.9	15.9	18.2
UK	**31.8**	**9.4**	**58.8**	**66.4**	**11.9**	**21.6**

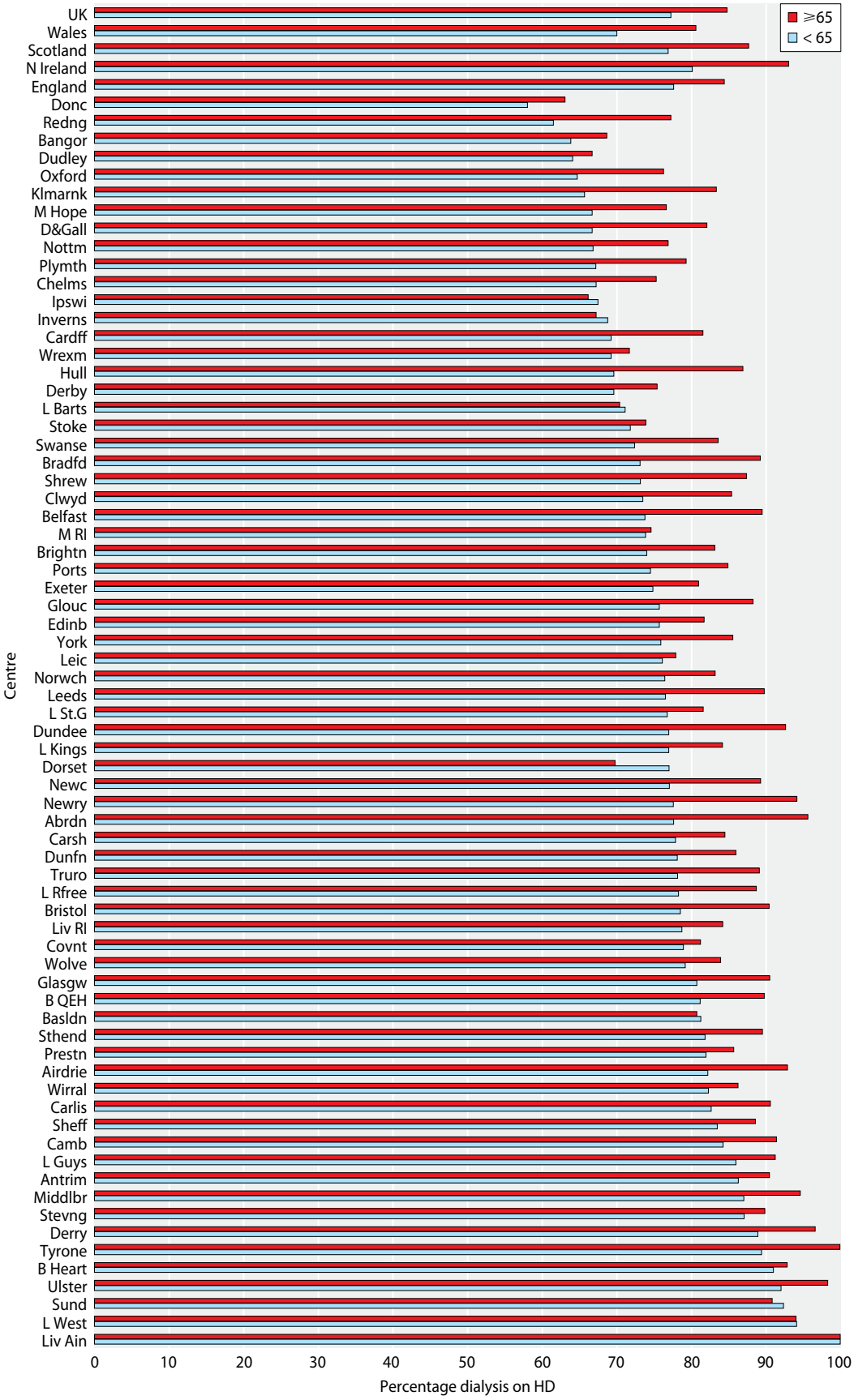

Fig. 4.14. Percentage of prevalent dialysis patients on haemodialysis by age and centre 31/12/07

The proportion of prevalent dialysis patients on HD in the UK in the 2007 cohort was 81%, and continued to increase having been 71% in 2002. The proportion was higher still in those aged over 65 years than in younger patients (85% vs. 77%). There was some variation among the 4 home countries with Wales tending to have a slightly lower percentage of patients on HD and Northern Ireland slightly higher.

The proportion of prevalent dialysis patients receiving HD, ranged from 60% in Doncaster to 100% in Liverpool Aintree. In only 6 centres was the national pattern of a higher percentage of older dialysis patients receiving HD reversed, and then only marginally. The centres were (figure 4.14), Dorset, Inverness, Ipswich, Sunderland, London Barts and Basildon.

Home haemodialysis

The percentage of dialysis patients receiving home HD varied from 0 in 20 centres, to greater than 5% of all dialysis activity in 6 centres, Sheffield (5.2%), London Guys (5.1%), Brighton (5.5%), Bangor (5.1%), Bristol (5.5%) and Manchester Royal Infirmary (8.6%) (table 4.16).

There was a peak in home haemodialysis use in 1982, when 60% of HD patients were on home HD

Table 4.16. Percentage of prevalent dialysis patients by dialysis modality by centre on 31/12/07

	Haemodialysis				Peritoneal dialysis			
Centre	Total	Home	Hospital	Satellite	Standard	Disconnect	Cycled ⩾6 nights	Cycled <6 nights
Liv Ain	100.0	1.7	62.6	35.7	0.0	0.0	0.0	0.0
Ulster	96.3	1.2	95.1	0.0	0.0	0.0	3.7	0.0
Tyrone	94.3	1.1	93.2	0.0	0.0	1.1	3.4	0.0
L West	94.0	1.0	20.0	73.0	0.0	2.7	3.3	0.0
Derry	92.9	0.0	91.1	1.8	1.8	1.8	3.6	0.0
B Heart	91.9	3.6	81.5	6.9	0.0	7.4	0.7	0.0
Sund	91.7	1.1	72.8	17.8	0.0	4.4	3.9	0.0
Middlbr	91.0	0.6	34.7	55.6	0.0	8.1	0.9	0.0
Antrim	89.0	2.1	86.9	0.0	0.0	2.8	8.3	0.0
Stevng	88.4	0.0	28.0	60.5	0.0	11.6	0.0	0.0
L Guys	88.3	5.1	21.8	61.3	0.0	4.6	0.0	7.2
Camb	87.7	1.0	50.0	36.7	0.0	0.0	0.0	0.0
Carlis	86.9	0.0	60.6	26.3	0.0	3.0	10.1	0.0
Airdrie	86.6	0.0	86.6	0.0	0.0	5.9	7.6	0.0
Newry	86.0	0.0	86.0	0.0	0.0	0.0	14.0	0.0
Sthend	85.9	0.0	85.9	0.0	0.0	14.1	0.0	0.0
Sheff	85.9	5.2	42.2	38.5	0.0	14.0	0.2	0.0
Abrdn	85.8	2.8	83.0	0.0	0.0	8.1	6.1	0.0
Dundee	85.4	0.0	85.4	0.0	0.0	2.0	10.6	2.0
B QEH	85.3	2.0	19.6	63.6	0.0	8.9	5.8	0.0
Truro	85.2	2.7	44.3	38.3	0.0	10.4	4.4	0.0
Glasgw	85.2	3.8	81.4	0.0	0.0	7.7	5.7	1.4
Bristol	85.1	5.5	13.1	66.5	0.0	11.2	3.5	0.2
Wirral	84.3	0.5	46.8	37.0	6.5	2.3	6.9	0.0
Glouc	83.8	0.0	83.8	0.0	0.0	7.1	9.1	0.0
Prestn	83.6	3.6	23.8	56.2	0.0	6.8	9.6	0.0
L Rfree	83.0	1.6	35.1	46.3	0.1	5.3	11.4	0.1
Leeds	82.8	2.8	46.5	33.6	0.0	7.2	10.0	0.0
Newc	82.2	2.6	79.6	0.0	0.0	3.0	14.8	0.0
Dunfn	81.8	0.0	81.8	0.0	0.0	1.5	16.8	0.0
Wolve	81.6	0.0	26.4	55.2	0.0	18.4	0.0	0.0
York	81.6	0.7	53.2	27.7	0.0	18.4	0.0	0.0
Carsh	81.4	0.0	27.4	54.0	0.0	9.1	9.4	0.0
Basldn	81.0	0.0	81.0	0.0	0.0	7.4	11.0	0.6
Liv RI	80.8	1.0	46.3	33.6	0.0	7.9	10.2	1.0

Table 4.16. Continued

	Haemodialysis				Peritoneal dialysis			
Centre	Total	Home	Hospital	Satellite	Standard	Disconnect	Cycled >6 nights	Cycled <6 nights
Belfast	80.6	2.2	78.5	0.0	0.0	4.3	14.2	0.0
Bradfd	80.5	0.0	64.3	16.3	0.0	6.3	13.1	0.0
Norwch	80.3	2.2	54.3	23.8	0.0	17.6	0.9	1.2
Covnt	80.0	2.1	77.9	0.0	0.0	20.0	0.0	0.0
L Kings	80.0	0.0	28.6	51.4	0.0	5.8	14.2	0.0
Shrew	79.8	0.5	53.2	26.1	0.5	19.7	0.0	0.0
Ports	79.8	0.0	37.8	42.0	0.0	20.2	0.0	0.0
L St.G	79.4	2.7	75.9	0.8	14.8	1.6	4.3	0.0
Brightn	79.3	5.5	44.1	29.8	0.0	10.5	10.2	0.0
Clwyd	78.9	1.1	77.8	0.0	12.2	0.0	8.9	0.0
Swanse	78.6	3.7	53.0	21.9	0.0	21.4	0.0	0.0
Exeter	78.5	0.5	36.9	41.1	0.0	13.6	7.6	0.3
Edinb	77.9	1.7	76.2	0.0	0.0	10.3	11.8	0.0
Hull	77.5	2.8	43.0	31.8	0.0	9.8	12.8	0.0
Leic	76.9	2.3	20.2	54.4	0.0	12.1	11.1	0.0
D & Gall	75.8	0.0	75.8	0.0	0.0	4.6	13.6	6.1
Cardff	75.7	0.0	35.4	40.3	0.0	24.4	0.0	0.0
Plymth	74.9	0.6	74.3	0.0	0.0	19.4	5.7	0.0
M RI	74.1	8.6	27.8	37.7	0.4	5.3	20.2	0.0
Klmarnk	73.4	0.6	72.9	0.0	0.0	10.2	13.0	3.4
Dorset	73.1	0.9	31.5	40.6	0.0	17.8	9.1	0.0
Stoke	72.7	1.4	58.8	12.5	8.2	0.0	19.0	0.0
Derby	72.3	3.6	68.8	0.0	0.0	24.1	3.6	0.0
Chelms	72.0	0.0	72.0	0.0	0.7	15.3	12.0	0.0
Nottm	71.5	1.7	51.9	17.8	0.0	12.8	15.7	0.0
L Barts	70.8	1.2	39.5	30.1	0.0	11.3	17.9	0.0
Wrexm	70.5	0.0	70.5	0.0	0.0	25.9	0.9	1.8
M Hope	70.4	1.3	29.4	39.7	0.0	19.7	9.0	0.0
Redng	70.1	0.3	45.4	24.4	0.0	29.9	0.0	0.0
Oxford	69.9	4.1	64.6	1.2	0.0	15.8	14.3	0.0
Inverns	68.0	1.6	66.4	0.0	0.0	14.4	17.6	0.0
Ipswi	66.9	2.7	64.2	0.0	0.0	19.2	12.6	0.7
Bangor	66.3	5.1	61.2	0.0	0.0	10.2	23.5	0.0
Dudley	65.1	1.1	46.3	17.7	0.0	34.9	0.0	0.0
Donc	60.4	0.0	59.4	1.0	1.0	25.0	13.5	0.0
England	**80.9**	**2.1**	**41.9**	**36.9**	**0.5**	**10.6**	**7.5**	**0.3**
N Ireland	**86.8**	**1.5**	**85.2**	**0.1**	**0.1**	**2.5**	**10.1**	**0.0**
Scotland	**81.8**	**2.0**	**79.8**	**0.0**	**0.0**	**7.6**	**9.5**	**1.1**
Wales	**75.6**	**1.5**	**48.1**	**26.0**	**0.8**	**21.0**	**2.4**	**0.2**
UK	**80.9**	**2.0**	**47.2**	**31.7**	**0.4**	**10.7**	**7.5**	**0.3**

(about 2,200 patients). With an 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 plateaued. By 2003 only 430 patients were on home HD, about 450 from 2004 to 2006 and in 2007 this had risen slightly to 478, which accounted for 2.4% 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.

Apart from the Manchester centre (which reported to the UKRR for the first time), there was little evidence of any substantial increase in home HD activity despite NICE guidance, particularly among centres starting from zero activity in this area. Of those centres with a zero return for home haemodialysis in 2006, only Liverpool Aintree and Reading submitted non-zero returns in 2007 [2].

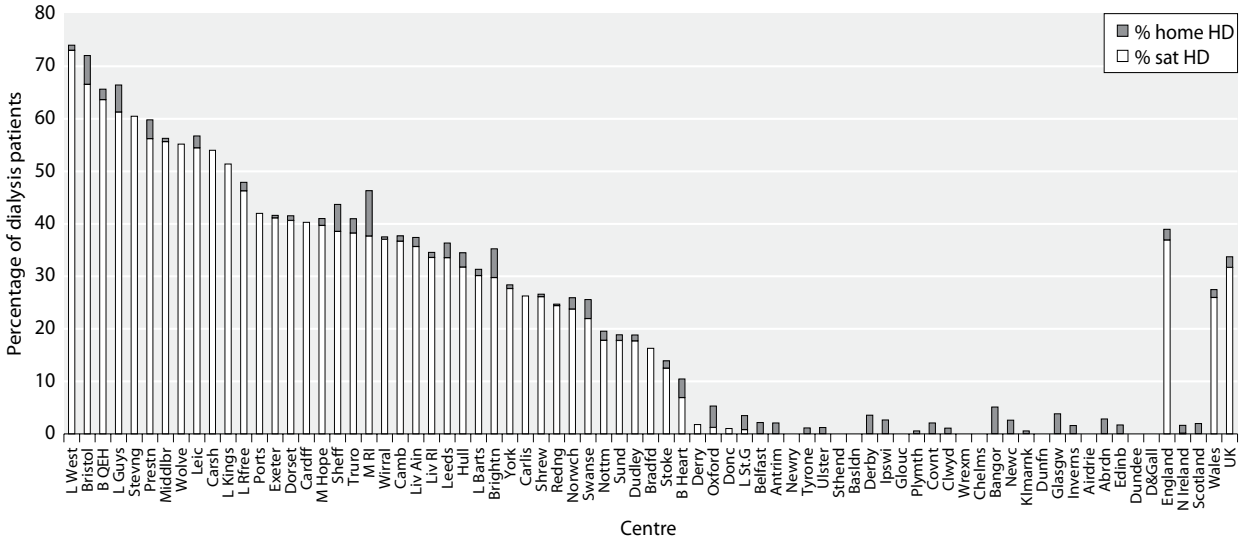

Fig. 4.15. Percentage of prevalent haemodialysis patients treated with satellite or home haemodialysis by centre in 2007

Satellite Dialysis

Twenty-six centres had no satellite haemodialysis whilst in 11 centres more than 50% of their dialysis activity took place in satellites (table 4.16). These variations with respect to home and satellite haemodialysis are depicted in figure 4.15. There was also much diversity between centres in the proportion of PD patients on cycling treatments, ranging from 0 to 100% (table 4.16). Eleven of the 68 centres with a PD programme, had no patients on cycling PD, whilst in two centres (Ulster and Newry) all PD patients were on this form of the modality.

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. By way of compensation there has been a continuous rise in the proportion of patients treated by HD. The proportion with a functioning transplant has fallen slightly over the same period.

Figure 4.17 depicts in more detail the changes in the prevalent dialysis population during this time and highlights a sustained reduction in the proportion of these patients treated by PD. This change was almost

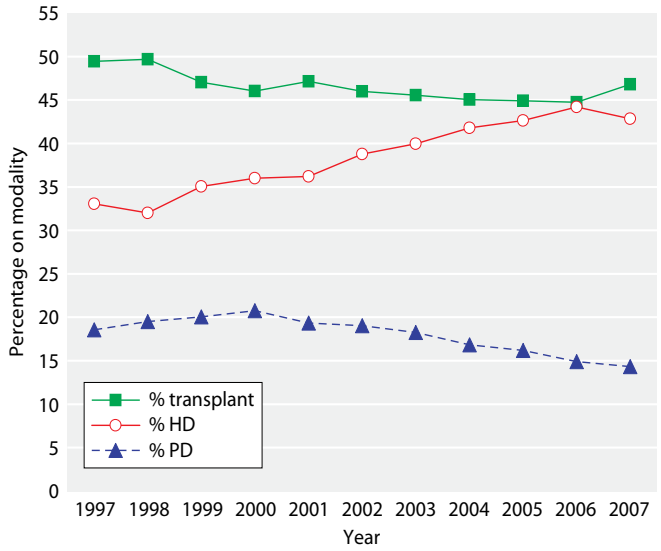

Fig. 4.16. Modality changes in prevalent RRT patients from 1997–2007 (England and Wales)

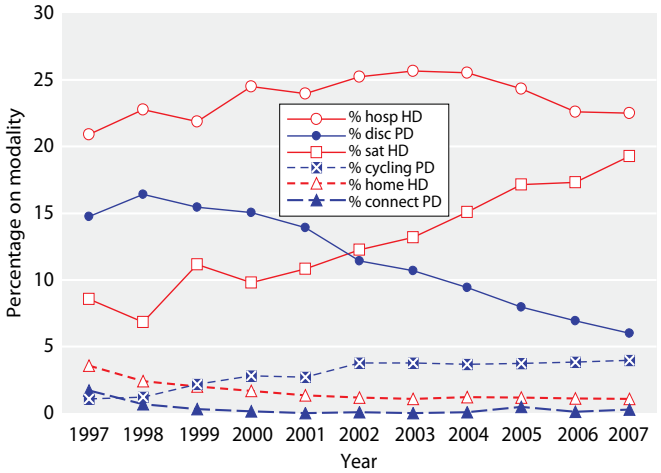

Fig. 4.17. Detailed dialysis modality changes in prevalent RRT patients from 1997–2007 (England and Wales)

completely counterbalanced by growth in the proportion of prevalent HD patients treated at satellite centres. The hospital haemodialysis population, other than the proportion dialysing in satellite centres has remained fairly constant.

Conflict of interest: none

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Chapter 5
Demographics and biochemistry profile of kidney transplant recipients in the UK in 2007: national and centre-specific analyses

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

Abstract
Introduction: Outcomes following renal transplantation are usually reported as graft or patient survival. However, graft function, haemoglobin and blood pressure are also important measures of quality of care. ***Methods:*** Transplant activity and incident graft survival data were obtained from NHS Blood and Transplant (NHSBT), laboratory and clinical variables and prevalent survival data were obtained from the UK Renal Registry (UKRR). 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. Transplant waiting list numbers continued to rise by 8%. Graft failure occurred in 3.2% of prevalent transplant patients. Death rates remained stable at 2.3/100 patient years. Malignancy accounted for 21% of these deaths. There was centre variation in outcomes such as eGFR and haemoglobin in prevalent and 1 year post-transplant recipients. Analysis of prevalent transplants by chronic kidney disease stage showed 16% with eGFR <30 and 2.2% <15. Of those in stage 5T, 26% had Hb <10 g/dl, 27% phosphate $\geqslant 1.8$ mmol/L and 50% an iPTH $\geqslant 32$ pmol/L. These patients were less likely to achieve the UK standards in comparison to CKD5 dialysis patients. ***Conclusion:*** Wide variations in clinical and biochemical outcomes may be secondary to variations in the care administered to transplant recipients 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, formerly UK Transplant) within NHS Blood and Transplant (NHSBT) and analyses regarding

demographics, clinical and biochemical variables in renal transplant recipients from the UK Renal Registry (UKRR). Whilst NHSBT records all information regarding the episode of transplantation, the UKRR holds 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 delivered clinical care to renal transplant recipients within the UK. This further allows for comparison of key outcomes between centres and provides insight into the processes involved in the care of such patients in the UK. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

The chapter is divided into five sections: (1) Transplant activity and survival data; (2) Transplant demographics; (3) Clinical and laboratory outcomes; (4) Analysis by chronic kidney disease (CKD) stage; (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 data on all relevant aspects around the episode of transplantation (donor and recipient) and also requests transplant centres to provide an annual paper based data return on the status of the recipient's graft function. This enables the organisation to generate comprehensive analysis of renal transplant activity and graft survival statistics which are regularly updated on its website.

NHSBT attributes a recipient to the centre that performed the transplant operation irrespective of where the patient is cared for before or after the procedure and hence only reports on transplant centre performance. Patients whose clinical management has been transferred back to a dialysis centre may be lost to NHSBT follow up although will still be monitored by the UKRR.

The UK Renal Registry methodology is described in chapter 15. The UKRR collects quarterly clinical data via an electronic data extraction process from hospital based renal IT systems, on all RRT patients across all their modalities until death.

Method

Following a period of consolidation and re-organisation in 2005/06, there are now 19 adult renal transplant centres in England, 2 in Scotland and one each in Northern Ireland and Wales.

Comprehensive information from 1995 onwards, concerning the number of patients on the transplant waiting list, the number of transplants performed, the number of heartbeating, non-heartbeating and living donors, and patient and graft survival are available on the NHSBT website (www.uktransplant.org.uk/ukt/statistics/statistics.jsp).

Results

As of 31st December 2007, there were 8,875 patients (including adult and paediatric) active or suspended on the renal or renal plus other organ waiting list, an increase of 8% compared to 2006. During 2007, absolute numbers of live donor and non-heartbeating donor transplants continued to increase and comprised 36.2% and 13.5% of all kidney transplants performed respectively (table 5.1). Combined pancreas and kidney transplant numbers continued to increase with nearly twice as many recipients in 2007 compared to 2005.

There was no statistically significant difference 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 (which are excluded in some countries).

Using data from the UKRR on prevalent renal only transplant patients on 1/1/2007, the death rate during 2007 was 2.3/100 patient years (CI 2.1–2.6) when cen-

Table 5.1. Kidney and kidney plus other organ transplant numbers in the UK, 1st January 2005–31st December 2007

Organ	2005	2006	2007	% change 2006–2007
Heartbeating donor kidney[a]	997	990	907	−8
Non-heartbeating kidney	200	250	300	20
Living donor kidney	543	671	804	20
Kidney and liver	11	17	9	−47
Kidney and heart	2	1	1	
Kidney and pancreas[b]	102	138	197	43
Total kidney transplants	**1,855**	**2,067**	**2,218**	**7**

[a] Includes en bloc kidney transplants (5 in 2005, 5 in 2006, 8 in 2007) and double kidney transplants (6 in 2005, 11 in 2006, 8 in 2007)
[b] Includes non-heartbeating transplants (2 in 2006, 13 in 2007) 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	96	76	84	96	100	92	100
Birmingham	90	96	84	90	91	98	91	96
Bristol	94	95	87	88	98	99	94	100
Cambridge	92	97	82	88	96	99	91	96
Cardiff	91	95	85	91	94	99	86	96
Coventry	97	97	91	89	97	100	90	95
Edinburgh	91	97	82	88	97	98	89	91
Glasgow	93	96	80	86	96	100	87	96
Guy's	92	96	84	88	98	100	94	94
Leeds	93	97	77	84	98	98	91	91
Leicester	90	92	79	87	95	95	86	93
Liverpool	89	99	82	88	90	94	84	94
Manchester	94	95	80	87	97	100	84	93
Newcastle	92	95	82	79	95	99	92	91
Nottingham	85	93	82	85	95	98	92	100
Oxford	94	95	87	87	97	99	88	97
Plymouth	93	95	73	86	94	100	65	89
Portsmouth	91	94	80	85	95	94	91	95
Royal Free	92	96	80	88	96	100	87	100
Royal London	94	96	82	84	95	98	77	96
Sheffield	91	99	84	91	95	100	83	95
St George's	93	98	88	89	95	99	85	93
WLRTC[b]	95	97	87	87	95	98	89	98
All centres	**92**	**96**	**82**	**87**	**96**	**98**	**88**	**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
[b] WLRTC – West London Renal and Transplant Centre
Cohorts for survival rate estimation:1 year survival: 1 Jan 2002–31 Dec 2006; 5 year survival: 1 Jan 1998–31 Dec 2002; First grafts only – re-grafts excluded for patient survival estimation. Since the cohorts to estimate 1 and 5 years survival are different, some centres may appear to have 5 year survival figures better than 1 year survival

sored for return to dialysis and 2.5/100 patient years (CI 2.2–2.7) without censoring for dialysis.

During 2007, 3.2% of prevalent transplant patients experienced graft failure (excluding death as cause of graft failure). These two figures have remained almost constant at this level since 2000.

This year the centre variation is not shown in the percentage of dialysis patients aged <65 years on the active waiting list.

Conclusions

The number of heartbeating kidney donors continued to decline, whilst numbers of non-heartbeating and live donors in 2007 increased to exceed this total.

There was no difference in the graft survival between UK centres. Graft failure rates remained stable at 3.2% per annum and transplant patient death rates also remained stable at 2.3 per 100 patient years.

Demographics

Introduction

As of 31st December 2007, 71 of the 72 adult renal centres in the UK were electronically linked to the UKRR. Only Colchester was unable to provide individual patient data, although this centre does not look after any transplant patients.

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 ongoing post-transplant care, some others only refer back 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 centre) and in such situations care is attributed to the referring centre.

Methods

Four centres (Bangor, Colchester, Wirral, Liverpool Aintree) 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. Eleven centres (nine centres in Scotland, Kent and London St Georges) do not currently submit sequential laboratory data to the UKRR and were not included in the analyses on post-transplant outcomes.

Information on patient demographics (age, gender, ethnicity and primary renal diagnosis) for patients in a given renal centre were obtained from UKRR patient registration data fields. Individual patients were assigned to the centre that returned data for that particular patient during 2007. The prevalence of transplant patients in areas covered by individual primary care trust (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, was retrieved from fields within renal centre IT systems. For the purpose of this analysis patients 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 Report 2008 appendix G at www.renalreg.org. 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 [1].

Results and discussion

Prevalent transplant numbers across the 4 nations in the UK are described in table 5.3. The prevalent patient cohort had a median time with a functioning transplant of 10.4 years.

The prevalence of renal transplant recipients in each PCT in England, Health Authority in Northern Ireland, Scotland and Wales 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. Further work to study whether this was secondary to differential access to transplantation is currently being undertaken by the UKRR.

The relative proportion of prevalent RRT patients with a transplant versus those on dialysis has been stable since at least 2000. While the proportion of patients on HD has been increasing, the proportion (and total numbers) 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, which has grown much more rapidly since 2004 when the UKRR first started reporting the variation between centres in the percentage of dialysis patients on the national transplant waiting list.

Age and gender

The gender ratio amongst incident and prevalent transplant patients has remained stable since 2002 (table 5.6 and figure 5.1). Whilst the median age of incident transplant patients has not changed much since 2002, there has been a small but steady increase in the median age of prevalent transplant patients, suggesting but not proving, that survival after renal transplantation has improved in the UK over the last 6 years.

Primary renal diagnosis

The number of patients achieving simultaneous kidney-pancreas (SPK) transplantation has increased by more than 200% since 2003 and this was reflected in

Table 5.3. Prevalence of transplants in adults in the UK on 31/12/2007

	England	Wales	Scotland	N Ireland	UK
All UK centres	17,568	1,041	1,927	596	21,132
Total population mid-2007 (millions)*	51.1	3.0	5.1	1.8	61.0
Prevalence pmp transplant	344	349	375	339	347

* Office of National Statistics, UK

Table 5.4. The prevalence per million population of patients with a renal transplant and standardised rate ratio in the UK, as on 31 December 2004–2007

[a] PCT/HA – Primary care trust in England; Health Authorities in N Ireland, Wales and Scotland
[b] Population numbers based on 2006 mid-year estimates by age group and gender obtained from the ONS
Estimates are not provided for PCTs/HAs for given year during which centres were not electronically linked to the UKRR
[c] O/E = age and gender standardised acceptance rate ratio
PCTs/HAs with significantly high average rate ratios are bold in darker grey areas; PCTs with significantly low average rate ratios are italicised in darker grey areas

UK Area	Region	PCT/HA[a]	Population covered[b]	Rate pmp				Age and gender standardised rate ratio 2007		
				2004	2005	2006	2007	O/E[c]	L 95% CL	U 95% CL
North East	County Durham and Tees Valley	County Durham	500,400	350	370	372	394	1.10	0.96	1.26
		Darlington	99,100	303	323	323	343	0.97	0.70	1.36
		Redcar, Cleveland	139,200	431	431	445	474	**1.33**	**1.05**	**1.69**
		Hartlepool	91,100	384	373	395	406	1.17	0.85	1.62
		Middlesbrough	138,500	397	397	397	404	1.22	0.94	1.59
		North Tees	189,200	312	328	370	349	1.00	0.79	1.28
	Northumberland, Tyne and Wear	Gateshead	190,500	399	446	415	409	1.16	0.93	1.44
		Newcastle	270,400	307	329	348	377	1.16	0.95	1.41
		North Tyneside	195,100	405	456	441	487	**1.37**	**1.12**	**1.67**
		Northumberland	309,900	378	381	378	390	1.05	0.88	1.25
		South Tyneside	151,000	338	364	377	411	1.17	0.91	1.50
		Sunderland Teaching	280,600	381	364	367	385	1.09	0.91	1.32
North West	Cheshire and Merseyside	Wirral	311,100	289	296	315	302	0.87	0.71	1.06
		Liverpool	436,200	282	298	303	303	0.91	0.77	1.08
		Central and E Cheshire	451,200				301	*0.83*	*0.70*	*0.98*
		Western Cheshire	235,100	315	315	306	345	0.96	0.77	1.19
		Knowsley	151,500	304	297	297	317	0.94	0.71	1.25
		Sefton	277,500	263	270	288	303	0.85	0.69	1.06
		Halton and St Helens	297,000	239	259	266	300	0.85	0.69	1.05
		Warrington	194,300	278	273	314	381	1.07	0.85	1.34
	Cumbria and Lancashire	Blackburn with Darwen	141,200	198	184	198	326	1.03	0.77	1.37
		Blackpool	142,800	217	210	231	315	0.89	0.66	1.19
		North Lancashire	329,000	228	231	277	313	0.89	0.73	1.08
		Cumbria	496,000	266	270	302	329	0.89	0.76	1.04
		Central Lancashire	451,600	219	217	244	301	0.85	0.72	1.01
		East Lancashire	384,500	289	283	304	395	1.14	0.97	1.34
	Greater Manchester	Ashton, Leigh and Wigan	305,500	144	167	206	383	1.07	0.89	1.28
		Bolton	262,500	187	221	248	415	**1.21**	**1.01**	**1.47**
		Bury	182,900	66	87	98	355	1.02	0.80	1.31
		Manchester	451,900				277	0.91	0.77	1.09
		Heywood, Middleton and Rochdale	206,400				383	1.13	0.91	1.41
		Oldham	219,800	114	114	150	346	1.03	0.83	1.30
		Salford	217,800	147	152	170	266	0.79	0.61	1.03
		Stockport	280,800				335	0.94	0.77	1.15
		Tameside and Glossop	247,700				384	1.10	0.90	1.34
		Trafford	212,100				316	0.91	0.72	1.16
Yorkshire and the Humber	N & E Yorkshire and N Lincolnshire	East Riding of Yorkshire	331,100	227	257	257	293	*0.79*	*0.65*	*0.96*
		Hull	256,200	246	262	304	336	1.01	0.82	1.25
		North East Lincolnshire	159,900	244	231	256	294	0.85	0.64	1.13
		North Lincolnshire	155,200	226	258	284	296	0.82	0.61	1.09
		North Yorkshire and York	783,200	260	277	309	327	0.91	0.81	1.03
	South Yorkshire	Barnsley	223,700	335	326	353	353	0.99	0.79	1.23
		Doncaster	290,400	275	282	320	313	0.89	0.73	1.10
		Rotherham	253,000	285	265	292	324	0.92	0.74	1.14
		Sheffield	526,100	239	251	272	285	0.85	0.73	1.00

Table 5.4. Continued

UK Area	Region	PCT/HA[a]	Population covered[b]	Rate pmp				Age and gender standardised rate ratio 2007		
				2004	2005	2006	2007	O/E[c]	L 95% CL	U 95% CL
Yorkshire and the Humber	West Yorkshire	Bradford and Airedale	493,000	318	337	347	381	**1.19**	**1.04**	**1.38**
		Calderdale	198,600	363	393	398	418	1.19	0.96	1.48
		Wakefield District	321,000	271	293	302	305	0.86	0.70	1.05
		Kirklees	398,400	364	399	427	429	**1.27**	**1.09**	**1.47**
		Leeds	750,300	271	276	309	320	0.98	0.86	1.11
East Midlands	Leicestershire, Northamptonshire, Rutland, Trent	Leicester City	289,700	414	428	466	504	**1.62**	**1.38**	**1.90**
		Leicestershire County and Rutland	673,600	312	334	346	370	1.03	0.91	1.17
		Northamptonshire	669,200	178	278	287	308	0.88	0.76	1.01
		Nottinghamshire County	657,500	283	287	301	312	0.87	0.76	1.00
		Bassetlaw	111,000	216	243	252	297	0.81	0.58	1.14
		Derby City	236,400	186	207	241	250	*0.75*	*0.58*	*0.97*
		Derbyshire County	720,800	216	225	241	284	*0.78*	*0.68*	*0.89*
		Lincolnshire	688,700	267	276	280	282	*0.77*	*0.67*	*0.89*
		Nottingham City	286,400	248	255	255	262	0.86	0.69	1.08
West Midlands	Birmingham and The Black Country	Dudley	305,200	249	239	249	272	*0.77*	*0.62*	*0.95*
		Birmingham East and North	395,900	288	296	326	331	1.05	0.89	1.25
		Heart of Birmingham Teaching	271,400	376	398	424	457	**1.63**	**1.37**	**1.95**
		South Birmingham	339,400	295	295	301	330	1.02	0.85	1.23
		Sandwell	287,700	313	334	337	358	1.07	0.89	1.30
		Solihull	203,000	217	241	281	281	0.80	0.61	1.03
		Walsall Teaching	254,700	283	298	310	353	1.04	0.85	1.28
		Wolverhampton City	236,900	257	257	257	300	0.89	0.71	1.13
	Coventry, Warwickshire, Herefordshire, Worcestershire, Shropshire and Staffordshire	Coventry Teaching	306,600	307	326	339	372	1.15	0.96	1.38
		Herefordshire	178,000	258	270	292	287	0.77	0.59	1.02
		Warwickshire	522,300	347	343	352	360	1.00	0.86	1.15
		Worcestershire	553,000	222	248	259	277	*0.76*	*0.65*	*0.89*
		North Staffordshire	211,400				312	0.86	0.68	1.10
		South Staffordshire	603,500				295	*0.81*	*0.70*	*0.94*
		Shropshire County	289,500	200	228	231	276	*0.75*	*0.61*	*0.94*
		Stoke on Trent	247,600				335	0.97	0.79	1.21
		Telford and Wrekin	161,800	130	136	179	222	*0.64*	*0.46*	*0.89*
East of England	Bedfordshire and Hertfordshire	Bedfordshire	403,600	240	273	295	334	0.95	0.80	1.12
		Luton	187,200	240	321	385	417	**1.30**	**1.04**	**1.62**
		West Hertfordshire	530,600	98	181	200	313	0.90	0.77	1.05
		East and North Hertfordshire	527,800	189	263	288	322	0.93	0.80	1.08
	Essex	Mid Essex	361,400	224	260	291	315	0.88	0.73	1.06
		North East Essex	315,400	193	235	247	254	*0.73*	*0.58*	*0.91*
		South East Essex	329,900	179	215	249	294	0.83	0.68	1.02
		South West Essex	388,300	201	234	242	301	0.88	0.73	1.05
		West Essex	274,700	244	266	280	280	*0.80*	*0.64*	*0.99*
	Norfolk, Suffolk, Cambridgeshire	Cambridgeshire	589,600	241	266	282	309	0.88	0.76	1.02
		Peterborough	163,400	190	196	233	251	0.75	0.55	1.02
		Norfolk	738,900	225	240	272	294	*0.81*	*0.71*	*0.93*
		Suffolk	585,300	231	239	270	287	*0.81*	*0.70*	*0.94*
		Great Yarmouth and Waveney	210,600	128	123	157	147	*0.41*	*0.29*	*0.58*
London	North Central London	Barnet	328,400		317	335	442	**1.33**	**1.13**	**1.57**
		Camden	227,200		233	268	304	0.93	0.74	1.18
		Enfield	285,400		347	382	417	**1.25**	**1.04**	**1.49**
		Haringey Teaching	225,600		293	346	381	1.17	0.95	1.44
		Islington	185,500		307	345	404	1.24	0.99	1.55

Table 5.4. Continued

UK Area	Region	PCT/HA[a]	Population covered[b]	Rate pmp 2004	2005	2006	2007	Age and gender standardised rate ratio 2007 O/E[c]	L 95% CL	U 95% CL
London	North East London	Barking and Dagenham	165,400	236	266	272	290	0.94	0.71	1.25
		City and Hackney Teaching	216,200			282	338	1.08	0.86	1.36
		Havering	227,500				268	*0.77*	*0.60*	*0.99*
		Newham	248,300	226	254	270	294	0.99	0.79	1.24
		Redbridge	251,800	258	286	326	357	1.09	0.88	1.34
		Tower Hamlets	212,500	179	216	249	254	0.86	0.66	1.12
		Waltham Forest	222,100			329	374	1.16	0.93	1.43
	North West London	Brent Teaching	271,400			140	486	**1.47**	**1.24**	**1.74**
		Ealing	306,400	255	277	304	493	**1.47**	**1.25**	**1.72**
		Hammersmith and Fulham	171,400	233	239	245	338	1.03	0.79	1.33
		Harrow	214,600				517	**1.53**	**1.27**	**1.84**
		Hillingdon	250,100	184	248	268	364	1.10	0.90	1.35
		Hounslow	218,600	220	256	293	425	**1.28**	**1.04**	**1.56**
		Kensington and Chelsea	178,000				258	*0.74*	*0.55*	*0.99*
		Westminster	231,700				268	0.79	0.62	1.01
	South East London	Bexley	221,600	370	393	402	456	**1.33**	**1.10**	**1.62**
		Bromley	299,400	314	344	371	418	**1.21**	**1.01**	**1.44**
		Greenwich Teaching	222,600	207	247	270	337	1.05	0.84	1.32
		Lambeth	272,200	217	224	231	298	0.91	0.73	1.14
		Lewisham	255,600	360	364	395	458	**1.39**	**1.16**	**1.67**
		Southwark	269,000	387	413	431	472	**1.46**	**1.22**	**1.73**
	South West London	Croydon	337,000	211	228	285	329	0.98	0.81	1.18
		Kingston	156,000				378	1.12	0.87	1.45
		Richmond and Twickenham	179,500				245	*0.70*	*0.52*	*0.94*
		Sutton and Merton	382,000				395	**1.17**	**1.00**	**1.37**
		Wandsworth	279,200				376	1.16	0.96	1.41
South East	Hampshire and Isle of Wight	Isle of Wight National Health Service	138,200	304	297	297	282	0.77	0.56	1.06
		Hampshire	1,265,900	292	293	320	339	0.95	0.87	1.05
		Portsmouth City Teaching	196,300	346	331	346	362	1.13	0.89	1.42
		Southampton City	229,100	301	314	336	354	1.12	0.90	1.39
	Kent and Medway	West Kent								
		Medway								
		Eastern and Coastal Kent								
	Surrey and Sussex	Hastings and Rother	176,200	221	244	244	272	0.77	0.58	1.02
		Brighton and Hove City	251,500	195	207	250	282	0.84	0.66	1.06
		East Sussex Downs and Weald	330,200	233	227	218	270	*0.76*	*0.61*	*0.93*
		Surrey	1,073,400	231	245	288	354	1.00	0.90	1.11
		West Sussex	770,600	241	256	276	321	0.91	0.80	1.03
	Thames Valley	Milton Keynes	230,100	256	278	304	343	1.00	0.80	1.24
		Berkshire East	382,200	283	267	283	434	**1.29**	**1.10**	**1.50**
		Berkshire West	445,400	328	272	290	411	**1.19**	**1.03**	**1.38**
		Oxfordshire	607,400	354	367	400	413	**1.21**	**1.07**	**1.37**
		Buckingham-shire	500,700	328	350	397	431	**1.22**	**1.07**	**1.39**
South West	Avon, Gloucestershire and Wiltshire	Bath and North East Somerset	175,600	222	239	251	279	0.82	0.62	1.09
		Bristol	410,700	377	380	399	426	**1.32**	**1.14**	**1.53**
		Gloucestershire	578,500	306	327	339	344	0.97	0.84	1.11
		Swindon	192,600	301	332	332	337	0.98	0.77	1.24
		South Gloucestershire	254,200	366	382	397	437	**1.23**	**1.02**	**1.48**
		Wiltshire	448,600	241	254	274	292	*0.82*	*0.69*	*0.98*

Table 5.4. Continued

UK Area	Region	PCT/HA[a]	Population covered[b]	Rate pmp				Age and gender standardised rate ratio 2007		
				2004	2005	2006	2007	O/E[c]	L 95% CL	U 95% CL
South West	Dorset and Somerset	Bournemouth and Poole	297,900	279	299	316	342	1.00	0.82	1.21
		Dorset	403,100	293	315	335	375	1.03	0.88	1.20
		North Somerset	201,200	403	388	388	348	0.96	0.76	1.22
		Somerset	518,800	297	320	330	339	0.95	0.82	1.10
	South West Peninsula	Devon	740,600	269	271	296	325	0.90	0.79	1.02
		Plymouth Teaching	247,900	343	395	420	436	**1.29**	**1.07**	**1.56**
		Torbay	133,000	278	308	331	361	1.01	0.76	1.34
		Cornwall and Isles of Scilly	526,200	272	306	321	357	0.98	0.85	1.13
Wales	Bro Taf	Cardiff	317,500	356	378	406	431	**1.36**	**1.15**	**1.61**
		Merthyr Tydfil	55,800	484	520	538	609	**1.75**	**1.25**	**2.45**
		Rhondda, Cynon, Taff	234,100	397	444	496	513	**1.49**	**1.24**	**1.78**
		Vale of Glamorgan	123,200	341	325	333	333	0.95	0.70	1.29
	Dyfed Powys	Carmarthenshire	177,800	326	349	382	388	1.08	0.85	1.36
		Ceredigion	77,100	350	324	324	324	0.92	0.62	1.37
		Pembrokeshire	116,800	308	351	325	351	0.97	0.71	1.32
		Powys	130,900	222	222	260	290	0.78	0.57	1.08
	Gwent	Blaenau Gwent	69,500	403	388	403	432	1.23	0.86	1.76
		Caerphilly	171,300	356	374	385	414	1.19	0.95	1.51
		Monmouthshire	87,800	478	513	513	513	**1.39**	**1.04**	**1.86**
		Newport	140,500	370	342	320	370	1.10	0.83	1.44
		Torfaen	91,000	451	451	462	505	**1.45**	**1.09**	**1.94**
	Morgannwg	Bridgend	132,600	370	400	415	445	1.26	0.97	1.62
		Neath Port Talbot	137,100	299	321	416	430	1.21	0.94	1.56
		Swansea	227,000	374	388	423	449	**1.31**	**1.08**	**1.59**
	North Wales	Conwy	111,300	314	314	314	314	0.87	0.63	1.22
		Denbighshire	95,900	250	302	292	292	0.82	0.56	1.18
		Flintshire	150,000	273	287	307	373	1.04	0.80	1.35
		Gwynedd	118,200	262	288	279	313	0.90	0.65	1.24
		Isle of Anglesey	68,800	203	203	218	247	0.68	0.42	1.09
		Wrexham	131,000	321	313	374	374	1.06	0.80	1.40
Scotland		Aberdeen City	207,000	333	333	348	357	1.01	0.81	1.27
		Aberdeenshire	236,300	317	334	339	351	0.95	0.76	1.18
		Angus	109,500	521	521	548	557	**1.51**	**1.18**	**1.94**
		Argyll & Bute	91,200	263	274	351	362	0.96	0.68	1.35
		Scottish Borders	110,300	236	263	254	281	0.75	0.53	1.07
		Clackmannan-shire	48,800	225	246	246	246	0.68	0.39	1.20
		West Dunbartonshire	91,100	296	296	307	362	1.02	0.73	1.44
		Dumfries & Galloway	148,000	291	297	311	331	0.87	0.66	1.16
		Dundee City	142,100	387	387	429	450	**1.32**	**1.04**	**1.69**
		East Ayrshire	119,300	251	260	277	285	0.79	0.56	1.10
		East Dunbartonshire	105,700	407	416	426	454	1.25	0.94	1.66
		East Lothian	92,600	324	313	292	302	0.84	0.58	1.21
		East Renfrewshire	89,000	382	404	427	449	1.27	0.93	1.73
		Edinburgh, City of	463,300	287	315	296	319	0.94	0.80	1.10
		Falkirk	149,500	314	328	294	348	0.97	0.74	1.27
		Fife	359,200	267	287	298	301	0.84	0.70	1.02
		Glasgow City	580,600	382	401	410	439	**1.31**	**1.16**	**1.48**
		Highland	215,400	292	320	344	367	0.98	0.79	1.22
		Inverclyde	81,300	344	369	332	332	0.93	0.64	1.35
		Midlothian	79,000	316	329	342	392	1.09	0.77	1.56
		Moray	86,700	334	404	438	427	1.16	0.84	1.60

Table 5.4. Continued

UK Area	Region	PCT/HA[a]	Population covered[b]	Rate pmp				Age and gender standardised rate ratio 2007		
				2004	2005	2006	2007	O/E[c]	L 95% CL	U 95% CL
Scotland		North Ayrshire	135,300	325	377	414	443	1.23	0.95	1.58
		North Lanarkshire	323,700	324	346	349	361	1.03	0.86	1.24
		Orkney Islands	20,000	500	550	550	450	1.20	0.63	2.31
		Perth & Kinross	140,200	300	307	314	328	0.89	0.67	1.19
		Renfrewshire	169,300	360	384	413	437	1.21	0.97	1.52
		Shetland Islands	22,000	318	273	273	273	0.74	0.33	1.65
		South Ayrshire	111,900	349	349	366	375	1.01	0.75	1.37
		South Lanarkshire	307,700	367	374	374	383	1.07	0.89	1.28
		Stirling	87,600	274	251	240	240	0.68	0.45	1.05
		West Lothian	165,700	338	362	326	344	0.97	0.75	1.26
		Eilean Siar	25,900	193	232	232	309	0.81	0.41	1.62
Northern Ireland	Northern Ireland	Antrim	51,500		369	447	466	1.41	0.95	2.11
		Ards	76,000		329	329	329	0.92	0.62	1.37
		Armagh	56,400		319	355	355	1.09	0.71	1.70
		Ballymena	61,400		228	261	277	0.81	0.51	1.31
		Ballymoney	29,300		205	273	239	0.72	0.34	1.51
		Banbridge	45,400		286	308	352	1.05	0.64	1.72
		Belfast	267,600		314	329	336	1.07	0.87	1.32
		Carrickfergus	39,800		477	477	477	1.39	0.89	2.18
		Castlereagh	65,600		366	442	457	1.32	0.92	1.88
		Coleraine	56,900		211	193	193	0.57	0.32	1.03
		Cookstown	34,600		87	116	116	*0.37*	*0.14*	*0.98*
		Craigavon	86,800		288	300	288	0.88	0.60	1.31
		Derry	107,800		297	343	353	1.13	0.82	1.55
		Down	68,400		234	249	263	0.80	0.50	1.27
		Dungannon	52,700		209	209	247	0.78	0.45	1.34
		Fermanagh	60,600		165	215	198	0.59	0.33	1.04
		Larne	31,400		605	541	541	1.53	0.95	2.46
		Limavady	33,900		354	324	324	1.00	0.55	1.81
		Lisburn	113,300		353	406	424	1.29	0.97	1.71
		Magherafelt	42,900		350	350	396	1.25	0.78	2.02
		Moyle	17,000		294	353	294	0.86	0.36	2.06
		Newry & Mourne	93,600		374	353	363	1.15	0.82	1.61
		Newtownabbey	81,400		307	381	381	1.12	0.79	1.59
		North Down	79,000		354	342	380	1.07	0.75	1.54
		Omagh	51,200		215	273	293	0.91	0.55	1.50
		Strabane	39,200		255	332	357	1.10	0.65	1.86

the increasing number of diabetic patients with a functioning transplant amongst incident dialysis patients as shown in table 5.7. If this trend of increasing transplantation activity for diabetics continues, there will be an inevitable decrease in the relative proportion of incident non-diabetic patients receiving a renal transplant.

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 and were classified as ethnicity 'unknown' (table 5.8).

Comorbidity

Although most renal centres' renal IT system contained fields for annual comorbidity data capture, these fields were mostly incomplete. The UKRR therefore has not attempted to analyse the development of comorbidity after the start of RRT. Based on data analysis from

Table 5.5. Distribution of prevalent patients on RRT by centre and modality on 31/12/2007

Centre	Total	% HD	% PD	% transplant
Transplant centres				
B QEH	1,626	47	8	45
Belfast	748	35	8	57
Bristol	1,234	38	7	56
Camb	935	38	5	57
Cardff	1,438	34	11	55
Covnt	717	43	11	46
Edinb	720	38	11	52
Glasgw	1,605	37	6	56
L Barts	1,473	40	16	44
L Guys	1,395	34	5	61
L Rfree	1,437	42	9	49
L St G	567	36	9	55
L West	2,162	49	3	48
Leeds	1,379	37	8	56
Leic	1,594	42	13	45
Liv RI	1,284	33	8	59
M RI	1,352	26	9	65
Newc	920	27	6	67
Nottm	971	38	15	47
Oxford	1,328	26	11	63
Plymth	421	31	10	58
Ports	1,182	34	9	57
Sheff	1,172	48	8	44
Dialysis centres				
Abrdn	452	47	8	45
Airdrie	230	64	10	26
Antrim	200	65	8	28
B Heart	578	67	6	27
Bangor	98	66	34	0
Basldn	205	64	15	20
Bradfd	395	45	11	44
Brightn	685	49	13	39
Carlis	202	43	6	51
Carsh	1,165	48	11	41
Chelms	188	57	22	20
Clwyd	155	46	12	42
Colchr	100	100	0	0
D & Gall	77	65	21	14
Derby	301	68	26	6
Derry	62	84	6	10
Donc	107	54	36	10
Dorset	442	36	13	50
Dudley	255	45	24	31
Dundee	376	45	8	47
Dunfn	220	51	11	38
Exeter	664	45	12	42
Glouc	326	54	10	36
Hull	672	46	13	40
Inverns	207	41	19	40
Ipswi	283	36	18	47
Kent	627	46	16	38
Klmarnk	214	61	22	17
L Kings	712	48	12	40
Liv Ain	115	100	0	0
M Hope	759	42	18	40

Table 5.5. Continued

Centre	Total	% HD	% PD	% transplant
Middlbr	667	44	4	52
Newry	147	59	10	32
Norwch	495	53	13	35
Prestn	855	49	10	42
Redng	545	42	18	40
Shrew	285	57	14	29
Stevng	548	60	8	32
Sthend	195	63	10	27
Stoke	588	44	16	40
Sund	282	59	5	36
Swanse	544	55	15	30
Truro	286	55	9	36
Tyrone	149	56	3	41
Ulster	86	92	3	5
Wirral	216	84	16	0
Wolve	441	62	14	24
Wrexm	142	56	23	21
York	231	50	11	39
England	**37,614**	**43**	**10**	**47**
N Ireland	**1,392**	**50**	**8**	**43**
Scotland	**4,101**	**43**	**9**	**48**
Wales	**2,377**	**42**	**14**	**44**
UK	**45,484**	**43**	**10**	**46**

patients where appropriate comorbidity information was available, it was not surprising to find that transplanted patients had none or fewer comorbidities compared to patients who remained on dialysis or had died (table 5.9). If all renal centres consistently reported on the comorbidity of their RRT patients it would be possible to compare whether inter-centre differences exist in wait-listed and transplanted patients by comorbidity.

Post-transplant follow-up

Introduction

There continued to be a huge variation in the extent of completeness of data (tables 5.10a and b) reported by each centre. Better data returns would facilitate more meaningful comparisons between centres and help to determine the causes of differences between centres in

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

	Incident transplants			Prevalent transplants[a]		
Year	N	Median age	M:F ratio	N	Median age	M:F ratio
2002	1,404	46.0	1.6	11,782	49.4	1.6
2003	1,509	44.5	1.5	12,815	49.5	1.6
2004	1,685	45.4	1.7	15,007	49.6	1.6
2005	1,742	45.4	1.4	16,765	49.7	1.6
2006	1,990	45.2	1.6	17,884	49.9	1.6
2007	2,196	45.7	1.5	20,819	50.1	1.5

[a] As on 31st December for given year, only centres submitting data to the UKRR in a given year are included

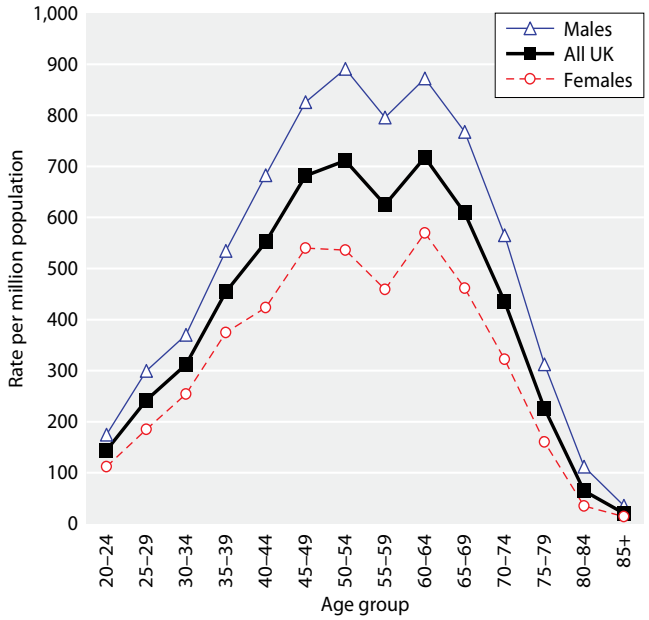

Fig. 5.1. Transplant prevalence rate per million population by age and gender on 31/12/2007

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, as unrecorded or unreported variables may be influencing outcome.

The 72 renal centres in the UK comprise of 52 centres in England, 5 in Wales, 6 in Northern Ireland and 9 in Scotland. Centres in Scotland only provided summary information and therefore laboratory outcome data for comparisons were not available for the Scottish renal centres. Kent and London St George's were also unable to provide laboratory data on their patients and were excluded from these analyses. Four centres (Bangor, Colchester, Liverpool Aintree, Wirral) were reported as having no transplanted patients and therefore excluded. After exclusion of these 15 centres, prevalent patient data from 57 renal centres across the UK were analysed.

For the one year post-transplant outcomes, the two Scottish transplant centres and London St George's

Table 5.7. Primary renal disease in renal transplant recipients

	New transplants by year						Established transplants on 1/1/2007	
	2003	2004	2005	2006	2007			
Primary diagnosis	%	%	%	%	%	N	%	N
Aetiology uncertain/GN[a] not biopsy proven	20.1	19.8	18.5	17.9	17.6	386	20.4	3,657
Diabetes	9.5	10.6	11.9	13.2	14.6	320	7.7	1,370
Glomerulonephritis	20.6	19.4	18.9	19.0	19.1	419	19.8	3,541
Polycystic kidney disease	12.7	12.5	11.4	12.2	12.7	279	12.0	2,139
Pyelonephritis	12.0	12.0	11.4	11.3	10.9	239	15.6	2,796
Reno-vascular disease	5.7	6.6	6.3	5.9	5.6	124	5.8	1,039
Other	15.1	13.3	14.5	15.1	15.0	329	15.8	2,831
Not available	4.4	5.8	7.2	5.4	4.6	100	2.9	511

[a] GN – glomerulonephritis

Table 5.8. Ethnicity of patients who received a transplant in the years 2002–2007

Year	% White	% South Asian	% Black	% Other	% unknown
2002	70.2	9.3	5.3	2.2	13.0
2003	71.2	5.6	4.8	2.1	16.4
2004	69.9	7.1	4.4	2.3	16.4
2005	71.9	7.2	5.4	1.2	14.3
2006	71.2	5.6	4.8	2.1	16.4
2007	68.7	7.5	5.7	2.5	15.5

Table 5.9. Comparison of comorbidity in patients starting RRT during 2002–2007 who underwent transplantation with those who remained on dialysis or died

	Not transplanted		Transplanted		
Comorbidity	N	%	N	%	p value[a]
Patients with comorbidity data	11,286		2,007		
Without comorbidity	4,782	42.4	1,541	76.8	<0.0001
Ischaemic heart disease	2,829	25.5	104	5.2	<0.0001
Peripheral vascular disease	1,438	12.9	45	2.3	<0.0001
Cerebrovascular disease	1,232	11.0	55	2.7	<0.0001
Diabetes (not cause of ERF)[b]	966	8.8	47	2.4	<0.0001
COPD[c]	855	7.7	30	1.5	<0.0001
Liver disease	298	2.7	11	0.5	<0.0001
Malignancy	1,470	13.1	36	1.8	<0.0001
Smoking	1,613	15.5	239	12.7	0.001

[a] Chi square p value comparing proportion with comorbidity between groups
[b] Established renal failure
[c] Chronic obstructive pulmonary disease

Table 5.10a. Percentage completeness by centre for prevalent transplant patients on 31/12/2007

Centre	Total number of patients	Ethnicity	eGFR[a]	Blood pressure	Centre	Total number of patients	Ethnicity	eGFR[a]	Blood pressure
Antrim	54	100.0	94.4	20.4	Liv RI	750	95.2	91.9	87.5
B Heart	154	100.0	90.9	2.0	M Hope	296	97.6	93.9	0.0
B QEH	704	99.7	87.9	1.1	M RI	844	90.2	96.8	0.1
Basldn	42	100.0	95.2	2.4	Middlbr	342	92.4	95.0	54.4
Belfast	410	100.0	97.3	90.0	Newc	591	99.5	96.8	0.7
Bradfd	170	67.1	94.1	97.1	Newry	47	100.0	87.2	4.3
Brightn	252	45.6	94.4	0.4	Norwch	170	87.1	91.8	0.6
Bristol	664	97.9	98.8	93.2	Nottm	442	95.9	98.0	96.6
Camb	511	84.7	88.5	1.6	Oxford	796	42.3	95.9	16.1
Cardff	753	42.4	97.5	96.7	Plymth	233	88.4	96.6	1.3
Carlis	103	99.0	91.3	0.0	Ports	665	98.7	83.2	11.7
Carsh	459	97.8	92.4	0.7	Prestn	350	92.6	91.1	0.3
Chelms	37	86.5	97.3	91.9	Redng	214	100.0	99.5	99.1
Clwyd	64	71.9	93.8	93.8	Sheff	496	98.4	99.0	98.8
Covnt	323	97.2	89.2	76.5	Shrew	78	100.0	100.0	19.2
Derby	18	94.4	72.2	16.7	Stevng	174	100.0	63.8	0.6
Derry	5	100.0	80.0	80.0	Sthend	53	86.8	100.0	0.0
Donc	7	100.0	100.0	100.0	Stoke	230	40.9	97.4	14.8
Dorset	222	100.0	91.4	12.6	Sund	99	96.0	98.0	2.0
Dudley	80	100.0	96.3	88.8	Swanse	155	100.0	98.1	11.0
Exeter	276	92.4	95.3	86.6	Truro	101	82.2	98.0	70.3
Glouc	115	99.1	96.5	1.7	Tyrone	61	100.0	93.4	86.9
Hull	270	80.0	90.0	0.4	Ulster	3	100.0	100.0	100.0
Ipswi	131	97.7	95.4	95.4	Wolve	104	100.0	98.1	99.0
L Barts	625	94.7	94.6	0.0	Wrexm	29	93.1	93.1	51.7
L Guys	820	86.8	96.5	0.1	York	88	75.0	98.9	96.6
L Kings	274	96.4	94.5	0.0	**England**	**16,516**	**88.6**	**90.5**	**30.3**
L RFree	679	98.5	91.0	0.2	**N Ireland**	**580**	**100.0**	**95.7**	**76.2**
L West	1,008	84.5	43.6	0.1	**Wales**	**1,001**	**54.7**	**97.2**	**81.9**
Leeds	757	73.2	96.6	90.2	**E, W & NI**	**18,097**	**87.1**	**91.0**	**34.6**
Leic	699	91.6	91.3	36.3					

[a] Patients with missing ethnicity were classed as White for eGFR calculation; eGFR – estimated glomerular filtration rate

Table 5.10b. Percentage completeness by centre for prevalent transplant patients on 31/12/2007

Centre	Patients N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[a]	Serum phosphate	Serum PTH
Antrim	54	94	94	94	94	85
B Heart	154	90	58	88	86	18
B QEH	704	88	87	88	87	60
Basldn	42	95	93	95	90	67
Belfast	410	97	98	97	97	20
Bradfd	170	89	89	93	91	38
Brightn	252	94	37	87	87	32
Bristol	664	99	94	98	98	78
Camb	511	88	83	87	87	70
Cardff	753	97	79	97	97	19
Carlis	103	94	88	91	89	7
Carsh	459	89	70	92	91	2
Chelms	37	95	86	97	97	11
Clwyd	64	94	83	92	94	56
Covnt	323	88	2	89	75	21
Derby	18	72	22	56	50	33
Derry	5	80	100	80	80	20
Donc	7	86	86	71	71	0
Dorset	222	91	88	90	62	14
Dudley	80	95	90	94	94	45
Exeter	276	95	86	94	85	20
Glouc	115	97	67	96	95	23
Hull	270	89	52	90	90	26
Ipswi	131	95	89	95	95	43
L Barts	625	95	97	94	94	80
L Guys	820	96	90	90	90	25
L Kings	274	95	82	95	95	0
L RFree	679	82	86	91	91	55
L West	1,008	44	82	43	42	4
Leeds	757	94	96	93	96	25
Leic	699	90	90	91	91	64
Liv RI	750	92	6	89	91	47
M Hope	296	93	95	94	94	85
M RI	844	96	62	97	97	61
Middlbr	342	93	76	93	93	18
Newc	591	97	95	97	97	57
Newry	47	87	91	85	83	36
Norwch	170	92	93	91	91	22
Nottm	442	98	93	96	96	83
Oxford	796	96	77	95	95	38
Plymth	233	93	92	94	92	16
Ports	665	84	52	83	79	7
Prestn	350	89	85	89	86	52
Redng	214	99	100	99	98	81
Sheff	496	99	74	99	99	17
Shrew	78	100	96	96	95	60
Stevng	174	84	80	83	82	47
Sthend	53	100	94	96	96	15
Stoke	230	97	99	97	97	30
Sund	99	98	76	98	93	79
Swanse	155	98	98	98	98	39
Truro	101	97	77	98	98	50
Tyrone	61	85	98	92	92	26
Ulster	3	100	100	100	100	33
Wolve	104	97	85	98	86	63

Table 5.10b. Continued

Centre	Patients N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[a]	Serum phosphate	Serum PTH
Wrexm	29	93	83	93	93	59
York	88	89	83	51	97	22
England	**16,516**	**90**	**77**	**89**	**88**	**41**
N Ireland	**580**	**95**	**97**	**95**	**95**	**28**
Wales	**1,001**	**97**	**82**	**97**	**97**	**26**
E, W & NI	**18,097**	**90**	**78**	**90**	**89**	**40**

[a] Serum calcium adjusted for serum albumin

were excluded as they did not submit biochemical data to the UKRR, Belfast and Manchester RI have only recently commenced submitting data to the UKRR and were therefore also excluded. After excluding these 5 from the 23 transplant centres, one year outcomes are described for 18 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 2000–2006 with patients attributed to the transplant centre that performed the procedure.

Time post-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, outcomes are also reported in patients one year post-transplantation. 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. It should be noted that several dialysis centres only receive patients back to their clinical care when 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 comprised of prevalent patients as on 31/12/2007. 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 for whom the exact date of transplant was not known were excluded from analyses. Four centres (Derby, Derry, Doncaster and Ulster) with <20 patients are not shown in the figures. Patients were considered as having a functioning transplant if 'transplant' was listed as the last mode of RRT in the last quarter of 2007. For haemoglobin, estimated glomerular filtration rate (eGFR), calcium and phosphate, the last value in quarter 3 or quarter 4 of 2007 was used. For blood pressure and cholesterol, the latest value from 2007 was used. For parathyroid hormone (PTH), the latest value in the last 3 quarters of 2007 was used.

Estimated glomerular filtration rate (eGFR)

For the purpose of eGFR calculation, the 4-variable MDRD formula was used, although serum creatinine has not been standardised to that of the assay used at the MDRD laboratory, and the different creatinine assay methods in use in the UK have not been taken into account. The majority of UK NHS laboratories are believed to have made appropriate adjustments taking into account differences between the Beckman assay and their current assays when reporting eGFR values. In the UK there is now a further move towards standardising against an isotope dilution mass spectrometry (ID-MS) traceable creatinine result, which will then require use of an adjusted 4v MDRD equation. The UK Association of Clinical Biochemists had stated that most UK laboratories were using the kinetic Jaffe assay and the standard 4v MDRD equation is most appropriate (personal communication, E Lamb). Patients with valid serum creatinine results but no ethnicity data were classed as White for the purpose of the eGFR calculation as few transplanted patients were from an ethnic minority.

One year post-transplant data

Patients who received a renal transplant between 1 January 2000 and 31 December 2006 were assigned according to the renal centre in which they were transplanted (table 5.11).

Brighton (until 1996) and Carshalton/St Helier's (until 2003) were transplanting centres, with subsequent transplants performed at London St George's. Patients who had died or experienced graft failure within 12 months post-transplantation were excluded from analysis. For patients with more than one transplant during 2000–2006, 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

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	587	2	Shrew
		4	Stoke
Bristol	572	1	Glouc
Camb	586	1	Norwch
		26	Stevng
Cardff	545	1	Swanse
Covnt	238	n/a	
L Barts	450	n/a	
L Guys	963	257	L Kings
L Rfree	500	2	Sthend
L St.G	360	4	Brightn
		190	Carsh
L West	509	n/a	
Leeds	773	20	Hull
Leic	352	n/a	
Liv RI	780	216	Prestn
		2	Wrexm
M RI	645	32	M Hope
Newc	584	11	Carlis
		18	Middlbr
		14	Sund
Nottm	245	3	Derby
Oxford	619	n/a	
Plymth	290	3	Truro
Ports	361	n/a	
Sheff	291	n/a	
Total	**10,250**	**807**	

n/a not applicable

post-transplant outcome. For the purpose of eGFR calculation, if there was a valid serum creatinine but no ethnicity data available, patients were classed as White.

Results and Discussion

Post-transplant eGFR in prevalent transplant patients

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 47.8 ml/min/1.73 m^2, with 16% of prevalent transplant recipients having an eGFR <30 ml/min/1.73 m^2. Whilst local repatriation policies on timing of transfer of care of patients with failing transplant 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 4v MDRD in estimating GFR $\geqslant 60$ ml/min/1.73 m^2 was poor and therefore a figure describing this is not included in this feature. Centres with a high prevalence of patients with eGFR <30 ml/min/1.73 m^2 were likely to expend 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 for the first time to more accurately compare outcomes in 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 the 53 centres included, it would be expected by chance that 2–3 centres would fall between the 2–3 standard deviation (sd) limit (1 in 20) (1 above and 1 below) and no centres should fall outside 3 sd limits.

These data show over dispersion with 13 centres within the 2–3 sd limits with 2 above (London Barts, Swansea) and 11 below. Swansea is known to receive late repatriation of transplant patients from the Cardiff

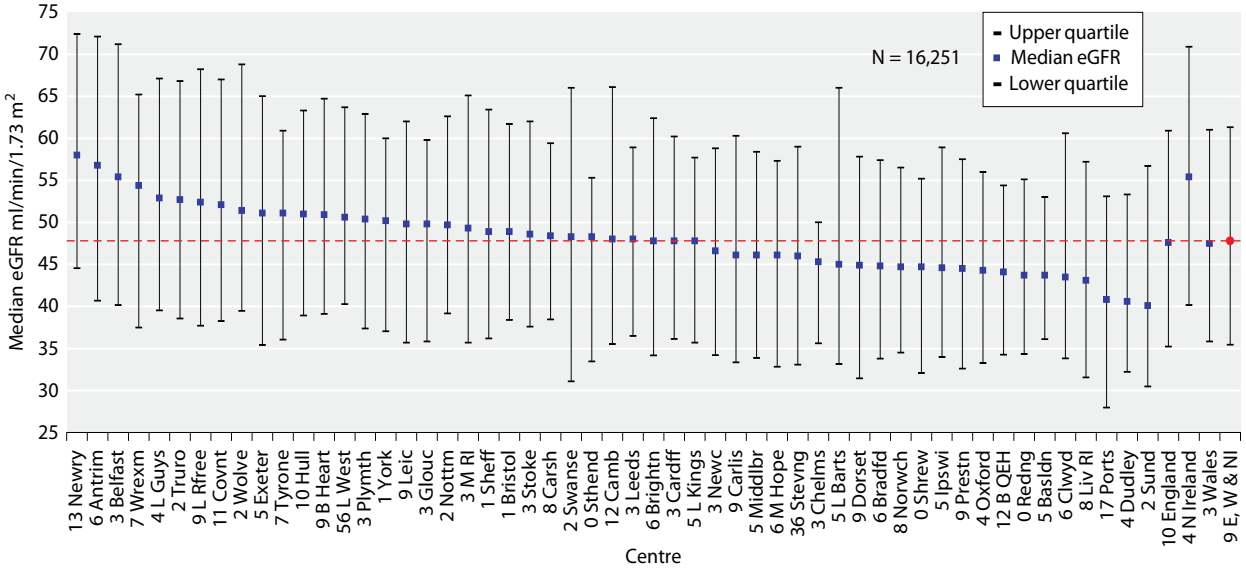

Fig. 5.2. Median eGFR in prevalent transplant patients by centre on 31/12/07

transplant centre only when grafts are failing so it is not unexpected for this centre to have a high proportion of patients with eGFR <30 ml/min/1.73 m^2.

There are 3 centres who fall outside the 3 sd limits with 2 above (Liverpool RI, Portsmouth) and 1 below (Carshalton). The 2 centres that fall outside the upper 99% CI (indicating a higher than expected proportion of patients with eGFR <30 ml/min/1.73 m^2), interestingly are both transplant centres.

eGFR in patients one year after transplantation

Graft function at one year post-transplantation may predict subsequent long term graft outcome. Table 5.12 shows the proportion of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2. Both patient level variables and centre practices will influence the efficiency of graft function at one year post-transplantation. Whilst it is outside the remit of this analysis to control for patient level variables, one year graft function remained one of the most important outcome variables in renal transplantation other than survival data. Figure 5.5 shows the median one year post-transplant eGFR for patients transplanted 2000–2006 was 49.4 ml/min/1.73 m^2.

There was a significant difference in one year post-transplant median eGFR between centres for patients

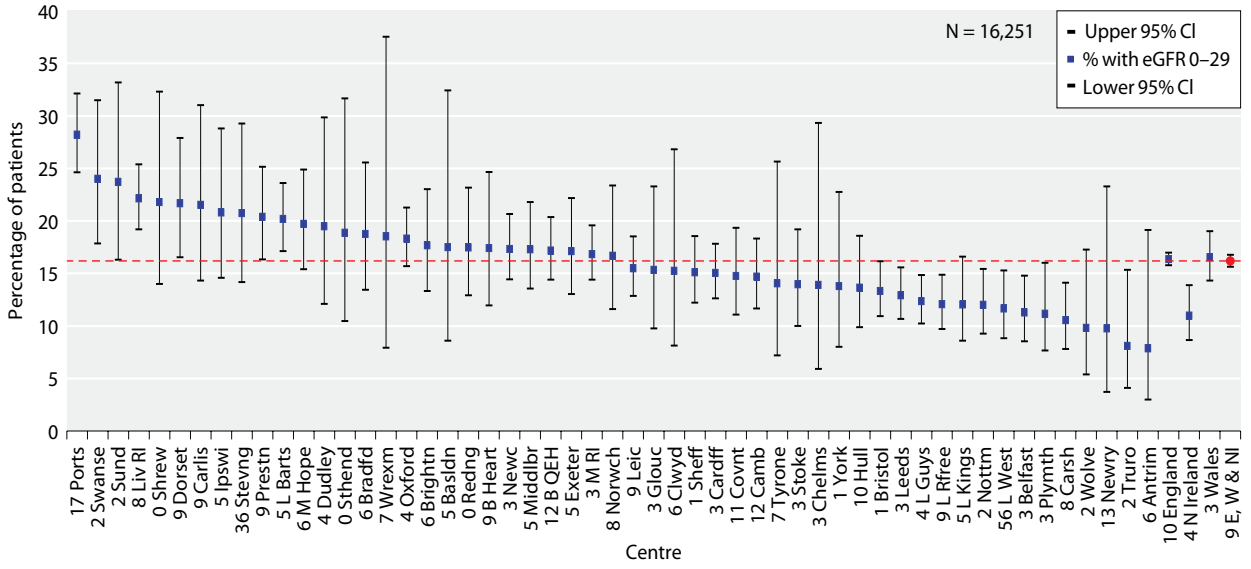

Fig. 5.3. Percentage of prevalent transplant patients by centre on 31/12/07 with eGFR <30 ml/min/1.73 m^2

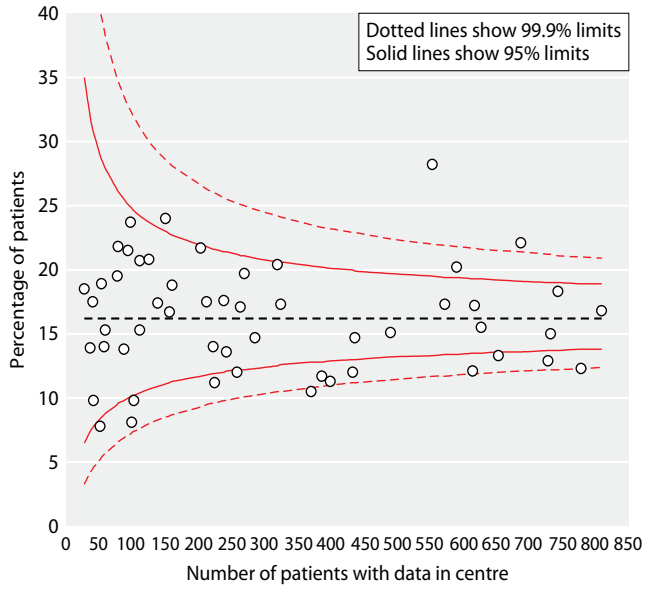

Fig. 5.4. Funnel plot of percentage of prevalent patients with eGFR <30 ml/min/1.73 m^2 by centre size on 31/12/07

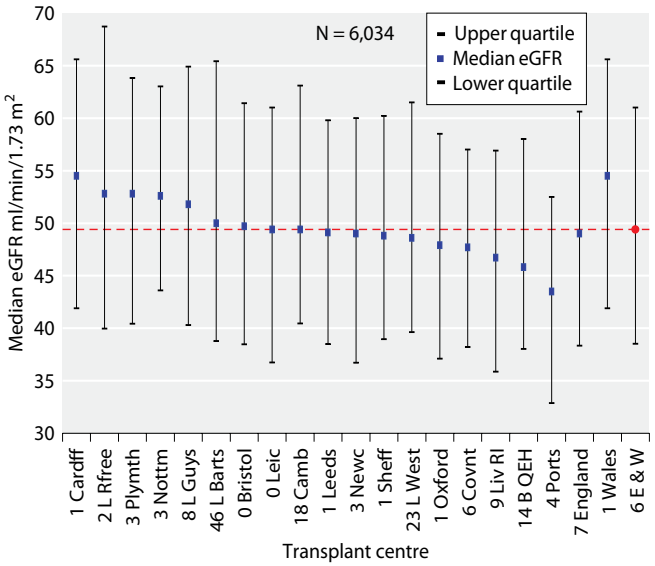

Fig. 5.5. Median eGFR one year post-transplant by transplant centre for patients transplanted between 2000–2006

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

Centre	Number of patients with eGFR data	Patients with eGFR <30 (%)	Centre	Number of patients with eGFR data	Patients with eGFR <30 (%)
Wrexm	27	18.5	Hull	242	13.6
Chelms	36	13.9	L Kings	258	12.0
Basldn	40	17.5	Exeter	263	17.1
Newry	41	9.8	M Hope	269	19.7
Antrim	51	7.8	Covnt	285	14.7
Sthend	53	18.9	Prestn	319	20.4
Tyrone	57	14.0	Middlbr	324	17.3
Clwyd	59	15.3	Carsh	370	10.5
Dudley	77	19.5	L West	386	11.7
Shrew	78	21.8	Belfast	399	11.3
York	87	13.8	Nottm	433	12.0
Carlis	93	21.5	Camb	436	14.7
Sund	97	23.7	Sheff	490	15.1
Truro	99	8.1	Ports	553	28.2
Wolve	102	9.8	Newc	572	17.3
Stevng	111	20.7	L Barts	590	20.2
Glouc	111	15.3	L Rfree	614	12.1
Ipswi	125	20.8	B QEH	617	17.2
B Heart	138	17.4	Leic	627	15.5
Swanse	150	24.0	Bristol	653	13.3
Norwch	156	16.7	Liv RI	687	22.1
Bradfd	160	18.8	Leeds	728	12.9
Dorset	203	21.7	Cardff	732	15.0
Redng	212	17.5	Oxford	743	18.3
Stoke	222	14.0	L Guys	778	12.3
Plymth	224	11.2	M RI	809	16.8
Brightn	238	17.6			

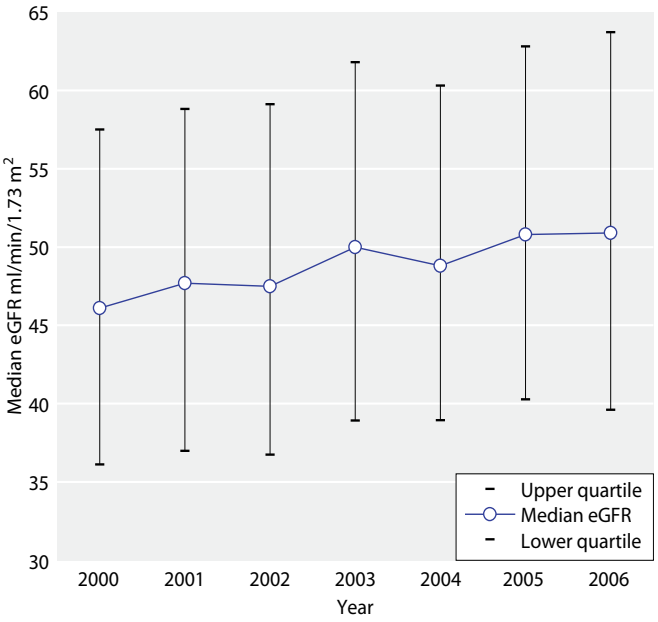

Fig. 5.6. Median eGFR one year post-transplant by year of transplantation 2000–2006

transplanted during the years 2000 to 2006 (Kruskal-Wallis $p < 0.0001$). This difference persisted even after the exclusion of Portsmouth which had the lowest median eGFR value in this analysis.

Regression analysis (least squares) indicated a small upward trend (+0.9 ml/min change in eGFR/year) in the one year post-transplant median eGFR between 2001 and 2006 (figure 5.6). 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 [2]. Therefore it may be possible to explain the slight upward trend seen in figure 5.6 solely on the basis of changing donor demographics in the UK. However, due to a number of patients with missing donor information in the years 2005 and 2006 this analysis is inconclusive. In conjunction with transplant data from NHSBT, the UKRR hope it will be possible to explore this further in next year's report. Amongst individual transplant centres, only two centres (Leicester and Portsmouth) did not demonstrate a positive slope in one year post-transplant eGFR (data not shown).

Haemoglobin in prevalent transplant patients

Transplant patients fall under the remit of the UK Renal Association chronic kidney disease (CKD) guidelines ***that all patients should have a haemoglobin concentration >10 g/dl.***

A number of factors including immunosuppressive medication, graft function, ACE inhibitors for BP control, erythropoietin (EPO) use, intravenous or oral iron use, as well as centre practices and protocols for management of anaemia, affect haemoglobin levels in transplant patients. Figure 5.7 shows the median haemoglobin from UK centres whilst figure 5.8 shows the percentage of transplant patients with a haemoglobin <10 g/dl. Centres with <20 patients or <50% completeness of haemoglobin data returns are not shown in these figures.

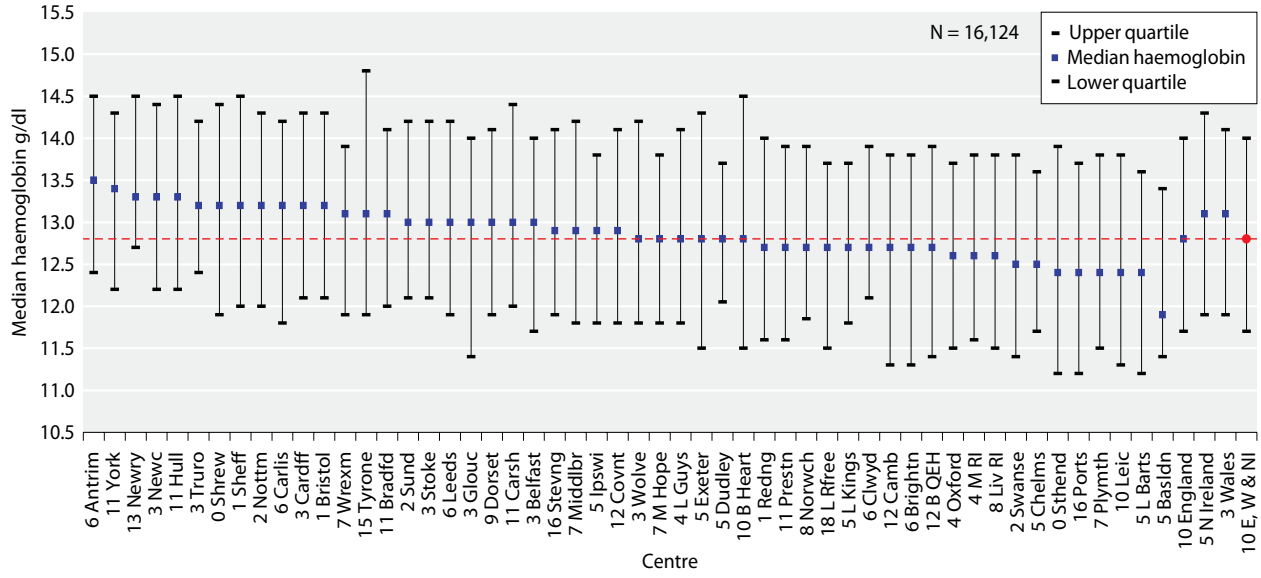

Fig. 5.7. Median haemoglobin for prevalent transplant patients by centre on 31/12/2007

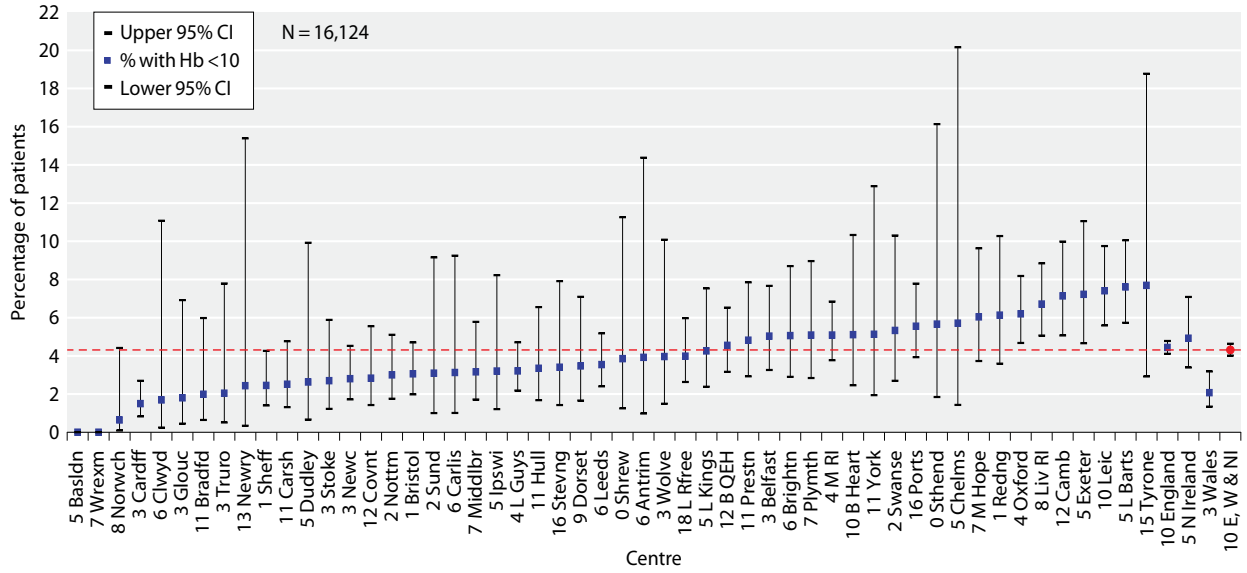

Fig. 5.8. Percentage of prevalent transplant patients by centre on 31/12/2007 with haemoglobin <10 g/dl

The percentage of prevalent transplant patients with a haemoglobin <10 g/dl were analysed using a funnel plot, the solid lines showing the 2 standard deviation limit (95% limits) and the dotted lines the limits for 3 standard deviations (99.9% limits). With over 50 centres included, it would be expected by chance that 2–3 centres would fall outside the 95% (1 in 20) confidence intervals (1 above and 1 below) and no centres outside 3 sd limits.

Figure 5.9 shows 5 centres between the 2–3 sd upper limits indicating a higher than predicted prevalence of anaemia amongst prevalent transplant patients in these centres and table 5.13 shows the data for these centres. Interestingly all 5 of these centres (Cambridge, London Barts, Leicester, Liverpool, Oxford) are transplant centres. Three centres fall between the lower 2–3 sd limits (Carshalton, Sheffield, Newcastle) and 4 centres below the 3 sd limits (Wrexham, Basildon, Norwich, Cardiff) possibly indicating better than expected management of anaemia.

Haemoglobin in patients one year post-transplantation

The median one year post-transplant haemoglobin continued to remain stable at 13.0 g/dl (figure 5.10).

Blood pressure in prevalent transplant patients

In the absence of controlled trial data, opinion based recommendation from the UK Renal Association (RA) states that ***BP targets for transplant patients should be similar to the targets for patients with CKD i.e. systolic BP <130 mmHg and diastolic BP <80 mmHg.***

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 (figure 5.11), diastolic (figure 5.12) and percentage of patients achieving RA targets (figure 5.13) are shown.

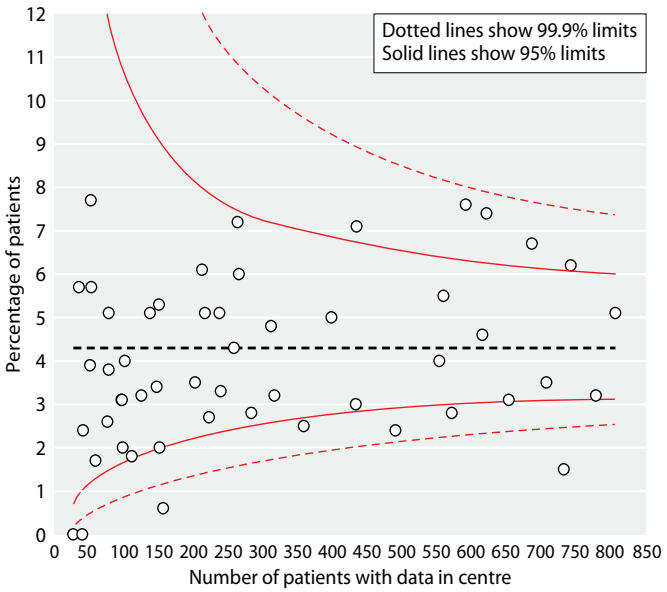

Fig. 5.9. Funnel plot of percentage of prevalent transplant patients with haemoglobin <10 g/dl by centre size on 31/12/2007

Table 5.13. Proportion of prevalent transplant patients with Hb <10 g/dl

Centre	Number of patients with Hb data	Patients with Hb <10 g/dl (%)	Centre	Number of patients with Hb data	Patients with Hb <10 g/dl (%)
Wrexm	27	0.0	Brightn	237	5.1
Chelms	35	5.7	Hull	239	3.3
Basldn	40	0.0	L Kings	258	4.3
Newry	41	2.4	Exeter	263	7.2
Antrim	51	3.9	M Hope	265	6.0
Tyrone	52	7.7	Covnt	283	2.8
Sthend	53	5.7	Prestn	311	4.8
Clwyd	59	1.7	Middlbr	316	3.2
Dudley	76	2.6	Carsh	358	2.5
York	78	5.1	Belfast	398	5.0
Shrew	78	3.8	Nottm	433	3.0
Carlis	96	3.1	Camb	434	7.1
Sund	97	3.1	Sheff	490	2.4
Truro	98	2.0	L Rfree	553	4.0
Wolve	101	4.0	Ports	559	5.5
Glouc	111	1.8	Newc	571	2.8
Ipswi	125	3.2	L Barts	591	7.6
B Heart	137	5.1	B QEH	615	4.6
Stevng	147	3.4	Leic	621	7.4
Swanse	150	5.3	Bristol	653	3.1
Bradfd	151	2.0	Liv RI	686	6.7
Norwch	156	0.6	Leeds	707	3.5
Dorset	202	3.5	Cardff	732	1.5
Redng	212	6.1	Oxford	742	6.2
Plymth	216	5.1	L Guys	778	3.2
Stoke	222	2.7	M RI	806	5.1

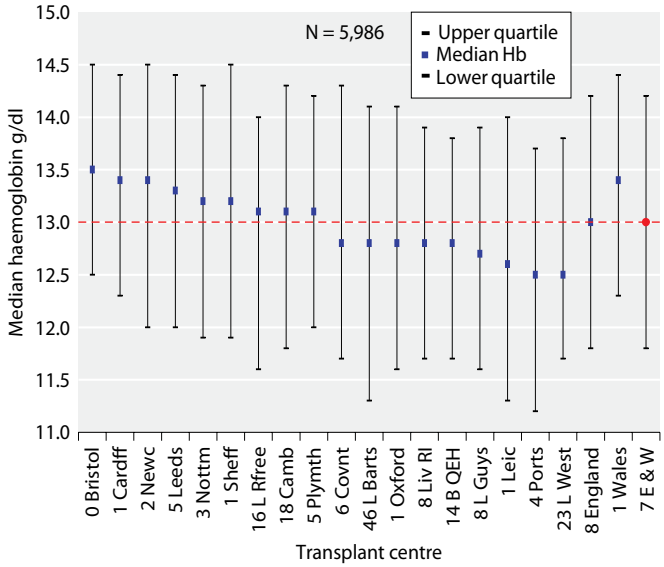

Fig. 5.10. Median haemoglobin one year post-transplant by transplant centre for transplant patients between 2000–2006

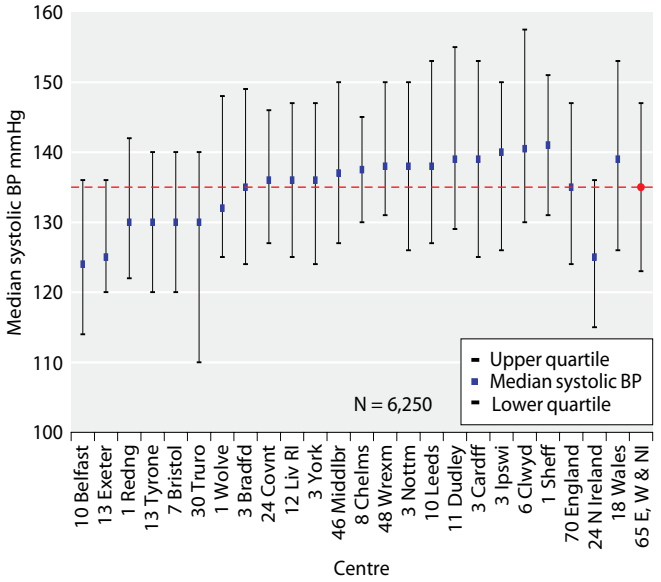

Fig. 5.11. Median systolic BP for prevalent transplant patients by centre on 31/12/2007

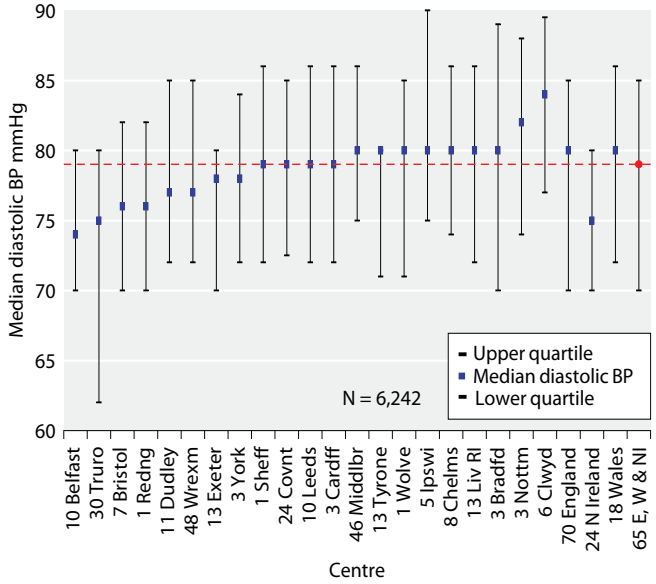

Fig. 5.12. Median diastolic BP for prevalent transplant patients by centre on 31/12/2007

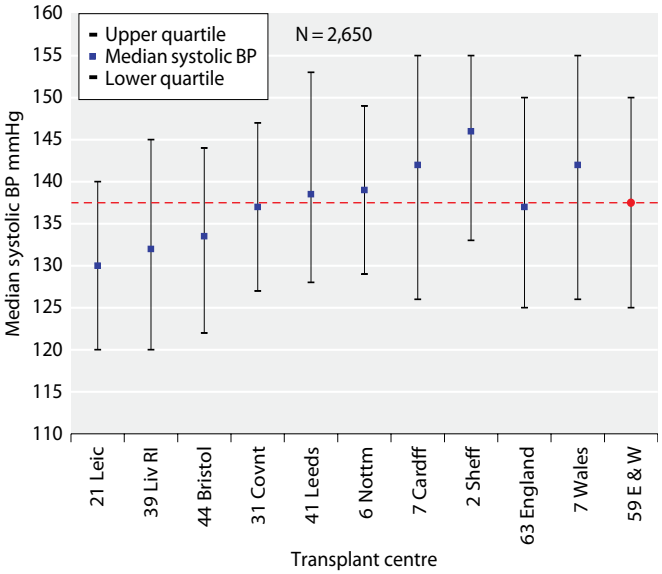

Fig. 5.14. Median systolic blood pressure one year post transplant for patients transplanted between 2000 and 2006

Blood pressure in patients one year after transplantation

Median systolic and diastolic blood pressure in patients one year after transplantation are shown in figures 5.14 and 5.15 respectively.

The current policy is to consider renal transplant recipients as a sub-group of the native kidney disease population and there is no current evidence to suggest otherwise that the knowledge gained from native kidney disease literature is not applicable to transplant recipients. Less than 30% of prevalent transplant patients across the UK achieved a BP of <130/80 mm Hg, 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 mm Hg in 41.6% of patients and the policies used to achieve this need to be investigated.

Cholesterol in transplant patients

UK guidelines pertaining to patients at risk of cardiovascular disease recommend a target total cholesterol of <5 mmol/L. In the absence of definitive evidence,

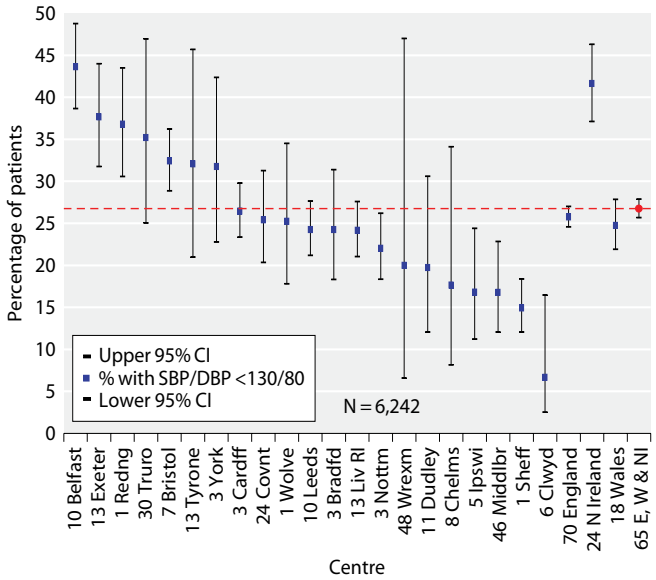

Fig. 5.13. Percentage of prevalent transplant patients by centre on 31/12/2007 achieving BP target of <130/80

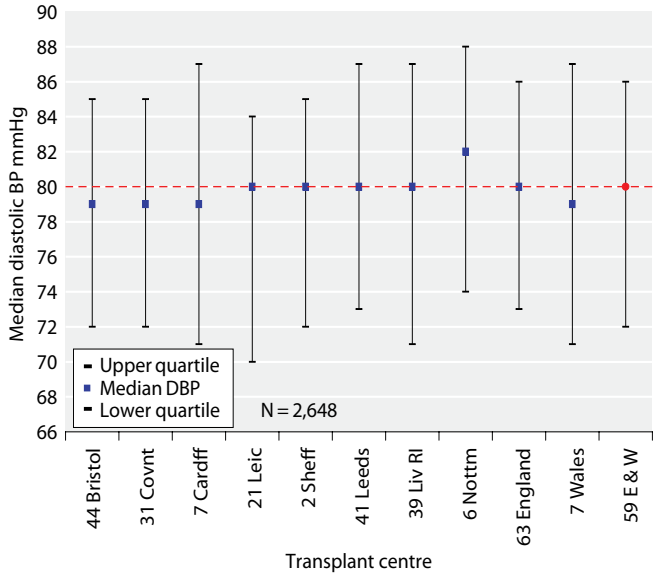

Fig. 5.15. Median diastolic blood pressure one year post transplant for patients transplanted between 2000 and 2006

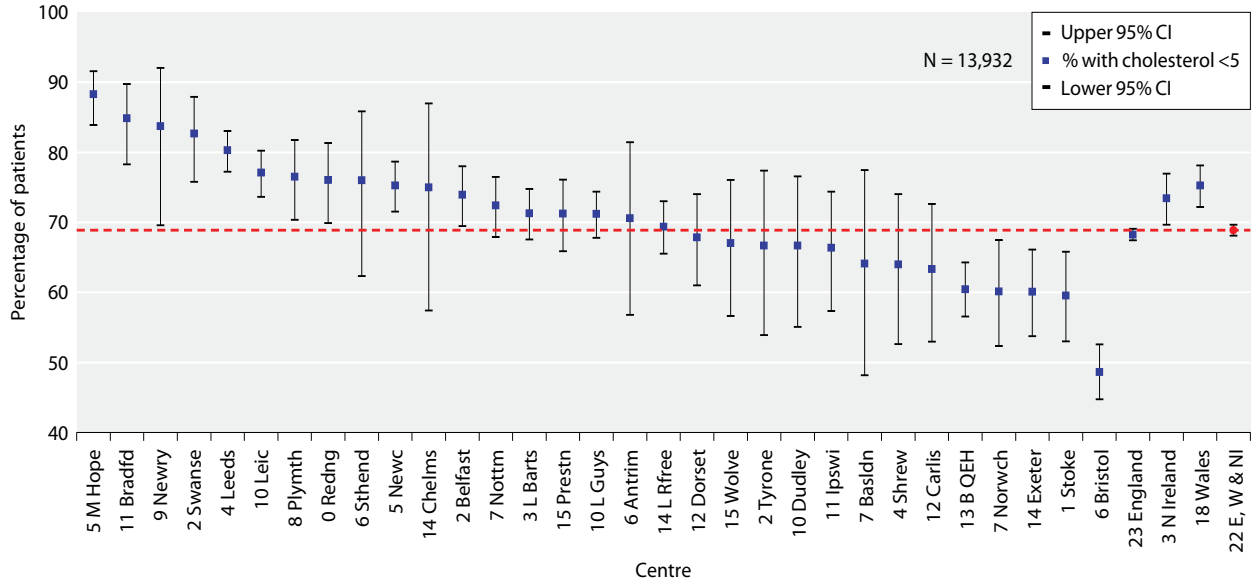

Fig. 5.16. Percentage of prevalent transplant patients by centre on 31/12/2007 achieving total cholesterol level of <5 mmol/L

opinion based RA recommendations suggest that transplant patients should be treated as having chronic kidney disease and hence at risk of cardio-vascular events and therefore by extension should achieve the same cholesterol levels.

The primary analysis of data from the ALERT study of fluvastatin in renal transplantation showed no difference in major cardiac events compared with placebo ($p = 0.139$) although secondary endpoints showed a 35 percent reduction in the cumulative incidence of cardiac death or first non-fatal MI ($p = 0.005$) [3, 4].

Analysis which included renal transplant function as a risk factor for cardiovascular disease and extending the 5 year study by 2 years suggested that patients with better control of hyperlipidaemia may suffer fewer adverse endpoints (major cardiac adverse events ($p < 0.0007$), cardiac death ($p < 0.00005$) and non-CV death ($p < 0.0005$), but not for stroke or non-fatal heart attack alone) compared to patients treated with placebo [5].

The percentage of prevalent transplant recipients achieving a cholesterol level <5 mmol/L by centre and median cholesterol level one year after transplantation are described in figures 5.16 and 5.17 respectively.

Bone metabolism in transplant patients

In the absence of definitive literature concerning evaluation and management of renal bone disease 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 widely accepted guidelines on target biochemical values concerning bone disease in transplant patients the chronic kidney disease audit measure has been adopted.

Serum phosphate

The percentage of prevalent patients achieving a phosphate level <1.8 mmol/L and the median phosphate in patients one year after transplantation are described in figures 5.18 and 5.19 respectively.

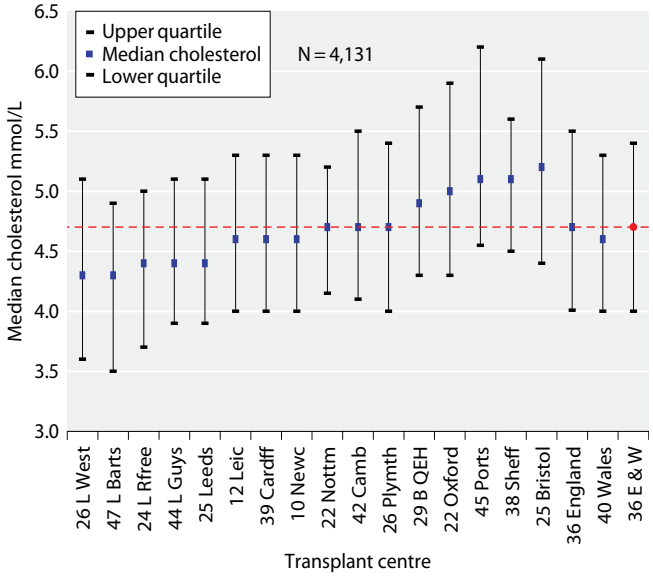

Fig. 5.17. Median total cholesterol one year post transplant for patients transplanted between 2000 and 2006

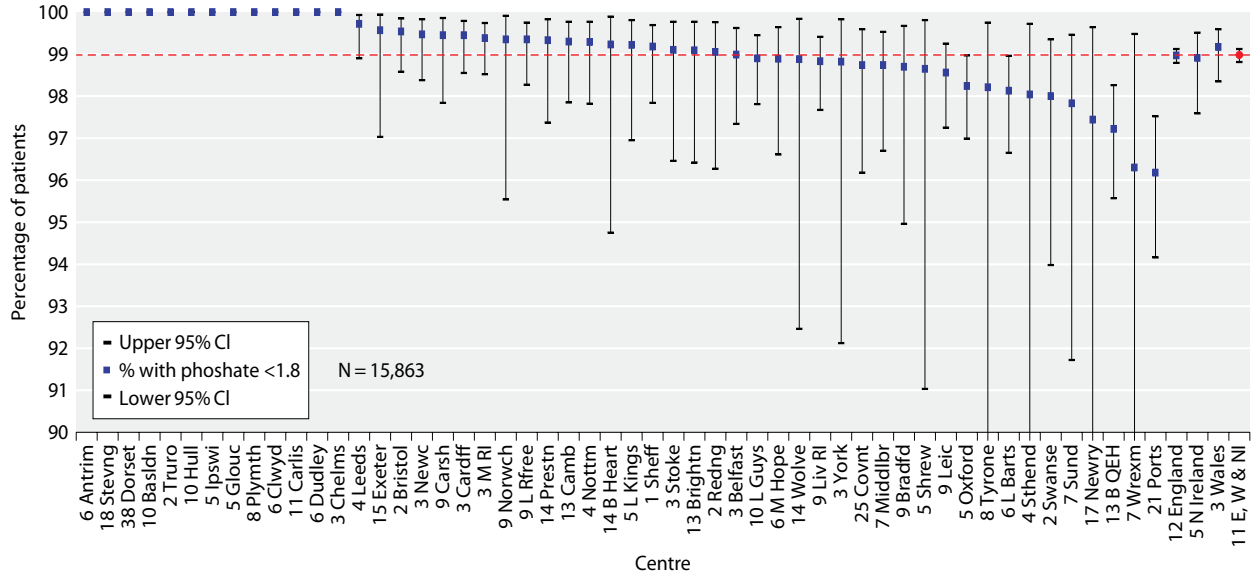

Fig. 5.18. Percentage of prevalent transplant patients by centre on 31/12/2007 with serum phosphate <1.8 mmol/L

With nearly 99% of prevalent patients achieving a phosphate level <1.8 mmol/L with achievement ranging from 96%–100%, this is probably not a useful clinical performance indicator and may also mask a more important problem of hypophosphataemia caused by phosphate loss post-transplantation.

Serum calcium

The percentage of prevalent transplant patients with a serum calcium level within the target range of 2.2–2.6 mmol/L and median serum calcium one year post-transplant are shown in figures 5.20 and 5.21.

The achievement of calcium within the Standard varied from 95% to 60%. It is possible that late repatriation of patients with failing grafts from transplant centres may result in some selective enrichment of non-transplanting renal centres with patients who were less likely to conform to target biochemical results. However, figure 5.20 shows both transplanting and non-transplanting renal centres are represented at both ends of the graph suggesting centre practices and possibly also laboratory measurement factors may be more relevant than repatriation policies in achieving target calcium levels in transplant patients.

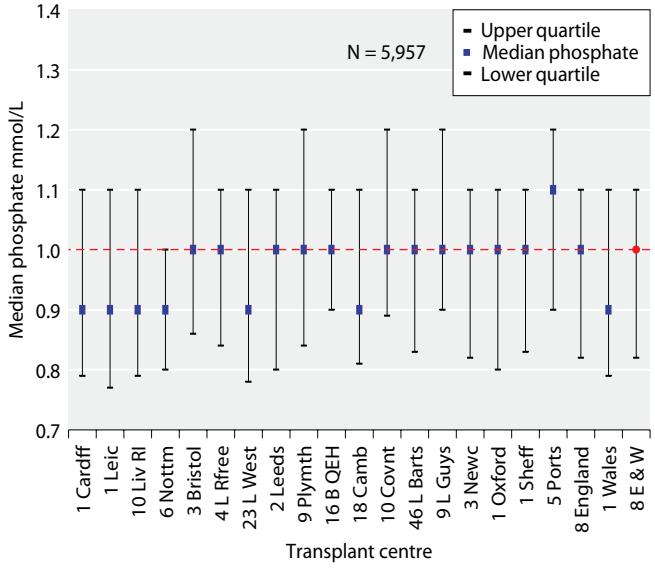

Fig. 5.19. Median serum phosphate one year post transplant for patients transplanted 2000–2006

Serum parathyroid hormone concentration

There are no definitive guidelines on the frequency with which serum iPTH should be measured in stable transplant recipients. Consequently there was very wide variability in data completeness across the UK with less than 50% of centres having iPTH measurements for the transplant patients under their care.

Analysis of data from 20 centres with measurements showed that over 50% of patients had an iPTH above the upper limit of normal (7–8 pmol/L) and the median iPTH was 10 pmol/L. The UK does not have a variable CKD stage related Standard compared with KDOQI, and more than 90% of patients achieved the target of <32 pmol/L (data not shown). However, given the extent of missing information extreme caution needs to be exercised when interpreting these data.

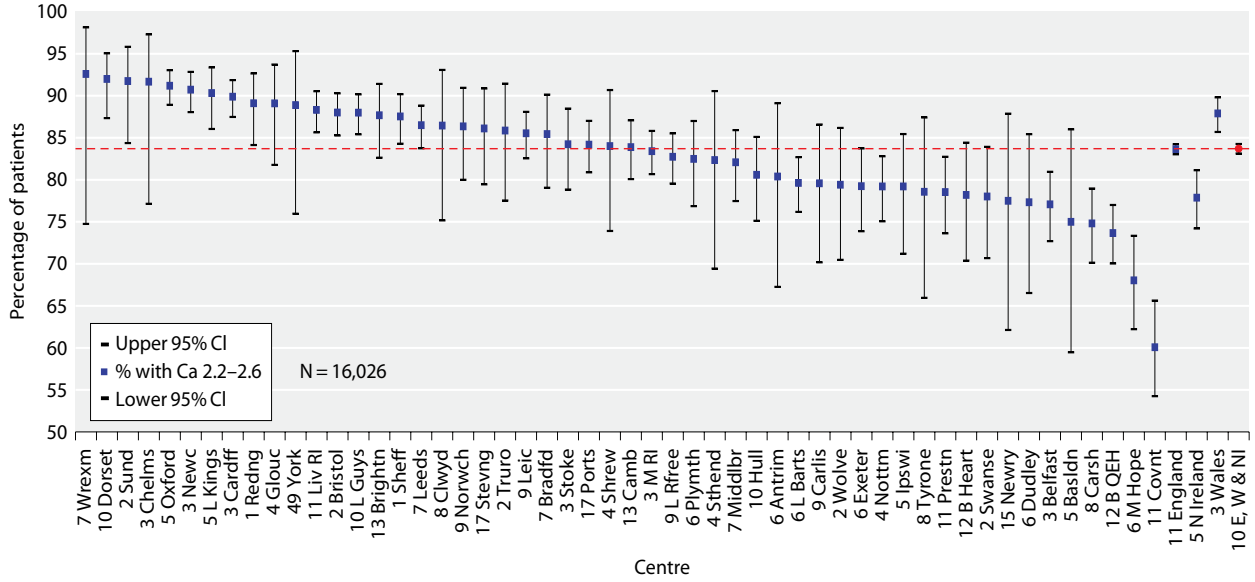

Figure 5.20. Percentage of prevalent renal transplant recipients by centre on 31/12/2007 with adjusted serum calcium between 2.2–2.6 mmol/L

Analysis of prevalent transplant patients by CKD stage

Introduction

About 3% of prevalent transplant patients returned to dialysis in 2007 and this was a similar percentage to the last 7 years. Patients presenting with native chronic kidney disease can have reasonable variability in timing of presentation to specialist care after disease initiation. This in turn can result in poorer outcomes as has been documented for late-presenters on dialysis therapies. Lack of specialist care resulting in lack of amelioration of modifiable risk factors like anaemia of CKD etc. is commonly quoted as the reason for poorer outcomes in late-presenters. 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.

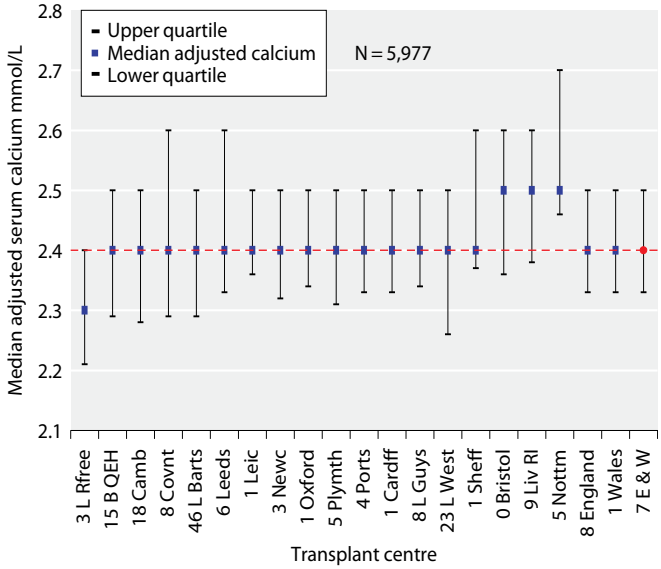

Fig. 5.21. Median adjusted serum calcium one year post transplant for patients transplanted 2000–2006

Methods

The transplant cohort consisted of prevalent transplant recipients as on 31/12/2007 (n = 16,469) and where 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 2006, comprised the comparison dialysis cohort (n = 16,252). This included 2,743 peritoneal dialysis patients. For both cohorts, the analysis used the most recent available value from the last two quarters of the 2007 laboratory data.

Results and Discussion

Table 5.14 shows that 16% of the prevalent transplant population, or nearly 2,600 patients, had moderate to advanced renal impairment of eGFR <30 mls/min/1.73 m^2. The table also demonstrates that patients with

Table 5.14. Analysis by CKD stage for prevalent transplant patients compared with prevalent dialysis patients

eGFR	Stage 1–2T (⩾60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D[a]
Number of patients	4,437	9,373	2,302	357	16,252
% of patients	26.9	56.9	14.0	2.2	
eGFR ml/min/1.73 m^2 [b]					
mean ± SD	74.5 ± 13.8	45.1 ± 8.3	23.9 ± 4.2	11.8 ± 2.5	
median	70.7	45.2	24.6	12.3	
Systolic BP mmHg					
mean ± SD	133.6 ± 17.9	136.3 ± 18.7	140.3 ± 20.1	142.3 ± 23.6	129.8 ± 24.4
% ⩾ 130	60.2	63.6	70.2	71.9	48.1
Diastolic BP mmHg					
mean ± SD	77.7 ± 10.4	78.2 ± 10.6	78.9 ± 11.3	79.3 ± 13.1	69.5 ± 14.1
% ⩾ 80	47.4	48.9	51.2	57.8	23.7
Cholesterol mmol/L					
mean ± SD	4.5 ± 1.0	4.6 ± 1.0	4.7 ± 1.2	4.5 ± 1.2	4.0 ± 1.1
% ⩾ 5	28.5	31.9	35.3	33.9	16.1
Haemoglobin g/dl					
mean ± SD	13.7 ± 1.5	12.8 ± 1.6	11.7 ± 1.5	10.9 ± 1.7	11.7 ± 1.5
% <10	1.2	2.9	12.7	26.3	12.5
Phosphate mmol/L[c]					
mean ± SD	1.0 ± 0.2	1.0 ± 0.2	1.2 ± 0.3	1.6 ± 0.4	1.6 ± 0.4
% ⩾ 1.8	0.1	0.2	2.4	26.9	28.1
Adjusted calcium mmol/L					
mean ± SD	2.4 ± 0.2	2.4 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.4 ± 0.2
% >2.6	7.5	7.4	5.3	5.6	7.9
% <2.2	7.8	8.2	14.9	25.8	18.4
iPTH pmol/L					
median	8.2	9.7	16.1	32.3	26.3
% ⩾ 32	3.9	5.4	21.5	50.4	42.7

[a] For stage 5D, prevalent dialysis patients in 2007 were excluded
[b] Prevalent transplant patients with no ethnicity data were classed as White
[c] Only PD patients included in stage 5D, n = 2,743

failing grafts do not achieve UK RA standards for key biochemical and clinical outcome variables with the same frequency as patients already on dialysis. This substantial group of patients represents a not inconsiderable challenge as resources need to be channelled not only to improve key outcome variables but also to achieve a safe and timely modality switch to another form of renal replacement therapy.

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. A more detailed discussion on causes of death in dialysis patients can be found in chapter 7.

Methods

The cause of death is sent in by renal centres as an EDTA-ERA code (appendix G). 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 Registry regarding cause of death, whilst others return no information. Provision of this information is not mandatory.

Adult patients aged 18 years and over, were included in the analyses on cause of death. Previous analysis was limited to data

Table 5.15. Cause of death by modality in prevalent RRT patients on 1/1/2007

	All modalities		Dialysis		Transplant	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	316	23	294	24	22	16
Cerebrovascular disease	67	5	57	5	10	7
Infection	252	18	223	18	29	21
Malignancy	118	9	89	7	29	21
Treatment withdrawal	179	13	173	14	6	4
Other	119	9	104	8	15	11
Uncertain	314	23	287	23	27	20
Total	**1,365**		**1,227**		**138**	
N with no cause of death data	2,296		1,948		348	

Table 5.16. Cause of death in prevalent transplant patients on 1/1/2007 by age

	All age groups		<55 years		⩾55 years	
Cause of death in transplanted patients	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	22	16	6	17	16	16
Cerebrovascular disease	10	7	1	3	9	9
Infection	29	21	7	19	22	22
Malignancy	29	21	8	22	21	21
Treatment withdrawal	6	4	2	6	4	4
Other	15	11	6	17	9	9
Uncertain	27	20	6	17	21	21
Total	**138**		**36**		**102**	
N with no cause of death data	348		100		248	

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. The analysis of prevalent patients included all patients receiving RRT on 1/1/2007.

Results and Discussion

Causes of death in prevalent RRT patients in 2007 by modality and age

Tables 5.15 and 5.16 and figure 5.22 show the differences in the causes of death between prevalent dialysis and transplant patients. These data are neither age adjusted nor adjusted for differences in the comorbidity between the 2 groups. As expected, cardiac disease as a cause of death is less common in the transplanted patients as these are a pre-selected low risk group of patients. Treatment withdrawal still occurs in the

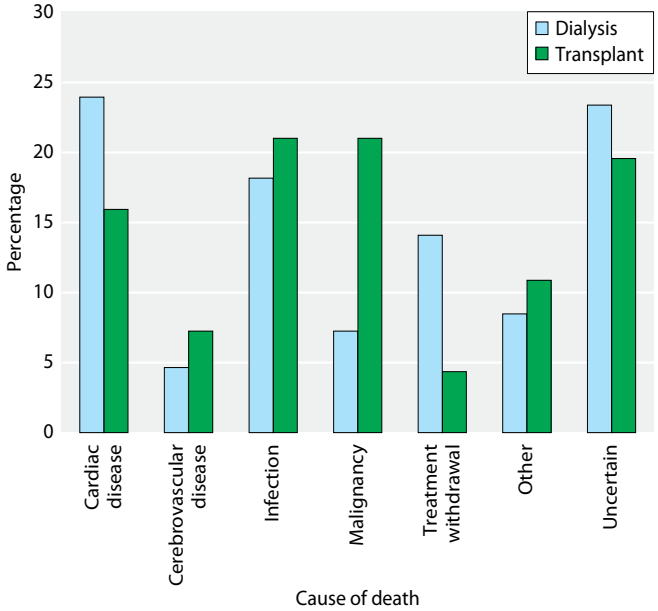

Fig. 5.22. Cause of death by modality for prevalent patients on 1/1/2007

transplanted group, in patients who choose not to restart dialysis when their renal transplant fails.

In Table 5.16, there were no differences in the causes of death between transplanted patients aged <55 or $\geqslant 55$ years with malignancy accounting for 21% of deaths with a functioning transplant in both age groups.

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: national and centre-specific analyses

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

Abstract
Introduction: The prevalence of 13 comorbid conditions and smoking status at the time of starting renal replacement therapy (RRT) in England, Wales and Northern Ireland are described. ***Methods:*** Adult patients starting RRT between 2002 and 2007 in centres reporting to the UK Renal Registry (UKRR) and with data on comorbidity (n = 13,293) were included. The association of comorbidity with patient demographics, treatment modality, haemoglobin, renal function at start of RRT and subsequent listing for kidney transplantation were studied. Association 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 data on comorbidity returned to the UKRR remained poor. Of patients with data, 52% had one or more comorbidities. Diabetes mellitus and ischaemic heart disease were the most common conditions seen in 28.9% and 22.5% of patients respectively. Comorbidities became more common with increasing age (up to the 65–74 age group), were more common amongst Whites and were associated with a lower likelihood of pre-emptive transplantation, a greater likelihood of starting on haemodialysis (rather than peritoneal dialysis) and a lower likelihood of being listed for kidney transplantation. In multivariable survival analysis, malignancy and ischaemic/neuropathic ulcers were the strongest predictors of poor survival at 1 year after 90 days from start of RRT. ***Conclusions:*** The majority of patients had at least one comorbid condition and comorbidity is an important predictor of early mortality on RRT.

Introduction

Recording and reporting of the extent of comorbidity amongst patients starting treatment for established renal failure (ERF) is important for a number of reasons.

1. Risk adjustment in reports of the outcomes of renal replacement therapy: comorbidity is associated with both early and long term mortality [1–11], poor quality of life [12, 13] and may also influence attainment of various clinical performance measures and choice of RRT modality [14]. Case mix adjustment is therefore essential to quality reporting as differences in patient populations that exist across centres may affect process and outcome measures.
2. Resource allocation: patients with significant comorbidity require more inpatient [15] and outpatient care [16] and their treatment costs more; information on comorbidity may therefore help policy-makers, commissioners and providers to plan services.
3. Management of individual patients: the National Kidney Foundation in the US and others have expanded clinical practice guidelines to include management of diabetes [17], dyslipidaemia [18] and cardiovascular disease [19] in patients with chronic kidney disease (CKD). It is therefore important as a first step, to document the presence of comorbid illness to facilitate attainment of these goals.
4. International comparisons: there are marked national and international variations in the number of patients per million population starting RRT with differences in the proportion of patients with diabetes mellitus and other comorbidities [20]. Comparisons of outcomes of ERF between countries require adjustment for the differences in comorbidities.

The prevalence of various comorbid conditions and smoking status at the time of starting RRT and the association of these comorbidities with patient demographics and early mortality are described in this chapter.

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 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

Study population

Incident adult (⩾18 years) RRT patients (n = 29,755) between 2002 and 2007 in the centres submitting data to the UKRR during these years were considered. Of these, patients who had data on comorbidity were included (n = 13,293; 44.6%). 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

In the 10th Annual Report [21], Ipswich and other centres using the Mediqal eMed system (all six centres in Northern Ireland, Basildon, Chelmsford, Dorset and Norwich) were excluded following discovery of an error in the data extraction software affecting some of these centres. This extraction error has now been rectified and these centres are included in this year's report. The nine centres in Scotland do not provide comorbidity data to the UKRR and are not included in these 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 elsewhere [22]. Complete data on comorbidity for a given patient was considered to have been provided if there was a non-missing entry (yes/no) for at least one of the comorbid conditions. For some analyses comorbidities have been collapsed into broader categories.

- '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.

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 the above four variables are combined under the term 'peripheral vascular disease')
Smoking
Malignancy

- '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). Ethnicity coding in these PAS systems is based on self-reported ethnicity and uses a different coding system [23]. For the remaining centres, 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, Chinese and Others. The details of regrouping of the PAS codes into the above ethnic categories are provided in appendix G.

Statistical methods

The statistical methods for the four individual sections of this chapter are described separately.

The number of patients with data on comorbidity and other data variables included in the various 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 $\geqslant$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 and renal function at start of RRT

The date of starting RRT and the date first seen by nephrologists were used to calculate the referral time. This was the number of days between first being seen and starting RRT. Referral times of 90 days or more were defined as early presentation. Referral times of less than 90 days were defined as late presentation. 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 = 5,633; 18.9% of all patients starting RRT).

The association of various comorbidities with haemoglobin (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 = 8,534; 28.7% of all patients starting RRT). Two-sample t-tests were used to compare the mean Hb at start of RRT amongst patients with a 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 [24]. For the purpose of eGFR calculation, patients who had missing ethnicity but a valid serum creatinine measurement were classed as Whites as the Black population only account for 3% 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 the 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 standard for a threshold eGFR at which patients should start RRT for ERF as the decision is based on clinical presentation, anticipated further deterioration and complications of uraemia as well as biochemistry. However, there are defined thresholds for pre-emptive listing for a kidney transplant. The European Best Practice Guidelines (EBPG) recommend that patients with progressive deterioration in renal function and a creatinine clearance of <15 ml/min/1.73 m^2 should be considered for pre-emptive transplantation; patients with ERF secondary to diabetes should

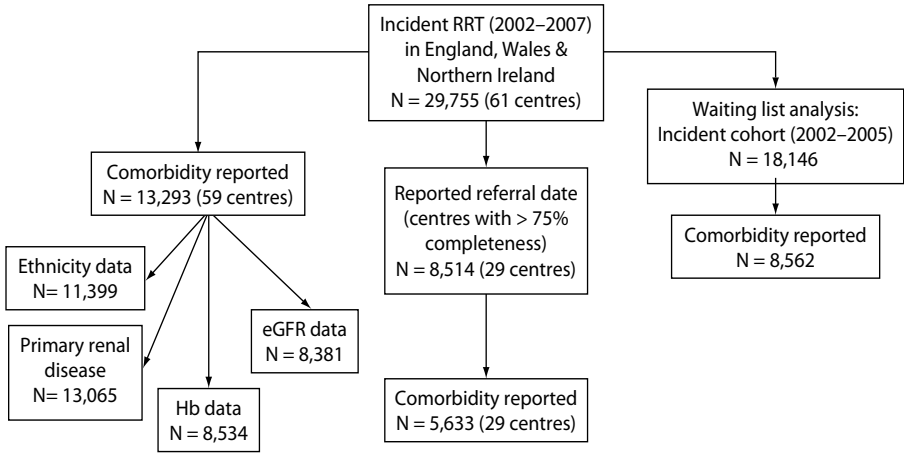

Fig. 6.1. Flow chart showing number of patients included in the various analyses

be considered for early and pre-emptive transplantation when their eGFR decreases to <20 ml/min/1.73 m^2 [25]. 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 [26]. 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. Patients with an eGFR >20 ml/min/1.73 m^2 were excluded from the eGFR analyses due to concerns on possible data extraction errors. Patients starting RRT between 2001 and 2005 from one centre (London West) were also excluded due to errors in the software data extraction process for this item. This extraction process was rectified in 2006. The eGFR analyses excluded 4,036 patients who had no data on eGFR within 14 days prior to start of RRT, 438 who had eGFR values >20 ml/min/1.73 m^2 and 438 patients from London West leaving 8,381 patients (28.2% of all patients starting RRT) in this 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 7.

3) Activation on deceased donor kidney transplant waiting list

The association between comorbidity and activation on the deceased donor kidney transplant waiting list in 8,562 patients was examined. Date of first activation on the waiting list for all patients starting RRT between 2002 and 2005 on the UKRR database were obtained from NHS Blood and Transplant (formerly UK Transplant), the independent organisation responsible for maintaining the national organ donor register. Data on activation on the waiting list for patients starting RRT in the year 2006 were not available at the time of writing and therefore this analysis was restricted to the years 2002 to 2005. All patients were followed until 31st December 2006 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 never activated. 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 who presented acutely and who were initially classified as acute renal failure requiring dialysis, but continued to require long-term dialysis can be re-classified by clinicians as having had ERF from the date of their first RRT. Many other national registries only collect data on patients who have survived the first 90 days of RRT. The UKRR, unlike these other registries, is able to collect and report data on factors affecting outcomes, including survival, in the first 90 days of RRT. However, the death rate is high in the first 90 days and highly 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 also 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 2002 and 30th September 2007 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 2002 and 30th September 2006.

For each variable, the models estimated the hazard ratio of death comparing those with a particular comorbidity with those who did not have the comorbidity. In the univariate 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 analysis. The multivariate Cox models used a backward stepwise method that included all variables and then sequentially removed the variable with the largest p value (i.e. the one which added least to the model); the procedure was continued until all remaining variables were significant contributors to the model. The variables included in the multivariate model 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, malignancy, claudication, ischaemic/neuropathic ulcers, angioplasty/vascular graft, amputation and smoking.

All statistical analyses were performed using SAS version 9.1.3.

Results

Completeness of comorbidity returns from each participating centre

Table 6.2 shows that completeness of data returns still varies markedly between centres with four centres providing data on 100% of patients but 20 providing data for less than 5% of their new patients in 2007. There was no relationship between the size of the centre and the completeness of data returns. Amongst all incident patients, data on comorbidity declined from 46.9% of patients starting in 2002 to only 40.0% in 2007 (table 6.3). However, this decline in data completeness in recent years was more marked in new centres joining the UKRR in the later years that had not yet set up systems to collect these data. The data completeness amongst centres that have been submitting data since 2002 has shown a smaller decline from 46.9% in 2002 to 44.6% in 2007. After excluding centres that returned no comorbidity data, the average completeness of data

Table 6.2. Completeness of comorbidity data returns on incident patients from individual centres (2002–2007)

	2002		2003		2004		2005		2006		2007	
Centre	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return
Antrim							42	5	33	9	36	14
B Heart	66	2	103	0	102	0	116	1	115	0	95	1
B QEH					194	0	196	1	186	0	222	0
Bangor	29	66	33	48	36	64	40	55	41	61	36	44
Basldn			53	45	46	39	28	57	45	82	39	74
Belfast							131	15	112	14	91	24
Bradfd	62	100	74	85	61	92	66	95	50	100	87	99
Brightn					118	0	109	0	131	1	115	1
Bristol	124	82	163	85	164	79	175	78	177	89	154	73
Camb	74	4	96	1	110	1	111	1	157	2	127	0
Cardff	181	1	166	3	186	5	182	20	207	4	207	0
Carlis	26	23	31	23	29	72	31	94	27	93	25	80
Carsh	172	23	198	27	165	36	180	42	184	47	196	57
Chelms					52	50	38	47	49	84	52	54
Clwyd	20	0	12	0	14	0	27	0	18	0	23	0
Covnt	94	1	75	1	76	0	83	0	102	2	109	0
Derby			59	75	67	81	71	92	69	88	60	95
Derry									3	67	7	43
Donc											18	100
Dorset			65	98	59	100	45	98	53	100	58	95
Dudley	25	8	41	0	54	0	38	0	44	2	35	0
Exeter	82	51	97	54	110	46	110	31	104	28	122	6
Glouc	54	67	53	87	53	89	60	97	73	88	57	96
Hull	105	5	81	88	109	86	126	97	98	97	99	98
Ipswi	43	53	38	45	45	47	59	31	42	60	40	30
L Barts					185	76	184	87	187	80	200	74
L Guys	141	2	93	3	104	3	132	5	134	3	150	2
L Kings	115	88	108	100	114	98	136	99	113	99	128	100
L Rfree							132	2	209	1	182	0
L St.G											89	58
L West	250	72	254	62	295	67	290	52	283	67	334	47
Leeds	152	86	185	86	175	83	164	70	181	66	117	66
Leic	153	88	167	96	162	94	223	64	241	65	240	70
Liv Ain					3	0	29	3	34	0	34	3
Liv RI	152	49	114	62	130	61	139	63	140	51	114	44
M Hope			143	33	111	41	112	35	129	12	99	9
M RI											159	0
Middlbr	111	100	103	0	102	1	84	0	105	0	98	0
Newc	102	1	94	3	109	0	113	3	110	1	111	1
Newry							28	14	14	21	15	27
Norwch					95	4	119	6	109	11	108	6
Nottm	87	99	115	98	107	95	145	99	135	97	127	76
Oxford	170	30	188	60	171	65	156	51	162	14	139	86
Plymth	79	32	64	27	62	44	58	45	91	60	76	67
Ports	145	49	141	63	118	65	151	60	173	56	157	54
Prestn	110	1	98	1	79	0	118	0	121	1	128	0
Redng	40	3	63	0	59	0	74	0	77	1	91	0
Sheff	156	63	159	64	168	55	157	40	168	57	166	52
Shrew					55	0	42	0	54	0	55	2
Stevng	100	2	122	3	84	5	91	4	118	0	86	2
Sthend	34	59	42	67	40	80	34	74	47	96	34	94
Stoke											87	44
Sund	56	48	55	64	50	92	58	91	56	91	61	100

Table 6.2. Continued

Centre	2002		2003		2004		2005		2006		2007	
	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return
Swanse	113	82	125	97	93	91	98	97	113	96	123	93
Truro	59	66	53	83	67	81	32	88	50	78	45	93
Tyrone							23	30	30	47	22	32
Ulster							9	56	8	63	14	100
Wirral	43	16	53	13	66	14	58	7	55	0	53	0
Wolve	98	100	88	100	105	98	92	85	87	60	68	47
Wrexm	42	0	32	3	29	0	40	0	26	0	27	0
York	63	81	57	84	48	92	43	91	47	89	35	74
Totals	**3,728**		**4,154**		**4,836**		**5,428**		**5,727**		**5,882**	

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

Table 6.3. Summary of completeness of incident patient comorbidity returns (2002–2007)

	Years						Combined years
	2002	2003	2004	2005	2006	2007	
Number of renal centres included	39	43	50	56	57	61	
Total number of new patients	3,728	4,154	4,836	5,428	5,727	5,882	29,755
Number of patients with comorbid data entries	1,749	2,120	2,338	2,355	2,381	2,350	13,293
Percentage	46.9	51.0	48.3	43.4	41.6	40.0	44.7
Percentage with comorbidity returns							
Median percentage amongst only centres returning >0% comorbidity	49.3	62.0	66.4	52.1	60.1	54.0	57.8

returns from centres ranged from 1–100% (mean 52.2%) for 2007, a moderate improvement on a mean of 46.0% in 2002.

As stated above, a return was considered to be 'complete' if there was at least one answer to the 14 questions on the comorbidity screen. However, most records that contained at least one answer contained answers to most or all of the other questions; only 0.7% had 10 or fewer questions answered, 1.0% contained 11 answers, 1.2% contained 12 answers, 7.5% contained 13 answers and 89.6% contained answers to all 14 questions.

Prevalence of multiple comorbidity

Of patients for whom comorbidity data were available, 52.4% had at least one comorbidity present and 26.3% had more than one comorbid condition (table 6.4).

Frequency of each comorbidity condition

Diabetes mellitus (either causing ERF or as a comorbidity) was present in 28.9% of all patients. Ischaemic heart disease was seen in 22.5% of all patients and as expected was more prevalent amongst those aged 65 years and above (32.1%) compared to those aged less than 65 years (13.4%). Peripheral vascular disease occurred in 11.3% of all patients being more common amongst those aged 65 years and above (15.0%) compared to those aged less than 65 years (7.8%). Table 6.5 gives the prevalence of each comorbidity and the percentage of the total number of incident patients for whom data was available for that item.

Table 6.4. Number of reported comorbidities in patients starting RRT, as a percentage of those for whom comorbidity data were available (2002–2007)

Number of comorbidities	0	1	2	3	4	5+
Percentage	47.6	26.2	13.0	7.1	3.7	2.5

Table 6.5. Frequency of each condition reported in incident RRT patients 2002–2007

Comorbidity	Age <65 years		Age ⩾65 years		p value*	% overall
	No. patients	(%)	No. patients	(%)		prevalence
Angina	581	(8.6)	1,434	(22.6)	<0.0001	15.3
MI in past 3 months	107	(1.6)	238	(3.7)	<0.0001	2.6
MI >3 months ago	391	(5.7)	987	(15.5)	<0.0001	10.4
CABG/angioplasty	333	(4.9)	565	(8.9)	<0.0001	6.9
Cerebrovascular disease	396	(5.8)	891	(14.0)	<0.0001	9.8
Diabetes (not cause of ERF)	331	(4.9)	682	(10.8)	<0.0001	7.8
Diabetes as primary disease	1,671	(24.4)	1,162	(18.1)	<0.0001	21.3
COPD	265	(3.9)	620	(9.8)	<0.0001	6.8
Liver disease	195	(2.9)	114	(1.8)	<0.0001	2.3
Malignancy	417	(6.1)	1,089	(17.0)	<0.0001	11.4
Claudication	301	(4.4)	705	(11.1)	<0.0001	7.6
Ischaemic/neuropathic ulcers	224	(3.3)	184	(2.9)	0.2	3.1
Angioplasty/vascular graft	111	(1.6)	319	(5.0)	<0.0001	3.3
Amputation	153	(2.3)	88	(1.4)	0.0002	1.8
Smoking	1,112	(17.7)	740	(12.3)	<0.0001	15.1
Some comorbidity present	2,811	(41.0)	4,159	(64.7)	<0.0001	52.4

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

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 patients with levelling off or slight reductions in reported comorbidity amongst patients aged over 75 years.

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 compared to the ethnic minorities. Figure 6.5 shows that the lower prevalence of comorbidity amongst patients of Black or South Asian origin is not entirely attributable to younger age amongst these groups, as the prevalence of comorbidity was lower than in the White population even in the 18–34 year age group. Table 6.6 shows the prevalence of major comorbidities in each group. Compared

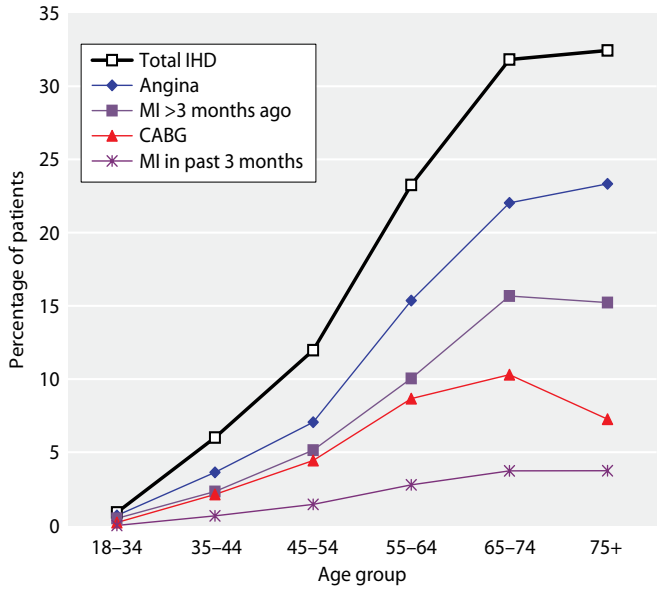

Fig. 6.2. Prevalence of ischaemic heart disease amongst incident patients 2002–2007 by age at start of RRT

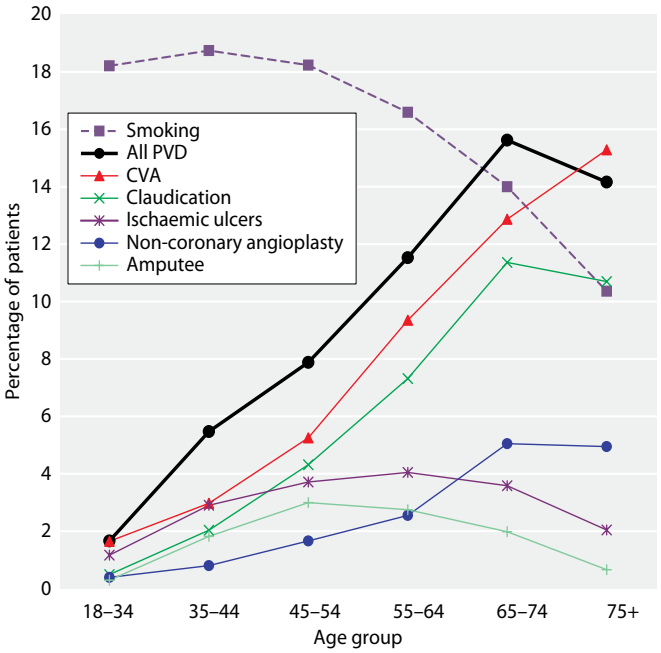

Fig. 6.3. Prevalence of non coronary vascular disease amongst incident patients 2002–2007 by age at start of RRT

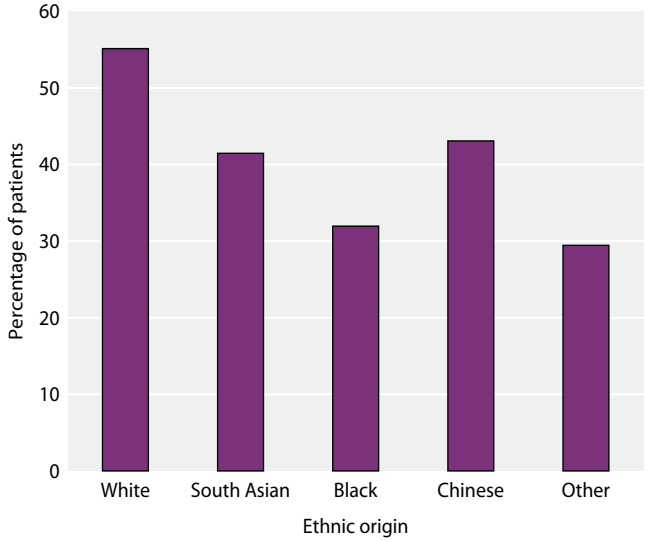

Fig. 6.4. Presence of comorbid conditions by ethnic origin at the start of RRT amongst patients starting RRT 2002–2007

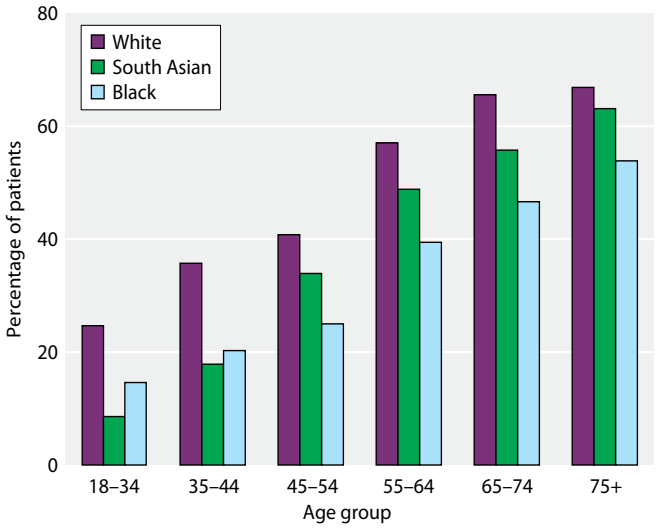

Fig. 6.5. Percentage of patients with comorbidity by ethnic origin in each age group at the start of RRT (2002–2007)

to Whites, Blacks and South Asians had lower prevalence of most comorbid conditions (with the exception of liver disease and diabetes mellitus).

Prevalence of comorbidity amongst patients with diabetes mellitus

Only 13,065 patients (43.9% of all patients starting RRT) who had data on comorbidity and primary renal disease were included in this analysis. Table 6.7 compares comorbidity amongst patients with and without diabetes (either as primary renal disease or comorbidity) who had at least one other comorbidity present, showing higher rates of ischaemic heart disease, cerebrovascular disease and peripheral vascular disease amongst diabetic patients.

Haemoglobin concentration at the time of starting RRT and comorbidity

The mean Hb prior to starting RRT in patients who were recorded as starting without any comorbidity present is 10.2 g/dl compared to 10.1 g/dl for those with some comorbidity. Of patients without any co-morbidity 55.7% achieved an Hb >10 g/dl compared to 52.8% with some comorbidity. Compared to those without any comorbidity, the mean Hb concentrations

Table 6.6. Prevalence of comorbidities amongst incident patients starting RRT 2002–2007 by ethnic group, as percentages of the total number of patients in that ethnic group for whom comorbidity data were available

	Patients with comorbidity										
	White		South Asian		Black		Chinese		Other		
Comorbidity	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	p value*
Smoking	1,452	(16.6)	52	(5.8)	32	(5.7)	4	(7.3)	14	(6.3)	<0.0001
Cerebrovascular disease	923	(10.0)	92	(8.6)	56	(8.6)	9	(14.3)	20	(6.5)	0.08
Peripheral vascular disease	1,105	(12.0)	83	(7.8)	28	(4.3)	7	(11.1)	23	(7.5)	<0.0001
Ischaemic heart disease	2,143	(23.4)	244	(23.4)	60	(9.3)	9	(14.5)	36	(11.9)	<0.0001
Liver disease	197	(2.1)	39	(3.7)	21	(3.2)	7	(10.9)	5	(1.6)	<0.0001
COPD	690	(7.5)	42	(4.0)	15	(2.3)	1	(1.6)	9	(2.9)	<0.0001
Malignancy	1,170	(12.6)	26	(2.4)	39	(6.0)	2	(3.2)	16	(5.2)	<0.0001
Diabetes of either category	2,419	(26.0)	525	(49.0)	227	(34.6)	18	(27.7)	121	(39.2)	<0.0001
Diabetes (not cause of ERF)	700	(7.7)	97	(9.4)	32	(4.9)	3	(4.8)	22	(7.2)	0.02
Diabetes as primary disease	1,719	(18.5)	428	(40.0)	195	(29.7)	15	(23.1)	99	(32.0)	<0.0001

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

Table 6.7. Patients with and without diabetes (either as primary diagnosis or comorbidity) that have other comorbid conditions

	Non-diabetic patients		Diabetic patients		
Comorbidity	N	(%)	N	(%)	p value*
Ischaemic heart disease	1,648	(18.2)	1,214	(32.2)	<0.0001
Smoking	1,281	(15.1)	524	(15.0)	0.9
Malignancy	1,178	(13.0)	279	(7.3)	<0.0001
Cerebrovascular disease	734	(8.1)	527	(13.8)	<0.0001
Peripheral vascular disease	657	(7.3)	794	(20.8)	<0.0001
COPD	612	(6.8)	254	(6.7)	0.9
Liver disease	204	(2.3)	97	(2.5)	0.3

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

at the start of RRT were lower amongst those with malignancy (10.1 g/dl, $p = 0.005$), a history of claudication (10.0 g/dl, $p = 0.005$), ischaemic/neuropathic ulcers (9.8 g/dl, $p = 0.0002$) and amputation (9.8 g/dl, $p = 0.001$).

Late presentation (referral) and comorbidity

Table 6.8 shows the prevalence of various comorbidities by referral time. Peripheral vascular disease was more frequent amongst those who presented earlier than later; malignancy was more frequent amongst those presenting later than earlier. There was no association between time of presentation and any other comorbidity.

Renal function at the time of starting RRT and comorbidity

The geometric mean eGFR prior to starting RRT in patients with each of the individual comorbidities is shown in table 6.9. The (geometric) mean eGFR prior to starting RRT in patients who were recorded as starting without any comorbidity present was 7.4 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

Amongst all patients with data on comorbidity, 2.2% started RRT with a pre-emptive transplant. The proportion of patients aged less than 65 years who had at least one comorbidity was 42% amongst those who started with either HD or PD compared to 17% amongst patients who had a pre-emptive transplant (Fischer's exact test, $p < 0.0001$). The number of pre-emptive transplants was too small to undertake comparisons for individual comorbidities.

The median age of all patients with comorbidity data on HD at the start of RRT was 66.3 years compared with 59.2 years for those starting PD (Kruskal Wallis test, $p < 0.0001$). For each of the comorbid conditions except for recent MI within 3 months prior

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

	Late referral		Early referral		
Comorbidity	N	(%)	N	(%)	p value*
Cerebrovascular disease	152	(10.6)	436	(10.4)	0.9
COPD	105	(7.3)	270	(6.5)	0.3
Diabetes (not a cause of ERF)	111	(7.8)	352	(8.6)	0.4
Ischaemic heart disease	332	(23.2)	1,010	(24.4)	0.4
Liver disease	35	(2.4)	82	(2.0)	0.3
Malignancy	263	(18.2)	424	(10.1)	<0.0001
Peripheral vascular disease	142	(9.9)	549	(13.1)	0.001
Smoking	222	(16.2)	646	(15.9)	0.8

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

Table 6.9. eGFR within 2 weeks prior to the reported start of RRT (2002–2007) by comorbidity

Comorbidity	eGFR geometric mean (ml/min/1.73 m^2)	eGFR 95% CI	p value*
Without comorbidity	7.4	7.3–7.5	Ref
Some comorbidity present	8.2	8.1–8.2	<0.0001
Angina	8.6	8.4–8.7	<0.0001
MI in past 3 months	8.5	8.1–8.9	<0.0001
MI >3 months ago	8.6	8.4–8.8	<0.0001
CABG/angioplasty	8.9	8.7–9.2	<0.0001
Cerebrovascular disease	8.3	8.1–8.5	<0.0001
Diabetes (not cause of ERF)	8.4	8.2–8.6	<0.0001
Diabetes as primary disease	8.5	8.4–8.7	<0.0001
Diabetes of either category	8.5	8.4–8.6	<0.0001
COPD	8.3	8.1–8.6	<0.0001
Liver disease	8.0	7.6–8.6	0.006
Malignancy	7.7	7.5–7.9	0.002
Claudication	8.6	8.4–8.8	<0.0001
Ischaemic/neuropathic ulcers	8.6	8.3–9.0	<0.0001
Angioplasty/vascular graft	8.6	8.3–9.0	<0.0001
Amputation	8.8	8.3–9.3	<0.0001
Smoking	8.1	8.0–8.3	<0.0001

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

to starting RRT, the median age of patients on HD was higher than those on PD (Table 6.10). Table 6.10 compares the prevalence of individual comorbidities in patients on HD and PD at the start of RRT, showing significantly higher prevalence amongst HD patients of all comorbid conditions other than previous CABG/coronary angioplasty. The percentages shown are out of the total population of patients on that modality at the start of RRT with data for that comorbidity.

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

Table 6.11 shows that patients starting dialysis as their first RRT modality and who were activated on the TWL

Table 6.10. Patients with comorbid conditions present in incident patients starting HD and PD 2002–2007

	HD			PD			
Comorbidity	N	(%)	Median age	N	(%)	Median age	p value*
Angina	1,635	(17.0)	71.8	370	(11.6)	68.3	<0.0001
MI >3 months ago	1,081	(11.2)	71.4	292	(9.1)	69.1	0.001
MI in past 3 months	302	(3.1)	70.3	43	(1.3)	70.6	<0.0001
CABG/angioplasty	663	(6.9)	69.1	227	(7.1)	67.7	0.8
Cerebrovascular disease	1,069	(11.0)	71.4	214	(6.7)	66.8	<0.0001
Diabetes (not cause of ERF)	842	(8.9)	70.6	166	(5.2)	67.0	<0.0001
COPD	761	(8.0)	71.2	122	(3.8)	66.9	<0.0001
Smoking	1,439	(15.9)	62.0	386	(13.0)	55.2	0.0001
Liver disease	267	(2.8)	60.1	38	(1.2)	58.2	<0.0001
Malignancy	1,290	(13.3)	72.0	208	(6.5)	70.0	<0.0001
Claudication	832	(8.6)	71.0	172	(5.4)	67.1	<0.0001
Ischaemic/neuropathic ulcers	353	(3.6)	64.1	54	(1.7)	61.4	<0.0001
Angioplasty/vascular graft	348	(3.6)	71.8	79	(2.5)	70.8	0.002
Amputation	202	(2.1)	61.9	38	(1.2)	56.7	0.001

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

Table 6.11. Comorbidity amongst incident patients 2002–2005 who were activated on the transplant waiting list within the first year compared to those who were not activated within the first year of 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	1,300	(19.4)	71.3	58	(3.5)	56.6	<0.0001
MI >3 months ago	857	(12.7)	70.9	28	(1.7)	56.7	<0.0001
MI in past 3 months	219	(3.2)	70.3	8	(0.5)	56.0	<0.0001
CABG/angioplasty	513	(7.7)	69.0	35	(2.2)	58.3	<0.0001
Cerebrovascular disease	791	(11.7)	71.5	47	(2.8)	57.9	<0.0001
Diabetes (not cause of ERF)	584	(8.8)	71.0	32	(2.0)	54.4	<0.0001
COPD	541	(8.1)	71.5	31	(1.9)	56.7	<0.0001
Smoking	1,044	(16.6)	64.8	217	(14.1)	43.3	0.02
Liver disease	170	(2.5)	62.1	15	(0.9)	55.0	<0.0001
Malignancy	957	(14.2)	71.9	30	(1.8)	57.4	<0.0001
Claudication	679	(10.1)	70.3	20	(1.2)	49.2	<0.0001
Ischaemic/neuropathic ulcers	246	(3.7)	64.1	12	(0.7)	47.1	<0.0001
Angioplasty/vascular graft	275	(4.1)	71.3	7	(0.4)	47.6	<0.0001
Amputation	126	(1.9)	58.9	5	(0.3)	51.7	<0.0001

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

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.

Comorbidity and survival within 90 days of starting RRT

On univariate analysis stratified for age, most comorbidities were 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 table 6.12 and table 6.13 respectively. Comorbidities when present in younger patients were a more important pointer to earlier death than when present in older patients. Diabetes did not emerge as an independent predictor, probably due to the close association between diabetes and ischaemic heart disease and peripheral vascular disease. Some comorbidities may appear not to be associated with an increased risk 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 or over).

Comorbidity and survival 1 year after 90 days of commencing RRT

Multivariable analyses using the stepwise Cox proportional hazards model and stratified by age group (<65 and ⩾65) are shown in table 6.14 and table 6.15

Table 6.12. Multivariate Cox proportional hazards model for predictors of death within the first 90 days of starting RRT during 01/01/02–30/09/07 amongst patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	5.5	3.5–8.5	<0.0001
Liver disease	5.0	2.7–9.1	<0.0001
Amputation	3.8	1.8–8.1	0.000
Angina	1.9	1.2–3.2	0.009
Age (per 10 yrs)	1.4	1.2–1.8	0.001

Table 6.13. Multivariate Cox proportional hazards model for predictors of death within the first 90 days of starting RRT during 01/01/02–30/09/07 amongst patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
MI in past 3 months	1.8	1.3–2.7	0.002
Ischaemic/neuropathic ulcers	1.6	1.0–2.6	0.031
Malignancy	1.6	1.2–2.0	0.000
Age (per 10 yrs)	1.5	1.3–1.7	<0.0001
COPD	1.5	1.1–1.9	0.006
MI >3 months ago	1.4	1.1–1.8	0.006
Angina	1.3	1.0–1.7	0.019

Table 6.14. Multivariate Cox proportional hazards model for predictors of death in the first year after completion of 90 days of starting RRT during 01/01/02–30/09/06 amongst patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	4.4	3.3–6.0	<0.0001
Ischaemic/neuropathic ulcers	2.1	1.3–3.5	0.002
Diabetes of either category	1.9	1.5–2.5	<0.0001
Amputation	1.8	1.1–3.1	0.032
COPD	1.6	1.0–2.5	0.037
Age (per 10 yrs)	1.4	1.2–1.6	<0.0001

respectively. Malignancy and ischaemic/neuropathic ulcers were the strongest predictors of death in the first year after completion of 90 days of starting RRT amongst those aged less than 65 years. Recent MI was no longer significantly associated with an increased risk of death, possibly because the prognostic importance of this marker is time-dependent and so would not be any more powerful a predictor than other markers of atherosclerotic vascular disease a year later.

Discussion

Data completeness remained poor in many centres. Unlike many data items that are transferred electronically from the local laboratory systems to the renal IT systems, the recording of comorbidity on the renal IT system requires clinical staff to be motivated to record these data, preferably at the point of care and at the time of starting RRT. It is possible that the introduction in England of a system of tariff-based payment by results might act to encourage clinicians to improve the systematic recording of comorbidity. The approval of the national renal dataset will make reporting of these items mandatory (http://www.ic.nhs.uk/services/datasets/dataset-list/renal). Furthermore, the publication, from 2006 onwards, of de-anonymised survival statistics for each centre and demonstrating the centre effect on survival of adjusting for these comorbidities [27] may provide some stimulus to clinical directors to improve collection of comorbidity data. The UKRR is also exploring the possibility of linking to the Hospital Episode Statistics dataset within the Secondary Uses Service (http://www.connectingforhealth.nhs.uk/), which would provide an alternative way of sourcing some of these data from inpatient diagnosis discharge codes, along the lines of the approach used by the United States Renal Data System.

Another 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 from which the centre draws its patients, 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 [28, 29]. 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.

These analyses demonstrate that comorbidities are common amongst UK patients starting RRT, with over 52% of patients with comorbidity data having at least one recorded comorbidity. Diabetes mellitus (either causing ERF or as a comorbidity) was the most common condition seen in 28.9% of patients compared to 52.2% reported in the USA [30]. Ischaemic heart disease was seen in 22.5% of all patients and this proportion was similar to that reported in the USA [30]. The prevalence of most comorbid conditions increased with increasing age up to 65–74 age group and the levelling off or slight reductions in reported comorbidity amongst patients aged over 75 years may reflect a 'healthy survivor effect' or decisions made by nephrologists and/or patients aged over 75 years with cardiovascular comorbidity not to embark on RRT.

Comorbidities were more prevalent amongst patients with diabetes mellitus; but non-Whites, who had more diabetes, had lower prevalence of most other comorbid conditions compared to Whites. This may once again reflect a 'healthy survivor effect' in that non-White

Table 6.15. Multivariate Cox proportional hazards model for predictors of death in the first year after completion of 90 days of starting RRT during 01/01/02–30/09/06 amongst patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
Ischaemic/neuropathic ulcers	2.0	1.5–2.9	<0.0001
Liver disease	1.9	1.2–2.9	0.005
Age (per 10 yrs)	1.7	1.5–1.9	<0.0001
Malignancy	1.6	1.3–1.9	<0.0001
Angina	1.6	1.3–1.8	<0.0001
COPD	1.5	1.2–1.9	0.000
Cerebrovascular disease	1.3	1.1–1.5	0.01
CABG/angioplasty	0.7	0.5–0.9	0.008

patients with significant comorbidity die prematurely before reaching ERF as suggested by a recent study [31]. The lower prevalence of comorbidity amongst those healthy survivors reaching ERF also explains some of the survival advantage on RRT reported amongst non-Whites compared to Whites [32, 33]. This survival advantage in Blacks is still seen after adjusting for comorbidity and one new theory is that this group of patients has demonstrated a more rapid decline through the stages of CKD (resulting in lead time CKD bias) and start RRT with a reduced arteriosclerotic load when compared with the White population.

In these analyses, patients with comorbidity started RRT at a higher eGFR compared to patients without comorbidity and this could suggest that patients with more comorbidity tend to be advised to start dialysis earlier or become symptomatic of their kidney failure earlier compared to those without comorbidity. Previous reports had suggested that an earlier start may be associated with better survival [34, 35]. However, Traynor *et al.* have subsequently shown that the better survival associated with earlier start could be due to lead time bias [36]. More recent studies have shown that greater kidney function at the start of RRT was associated with poor survival [37, 38] and this could be partly explained by high prevalence of comorbidity amongst those starting RRT at a higher GFR. Another study however reported that earlier start was associated with poor survival even after adjusting for comorbidity [39].

Late presentation for nephrology services and RRT commencement is reducing and the insight from this analysis is perhaps relevant. In the report covering a similar analysis for the years 1999–2004 there were some centres included who had sent incorrect comorbidity data returns [40]. The corrected data has been re-analysed for these years (data not shown) and there has been little change in the pattern of comorbidity with late presentation. Malignancy remained as the condition with the largest absolute difference in prevalence between early (10.1%) and late presentation (18.2%). A further analysis of the type of malignant diseases would be useful to better understand this. Peripheral vascular disease remained more common in those presenting earlier.

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 nephrologists, nurses 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 that adversely affect the ability of patients to perform PD exchanges or to tolerate large volumes of dialysate in the peritoneum could have favoured the choice of HD in these patients. Some centres in the UK are starting to provide assisted PD (by a carer) which may alter this patient distribution in future.

The proportion of patients who subsequently get activated on the deceased donor transplant waiting list and receive a transplant was 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.

The analyses also demonstrate that comorbidity was associated with increased mortality in patients on RRT in the UK. This is consistent with the findings of many other studies elsewhere using a variety of comorbidity scores [1–11]. The prevalence and severity of comorbidity increases with time on RRT and this change in comorbidity over time has been reported to be associated with mortality [3]. The UKRR, in addition to collecting baseline comorbidity data, is therefore hoping to stimulate collection of annual comorbidity data on RRT patients. Further research using baseline and annual comorbidity is needed to develop risk scores to predict mortality on RRT. The development of these risk scores would help clinicians to provide prognostic advice to patients and guide them in making decisions on initiation of RRT and when assessing patients for a kidney transplant.

Renal registries are an integral part of national quality control processes and provide a tool for benchmarking of clinical outcomes. Adequate case mix adjustment is essential in order to compare survival and other intermediate outcomes amongst patients on RRT within and between countries. Currently such an exercise is not feasible due to differences in definitions of comorbidity, poor data completeness and variation in methods

of data collection between registries. Standardised data collection methods, including those for recording comorbid conditions and their severity, have long been recognised as important and are central to the EU-funded QUEST initiative of the ERA-EDTA Registry [41]. The UKRR is currently undertaking a collaborative study with other registries such as the USRDS, ANZDATA and CORR to identify and share good practice in the collection of comorbidity data between these four registries with a view to improving data completeness rates for countries already collecting such data and giving guidance to those considering doing so.

Conflict of interest: none

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Chapter 7
Survival and causes of death of UK adult patients on Renal Replacement Therapy in 2007: national and centre-specific analyses

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Key Words
Cause of death · Comorbidity · Dialysis · ESRD · ESRF · 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 dialysis population reported to the Registry, including the 21% who started on PD and the 5% who received a pre-emptive transplant. Survival of prevalent patients and changes in survival between 1997–2006 are reported. The article includes a discussion on the technical definition for the date of start of both PD and HD. ***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 during 2006) was calculated with and without a 90 day RRT start cut off. Survival of incident patients is shown 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 2006 unadjusted 1 year after 90 day survival for patients starting RRT was 86%. In incident 18–64 year olds the unadjusted 1 year survival had risen from 85.9% in 1997 to 91.5% in 2006 and for those aged $\geqslant$65 it had risen from 63.8% to 72.9%. The age adjusted survival of prevalent dialysis patients rose from 85% in 2000 to 89% in 2007. Diabetic patient survival rose from 76.6% in 2000 to 84.0% in 2007. The relative risk of death on RRT compared with the general population was 30 at age 30 years compared with 3 at age 80 years. In the prevalent RRT dialysis population, cardiovascular disease accounted for 34% of deaths, infection 20% and treatment withdrawal 14%. ***Conclusions:*** Incident and prevalent 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.

This year some analyses on causes of death are included within this chapter.

Introduction

The analyses presented in this chapter examine survival both from the start of renal replacement therapy (RRT) and of prevalent patients. They encompass the outcomes from the total incident UK dialysis population reported to the UK Renal Registry (UKRR), including the 21% who started on peritoneal dialysis and also the 5% who received a pre-emptive transplant. These results therefore show a true reflection of the whole UK RRT population. Additionally, 1st year UK survival data included patients who had died within the first 90 days of starting RRT, a period excluded from most other countries' registry data.

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 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.

In the UKRR 2006 Report, with the agreement of all UK clinical directors, centre anonymity for survival analyses was removed. It is again stressed that these are raw data which require very cautious interpretation. The UKRR 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 (e.g. 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 changes in estimates of survival rates by centre after adjusting for age, primary renal diagnosis and comorbidity. It is hoped this will encourage all centres to allocate the resources to return the comorbidity data.

Despite the uncertainty about any apparent differences in outcome for centres which appear to be outliers, the UKRR will follow the clinical governance procedures as set out in chapter 2.

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 accounting for the characteristics of the members of that 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 age was chosen because it was approximately the average age of patients starting RRT 10 years ago at the start of the Registry's data collection. The average age of patients commencing RRT in the UK in 2006 was approximately 65 years, but the Registry has maintained age adjustment to 60 years for comparability with previous years' analyses. All analyses were undertaken using SAS v 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. Ongoing 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. This concern will not 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.

The variability in the date decided as the start of PD is attributable to the lack of an agreed national or international definition. Clinical staff may use the date the PD catheter was inserted, the date of the first dialysis exchange, the date training started or the date of discharge home on daily PD. This variability between centres may lead to a small lead time survival bias, but is a critical date when analysing the influence of biochemical variables in the period prior to starting PD on longer term outcomes.

The UK Renal Association PD Working Group has now agreed a preliminary clinical definition:

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 contrasts with an exchange solely for confirming or maintaining catheter patency. In general, exchanges which are part of PD training should be considered as the start of PD. However, if it is not planned that the patient starts therapy at that time, several exchanges as part of training need not necessarily be considered the start of dialysis.

A similar problem has also been highlighted with the biochemistry data of patients starting haemodialysis. Investigation of patient level data from renal clinical IT systems has shown that some patients have had several episodes of haemodialysis (sometimes even a week or more apart) in the weeks prior to that defined in the IT system as the start date of RRT. This may only have been for fluid overload, but has resulted in significant sustained improvements in the patients' biochemistry.

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 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. However, this has relied on clinicians retrospectively assigning the date of first RRT in patients who present acutely but do not recover, and it has become clear that this is not a uniform practice, with other clinicians recording the date on which the patient first started outpatient dialysis, or the date on which it was decided to plan for long-term RRT. The 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, other such patients may not be managed by nephrologists or may be categorised as 'acute renal failure' on the timeline screen which the extraction software uses to flag a patient's data for extraction and submission to the UKRR. These variations have highlighted the need for clearer instructions to UK nephrologists on how to classify such patients.

Due to this variability between countries, in many instances in this chapter survival from day 90 onwards is also reported as this allows comparison with many other registries, including the US, which mainly record data from day 90 onwards. Although the USRDS 2008 data is now reporting on survival data from day 0, their initial reporting of a lower rate of death which then increases throughout the first 90 day period probably indicates the 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 preemptive transplant. Censoring excluded 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 origin are likely to have a healthier dialysis population, because South Asian patients are less likely to undergo early transplantation.

The take-on population in any specific year included patients who recovered from established renal failure (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 take-on population for that centre and were counted at the centre on which they started RRT. Patients restarting dialysis after a failed transplant were also excluded (unless they started RRT in that current 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 2006 was calculated for those who had all been followed for 1 full year through 2006 and 2007 (e.g. patients starting RRT on 1st December 2006 were followed through to 30th November 2007). The 2007 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 2006, 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 2005 rather than 2006 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 will now use the previous year's data (2006 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 2003 to 2006 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 100 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 transferred out) 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 2002 to 2006. For the 5 years combined, 8 centres had returned >85% of comorbidity data for patients. Adjustment was first performed to a mean age of 60 years, then to the average primary diagnosis mix for all the eight centres. The individual centre data were then further adjusted for average comorbidity mix 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 2007 were included in this analysis. 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 uncensored results have been quoted throughout the prevalent analyses.

Methodology of causes of death

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

Cardiac disease
Cerebrovascular disease
Infection
Malignancy
Treatment withdrawal
Other
Uncertain

Some centres had high 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 2002–2006. 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 1/1/2007. The death rate was calculated for the UK general population (data from 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 1/1/2007.

Results of incident (new RRT) patient survival

The 2006 cohort included 6,311 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)

Table 7.1. Summary of the exclusions from the incident cohorts

	Cohort year				
	2006	2005	2004	2003	2002
All incident patients	6,322	6,060	5,411	4,755	4,284
Exclusion category (1)	−1	−1	−4	−3	−2
Exclusion category (2)	−6	−5	−2	−5	−1
Exclusion category (3)	−4	−10	−14	−11	−19
Remaining incident cohort	6,311	6,044	5,391	4,736	4,262
Died within 90 days of start	−460	−475	−484	−449	−428
Lost within 90 days of start	−29	−15	−30	−15	−12
Centres not contributing to UKRR	−25	−13	−16	−23	−18
Cohort at 1yr after 90 days	5,797	5,541	4,861	4,249	3,804
Deaths at one year after 90 days	786	821	777	653	680

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

Table 7.2. One-year patient survival (from day 0–365), patients aged 18–54, 2006 cohort

First treatment	Standard primary renal disease	All primary renal diseases except diabetes
All Dialysis %	95.7	94.8
95% CI	*94.1–96.8*	*93.4–95.8*
HD %	93.9	93.2
95% CI	*91.8–95.5*	*91.4–94.6*
PD %	99.1	98.5
95% CI	*97.1–99.7*	*96.7–99.3*

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) (appendix G); 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.

Between country

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 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 was no significant difference in 90 day survival between UK countries ($p = 0.8$), although the 1 year after 90 day survival differed significantly ($p = <0.0001$, Chi Squared). The greater prevalence of cardiovascular disease in Wales and Scotland compared with England may account for these differences.

Table 7.4. One-year after day 90 survival by first established treatment modality (adjusted to age 60)

Year	Adjusted 1 year after 90 days % *95% CI*	
	HD	PD
2006	87.2	94.1
	86.0–88.3	*92.8–95.5*
2005	85.8	93.2
	84.6–87.1	*91.8–94.6*
2004	85.5	90.4
	84.2–86.8	*88.7–92.1*
2003	85.0	92.3
	84.1–86.9	*90.7–93.9*
2002	83.9	90.2
	82.3–85.4	*88.3–92.1*

Modality

The age-adjusted one year survival estimates on HD and PD were 87.2% and 94.1% respectively which both showed a trend in improvement in survival from 2002 (table 7.4). There appeared to be better one year survival on PD compared with HD after age adjustment, similar to findings from the USRDS and Australasian (ANZDATA) registries. However, a straightforward comparison of the modalities in this way is misleading, given that in general, PD is used in younger patients and those with less severe 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 eight 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 to be expected there was also a steep age related decline in survival over all time periods (see also figures 7.1 and 7.2).

If the survival data in tables 7.8 to 7.10 are calculated from day 90 (1 year after day 90 survival, 2 year after day 90 survival, etc) the survival in all cases increased by an

Table 7.3. Incident patient percentage survival across the UK countries, combined 2 year cohort (2005–2006), adjusted to age 60

	England	N Ireland	Scotland	Wales	UK
% 90 day	95.0	94.9	94.3	94.1	94.9
95% CI	*94.5–95.5*	*93.2–96.6*	*93.2–95.5*	*92.7–95.4*	*94.4–95.3*
% 1 year after 90 days	89.0	90.8	85.2	86.6	88.6
95% CI	*88.3–89.7*	*88.3–93.3*	*83.2–87.2*	*84.4–88.9*	*87.9–89.2*

Table 7.5. Unadjusted 90 day survival of new patients, 2006 cohort, by age

Age	KM* survival (%)	KM 95% CI	N
18–64	97.2	96.6–97.7	3,165
⩾65	88.1	87.0–89.2	3,145
All ages	92.7	92.0–93.3	6,310

* KM Kaplan–Meier.

Table 7.6. Unadjusted 1 year after day 90 survival of new patients, 2006 cohort, by age

Age	KM survival (%)	KM 95% CI	N
18–64	92.4	91.4–93.3	3,044
⩾65	79.0	77.4–80.5	2,753
All ages	86.0	85.1–86.9	5,797

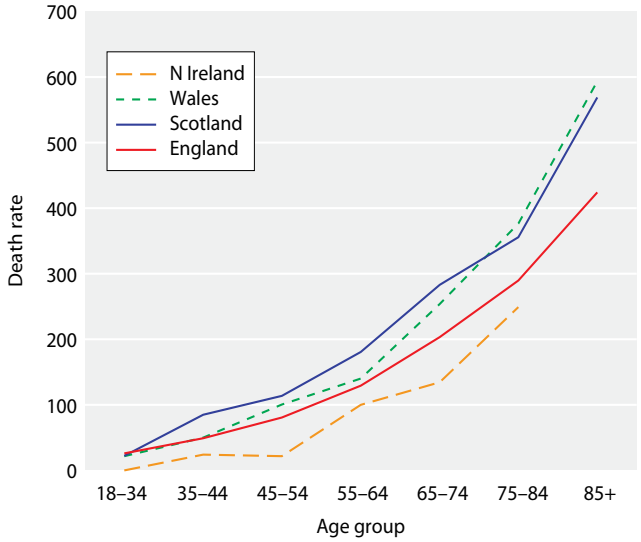

Fig. 7.2. One year after 90 days death rate per 1,000 patients years by UK country and age group for incident patients, 2003–2006 cohort

additional 3–4% across both age bands. These are the results most comparable to the figures quoted by the USRDS from the USA [3] and most other national registries, see chapter 14.

There was a curvilinear increase in death rate per 1,000 patient years with age, shown in figure 7.2 for 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 last year 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. To demonstrate this difference in outcome between these two methods, figure 7.3a is

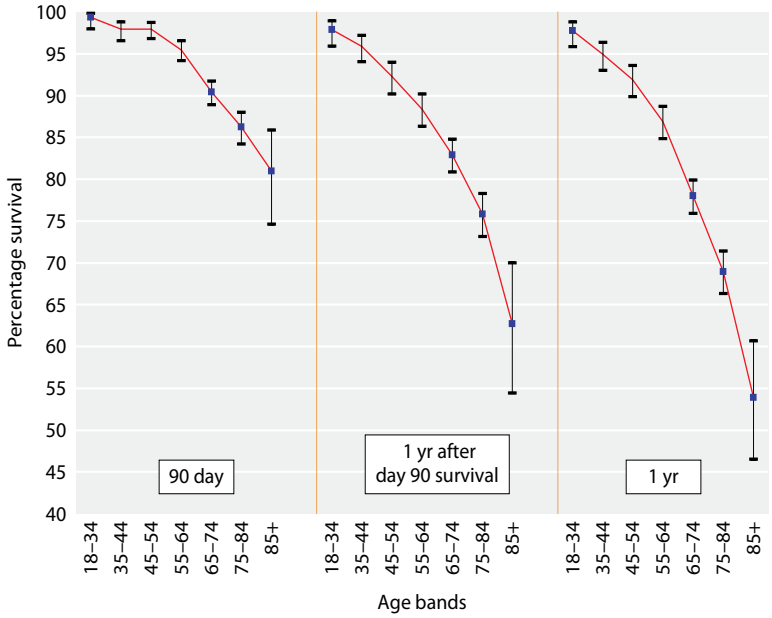

Fig. 7.1. Unadjusted survival of all incident patients 2006 by age band

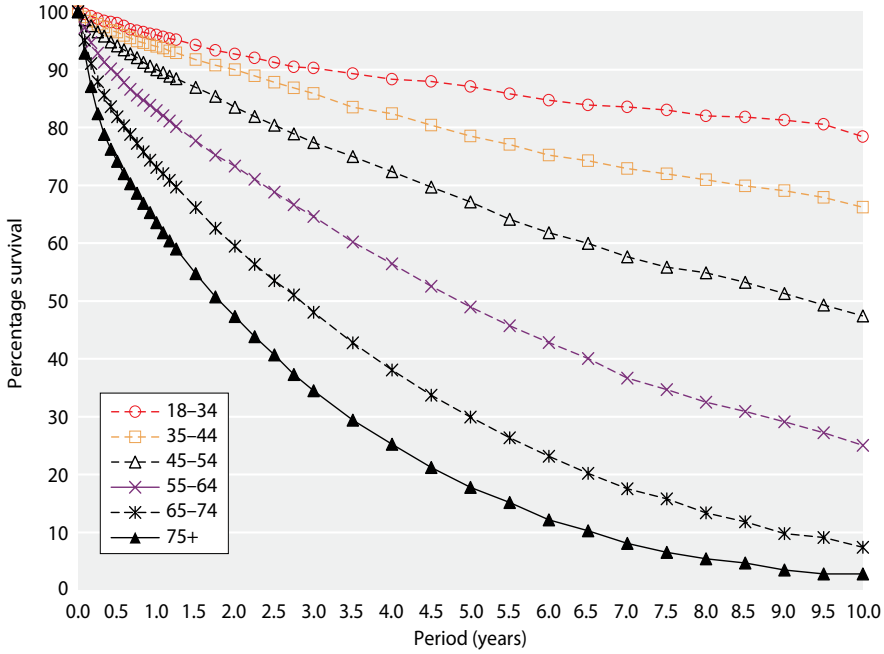

Fig. 7.3a. Kaplan–Meier 9-year survival of incident patients 1997–2006 cohort (from day 0), without censoring at transplantation

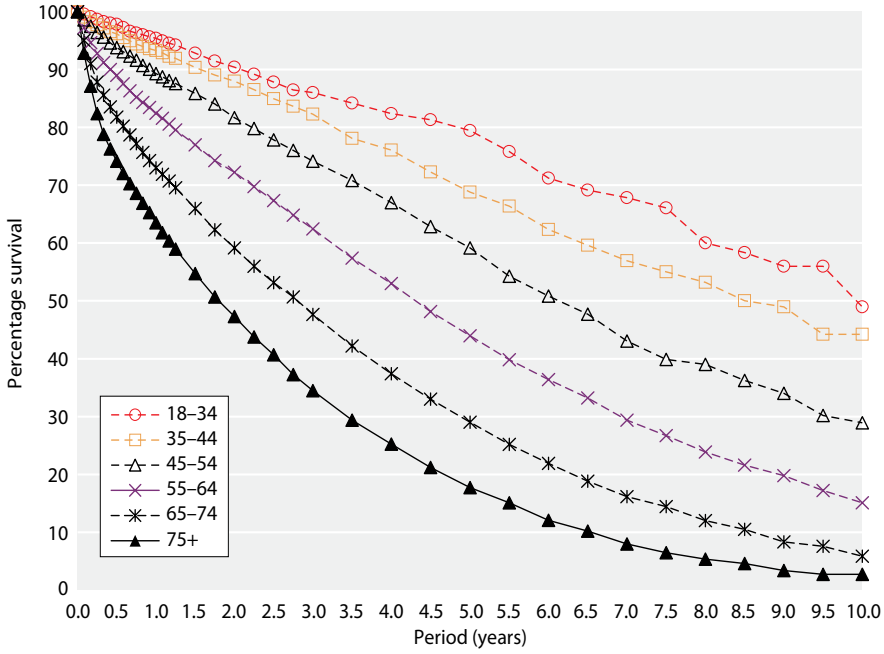

Fig. 7.3b. Kaplan–Meier 9-year survival of incident patients 1997–2006 cohort (from day 0), with censoring at transplantation

shown below without censoring for transplantation and figure 7.3b with censoring. In future reports it is planned to reproduce only the single figure of the longer term age related survival which is uncensored at the time of transplantation.

From figure 7.3a (uncensored), it can be seen that the 50% survival for a patient starting RRT in the UK aged 50, 60 and 70 years is 9.5 years, 5 years and 3 years respectively.

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

Figure 7.4 shows the monthly hazard of death from the 1st day of starting RRT by age, which falls during the first 3–4 months. For patients aged over 55, the hazard of death was 60% lower in those patients who survived beyond 4 months. This same large reduction in hazard of death was not seen in the younger aged patients and will therefore affect proportionality in any

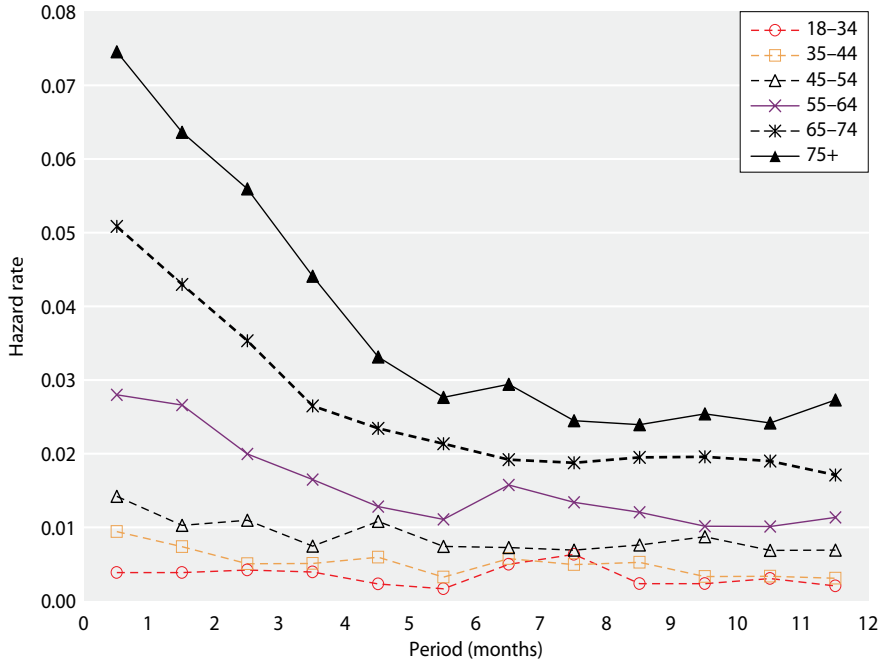

Fig. 7.4. First year monthly hazard of death, by age band 1997–2006 cohort

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] probably reflecting 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.

Changes in survival from 1997–2006

The 1st year death rate per 1,000 patient years is shown in figure 7.5. These death rates are not directly comparable with those produced by the USRDS Registry, as the UK data included the first 90 day period where the death rates will be much greater. The death rate for patients aged over 65 years was unchanged from last year at 326 per 1,000 patient years, compared with a fall in the under 65 year age group from 110 per 1,000 patient years in 2005 to 89 per 1,000 patient years in 2006.

The unadjusted KM survival analyses (tables 7.8 and 7.9, figures 7.6 and 7.7) and annual death rates appear to be showing a large improvement in 1 to 7 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 86% to 91.5%. As

Table 7.7. Increase in proportional hazard of death for each 10 year increase in age, at 90 days and for 1 year thereafter, 2006 cohort

Interval	Hazard of death for 10 year age increase	95% CI
First 90 days	1.78	1.65–1.94
1 year after first 90 days	1.61	1.52–1.71

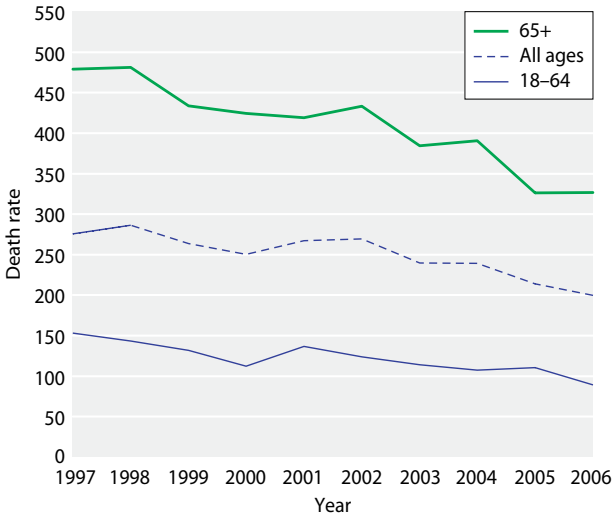

Fig. 7.5. One-year incident death rate per 1,000 patient years for all age groups

Table 7.8. Unadjusted KM survival of incident patients 1997–2006 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	95% CI for latest year	N
2006	91.5										90.5–92.4	3,147
2005	89.6	83.7									82.3–85.0	2,939
2004	89.9	83.9	77.6								75.9–79.1	2,626
2003	89.3	82.2	76.6	71.1							69.2–73.0	2,284
2002	88.5	81.4	75.5	70.0	64.9						62.7–66.9	2,008
2001	87.4	79.8	74.0	68.3	63.5	58.5					56.2–60.8	1,786
2000	89.5	81.9	75.1	70.3	64.9	59.8	55.6				53.0–58.0	1,535
1999	87.7	81.6	74.2	68.2	62.9	58.8	54.6	50.9			48.2–53.6	1,316
1998	86.8	79.4	72.7	67.7	61.4	56.4	52.2	49.5	46.4		43.5–49.2	1,239
1997	85.9	78.4	71.1	65.5	60.4	55.5	51.8	49.3	47.1	42.6	39.0–46.1	762

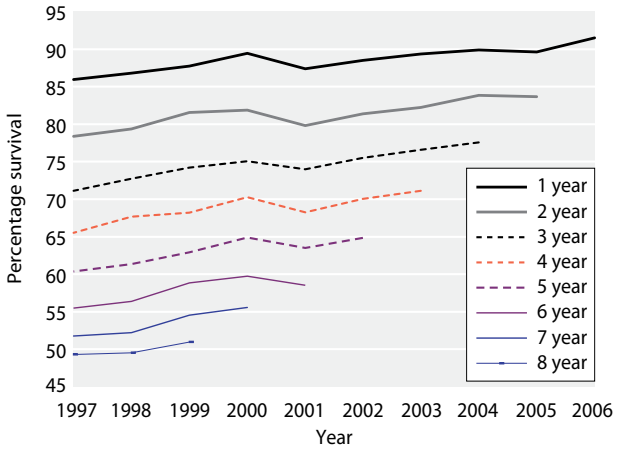

Fig. 7.6. Change in KM long term survival by year of starting RRT; for incident patients aged 18–64 years

survival rates were already high in these patients, the overall survival improvement was only 5%. The reduction in the death rate (= relative survival improvement) in figure 7.5 shows that this equates to a 42% relative improvement over this 10 year period (= 4% annual improvement in the reduction in death rate).

Similarly for patients aged over 65 years there has been a 9% improvement in 1st year survival, which translates into a similar 32% relative reduction in death rate over this 10 year period.

A confounding factor may be the fact that additional renal centres have joined the UKRR over these intervening years. If they had better survival relative to existing centres, this would appear as a time trend. However separate analysis of survival in the earlier versus later centres has shown this not to be the case.

As these are observational data it is difficult to attribute this reduction in risk of death to any specific improvement in care. During this period mean haemoglobin in HD patients has shown annual improvement rising from 10.2 g/dl in 1998 to 11.8 g/dl in 2007. Other improvements in phosphate and calcium control have been restricted to the last 4 years. This recent improvement contrasts with dialysis dose where the main improvements were in the first 4 years.

Table 7.9. Unadjusted KM survival of incident patients 1997–2006 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	95% CI for latest year	N
2006	72.9										71.3–74.4	3,144
2005	72.9	58.7									57.0–60.5	3,076
2004	68.7	54.8	43.3								41.4–45.1	2,724
2003	69.1	53.8	42.3	32.3							30.4–34.2	2,363
2002	65.9	51.4	40.9	32.7	25.3						23.5–27.2	2,169
2001	67.0	51.9	39.4	30.3	22.8	17.0					15.3–18.7	1,846
2000	66.7	53.2	40.0	29.1	22.5	17.8	13.7				12.0–15.6	1,493
1999	66.3	50.6	38.4	28.7	21.5	15.3	10.9	8.5			7.0–10.1	1,257
1998	63.7	46.5	36.2	27.5	20.4	14.4	10.3	7.1	5.0		3.8–6.4	1,125
1997	63.8	45.7	33.0	23.8	16.4	11.7	8.0	6.4	4.6	3.9	2.5–5.7	575

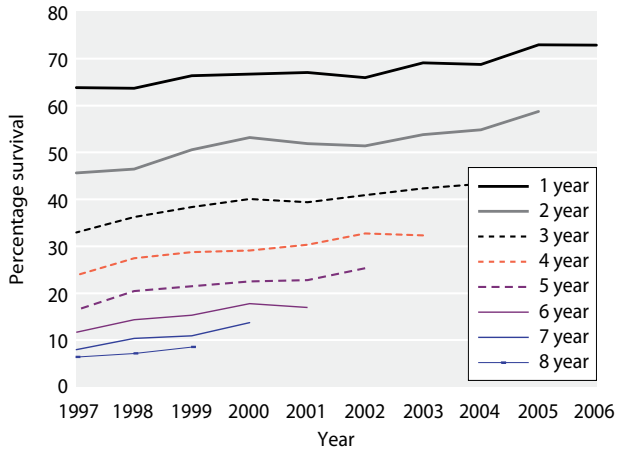

Fig. 7.7. Change in KM long term survival by year starting RRT; for incident patients aged ⩾65 years

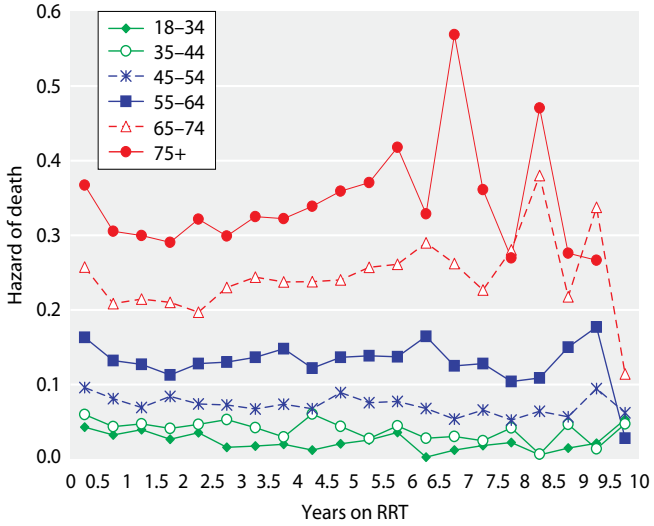

Fig. 7.8. Six monthly hazard of death, by vintage and age band, 1997–2006 incident cohort after day 90

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 10 years. Figure 7.8 demonstrates this clearly for patients aged under 65 years. For those patients aged 65 years and over, no vintage effect was seen within the first 7 years (after adjusting for the increasing age of the patient), though with the decreasing numbers remaining alive beyond 7 years the numbers become too small to draw any further conclusions. This lack of a 'vintage' effect was partly related to the effect of having a survivor cohort who were 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.

Figures 7.9 and 7.10 show these data for the non-diabetic and diabetic patients respectively with a suggestion of worsening prognosis in older diabetic patients.

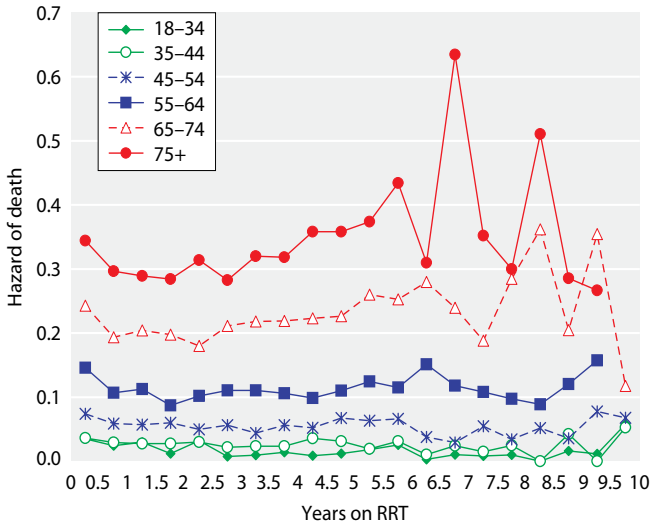

Fig. 7.9. Six monthly hazard of death, by vintage and age band, 1997–2006 non-diabetic incident cohort after day 90

Table 7.10. Unadjusted KM survival of incident patients 1997–2006 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	95% CI for latest year	N
2006	82.2										81.2–83.1	6,291
2005	81.1	70.9									69.7–72.0	6,015
2004	79.2	69.1	60.1								58.7–61.4	5,350
2003	79.2	67.9	59.2	51.4							49.9–52.9	4,647
2002	76.9	65.9	57.6	50.6	44.2						42.7–45.8	4,177
2001	77.2	65.8	56.5	49.0	42.9	37.4					35.8–39.0	3,632
2000	78.4	67.9	58.0	50.3	44.2	39.2	35.0				33.3–36.7	3,028
1999	77.4	66.7	56.9	49.2	42.8	37.7	33.3	30.2			28.4–32.0	2,573
1998	75.9	63.9	55.5	48.7	42.1	36.5	32.4	29.4	26.6		24.8–28.5	2,364
1997	76.6	64.6	55.0	47.9	41.7	36.9	33.2	31.0	28.9	26.0	23.6–28.4	1,337

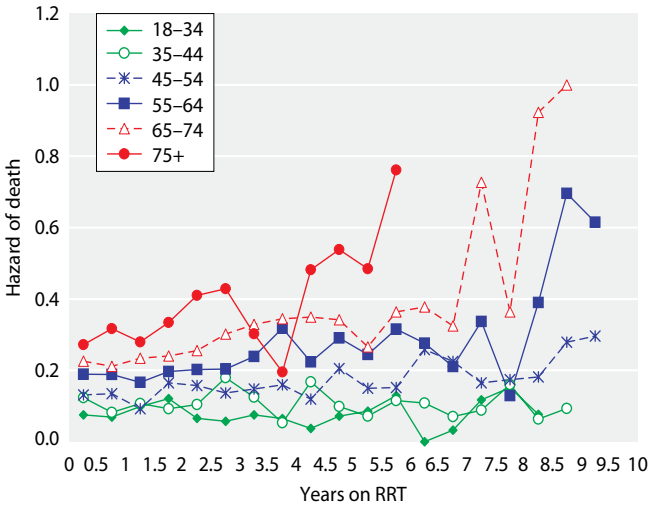

Fig. 7.10. Six monthly hazard of death, by vintage and age band, 1997–2006 diabetic incident cohort after day 90

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 appears to have narrowed.

Time trend changes in incident patient survival, 1999–2006

The time trend changes are shown in figure 7.11.

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2006 incident cohort is shown in figure 7.12 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 8 years can also be found in appendix 1, table 7.26.

In the analysis of 2006 survival data, some of the smaller centres had wide confidence intervals (figure 7.12). This can be addressed by including a larger cohort, which will also assess sustained performance and as in previous reports has shown this as a rolling 4 year cohort, with the data in this report for the 4 year period 2003 to 2006. These data are presented as a funnel plot in figure 7.13. 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 standard deviations (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 4 centres that fall between 2 and 3 standard deviations below average (Airdrie, Plymouth, Swansea and Glasgow) and 4 centres between 2 and 3 SDs above average (Kilmarnock, London Royal Free, London Guys and London St Bartholomew's). These data have not been adjusted for any patient related factor except age (i.e. not comorbidity, primary renal disease or ethnicity). The 3 London centres within the upper 2–3 SDs may reflect their higher ethnic minority mix with better survival, although this pattern is not seen in London Kings or other non-London centres with a high ethnic minority mix. These data have not been censored at transplantation, so the effect of differing centre rates of transplantation was not taken into account.

The analysis of Swansea data after adjustment for comorbidity (figure 7.14) indicates that patients at this centre had a higher comorbid burden when compared with other centres.

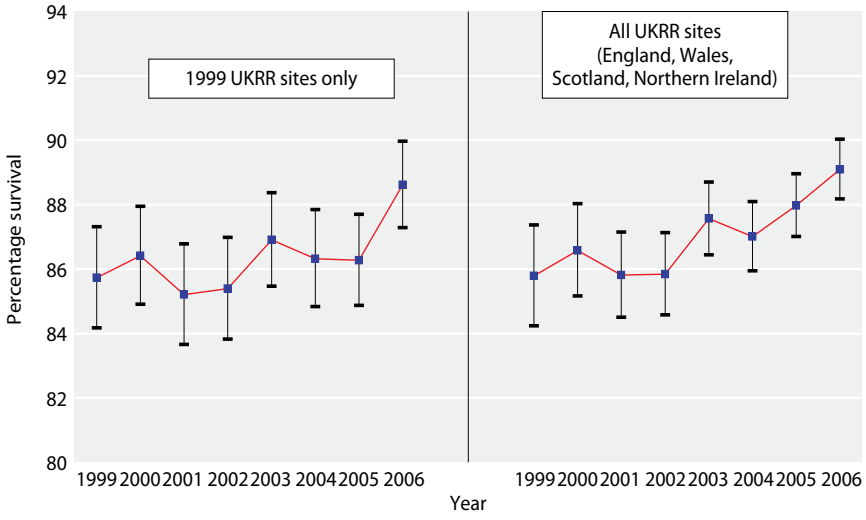

Fig. 7.11. Change in one-year after 90 day adjusted (age 60) survival, 1999–2006
Showing 95% confidence intervals

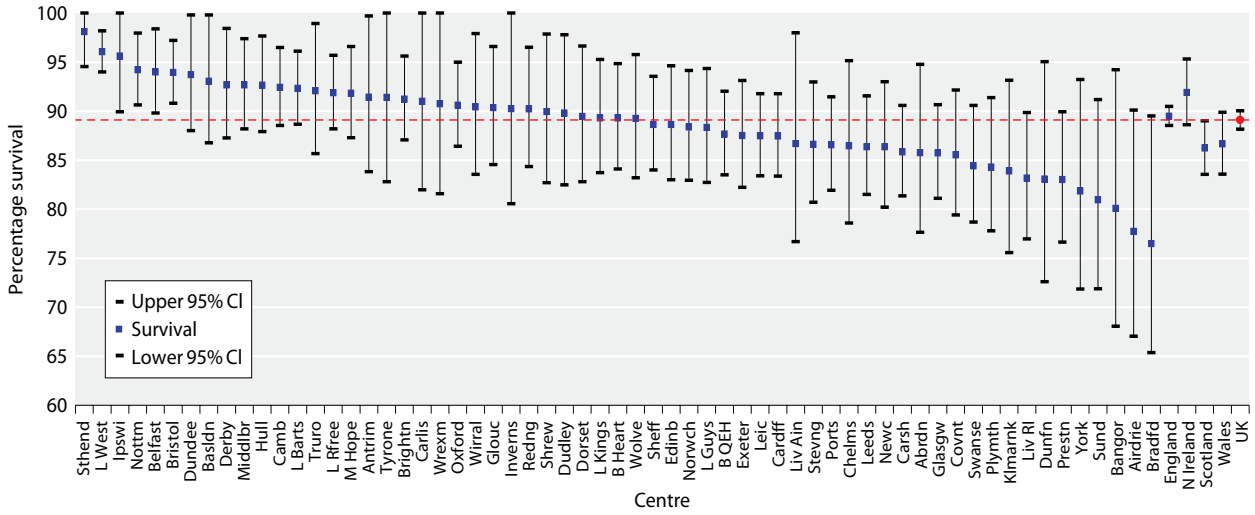

Fig. 7.12. Survival one-year after 90 days, adjusted to age 60, 2006 cohort
Showing 95% confidence intervals

Table 7.11. Adjusted 1 year after 90 day survival 2003–2006

Centre	Incident pts N	1 year after 90 day survival %
Ulster	26	87.7
Tyrone	40	93.4
Newry	42	87.5
Clwyd	63	86.9
Liv Ain	70	88.4
D & Gall	70	86.0
Antrim	73	89.1
Bangor	107	83.3
Wrexm	108	88.6
Carlis	110	84.6
Chelms	121	84.2
Dunfn	127	82.8
Inverns	129	86.6
Shrew	130	89.2
Sthend	140	92.4
Ipswi	152	91.0
Basldn	155	92.4
Dudley	155	89.5
Klmarnk	159	86.6
York	165	83.2
Airdrie	183	79.1
Truro	189	90.9
Belfast	195	91.9
Sund	200	83.0
Glouc	202	88.9
Dorset	207	87.4
Wirral	207	88.5
Abrdn	216	85.0
Bradfd	219	83.5
Dundee	223	87.9
Redng	235	90.1
Derby	237	88.3
Plymth	238	82.4
Norwch	267	88.5
Covnt	308	85.1
Wolve	316	86.6
L Rfree	326	92.3
Brightn	330	87.7
Middlbr	346	86.1
Edinb	364	84.6
Hull	365	89.0
Swanse	370	83.1
B Heart	371	87.3
Stevng	373	87.5
Exeter	384	86.4
Prestn	384	86.6
Newc	389	84.9
Nottm	439	87.8
L Kings	441	88.3
Camb	449	90.6
L Guys	449	91.2
M Hope	463	88.7
Liv RI	464	85.9
L Barts	525	91.0
Ports	533	86.4
B QEH	548	88.8
Sheff	601	90.0
Leeds	603	88.2
Bristol	606	88.2
Oxford	617	88.8
Carsh	655	88.7
Cardff	683	87.8
Glasgw	719	84.4
Leic	758	87.6
L West	1,063	94.2

One centre (London West) appears to be an extreme outlier with much better than expected survival. Even after the survival data were re-analysed for the 2006 cohort alone, this centre remained outside the 3 SD limit, with better than expected survival. Removing this centre from the funnel plot (because it is a statistical outlier) and from the calculation of the lower SDs does not alter the number of centres falling below 2 SDs. Reasons for this are actively being investigated, in cooperation with the London West centre. It is unlikely that this may solely be accounted for by ethnic mix as the second year patient survival (survival of RRT patients between month 13 and month 24) is within 2 SDs of expected. Preliminary investigations suggest that there has been over-estimation of the denominator as a result of incorrect inclusion of patients from other centres (predominantly transplant recipients) in the numbers of incident patients. The UKRR identified some under-reporting of deaths (via the use of the NHS tracing service), although these deaths were included in the current survival calculation. Under-reporting of incident RRT patients may also play a potential role, although current investigations show this is not causing a significant underestimation of deaths.

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 [4, 5]. The UKRR is investigating ways to adjust centre survival for the differences in the underlying population.

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). With the de-anonymisation of centre names, it is essential to show what the importance is of adjusting patient survival for comorbidity. Figure 7.14 shows the effect of adjusting for comorbidity. Using the combined incident cohort from 2002–2006, 8 centres had returned comorbidity data for more than 85% of patients. Adjustment was first performed to age 60, then to the average primary diagnosis mix for all the 8 centres. Further adjustment was then made to the average diversity of comorbidity present at these centres.

This shows how survival changes with adjustment highlighting the importance of improving the quality of comorbidity returns to the Renal Registry.

Table 7.12. Life expectancy 2004–2006 in UK countries (source ONS)

	At birth		At age 65	
Country	Male	Female	Male	Female
England	77.2	81.5	17.1	19.9
Wales	76.6	80.9	16.7	19.5
Scotland	74.6	79.6	15.8	18.6
N Ireland	76.1	81.0	16.6	19.5
UK	**76.9**	**81.3**	**16.9**	**19.7**

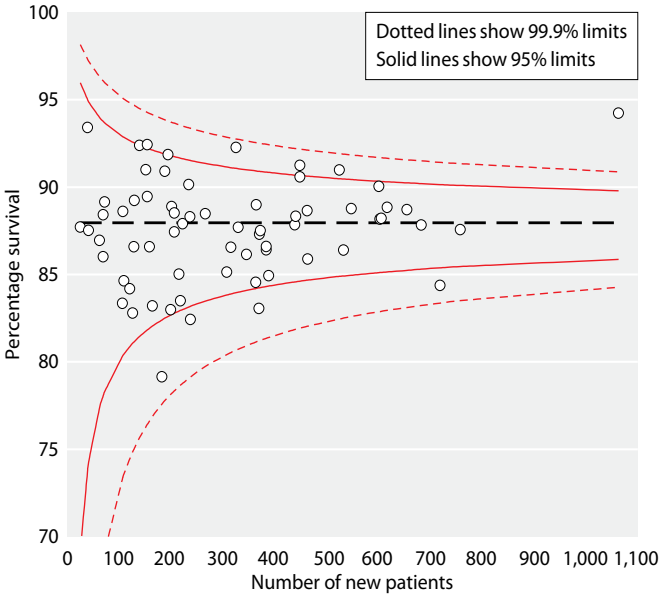

Fig. 7.13. Funnel plot for age adjusted 1 year after 90 days survival, 2003–2006 cohort
(patients who died within the first 90 days have been excluded)

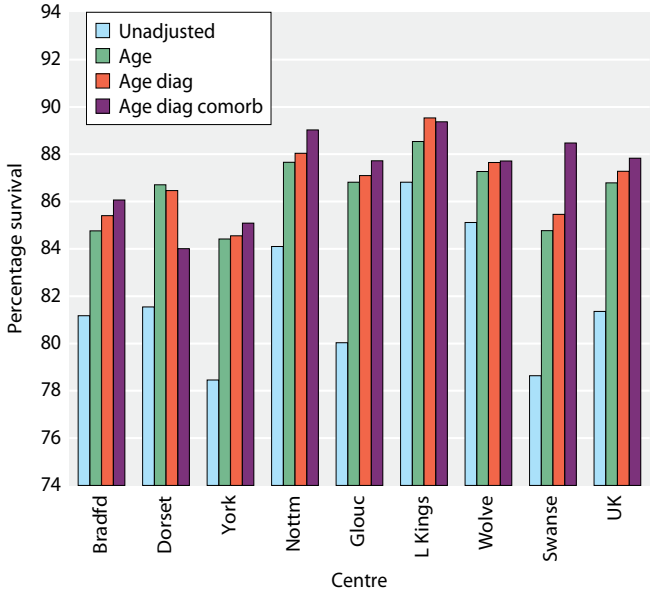

Fig. 7.14. Change in 1 year after 90 day survival after adjustment for age, diagnosis and comorbidity 2002–2006

Results of prevalent patient survival analyses

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

In tables 7.14 and 7.15 the 2007 one year death rate is shown for dialysis and transplanted patients respectively. The median age of prevalent patients in Northern Ireland and Wales was older than those in England.

Figure 7.15 shows the one year survival of prevalent dialysis patients in different age groups on 1/1/2007.

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 figures 7.16 and 7.17, dividing the data into those patients aged <65 years and those 65 years and over. Figure 7.18 shows the age adjusted data (60 years) and in figure 7.19 as a funnel plot. The solid lines show the 2 standard deviation limit (95% limits) and the dotted

Table 7.14. One-year death rate per 1,000 dialysis patient years in 2007 by country

	England	N Ireland	Scotland	Wales
Death rate	153	154	161	173
95% CI	147–160	126–186	143–181	149–200
Median age	63.6	65.7	63.4	65.7

Table 7.13. Prevalent 1 year KM* survival of dialysis patients in 2007, censoring at transplantation (adjusted for age 60)

Centre	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI
Abrdn	89.6	86.0	93.4
Airdrie	78.3	72.4	84.7
Antrim	85.4	80.8	90.4
B Heart	87.6	84.7	90.6
B QEH	88.6	86.6	90.6
Bangor	80.7	74.2	87.8
Basldn	91.4	87.5	95.5
Belfast	90.9	88.0	93.9
Bradfd	83.2	78.3	88.4
Brightn	87.7	84.9	90.6
Bristol	89.3	87.0	91.7
Camb	88.3	85.5	91.1
Cardff	88.8	86.6	91.2
Carlis	87.0	81.1	93.3
Carsh	89.0	86.8	91.2
Chelms	85.6	80.4	91.2
Clwyd	91.1	85.4	97.1
Covnt	86.9	83.6	90.3
D & Gall	90.5	84.6	96.9
Derby	87.5	83.9	91.2
Derry	86.4	76.9	96.9
Dorset	86.9	82.7	91.3
Dudley	86.7	82.0	91.7
Dundee	84.5	80.1	89.1
Dunfn	89.2	84.6	94.2
Edinb	88.7	85.5	92.0
Exeter	87.3	84.2	90.4
Glasgw	88.8	86.6	91.0
Glouc	87.8	83.9	91.9
Hull	89.9	87.0	92.8
Inverns	94.2	90.4	98.2
Ipswi	85.2	79.9	90.8
Klmarnk	87.1	82.6	91.9
L Barts	89.1	86.9	91.4
L Guys	90.9	88.5	93.3
L Kings	84.6	81.2	88.1
L Rfree	90.5	88.4	92.6
L West	92.8	91.5	94.1
Leeds	88.8	86.5	91.2
Leic	89.9	87.9	91.9
Liv Ain	90.9	85.4	96.7
Liv RI	85.8	82.9	88.8
M Hope	88.6	85.6	91.6
M RI	85.0	81.7	88.4
Middlbr	86.7	83.1	90.5
Newc	87.2	83.7	90.9
Newry	86.7	80.9	93.0
Norwch	86.5	83.2	89.9
Nottm	89.5	87.0	92.2
Oxford	87.8	85.3	90.3
Plymth	83.6	78.9	88.5
Ports	89.6	87.0	92.2
Prestn	90.8	88.3	93.5
Redng	89.7	86.4	93.1
Sheff	88.4	86.1	90.8
Shrew	89.4	85.2	93.8
Stevng	89.7	87.2	92.2
Sthend	85.8	80.8	91.1
Stoke	84.4	80.8	88.3
Sund	82.4	76.9	88.3
Swanse	88.4	85.5	91.4
Truro	88.8	85.0	92.8
Tyrone	93.3	89.1	97.6
Ulster	89.0	82.5	96.0
Wirral	87.8	83.7	92.1
Wolve	87.8	84.5	91.1
Wrexm	88.8	83.9	94.0
York	88.0	83.4	93.0
England	**88.6**	**88.1**	**89.1**
N Ireland	**89.2**	**87.2**	**91.2**
Scotland	**88.0**	**86.6**	**89.3**
Wales	**88.2**	**86.5**	**89.8**
UK	**88.5**	**88.1**	**89.0**

* Kaplan Meier

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

Patient group	Patients	Deaths	KM* survival	KM 95% CI
Transplant patients 2007				
Censored at dialysis	17,545	395	97.7	97.5–97.9
Not censored at dialysis	17,545	433	97.5	97.3–97.7
Dialysis patients 2007				
All	22,115	3,046	85.7	85.2–86.1
All adjusted age = 60	22,115	3,046	88.5	88.1–89.0
2 year survival – dialysis patients 2006				
All 1/1/2006 (2 year)	19,937	5,109	72.5	71.9–73.2
Dialysis patients 2007				
All age <65	11,693	913	91.7	91.1–92.2
All age 65+	10,422	2,133	79.3	78.5–80.1
Non-diabetic <55	5,841	265	95.1	94.5–95.6
Non-diabetic 55–64	3,280	323	89.7	88.6–90.7
Non-diabetic 65–74	4,075	632	84.3	83.1–85.3
Non-diabetic 75+	4,076	1,004	75.2	73.9–76.5
Non-diabetic <65	9,121	588	93.1	92.5–93.6
Diabetic <65	2,020	264	86.2	84.6–87.7
Non-diabetic 65+	8,151	1,636	79.7	78.8–80.6
Diabetic 65+	1,753	376	78.4	76.3–80.2

* KM = Kaplan–Meier survival
Cohorts of patients alive 1/1/2007 unless indicated otherwise

lines the limits for 3 standard deviations (99.9% limits). With over 60 centres included, it would be expected by chance that 3 centres would fall outside the 95% (1 in 20) confidence intervals. Figure 7.19 shows 4 centres between the 2–3 SD interval, with 1 clearly below (Airdrie), 2 marginally below (London Kings and Manchester RI) and 1 above 2 SDs (Inverness). Similarly to the incident survival, one centre (London West) was demonstrating a survival that was beyond 3 SDs better than expected. Reasons for this are being investigated.

The 2007, one year death rate in prevalent dialysis patients by age band

The death rates on dialysis by age band are shown in figure 7.20. The younger patients are a selected higher risk group, as transplanted patients have been excluded. For 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 analysis was not

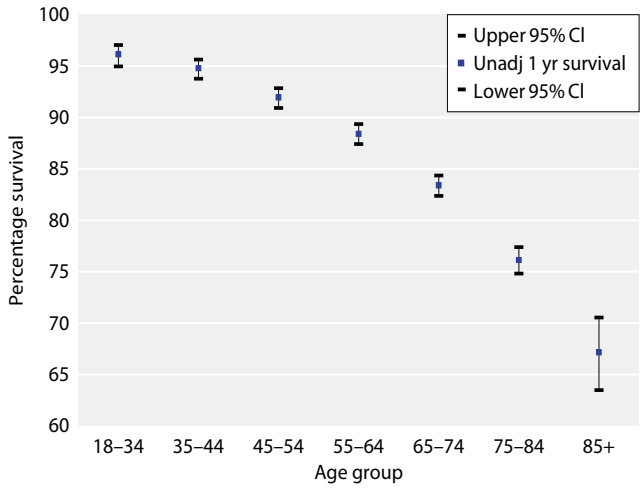

Fig. 7.15. One year survival of prevalent dialysis patients in different age groups – 2007

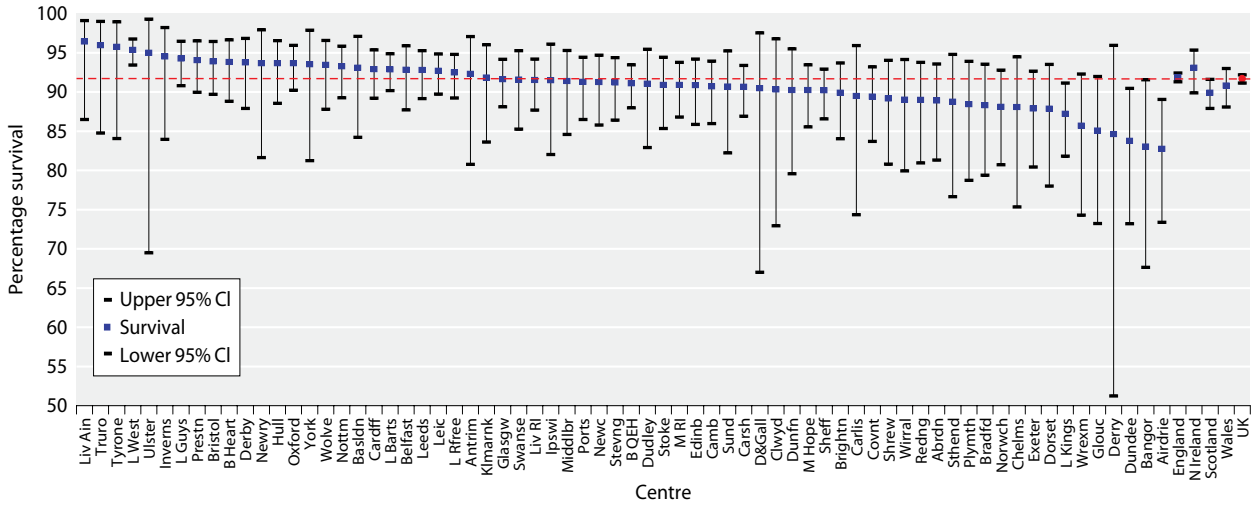

Fig. 7.16. One year survival of prevalent dialysis patients aged under 65 in each centre

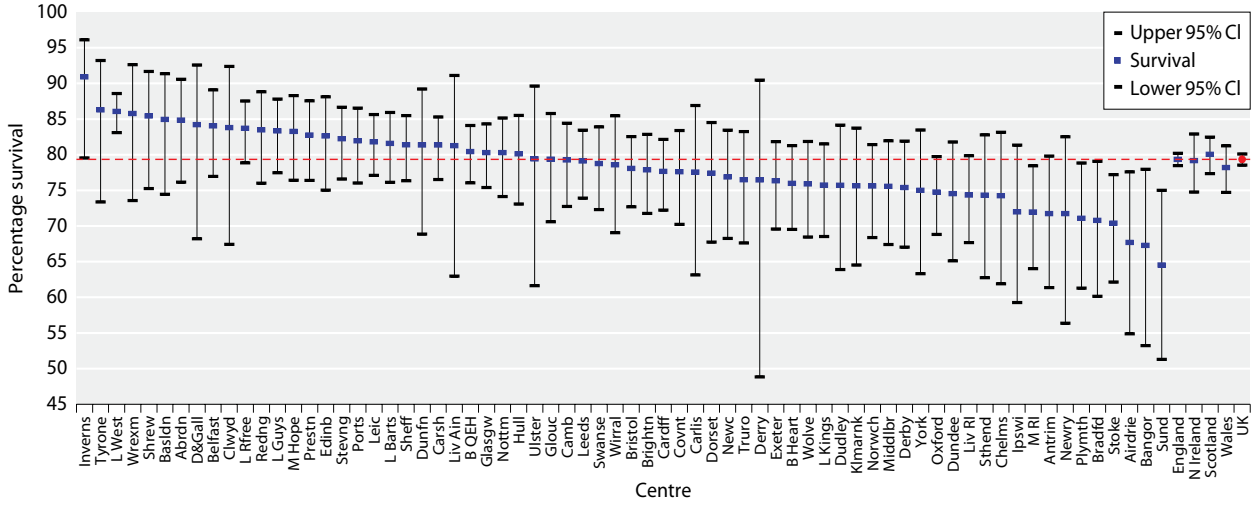

Fig. 7.17. One year survival of prevalent dialysis patients aged 65 and over in each centre

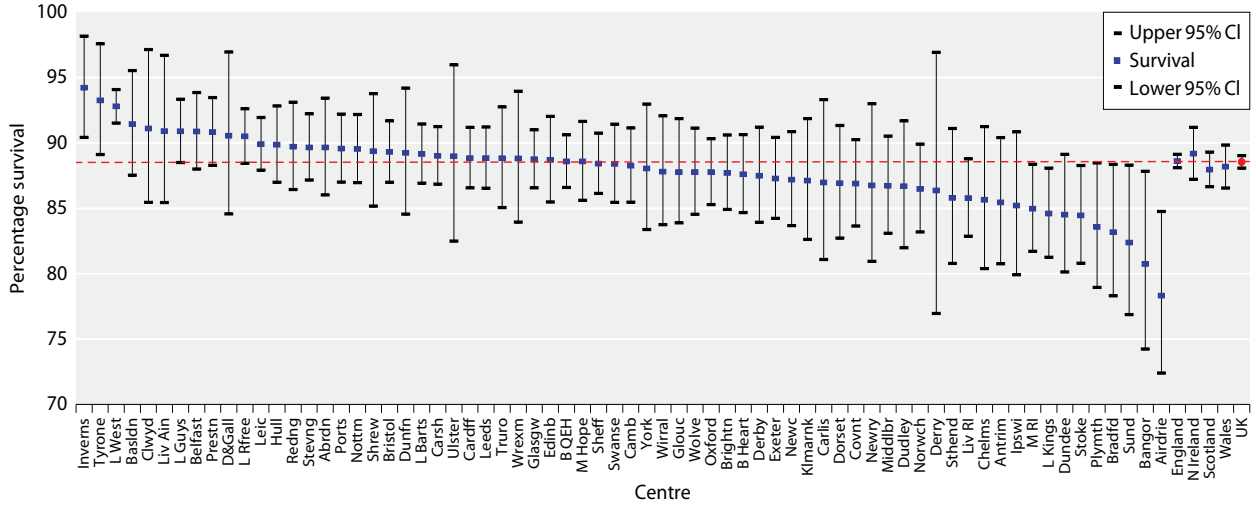

Fig. 7.18. One year survival of prevalent dialysis patients in each centre adjusted to age 60

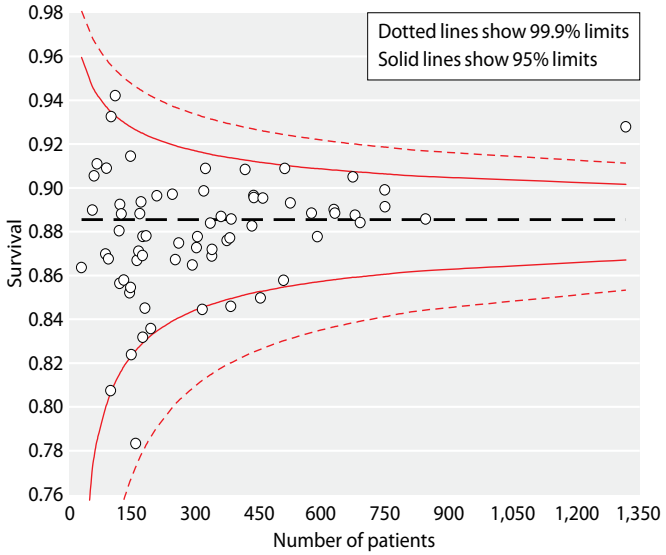

Fig. 7.19. Funnel plot of one year survival of prevalent dialysis patients in each centre adjusted to age 60

repeated in the 2008 USRDS Report), the death rates for UK dialysis patients were lower than dialysis patients in the USA across all age bands (figure 6.12 USRDS) [6].

One year survival of prevalent dialysis patients by UK country from 1997–2007

All UK countries are showing a continued improvement in the age adjusted survival on dialysis (figure 7.21). The change in prevalent survival by centre over the years 2000 to 2006 is shown in this chapter appendix 1, table 7.27.

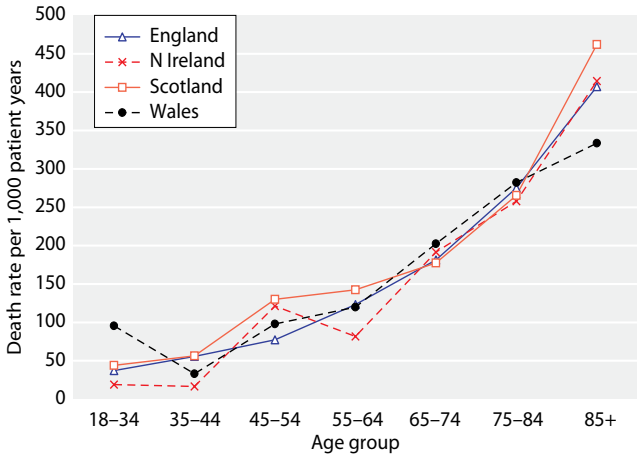

Fig. 7.20. Death rate per 1,000 patient years by UK country and age group for prevalent dialysis patients

One year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2000–2007

The UK has shown a continued improvement in the age adjusted one year survival of prevalent patients whose primary renal diagnosis was diabetes (table 7.16).

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 7.22 shows that the relative risk with RRT decreased with age from 30 at age 30 to 3 at age 80 although it still remained higher than that of the general population. With the reduction in rates

Fig. 7.21. Serial 1 year survival for prevalent dialysis patients by UK country from 1997–2007 adjusted to age 60
Showing 95% confidence intervals

Table 7.16. Serial 1 year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2000–2007

Year	2000	2001	2002	2003	2004	2005	2006	2007
1 year survival	76.6	77.2	78.4	77.8	80.6	82.3	81.4	84.0

Table 7.17. Death rate by age for all prevalent RRT patients on 01/01/2007, compared with the general population and with previous analyses in the 1998–2001 cohort

Age group	UK population mid 2006 (thousands)	UK deaths	Death rate per 1,000 population	Expected number of deaths	UKRR deaths	UKRR deaths per 1,000 prev RRT pts	Observed: expected ratio 2002–2006	Observed: expected ratio 1998–2001
20–24	4,024	2,002	0.5	0	9	10.7	21.5	41.1
25–29	3,856	2,263	0.6	1	22	17.7	30.1	41.8
30–34	4,040	3,053	0.8	1	28	15.4	20.4	31.2
35–39	4,599	4,834	1.1	3	56	20.3	19.3	26.0
40–44	4,663	7,085	1.5	6	101	27.9	18.3	22.6
45–49	4,151	9,864	2.4	9	145	38.1	16.0	19.0
50–54	3,683	14,017	3.8	14	202	54.1	14.2	12.8
55–59	3,910	22,654	5.8	24	257	62.8	10.8	10.1
60–64	3,240	30,213	9.3	38	393	97.6	10.5	10.4
65–69	2,691	39,904	14.8	56	489	129.5	8.7	7.9
70–74	2,338	56,705	24.3	83	589	172.6	7.1	7.2
75–79	1,959	81,497	41.6	110	644	243.6	5.9	5.3
80–84	1,456	103,912	71.3	104	480	329.0	4.6	4.0
85+	1,243	187,545	150.9	84	245	440.1	2.9	3.0
Total	**45,853**	**565,548**	**12.3**	**532**	**3,660**	**96.8**	**6.9**	**7.7**

of death on RRT over the last 10 years this relative risk of death compared with the general population has fallen since the previous analysis in the 2003 Registry Report which compared UKRR mortality data 1998–2001 to national data from 2000.

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.

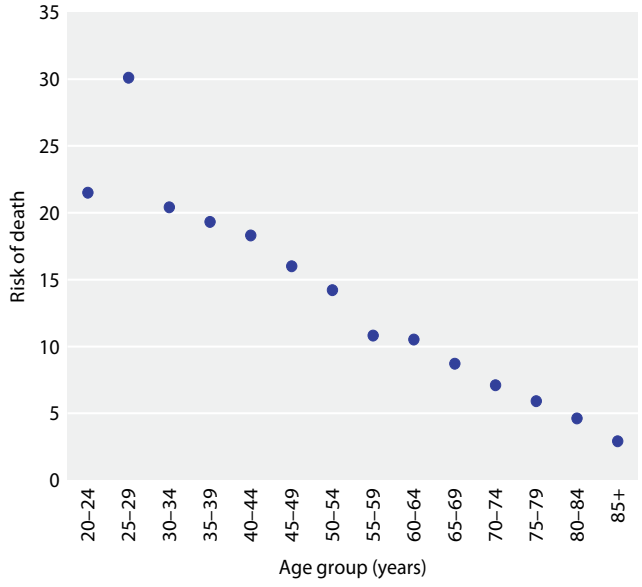

Fig. 7.22. Relative risk of death in all prevalent RRT patients compared with the UK general population in 2007

Table 7.18. Data completeness of EDTA causes of death by centre by year of start

Centre	2000	2001	2002	2003	2004	2005	2006	Total
Abrdn	24.4	26.7	26.5	10.7	4.0	0.0	0.0	15.7
Airdrie	34.1	31.1	28.9	28.1	42.3	33.3	37.5	32.9
Antrim						12.5	0.0	9.5
B Heart	75.8	82.8	79.5	67.3	72.9	84.8	91.9	78.3
B QEH					49.4	1.9	2.5	23.8
Bangor			50.0	12.5	55.0	50.0	42.1	43.3
Basldn				47.6	65.0	37.5	66.7	55.2
Belfast						26.3	10.5	21.1
Bradfd		78.9	87.5	90.9	82.8	92.6	94.7	87.3
Brightn					3.4	4.3	6.7	4.5
Bristol	49.5	49.5	65.8	71.4	76.5	54.9	61.3	60.5
Camb	0.0	0.0	0.0	0.0	0.0	0.0	8.1	1.2
Cardff	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.2
Carlis	33.3	30.0	64.7	61.9	78.6	81.8	100.0	56.5
Carsh	3.8	2.5	0.0	0.0	0.0	0.0	0.0	1.0
Chelms					46.4	95.0	92.9	72.6
Clwyd	0.0	0.0	6.7	0.0	0.0	0.0	40.0	6.0
Covnt	22.6	9.9	16.3	2.7	0.0	0.0	0.0	9.2
D & Gall	92.3	72.2	90.9	81.8	72.7	91.7	83.3	82.9
Derby	36.4	38.9		50.0	67.9	90.5	81.3	56.0
Dorset				22.2	65.2	80.0	66.7	51.1
Dudley	33.3	5.6	33.3	0.0	0.0	0.0	0.0	11.7
Dundee	78.1	70.6	57.8	54.3	55.9	29.7	0.0	53.7
Dunfn	80.0	84.0	78.9	58.3	69.2	61.1	44.4	72.5
Edinb	75.8	57.9	51.1	38.3	45.5	36.4	48.1	52.4
Exeter	29.5	27.0	23.1	29.1	20.4	13.7	10.7	22.9
Glasgw	51.0	56.6	54.6	50.0	44.1	50.7	57.4	51.9
Glouc	52.9	74.1	53.3	46.9	56.0	47.1	21.4	52.5
Hull	72.6	75.0	78.0	61.5	77.4	75.0	73.3	73.7
Inverns	11.1	0.0	0.0	0.0	0.0	9.1	0.0	2.9
Ipswi			28.6	27.8	30.0	21.1	57.1	29.4
Klmarnk	0.0	5.3	16.7	5.9	0.0	11.8	0.0	5.7
L Barts					77.8	84.4	72.4	78.2
L Guys	0.0	6.5	0.0	0.0	0.0	0.0	0.0	1.1
L Kings			59.1	69.8	75.5	80.0	85.7	71.0
L Rfree								0.0
L West			63.2	61.3	52.4	13.8	4.0	47.2
Leeds	50.0	63.5	58.2	55.4	60.0	57.4	51.1	56.8
Leic	71.4	77.5	83.5	83.9	83.3	78.6	72.1	78.4
Liv Ain	0.0	0.0	0.0	0.0	0.0	44.4	75.0	58.8
Liv RI	0.0	77.7	71.4	71.4	67.9	68.8	70.7	72.4
M Hope			0.0	0.0	0.0	0.0	5.6	0.6
Middlbr	78.7	80.4	72.3	60.3	56.3	66.7	45.0	68.3
Newc			43.4	19.5	36.5	50.0	48.1	38.8
Newry						37.5	0.0	27.3
Norwch					28.9	16.4	22.9	21.9
Nottm	93.6	97.3	96.2	94.9	98.0	91.4	84.0	94.4
Oxford	9.2	6.0	4.9	3.2	5.3	4.2	0.0	5.2
Plymth	40.4	37.0	49.0	54.5	37.8	42.3	42.9	43.7
Ports		27.7	21.3	19.7	17.0	8.3	19.1	20.0
Prestn	72.6	74.4	68.4	68.9	58.6	60.0	55.6	68.1
Redng	69.2	58.3	75.0	87.5	100.0	70.8	100.0	76.9
Sheff	56.8	48.2	55.1	31.4	0.0	0.0	0.0	34.3
Shrew					54.2	46.2	36.4	47.9
Stevng	23.9	40.3	72.9	40.7	37.9	48.4	48.3	43.0
Sthend	40.6	33.3	20.0	33.3	15.8	13.3	0.0	27.1
Sund	46.9	58.3	62.2	50.0	47.8	72.4	68.4	57.9

Table 7.18. Continued

Centre	2000	2001	2002	2003	2004	2005	2006	Total
Swanse	83.0	87.7	92.1	96.1	89.8	92.5	97.0	91.0
Truro		45.5	39.5	37.5	0.0	0.0	0.0	27.8
Tyrone						50.0	71.4	58.8
Ulster						75.0	75.0	75.0
Wirral			53.6	75.0	64.5	63.6	55.6	63.6
Wolve	92.9	92.0	86.8	87.2	75.0	50.0	50.0	79.9
Wrexm	7.9	0.0	6.3	0.0	0.0	0.0	25.0	3.9
York	34.4	45.8	57.1	64.5	60.9	52.6	50.0	52.4
England	**49.5**	**49.9**	**50.5**	**45.8**	**45.8**	**42.3**	**40.1**	**46.6**
N Ireland						**30.3**	**26.3**	**28.9**
Scotland	**51.5**	**48.7**	**47.0**	**39.5**	**39.8**	**37.6**	**36.4**	**44.0**
Wales	**26.0**	**33.0**	**36.2**	**36.8**	**32.4**	**32.0**	**38.7**	**33.5**
UK	**47.7**	**48.3**	**48.7**	**44.2**	**44.0**	**40.4**	**39.2**	**45.0**

Blank cells, data not available for that year

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. Nottingham) 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. Several centres that were reporting these data in previous years appear to have discontinued collection.

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 >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.

Causes of death in prevalent RRT patients in 2007

Causes of death in prevalent RRT patients in 2007 by modality and age

Table 7.21 and figures 7.23 and 7.24 show the frequency of the causes of death for both prevalent dialysis and transplant patients. A comparison has been made with data available from the 2007 ANZDATA Registry report (tables 7.22 and 7.23). The Australian Registry

Table 7.19. Cause of death by age in the first 90 days for incident patients, 2000–2006

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	399	29	97	31	302	28
Cerebrovascular disease	70	5	17	5	53	5
Infection	252	18	43	14	209	19
Malignancy	112	8	28	9	84	8
Treatment withdrawal	205	15	31	10	174	16
Other	135	10	30	10	105	10
Uncertain	216	16	64	21	152	14
Total	**1,389**		**310**		**1,079**	
No cause of death data	1,594		349		1,245	

Table 7.20. Cause of death by age in 1 year after 90 days for incident patients, 2000–2006

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	534	25	165	27	369	24
Cerebrovascular disease	137	6	36	6	101	7
Infection	400	19	114	19	286	19
Malignancy	213	10	79	13	134	9
Treatment withdrawal	344	16	51	8	293	19
Other	373	17	109	18	264	17
Uncertain	153	7	56	9	97	6
Total	**2,154**		**610**		**1,544**	
No cause of death data	2,578		730		1,848	

Table 7.21. Cause of death by age in prevalent RRT patients by modality on 1/1/2007

	All modalities		Dialysis		Transplant	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	316	23	294	24	22	16
Cerebrovascular disease	67	5	57	5	10	7
Infection	252	18	223	18	29	21
Malignancy	118	9	89	7	29	21
Treatment withdrawal	179	13	173	14	6	4
Other	119	9	104	8	15	11
Uncertain	314	23	287	23	27	20
Total	**1,365**		**1,227**		**138**	
No cause of death data	2,296		1,948		348	

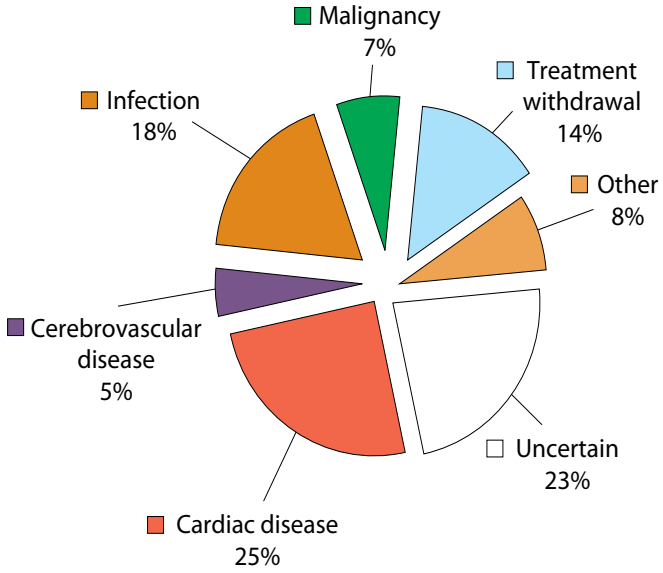

Fig. 7.23. Frequency of causes of death for prevalent dialysis patients in 2007

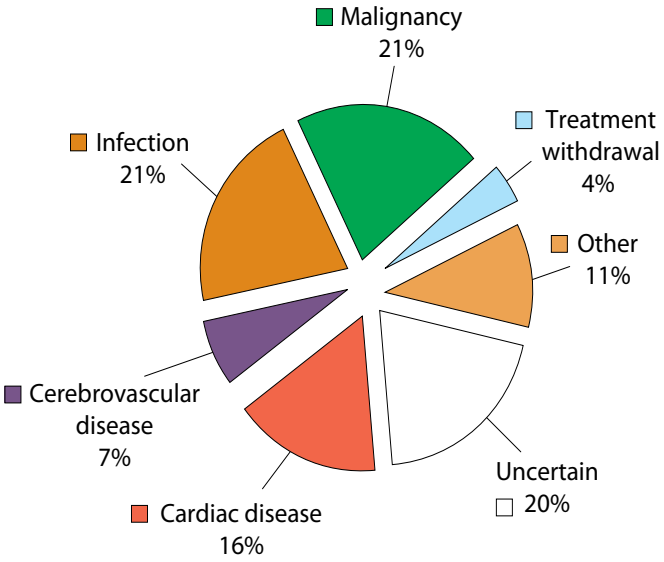

Fig. 7.24. Frequency of causes of death for prevalent transplant patients in 2007

appears to have many fewer cases of 'uncertain' causes of death and infections in both transplant and dialysis patients, this may account for fewer causes of death although this may be due to their difference in classification into the category of 'treatment withdrawal'.

Figure 7.25 contrasts the differences in frequency of these causes, between the 2 modalities within the UK. These data are neither age adjusted nor adjusted for differences in the comorbidity between the 2 groups. As expected, 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 occurred in the transplanted group, in patients who chose not to restart dialysis when their renal transplant failed.

In Table 7.22, 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.

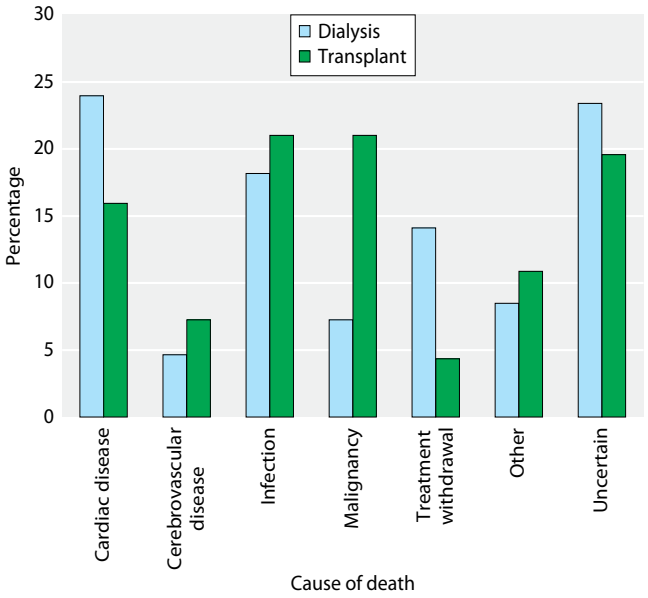

Fig. 7.25. Cause of death by modality for all prevalent patients on 01/01/2007

Conflict of interest: none

Table 7.22. Cause of death in prevalent transplanted patients on 1/1/2007 by age

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	22	16	6	17	16	16	30
Cerebrovascular disease	10	7	1	3	9	9	7
Infection	29	21	7	19	22	22	15
Malignancy	29	21	8	22	21	21	32
Treatment withdrawal	6	4	2	6	4	4	1
Other	15	11	6	17	9	9	15
Uncertain	27	20	6	17	21	21	0
Total	**138**		**36**		**102**		
No cause of death data	348		100		248		

* ANZDATA Registry Report 2007

Table 7.23. Cause of death in prevalent dialysis patients on 1/1/2007 by age

Cause of death in dialysis patients	All age groups		<65 years		⩾65 years		ANZdata*
	Number of deaths	%	Number of deaths	%	Number of deaths	%	%
Cardiac disease	294	24	99	28	195	22	35
Cerebrovascular disease	57	5	14	4	43	5	9
Infection	223	18	61	17	162	19	10
Malignancy	89	7	24	7	65	7	7
Treatment withdrawal	173	14	35	10	138	15	34
Other	104	8	47	13	57	7	5
Uncertain	287	23	79	22	208	24	1
Total	**1,227**		**359**		**868**		
No cause of death data	1,948		583		1,365		

* ANZDATA Registry Report 2007

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5. Office for National Statistics http://www.statistics.gov.uk
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Appendix 1: Survival tables

Table 7.24. One-year after 90-day incident survival by centre for 2006 unadjusted and adjusted to age 60

Centre	Unadjusted 1yr after 90d survival	Adjusted 1yr after 90d survival	Adjusted 1yr after 90d 95% CI	Centre	Unadjusted 1yr after 90d survival	Adjusted 1yr after 90d survival	Adjusted 1yr after 90d 95% CI
Abrdn	81.1	85.8	77.6–94.8	L Rfree	91.0	91.9	88.2–95.7
Airdrie	79.1	77.7	67.0–90.1	L West	95.3	96.1	94.0–98.2
Antrim	86.1	91.4	83.8–99.7	Leeds	83.6	86.4	81.5–91.5
B Heart	84.5	89.3	84.1–94.8	Leic	84.9	87.5	83.4–91.8
B QEH	83.5	87.7	83.5–92.0	Liv Ain	84.8	86.7	76.7–98.0
Bangor	73.6	80.1	68.0–94.2	Liv RI	81.9	83.2	77.0–89.9
Basldn	89.9	93.0	86.7–99.8	M Hope	90.6	91.8	87.3–96.6
Belfast	92.1	94.0	89.8–98.4	Middlbr	90.5	92.7	88.2–97.4
Bradfd	73.1	76.5	65.4–89.5	Newc	84.9	86.4	80.2–93.0
Brightn	87.0	91.2	87.1–95.6	Norwch	82.9	88.4	83.0–94.1
Bristol	91.9	93.9	90.8–97.2	Nottm	92.1	94.2	90.6–97.9
Camb	90.6	92.4	88.5–96.5	Oxford	88.7	90.6	86.4–95.0
Cardff	83.7	87.5	83.4–91.8	Plymth	78.7	84.3	77.8–91.4
Carlis	88.5	91.0	82.0–100	Ports	82.4	86.5	81.9–91.4
Carsh	79.7	85.8	81.3–90.6	Prestn	78.5	83.0	76.6–89.9
Chelms	78.6	86.5	78.6–95.1	Redng	86.5	90.2	84.4–96.5
Covnt	82.1	85.5	79.4–92.2	Sheff	86.6	88.6	84.0–93.5
Derby	90.2	92.7	87.2–98.4	Shrew	87.8	90.0	82.7–97.9
Dorset	84.6	89.5	82.8–96.6	Stevng	84.1	86.6	80.7–93.0
Dudley	85.0	89.8	82.5–97.8	Sthend	97.6	98.1	94.5–100
Dundee	91.3	93.7	88.0–99.8	Sund	76.0	80.9	71.9–91.2
Dunfn	80.0	83.1	72.6–95.0	Swanse	76.7	84.4	78.7–90.6
Edinb	86.5	88.6	83.0–94.6	Truro	88.0	92.1	85.7–98.9
Exeter	81.5	87.5	82.2–93.1	Tyrone	87.5	91.4	82.8–100
Glasgw	82.1	85.7	81.1–90.6	Wirral	88.2	90.4	83.5–97.9
Glouc	85.7	90.4	84.5–96.6	Wolve	86.2	89.3	83.2–95.8
Hull	91.3	92.7	87.9–97.7	Wrexm	87.6	90.7	81.6–100
Inverns	87.6	90.2	80.6–100	York	77.0	81.8	71.8–93.2
Ipswi	94.0	95.6	89.9–100	**England**	**86.6**	**89.5**	**88.5–90.5**
Klmarnk	77.9	83.9	75.6–93.1	**N Ireland**	**88.6**	**91.9**	**88.6–95.3**
L Barts	91.5	92.3	88.6–96.1	**Scotland**	**82.8**	**86.2**	**83.5–89.0**
L Guys	87.9	88.3	82.7–94.3	**Wales**	**81.7**	**86.7**	**83.6–89.9**
L Kings	87.5	89.3	83.7–95.3	**UK**	**86.0**	**89.1**	**88.2–90.0**

Table 7.25. Ninety day incident survival by centre for 2006 unadjusted and adjusted to age 60

Centre	Unadjusted 90d survival	Adjusted 90d survival	Adjusted 90d 95% CI	Centre	Unadjusted 90d survival	Adjusted 90d survival	Adjusted 90d 95% CI
Abrdn	90.6	94.1	89.3–99.2	L Rfree	96.2	97.1	95.1–99.1
Airdrie	96.4	96.9	92.7–100	L West	98.2	98.7	97.5–99.8
Antrim	96.9	98.4	95.4–100	Leeds	92.2	94.5	91.7–97.4
B Heart	86.0	91.8	87.9–95.8	Leic	89.3	92.5	89.7–95.4
B QEH	95.1	97.0	95.1–99.0	Liv Ain	91.2	93.3	86.4–100
Bangor	75.0	83.6	74.8–93.4	Liv RI	89.3	91.8	87.9–95.9
Basldn	95.7	97.1	93.3–100	M Hope	96.1	97.1	94.6–99.6
Belfast	94.5	96.5	93.8–99.3	Middlbr	93.3	95.5	92.4–98.8
Bradfd	85.7	89.3	82.1–97.1	Newc	91.7	93.5	89.4–97.7
Brightn	92.4	95.6	92.9–98.3	Norwch	82.6	90.5	86.4–94.8
Bristol	93.1	95.8	93.5–98.2	Nottm	89.5	93.6	90.4–97.0
Camb	86.7	90.7	86.9–94.6	Oxford	95.5	97.0	94.8–99.2
Cardff	92.8	95.5	93.2–97.8	Plymth	93.4	96.3	93.4–99.3
Carlis	96.3	97.4	92.5–100	Ports	90.2	93.7	90.8–96.7
Carsh	93.4	96.3	94.2–98.4	Prestn	96.7	97.7	95.6–100
Chelms	91.8	95.9	92.1–99.9	Redng	94.8	96.8	93.8–99.9
Covnt	94.2	96.1	93.1–99.2	Sheff	94.6	96.2	93.8–98.7
Derby	88.4	92.7	88.0–97.7	Shrew	92.6	94.4	89.3–99.8
Dorset	100.0	–	–	Stevng	90.7	93.1	89.2–97.1
Dudley	90.9	94.9	90.2–99.9	Sthend	93.5	95.4	90.5–100
Dundee	86.5	91.4	85.6–97.7	Sund	87.5	91.9	86.3–97.8
Dunfn	94.6	96.3	91.4–100	Swanse	92.0	95.9	93.3–98.6
Edinb	91.3	93.8	89.9–97.8	Truro	94.0	96.6	93.0–100
Exeter	94.3	96.9	94.5–99.4	Tyrone	97.0	98.2	94.8–100
Glasgw	88.9	92.6	89.6–95.8	Wirral	96.4	97.6	94.5–100
Glouc	94.5	96.9	93.9–99.9	Wolve	88.4	92.2	87.7–97.0
Hull	94.8	96.3	93.2–99.5	Wrexm	100.0	–	–
Inverns	96.2	97.6	93.2–100	York	89.4	93.1	87.5–99.1
Ipswi	92.6	95.3	90.4–100	**England**	**92.9**	**95.3**	**94.6–96.0**
Klmarnk	94.6	96.8	93.4–100	**N Ireland**	**95.0**	**97.0**	**95.2–98.9**
L Barts	96.2	97.0	94.9–99.2	**Scotland**	**91.2**	**94.2**	**92.6–95.8**
L Guys	98.5	98.8	97.1–100	**Wales**	**90.8**	**94.6**	**92.9–96.4**
L Kings	95.5	96.6	93.7–99.6	**UK**	**92.7**	**95.2**	**94.6–95.8**

Table 7.26. One year after 90-day incident survival by centre for incident cohort years 1999–2006 adjusted to age 60

Centre	1999	2000	2001	2002	2003	2004	2005	2006
Abrdn	81.8	79.8	92.4	87.9	82.9	89.8	80.1	85.8
Airdrie	74.8	81.6	84.8	78.4	80.0	85.6	72.3	77.7
Antrim							87.2	91.4
B Heart	86.6	82.7	85.1	87.8	86.3	88.0	86.1	89.3
B QEH						88.2	90.7	87.7
Bangor				82.2	86.9	84.0	83.4	80.1
Basldn					91.8	95.1	89.7	93.0
Belfast							90.0	94.0
Bradfd			93.1	85.2	83.9	85.5	85.6	76.5
Brightn						87.9	83.0	91.2
Bristol	85.7	86.3	85.8	88.4	87.3	87.5	83.3	93.9
Camb			90.7	82.0	89.4	87.9	91.2	92.4
Cardff	88.3	88.7	83.6	82.7	89.6	86.3	88.5	87.5
Carlis	–	79.4	–	88.4	78.3	86.5	82.8	91.0
Carsh	86.2	85.9	75.8	85.7	90.6	86.3	91.9	85.8
Chelms						81.7	84.5	86.5
Clwyd				–	–	–	81.7	–

Table 7.26. Continued

Centre	1999	2000	2001	2002	2003	2004	2005	2006
Covnt	78.9	82.6	87.8	90.6	82.4	85.3	87.2	85.5
D & Gall	–	–	74.6	78.1	85.5	–	–	–
Derby		88.2	85.1		83.6	86.7	89.3	92.7
Derry							–	–
Dorset					86.0	91.1	81.4	89.5
Dudley	89.8	86.2	90.2	89.3	88.8	85.6	97.0	89.8
Dundee	89.6	77.6	86.8	83.9	89.6	84.1	86.1	93.7
Dunfn	80.0	72.2	70.3	86.8	85.7	87.8	77.1	83.1
Edinb	84.9	80.4	80.5	82.5	83.2	79.9	86.0	88.6
Exeter	87.2	86.3	86.2	87.0	86.1	86.8	85.5	87.5
Glasgw	85.2	84.7	79.9	84.6	85.0	81.6	85.0	85.7
Glouc	88.3	95.0	82.1	81.2	84.3	86.7	94.6	90.4
Hull	88.2	86.3	90.0	85.0	87.9	86.3	89.3	92.7
Inverns	–	84.1	91.7	83.6	88.0	83.4	85.4	90.2
Ipswi				98.3	93.7	90.9	85.7	95.6
Klmarnk	90.5	91.5	88.3	87.3	85.3	83.9	93.7	83.9
L Barts						87.4	92.9	92.3
L Guys		89.3	88.4	85.1	95.6	88.0	92.7	88.3
L Kings				88.0	86.2	88.7	89.0	89.3
L Rfree							92.8	91.9
L West				92.9	95.0	92.5	93.7	96.1
Leeds	81.8	91.1	89.2	85.4	87.9	90.0	88.6	86.4
Leic	85.6	84.5	87.2	87.6	91.5	85.5	85.6	87.5
Liv Ain						–	87.5	86.7
Liv RI			87.9	85.2	83.5	83.6	92.5	83.2
M Hope					88.1	82.7	92.2	91.8
Middlbr	81.0	89.1	84.1	79.0	82.4	85.1	83.2	92.7
Newc				87.1	87.3	83.2	83.6	86.4
Newry							87.1	–
Norwch						86.0	90.1	88.4
Nottm	86.9	90.0	89.3	87.1	86.4	83.7	86.2	94.2
Oxford	94.4	90.4	86.5	89.1	87.9	90.5	86.6	90.6
Plymth	82.5	86.3	73.5	81.9	81.6	80.9	81.9	84.3
Ports			87.1	86.2	88.2	87.9	83.7	86.5
Prestn	87.7	87.3	86.9	87.2	86.4	84.4	91.5	83.0
Redng		77.7	83.6	91.7	89.9	93.1	88.2	90.2
Sheff	85.0	95.0	93.8	84.0	90.1	89.4	92.2	88.6
Shrew						87.9	90.3	90.0
Stevng	87.1	90.4	81.4	87.5	94.8	87.7	78.7	86.6
Sthend	88.6	82.5	82.5	87.4	90.7	88.7	92.3	98.1
Sund	80.5	84.8	83.9	69.5	81.0	87.5	82.4	80.9
Swanse		86.4	85.2	82.8	81.4	83.0	84.3	84.4
Truro			91.5	83.8	88.6	93.3	87.8	92.1
Tyrone							–	–
Ulster							–	–
Wirral				77.1	95.0	82.9	87.6	90.4
Wolve	86.5	87.3	76.7	87.0	83.0	87.8	86.2	89.3
Wrexm	81.7	84.7	83.0	93.2	82.0	91.8	91.2	90.7
York		83.8	86.7	82.1	77.0	89.2	84.9	81.8
England	**85.8**	**87.7**	**86.5**	**86.4**	**88.2**	**87.6**	**88.5**	**89.5**
N Ireland							**89.8**	**91.9**
Scotland	**85.3**	**82.0**	**82.7**	**83.8**	**85.2**	**83.8**	**84.2**	**86.2**
Wales	**87.1**	**87.4**	**84.2**	**84.3**	**85.9**	**85.7**	**86.5**	**86.7**
UK	**85.8**	**86.6**	**85.8**	**85.9**	**87.6**	**87.1**	**88.0**	**89.1**

– Centres with <20 patients are excluded for that year
Blank cells, data not available for that year

Table 7.27. One year prevalent survival by centre for prevalent cohort years 2000–2007 adjusted to age 60

	1 year survival by centre and year							
Centre	2000	2001	2002	2003	2004	2005	2006	2007
Abrdn	85.8	89.3	87.2	80.4	85.3	87.4	86.7	89.6
Airdrie	77.3	76.8	81.2	83.6	84.3	82.6	79.4	78.3
Antrim						83.4	91.9	85.4
B Heart	86.6	87.4	87.6	87.5	86.8	87.9	86.4	87.6
B QEH					89.0	89.0	88.7	88.6
Bangor			86.0	81.6	89.8	86.6	90.4	80.7
Basldn				81.5	88.0	90.7	90.2	91.4
Belfast						86.4	87.3	90.9
Bradfd		79.9	88.0	82.7	87.9	86.1	82.2	83.2
Brightn					86.7	84.3	88.0	87.7
Bristol	87.3	86.1	87.8	88.9	87.0	87.7	87.9	89.3
Camb		86.1	86.7	86.9	87.6	87.8	88.8	88.3
Cardff	85.2	85.7	85.9	81.1	84.5	84.4	84.4	88.8
Carlis	82.8	88.9	80.6	83.1	82.5	85.0	84.4	87.0
Carsh	83.7	83.9	83.2	85.4	88.4	86.5	89.3	89.0
Chelms					86.4	81.6	85.1	85.6
Clwyd			88.1	89.0	75.8	82.2	79.9	91.1
Covnt	87.2	85.7	85.1	87.7	88.7	89.4	85.4	86.9
D & Gall	87.2	83.8	84.6	86.3	83.1	91.3	82.0	90.5
Derby	88.8	89.6		86.5	88.8	88.4	89.2	87.5
Derry								86.4
Dorset				90.0	87.8	90.2	85.9	86.9
Dudley	85.4	83.3	83.2	84.8	86.7	86.3	87.5	86.7
Dundee	76.7	85.7	84.9	84.0	85.4	87.8	87.6	84.5
Dunfn	76.2	78.5	82.1	83.5	88.9	91.0	87.9	89.2
Edinb	83.7	82.5	84.8	83.8	86.3	86.4	87.1	88.7
Exeter	86.0	84.9	87.2	86.3	85.8	83.8	90.7	87.3
Glasgw	86.2	83.4	85.9	83.8	85.6	87.5	86.5	88.8
Glouc	89.0	79.1	83.6	81.7	89.0	88.3	90.9	87.8
Hull	81.0	86.8	87.2	85.3	85.6	84.7	85.3	89.9
Inverns	80.8	88.8	88.3	87.4	87.3	86.9	86.2	94.2
Ipswi			81.7	84.8	90.4	85.9	84.8	85.2
Klmarnk	80.2	85.2	82.5	82.0	86.9	84.5	91.3	87.1
L Barts					83.8	85.6	88.2	89.1
L Guys	86.2	86.7	86.3	88.8	88.7	89.2	87.9	90.9
L Kings			81.0	77.6	81.5	86.5	88.8	84.6
L Rfree						90.1	90.5	90.5
L West			89.9	91.4	91.1	91.6	91.6	92.8
Leeds	83.4	85.4	87.4	86.1	85.5	88.8	89.2	88.8
Leic	83.2	84.7	84.1	83.8	85.2	87.2	84.5	89.9
Liv Ain		92.5	90.5	90.5	86.6	96.8	86.3	90.9
Liv RI		81.4	82.4	85.2	86.4	84.5	88.9	85.8
M Hope				84.8	82.0	84.1	85.9	88.6
M RI								85.0
Middlbr	84.0	84.0	84.2	84.4	83.0	85.9	85.3	86.7
Newc			83.9	81.7	81.8	86.9	84.9	87.2
Newry						85.9	87.9	86.7
Norwch					86.3	86.9	89.4	86.5
Nottm	85.1	87.0	82.6	85.1	86.3	85.2	83.4	89.5
Oxford	87.7	88.4	85.5	86.8	88.3	87.7	88.3	87.8
Plymth	85.0	87.5	77.2	85.5	87.1	88.1	84.0	83.6
Ports		83.7	80.9	81.5	89.0	85.6	84.9	89.6
Prestn	85.7	87.1	86.3	84.7	85.9	85.5	86.7	90.8
Redng	83.7	77.6	85.0	83.0	89.4	86.8	88.8	89.7

Table 7.27. Continued

	1 year survival by centre and year							
Centre	2000	2001	2002	2003	2004	2005	2006	2007
Sheff	84.1	88.1	90.5	91.0	87.8	87.1	89.2	88.4
Shrew					85.0	87.1	86.1	89.4
Stevng	89.6	90.5	86.5	88.3	89.4	88.7	89.4	89.7
Sthend	85.2	88.6	88.7	86.9	88.9	86.3	83.5	85.8
Stoke								84.4
Sund	76.7	79.3	77.6	75.4	82.7	86.4	78.8	82.4
Swanse	84.2	87.7	80.9	82.4	87.9	89.3	85.9	88.4
Truro		88.8	82.3	90.2	89.9	85.7	91.8	88.8
Tyrone						89.1	83.6	93.3
Ulster						85.8	91.3	89.0
Wirral			92.9	84.8	87.4	89.1	89.1	87.8
Wolve	84.2	90.1	86.6	83.5	86.3	87.8	89.7	87.8
Wrexm	83.4	87.8	87.0	85.6	86.0	84.4	85.1	88.8
York	87.1	79.0	84.7	81.6	82.7	88.3	83.0	88.0
England	**85.3**	**85.8**	**85.7**	**86.2**	**87.1**	**87.5**	**87.8**	**88.6**
N Ireland						**86.1**	**88.0**	**89.2**
Scotland	**83.2**	**83.6**	**85.0**	**83.6**	**85.8**	**87.0**	**86.4**	**88.0**
Wales	**84.5**	**86.7**	**84.9**	**82.6**	**85.6**	**86.0**	**85.2**	**88.2**
UK	**84.9**	**85.6**	**85.5**	**85.6**	**86.9**	**87.3**	**87.6**	**88.5**

Blank cells, data not available for that year

Chapter 8
Adequacy of haemodialysis in UK renal centres in 2007: 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-one 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 2007 and the incident patient population for 2007. Centres returning data on <50% of their patient population were excluded from centre-specific comparisons. ***Results:*** Data regarding URR were available from 61 renal centres in the UK. Forty six centres provided URR data on more than 90% of prevalent patients. 81% of prevalent HD patients met the UK Clinical Practice Guideline for URR (>65%) in 2007. There has been an increase from 56% in 1998 to 81% in 2007 in the proportion of patients in the UK who achieved a URR >65%. The HD dose (URR) delivered to patients who have just started dialysis treatment is lower than that of patients who have been treated for longer and increases further with time. ***Conclusions:*** The delivered dose of HD for patients with established renal failure has increased over 9 years. There was considerable variation from one centre to another, with 8 centres attaining the RA clinical practice guideline in >90% of patients and 7 centres attaining the standard in <60% of patients.

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, 3]. It depends on treatment (duration & frequency of dialysis; dialyser size; dialysate and blood flow rate) and patient (size; weight; haematocrit and vascular access) characteristics [4]. 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 and although it can be estimated using one of several formulae, 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].

Further analysis of the data [5] 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 [6] 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 slight differences in the methodology advised [7, 8].

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 small molecular clearance during HD relying on studies that have demonstrated a close linear relationship between this measure and conventional measures of urea clearance [9]. 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 is to determine the extent to which patients undergoing HD treatment for established renal failure in the UK receive the dose of HD recommended in the UK RA Clinical Practice Guidelines [8].

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 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

Seventy-one renal centres in the UK submit data electronically to the UKRR on a quarterly basis. 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 2007. For this analysis, data for URR were taken from the last quarter of 2007 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 2007. For these patients analysis was undertaken using the last recorded URR during the quarter in which the patient had started dialysis.

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 [8] 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 [8].

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.

A further 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 [10] aimed to achieve uniformity and this was reflected in the RA standards [11]. No reliable data were available to clarify whether the important variations in post-dialysis sampling methodology that were identified at that time persist.

Results

Data completeness

Data regarding HD dose (URR) were available from 61 of the 71 renal centres which submitted data to the UKRR (table 8.1). The prevalent patient population with complete data was 11,932. There were 2,256 incident patients for whom data were available for URR during the 3 months after they had started treatment with HD.

Forty six centres submitted data on at least 90% of patients treated with HD. Eleven centres were included in the analysis but returned data from less than 90% of patients – Chelmsford (88%), Norwich (86%), Dudley (85%), Kilmarnock (85%), Southend (84%), Wrexham (83%), Preston (82%), Wolverhampton (80%), Carshalton (75%), Oxford (75%) and Manchester Hope (53%). Twelve centres (Brighton, Cambridge, Derby, Dundee, London Barts, London Kings, London Royal Free, London West, Manchester Royal Infirmary, Newcastle, Stoke 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. The number preceding the centre name in each figure indicates the percentage of missing data from that centre.

Table 8.1. Percentage completeness of URR data returns

Centre	% complete	Centre	% complete
Abrdn	98	L Rfree	0
Airdrie	91	L St G	0
Antrim	98	L West	30
B Heart	92	Leeds	94
B QEH	95	Leic	98
Bangor	94	Liv Ain	96
Basldn	98	Liv RI	91
Belfast	94	M Hope	53
Bradfd	97	M RI	0
Brightn	0	Middlbr	95
Bristol	99	Newc	0
Camb	45	Newry	99
Cardff	91	Norwch	86
Carlis	95	Nottm	98
Carsh	75	Oxford	75
Chelms	88	Plymth	95
Clwyd	91	Ports	96
Covnt	96	Prestn	82
D&Gall	96	Redng	98
Derby	0	Sheff	95
Derry	100	Shrew	91
Donc	100	Stevng	92
Dorset	95	Sthend	84
Dudley	85	Stoke	0
Dundee	1	Sund	96
Dunfn	98	Swanse	98
Edinb	98	Truro	98
Exeter	96	Tyrone	96
Glasgw	95	Ulster	99
Glouc	95	Wirral	31
Hull	93	Wolve	80
Inverns	99	Wrexm	83
Ipswi	100	York	98
Kent	0	**England**	**68**
Klmarnk	85	**N Ireland**	**97**
L Barts	0	**Scotland**	**86**
L Guys	91	**Wales**	**93**
L Kings	0	**UK**	**72**

Achieved URR

The median URR (72% for UK; centre range 65%–77%) and percentage (81% for UK; centre range 47%–97%) of reported patients attaining the RA Standard of a URR >65% from 57 renal centres are shown in figures

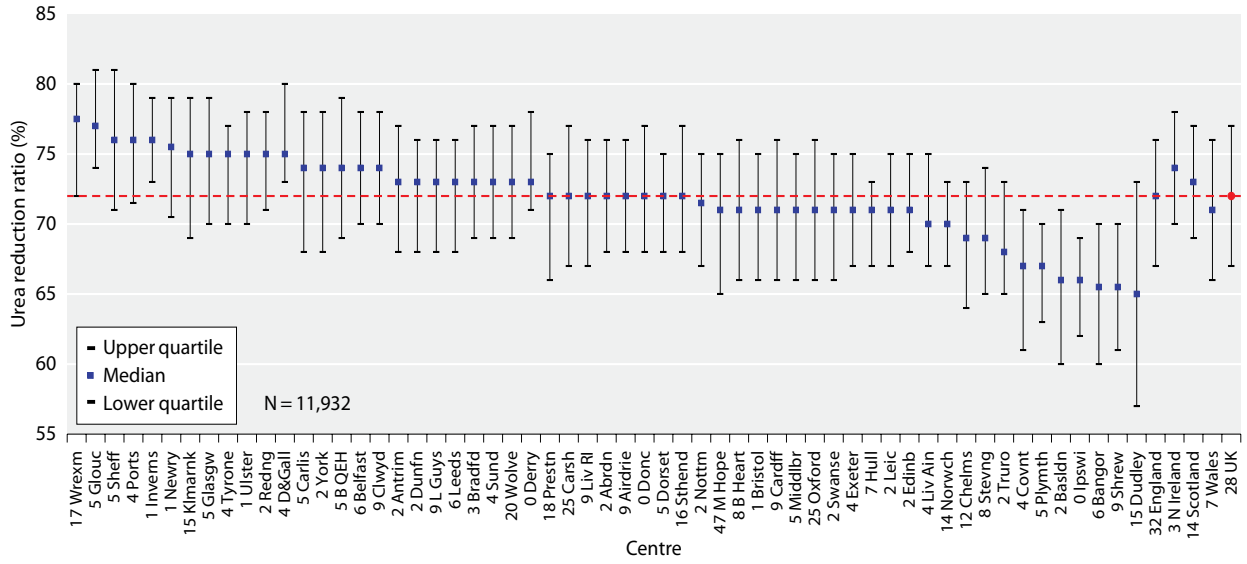

Fig. 8.1. Median URR achieved in each centre, 2007

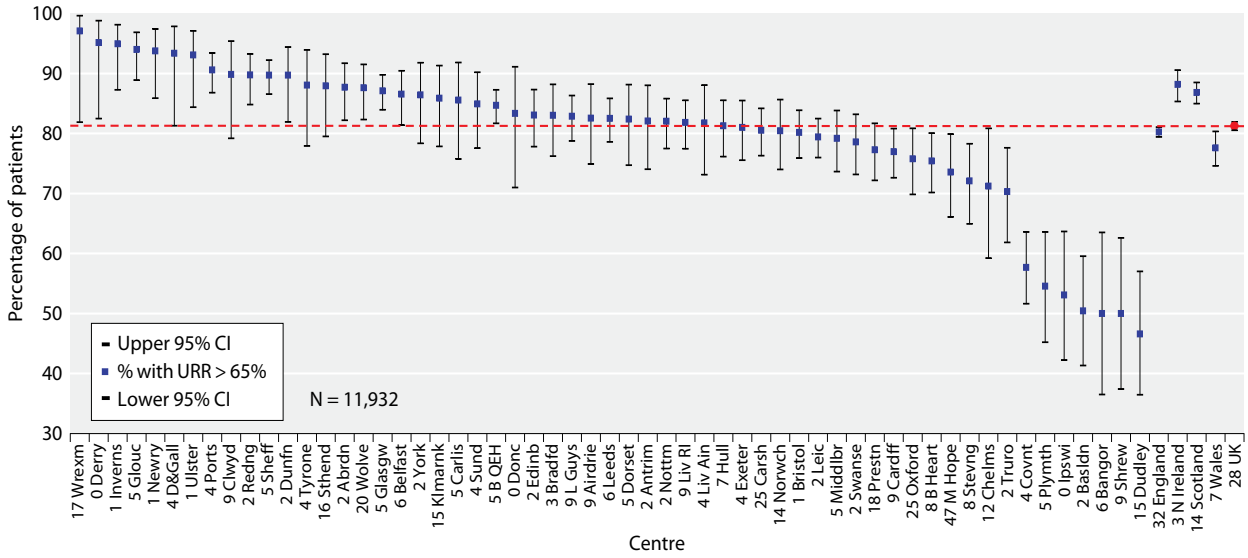

Fig. 8.2. Percentage of patients with URR >65% in each centre, 2007

8.1 and 8.2. Figure 8.3 illustrates the close relationship between the two. With one exception (Derry; median URR 73%) all 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 7 centres with a median URR of 67% or less achieved the RA Standard for HD dose in less than 60% of their patients.

Changes in URR over time

The change in both the percentage attainment of the RA clinical practice guidelines (URR >65%) and the median URR for England, Wales and Scotland from

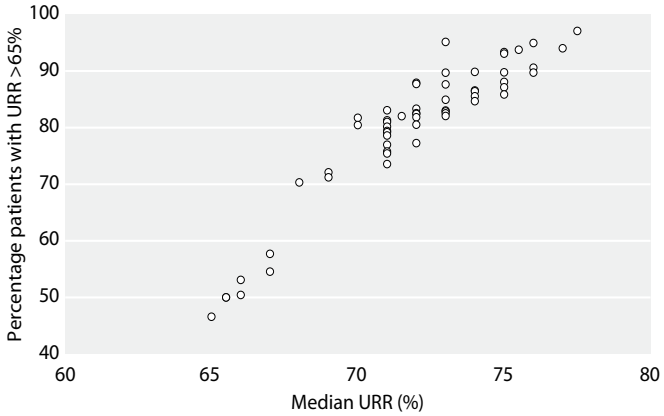

Fig. 8.3. Relationship between achievement of the Renal Association Standard for URR and the median URR in each centre, 2007

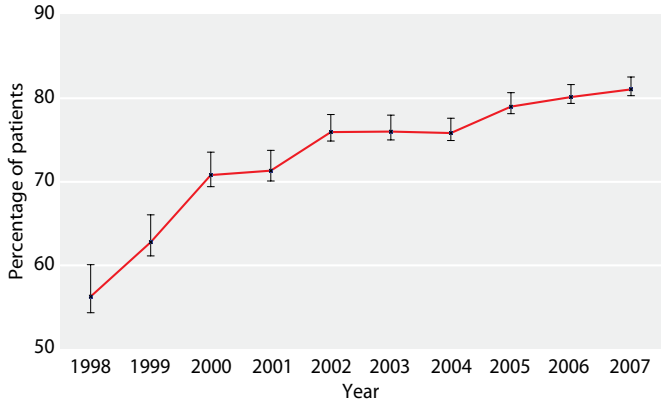

Fig. 8.4. Change in the percentage of patients with URR >65% between 1998 and 2007 in England, Wales and Scotland

1998 to 2007 are shown in figures 8.4 and 8.5. Northern Ireland has only provided complete data since 2005 and has therefore been excluded from these two analyses. The results show that the proportion of patients attaining the RA standard has increased from 56% to 81% from 1998 to 2007 (figure 8.4) and over the same time period the median URR has risen from 67% to 72% (figure 8.5). The UKRR is aiming to provide centre-specific reports within the near future. This will enable centres to view their own longitudinal trends for data such as these.

Variation of achieved URR with time on dialysis

The proportion of patients who attained the RA Standard increased in parallel with the time since those patients started dialysis (figure 8.6). Of those dialysed for less than six months, 62% had a URR >65% whilst 85% of patients who had been dialysed for more than two years attained the standard in 2007.

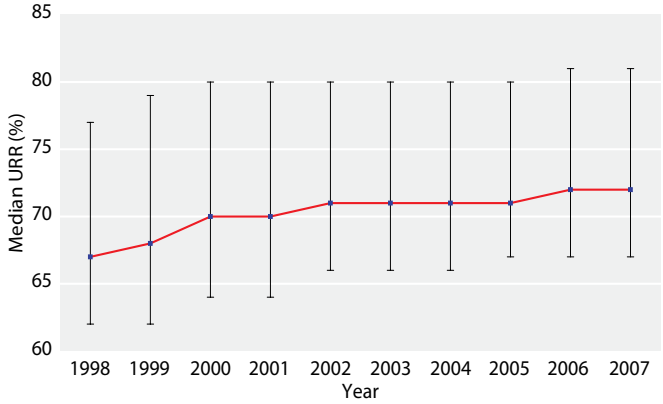

Fig. 8.5. Change in median URR between 1998 and 2007 in England, Wales and Scotland

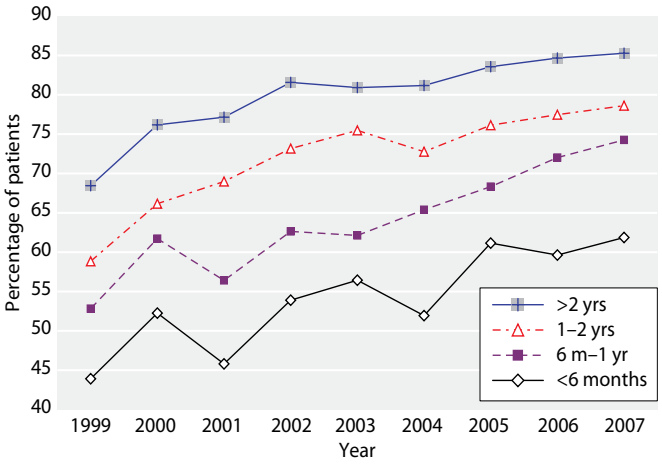

Fig. 8.6. Percentage of prevalent haemodialysis patients achieving URR >65% against duration on haemodialysis between 1999 and 2007

The median URR during the first quarter after starting HD treatment of the incident HD population in the UK in 2007 was 64% (figure 8.7).

Discussion

The proportion of patients achieving the RA standard for URR has increased steadily during the 8 years since 1998. This observation is also consistent when patients are grouped on the basis of length of time since starting HD treatment. In 2007 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 more than 85% achieved the target. The figure for patients during the first 6 months after starting treatment was lower (64%) but in these patients a high proportion will have residual renal function to compensate.

There was a wide range (47%–97%) of achievement 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 [10].

The median URR of patients undergoing HD in the UK in 2007 was 72% (centre range of 65%–77%). 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.

Furthermore, recent studies have suggested that prescription of a target Kt/V of 1.2 in females and small males underestimates the required dose [12].

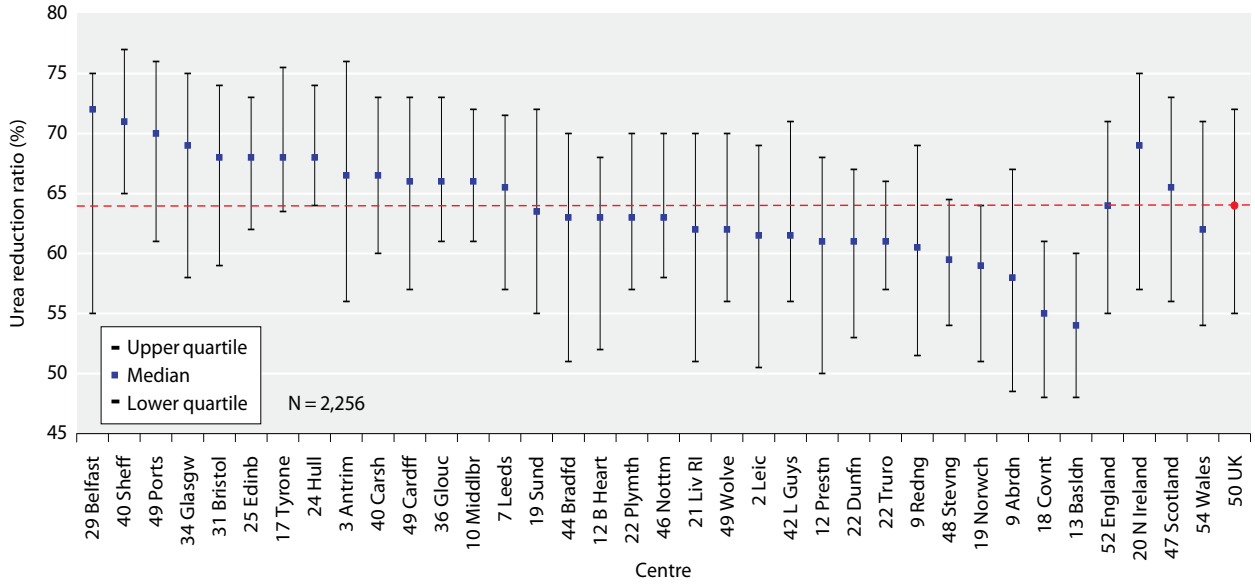

Fig. 8.7. Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2007

These observations support the K-DOQI guidelines for HD which advise an increase in the minimum dialysis dose target for women and small men [13].

Some commentators [14] have cast doubt on the utility of measures of urea clearance for the measurement of HD dose, justifying these doubts by reference to the studies that show that body size confounds the relationship between URR and outcome [12]; studies that show that outcome is better with longer treatment times, independent of urea removal [4, 15–19]; and that clearance of 'middle molecules' is also important in determining outcomes [20, 21]. However, no consensus has yet emerged on alternative markers of HD dose. The findings of the HEMO study [6] should not be interpreted as showing that urea clearance is unimportant; only that there may be a 'ceiling effect' above which greater urea clearance, achieved using thrice weekly dialysis, has no additional benefit.

The failure to demonstrate any beneficial effect on survival by increasing HD dose above a URR of 65% [6] has raised doubts about the validity of URR and Kt/V as the appropriate measures to assess HD dose [14]. The impact of duration and frequency of HD independent of dialysis dose as measured by Kt/V or URR is uncertain [4, 15]. There is some evidence that longer treatment time improves survival [16, 17] and that care should be taken when using Kt/V or reduction ratios as the only parameters to quantify HD adequacy [18, 19]. Furthermore, it may be that urea is not the most appropriate retention product to use for measuring HD dose and that alternate marker molecules should be used [20, 21]. Both topics warrant further investigation.

Conflict of interest: none

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Chapter 9
Haemoglobin, ferritin and erythropoietin amongst patients receiving dialysis in the UK in 2007: national and centre-specific analyses

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Key Words
Anaemia · Chronic kidney disease · Dialysis · End stage renal disease · Erythropoietin · Ferritin · Haemoglobin · Renal Registry · Epidemiology · Quality improvement

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 and Northern Ireland (EWNI), and annual data from the Scottish Renal Registry for incident and prevalent renal replacement therapy (RRT) cohorts for 2007 were analysed by the UK Renal Registry (UKRR). ***Results:*** In the UK, in 2007 58% of patients commenced dialysis therapy with Hb $\geqslant$10.0 g/dl (median Hb 10.3 g/dl). Of incident patients 81% and 87% had a Hb $\geqslant$10.0 g/dl by 3 and 6 months of dialysis treatment respectively. The median Hb of haemodialysis (HD) patients was 11.6 g/dl with an interquartile range (IQR) of 10.6–12.6 g/dl. Of HD patients 86% had a Hb $\geqslant$10.0 g/dl. The median Hb of peritoneal dialysis (PD) patients in the UK was 11.9 g/dl (IQR 11.0–12.8 g/dl). 91% of UK PD patients had a Hb $\geqslant$10.0 g/dl. The median ferritin in HD patients in EWNI was 417 μg/L (IQR 270–598) and 95% of HD patients had a ferritin $\geqslant$100 μg/L. The median ferritin in PD patients was 255 μg/L (IQR 143–411) with 85% of PD patients having a ferritin $\geqslant$100 μg/L. In EWNI the mean ESA dose was higher for HD than PD patients (9,300 vs. 6,100 IU/week). ***Conclusions:*** This year for the first time there has been a small fall (from 85.9% in 2006 to 85.6%) in the percentage of HD patients with an Hb of $\geqslant$10 g/dl. This contrasts with previous annual improvements in this figure and is related to implementation of the new Hb Standard which has a target range of 10.5–12.5 g/dl.

Introduction

This chapter describes data reported to the UKRR relating to management of renal anaemia during 2007.

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 specific measurement 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 2007 [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. In the 2006 Report much of the data collection had preceded the publication of the NICE guidelines. The 2007 Report begins to show how the attempt to comply with both the 10.5–12.5 g/dl range and the minimum standard of Hb $\geqslant$10.0 g/dl has impacted on the performance against a combination of measures. The risks associated with low ($<$10 g/dl) and high ($>$13 g/dl) Hb are not necessarily equivalent.

National and international recommendations for target iron status in CKD remained unchanged from the 2006 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 (HRC).

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 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 2007 were analysed. The UKRR extracted quarterly data electronically from renal centres in EWNI, data were sent annually from the Scottish Renal Registry. Patients treated with dialysis during the last quarter of 2007 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 2007 was used for analysis.

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. Patients were analysed as a complete cohort and divided by modality into groups.

The last available ferritin measurement was taken from the last three quarters of the year and analysed for prevalent patients. Ferritin data were only received for three patients from Scotland, so all Scottish centres were excluded from ferritin analyses.

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 $\geqslant 100\,\mu g/L$ and $\geqslant 200\,\mu g/L$ 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 2007.

The UK RA Clinical Practice [1,6] 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 centres. Centres were excluded if fewer than 90% of patients were on the ESA file. Centres reporting that fewer than 80% of HD patients or fewer than 65% of PD patients were 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 this data and incomplete data returns risk seriously impacting on any conclusions drawn. Scotland is excluded from the analysis as there were ESA data returns for only 2 patients.

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 end stage renal failure were by definition excluded from the dataset. 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.

The median Hb of patients at the time of starting dialysis in the UK was 10.3 g/dl with 58% of patients having a Hb $\geqslant 10.0$ g/dl (vs. 60% for 2006 Report). The variation between centres remained high (35–88%).

The median starting Hb 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 2007 is shown in figure 9.3. The median Hb and the percentage of incident dialysis patients in 2006 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 not changed significantly since 2002.

Haemoglobin in prevalent haemodialysis patients

The compliance with data returns and Hb outcome for prevalent HD patients 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 10.6–12.6 g/dl. In the UK, 86% 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 fall within 2–3 sd limits of the mean in the funnel

Table 9.1. Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis during 2007

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Abrdn	98	10.2	7.9–13.4	9.3–11.7	54
Airdrie	18				
Antrim	79	10.6	9.2–11.8	9.6–11.5	69
B Heart	90	10.1	7.7–13.6	9.1–11.2	51
B QEH	67	9.9	7.6–12.7	8.9–11.3	48
Bangor	100	10.3	7.6–12.9	9.5–11.7	56
Basldn	100	10.1	7.4–12.0	9.2–11.0	56
Belfast	86	10.1	7.8–13.3	8.8–10.9	58
Bradfd	95	10.1	7.6–13.0	8.5–11.4	52
Brightn	97	10.1	8.0–14.2	9.2–11.5	53
Bristol	99	10.1	7.9–13.7	9.2–11.3	54
Camb	76	10.5	8.0–13.3	9.3–11.5	57
Cardff	99	10.7	8.1–13.3	9.6–11.5	65
Carlis	100	10.3	8.8–13.5	9.7–10.9	63
Carsh	98	10.2	7.8–12.7	9.5–11.4	60
Chelms	94	11.1	7.5–12.9	9.5–11.7	68
Clwyd	87				
Covnt	95	10.5	8.7–12.7	9.6–11.4	62
D & Gall	94				
Derby	91	10.6	8.2–13.0	9.3–11.6	63
Derry	60				
Donc	100				
Dorset	87	10.4	7.4–13.7	9.3–11.6	69
Dudley	97	9.8	7.6–13.3	9.2–11.5	47
Dundee	70	10.3	7.6–13.1	9.4–11.5	58
Dunfn	9				
Edinb	0				
Exeter	99	9.7	7.5–13.1	8.9–10.9	42
Glasgw	90	9.8	7.8–13.1	8.9–10.9	45
Glouc	100	10.1	7.7–12.1	8.7–10.9	55
Hull	95	9.9	7.6–13.3	9.1–11.3	48
Inverns	81				
Ipswi	91	10.0	8.4–11.8	9.3–11.1	50
Klmarnk	63	11.3	8.4–13.4	10.4–12.3	80
L Barts	100	9.8	7.2–13.3	8.6–11.6	48
L Guys	78	10.0	7.8–13.0	8.9–11.3	54
L Kings	96	10.4	8.2–12.9	9.2–11.5	59
L Rfree	75	10.8	8.7–13.2	9.7–11.9	70
L West	67	11.6	9.1–13.7	10.5–12.5	88
Leeds	100	10.0	7.9–12.8	9.2–11.2	52
Leic	100	10.0	7.4–12.8	8.9–10.9	54
Liv Ain	97	9.6	7.8–12.0	8.9–10.5	35
Liv RI	95	10.4	7.7–13.1	9.4–11.5	62
M Hope	97	10.0	7.3–13.6	8.9–11.8	51
M RI	76	10.4	7.8–13.2	9.5–11.4	61
Middlbr	99	10.2	8.0–12.6	8.9–11.0	54
Newc	97	10.7	8.1–13.2	9.4–11.6	67
Newry	100				
Norwch	93	10.0	7.8–13.0	8.9–11.3	52
Nottm	100	10.4	7.6–12.9	9.1–11.4	60
Oxford	100	10.7	8.5–12.8	9.7–11.7	70
Plymth	79	10.6	7.9–13.7	9.7–11.7	63
Ports	100	10.3	7.8–13.4	9.3–11.5	55
Prestn	95	9.9	7.0–12.6	8.8–11.4	49
Redng	99	10.3	8.0–14.0	9.2–11.7	59
Sheff	100	9.9	7.7–12.7	9.0–11.2	50
Shrew	100	11.2	7.7–13.5	9.9–12.1	71
Stevng	100	10.2	8.3–12.7	9.3–11.2	57

Table 9.1. Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Sthend	100	9.9	8.2–14.2	9.1–10.8	48
Stoke	100	10.1	8.0–13.5	9.2–11.8	55
Sund	100	10.3	7.6–13.0	9.1–10.9	58
Swanse	100	10.4	7.7–13.4	9.2–11.7	57
Truro	100	10.6	9.0–12.2	9.8–11.1	67
Tyrone	95	9.7	7.4–12.3	9.2–11.0	43
Ulster	95				
Wirral	75	10.6	8.6–13.7	9.4–11.4	67
Wolve	97	10.8	7.6–14.2	9.5–12.1	64
Wrexm	96	10.4	8.3–12.6	9.3–11.8	56
York	97	10.8	7.2–13.8	9.1–11.7	63
England	**91**	**10.3**	**7.8–13.1**	**9.2–11.5**	**58**
N Ireland	**87**	**10.2**	**7.8–12.6**	**9.3–11.4**	**59**
Scotland	**60**	**10.2**	**7.9–13.2**	**9.2–11.3**	**54**
Wales	**99**	**10.5**	**8.0–13.3**	**9.4–11.7**	**62**
UK	**88**	**10.3**	**7.8–13.1**	**9.2–11.5**	**58**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

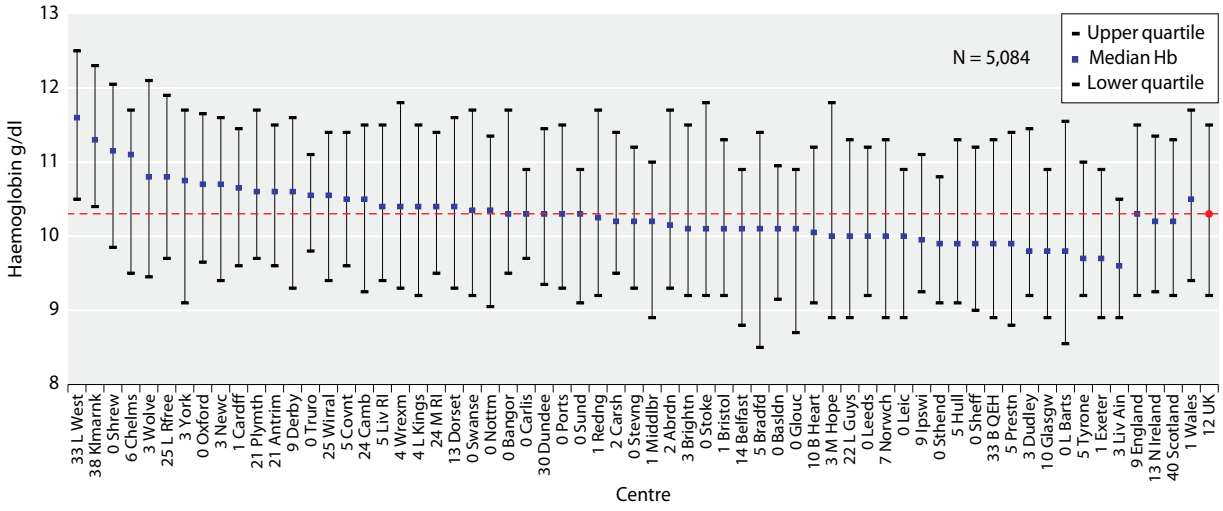

Fig. 9.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2007

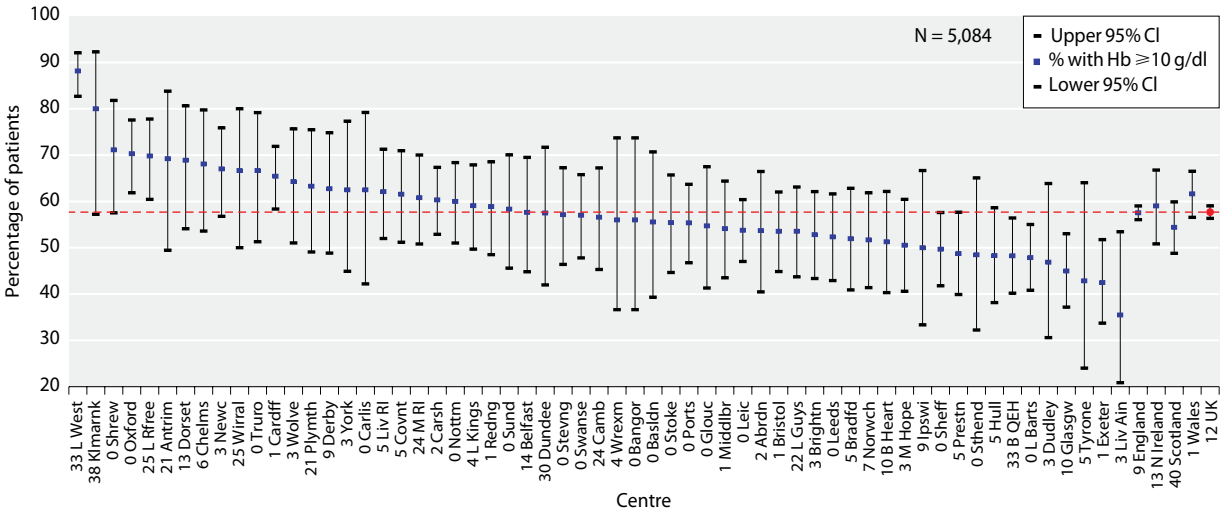

Fig. 9.2. Percentage of incident dialysis patients with Hb ⩾10 g/dl at start of dialysis treatment in 2007

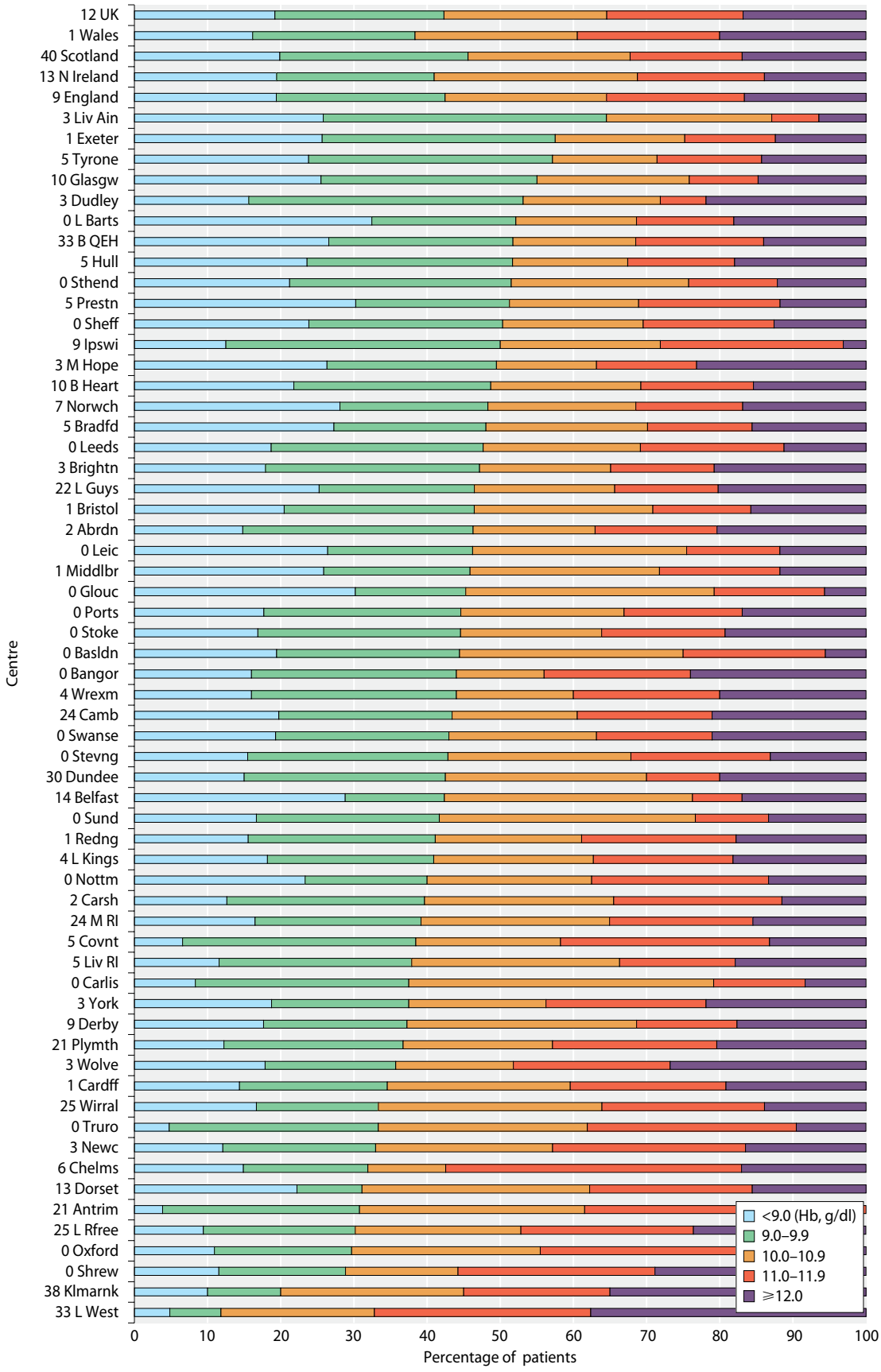

Fig. 9.3. Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment in 2007

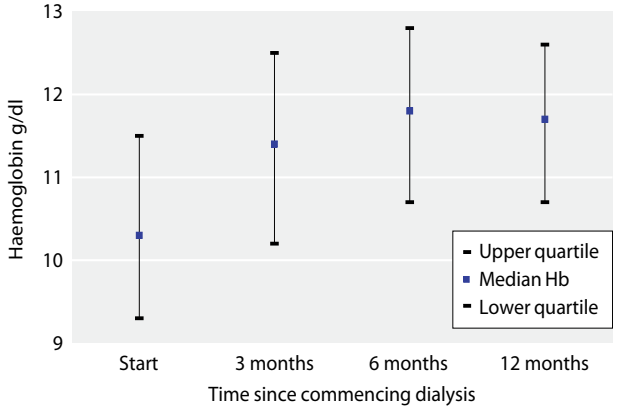

Fig. 9.4. Median haemoglobin, by time on dialysis, for incident dialysis patients in 2006

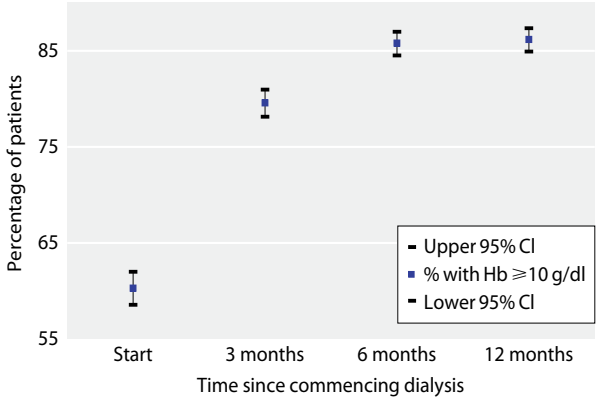

Fig. 9.5. Percentage of incident dialysis patients in 2006 with Hb ⩾10 g/dl, by time on dialysis

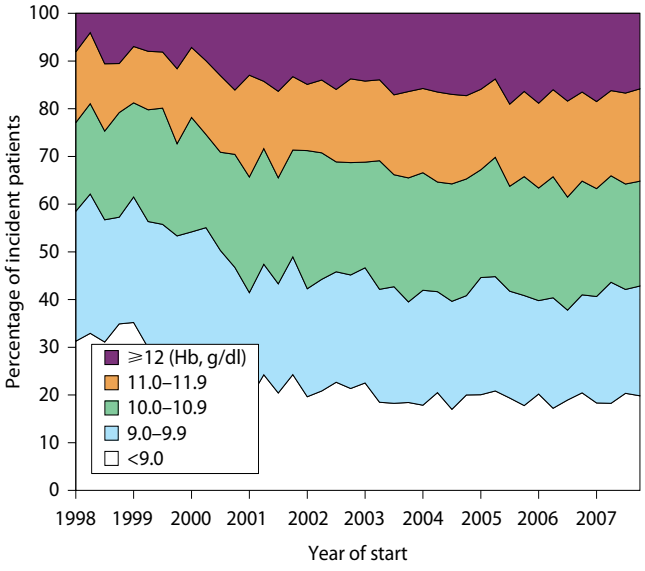

Fig. 9.6. Distribution of haemoglobin in incident dialysis patients by year of start

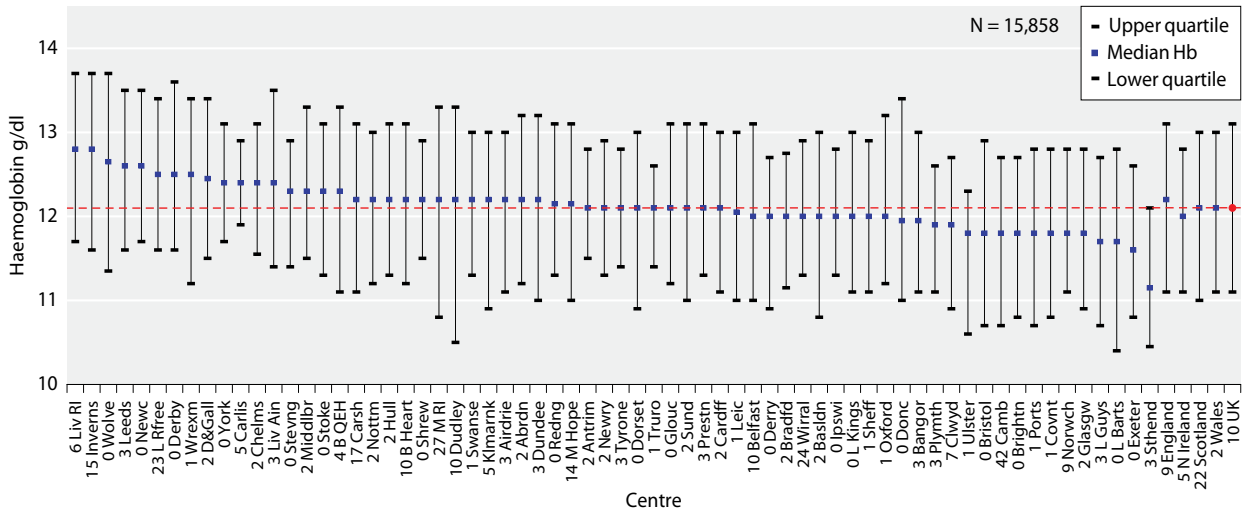

Fig. 9.7. Median haemoglobin in patients treated with HD

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	98	11.7	8.8–13.9	10.7–12.7	11.6	1.5	87	70
Airdrie	97	11.7	9.0–14.2	10.6–12.5	11.6	1.5	86	67
Antrim	98	11.6	8.6–13.4	11.0–12.3	11.5	1.4	89	76
B Heart	90	11.7	8.9–14.0	10.7–12.6	11.6	1.5	86	72
B QEH	96	11.8	8.5–14.1	10.6–12.8	11.6	1.7	86	68
Bangor	97	11.5	8.8–14.1	10.6–12.5	11.5	1.5	88	64
Basldn	98	11.5	9.0–13.6	10.3–12.5	11.4	1.6	80	60
Belfast	90	11.5	8.4–14.1	10.5–12.6	11.4	1.7	79	63
Bradfd	98	11.5	9.3–14.1	10.7–12.3	11.4	1.4	85	67
Brightn	100	11.3	8.7–13.3	10.3–12.2	11.2	1.4	82	61
Bristol	100	11.3	8.8–14.0	10.2–12.4	11.3	1.6	81	61
Camb	58	11.3	8.6–13.9	10.2–12.2	11.2	1.6	79	59
Cardff	98	11.6	9.2–14.1	10.6–12.5	11.5	1.5	86	64
Carlis	95	11.9	9.8–14.1	11.4–12.4	11.9	1.2	95	77
Carsh	83	11.7	9.0–14.2	10.6–12.6	11.6	1.6	86	69
Chelms	98	11.9	9.2–14.3	11.1–12.6	11.8	1.4	86	77
Clwyd	93	11.4	8.4–13.6	10.4–12.2	11.2	1.6	82	58
Covnt	99	11.3	9.1–13.4	10.3–12.3	11.3	1.3	84	61
D & Gall	98	12.0	9.5–14.0	11.0–12.9	11.9	1.4	91	78
Derby	100	12.0	9.9–14.5	11.1–13.1	12.1	1.4	93	80
Derry	100	11.5	9.2–13.0	10.4–12.2	11.3	1.2	85	63
Donc	100	11.5	8.9–14.4	10.5–12.9	11.6	1.6	81	61
Dorset	100	11.6	8.4–14.1	10.4–12.5	11.5	1.6	84	66
Dudley	90	11.7	7.6–13.7	10.0–12.8	11.3	1.8	77	64
Dundee	97	11.7	8.8–13.8	10.5–12.7	11.5	1.7	83	67
Dunfn	25							
Edinb	1							
Exeter	100	11.1	8.9–13.0	10.3–12.1	11.1	1.3	80	55
Glasgw	98	11.3	8.7–13.8	10.4–12.3	11.3	1.5	82	61
Glouc	100	11.6	9.1–14.1	10.7–12.6	11.7	1.6	86	67
Hull	98	11.7	9.3–13.6	10.8–12.6	11.6	1.4	91	73
Inverns	85	12.3	9.9–14.3	11.1–13.2	12.2	1.7	94	79
Ipswi	100	11.5	8.5–13.3	10.8–12.3	11.4	1.4	88	70
Klmarnk	95	11.7	8.6–13.8	10.4–12.5	11.5	1.5	85	64
L Barts	100	11.2	8.0–13.6	9.9–12.3	11.0	1.8	74	55
L Guys	97	11.2	8.4–13.6	10.2–12.2	11.1	1.5	80	59
L Kings	100	11.5	8.9–13.5	10.6–12.5	11.4	1.4	85	67
L Rfree	77	12.0	9.3–14.3	11.1–12.9	11.9	1.5	91	76
L West	44							
Leeds	97	12.1	9.0–14.7	11.1–13.0	12.0	1.7	89	77
Leic	99	11.6	8.8–14.1	10.5–12.5	11.5	1.6	84	65
Liv Ain	97	11.9	9.6–13.6	10.9–13.0	11.9	1.4	92	74
Liv RI	94	12.3	9.4–14.8	11.2–13.2	12.2	1.6	90	80
M Hope	86	11.7	8.6–14.0	10.5–12.6	11.5	1.7	85	66
M RI	73	11.7	8.6–14.5	10.3–12.8	11.6	1.8	82	66
Middlbr	98	11.8	9.3–14.2	11.0–12.8	11.8	1.5	91	75
Newc	100	12.1	9.1–14.3	11.2–13.0	12.0	1.5	90	78
Newry	98	11.6	9.3–13.1	10.8–12.4	11.5	1.3	88	73
Norwch	91	11.3	9.2–14.0	10.6–12.3	11.4	1.5	89	63

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
Nottm	98	11.7	9.1–13.9	10.7–12.5	11.6	1.6	87	70
Oxford	99	11.5	8.8–13.8	10.7–12.7	11.6	1.6	85	67
Plymth	97	11.4	9.3–13.0	10.6–12.1	11.4	1.3	88	66
Ports	99	11.3	8.5–13.8	10.2–12.3	11.2	1.6	80	58
Prestn	97	11.6	9.0–14.0	10.8–12.6	11.7	1.5	88	70
Redng	100	11.7	9.3–13.9	10.8–12.6	11.7	1.4	87	71
Sheff	99	11.5	9.0–13.5	10.6–12.4	11.5	1.4	85	66
Shrew	100	11.7	9.7–13.7	11.0–12.4	11.7	1.2	93	76
Stevng	100	11.8	9.3–13.5	10.9–12.4	11.6	1.4	89	72
Sthend	97	10.7	8.8–12.8	10.0–11.6	10.8	1.3	75	45
Stoke	100	11.8	9.4–14.0	10.8–12.6	11.7	1.4	91	74
Sund	98	11.6	8.8–13.7	10.5–12.6	11.5	1.6	85	68
Swanse	99	11.7	9.1–13.4	10.8–12.5	11.6	1.3	89	73
Truro	99	11.6	9.0–13.2	10.9–12.1	11.4	1.2	89	70
Tyrone	97	11.6	9.5–13.2	10.9–12.3	11.5	1.1	90	72
Ulster	99	11.3	8.5–13.5	10.1–11.8	11.1	1.4	79	53
Wirral	76	11.5	9.3–14.2	10.8–12.4	11.7	1.4	91	69
Wolve	100	12.2	8.8–14.9	10.9–13.2	12.0	1.8	86	73
Wrexm	99	12.0	8.9–13.8	10.7–12.9	11.6	1.5	89	68
York	100	11.9	9.5–13.8	11.2–12.6	11.9	1.2	93	79
England	**91**	**11.7**	**8.9–14.0**	**10.6–12.6**	**11.6**	**1.6**	**86**	**68**
N Ireland	**95**	**11.5**	**8.8–13.5**	**10.6–12.3**	**11.4**	**1.5**	**84**	**67**
Scotland	**78**	**11.6**	**8.8–13.9**	**10.5–12.5**	**11.5**	**1.5**	**84**	**65**
Wales	**98**	**11.6**	**9.0–13.8**	**10.6–12.5**	**11.5**	**1.5**	**87**	**67**
UK	**90**	**11.6**	**8.9–14.0**	**10.6–12.6**	**11.6**	**1.5**	**86**	**68**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

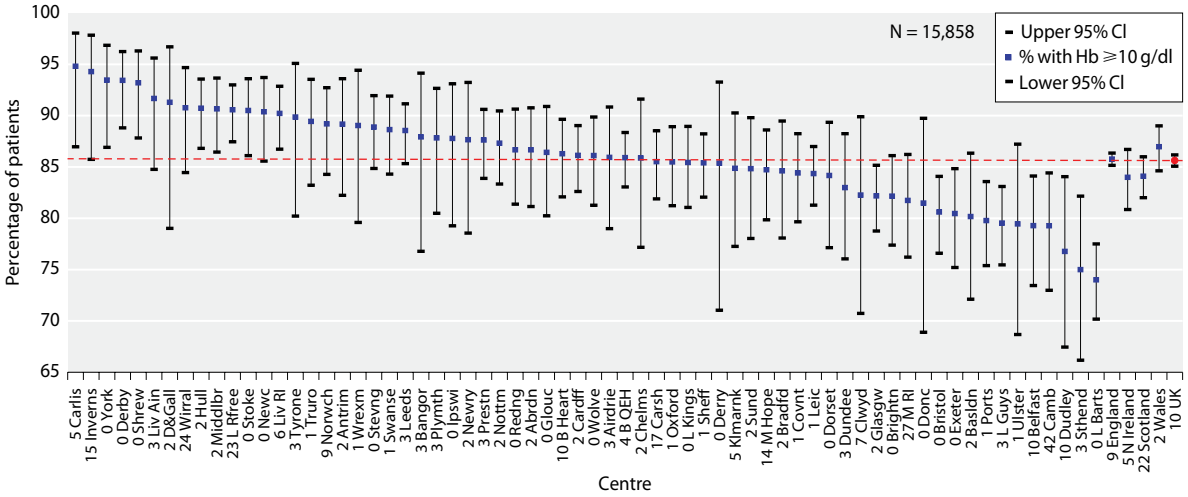

Fig. 9.8. Percentage of HD patients with Hb ⩾10 g/dl

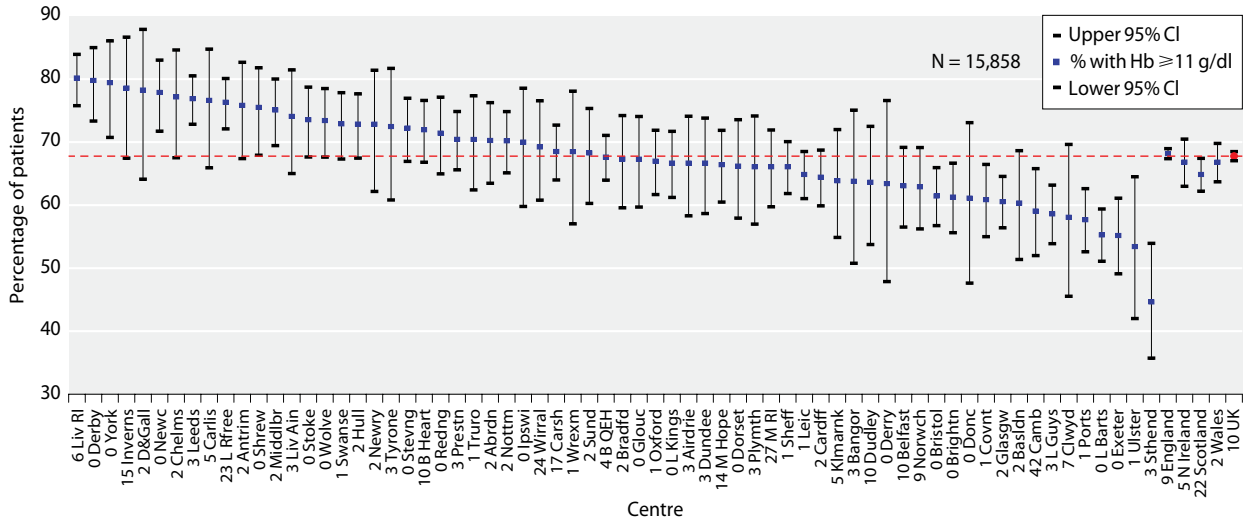

Fig. 9.9. Percentage of HD patients with Hb ⩾11 g/dl

plot (figure 9.12) for percentage of patients with Hb ⩾10.5 and ⩽12.5 g/dl and yet have a poor compliance with percentage of Hb ⩾10.0 g/dl (figure 9.13). This demonstrated that compliance with one standard (Hb ⩾10.5 and ⩽12.5 g/dl) can be achieved without compliance with another standard (Hb ⩾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 91% of patients on PD had a Hb ⩾10.0 g/dl (table 9.4). The median Hb of patients on PD in the UK was 11.9 g/dl with an IQR of 11.0–12.8 g/dl (table 9.4). The median Hb by centre, compliance with the UK minimum standard Hb ⩾10.0 g/dl and EBPG Hb ⩾11.0 g/dl are shown in figures 9.14, 9.15 and 9.16 respectively. The compliance with recommended range Hb ⩾10.5 and ⩽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 ⩾10.0 g/dl is shown in figure 9.19 which can be used in conjunction with table 9.5 to identify centres.

Relationship between Hb in incident and prevalent dialysis patients in 2007

The relationship between the percentage of new and prevalent dialysis (HD and PD) patients with a Hb ⩾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 mean (and standard deviation) and the compliance with minimum standards. The plots for Hb ⩾10.0 g/dl and ⩾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 2007 are shown in figure 9.25 for prevalent patients and in figure 9.26 for incident and prevalent patients between 1998 and 2007.

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 median Hb of HD patients in 2007 (figure 9.27) was lower than in 2006 irrespective of time on RRT. The Hb in PD patients (figure 9.28) had been stable for some years and remained higher than in HD patients.

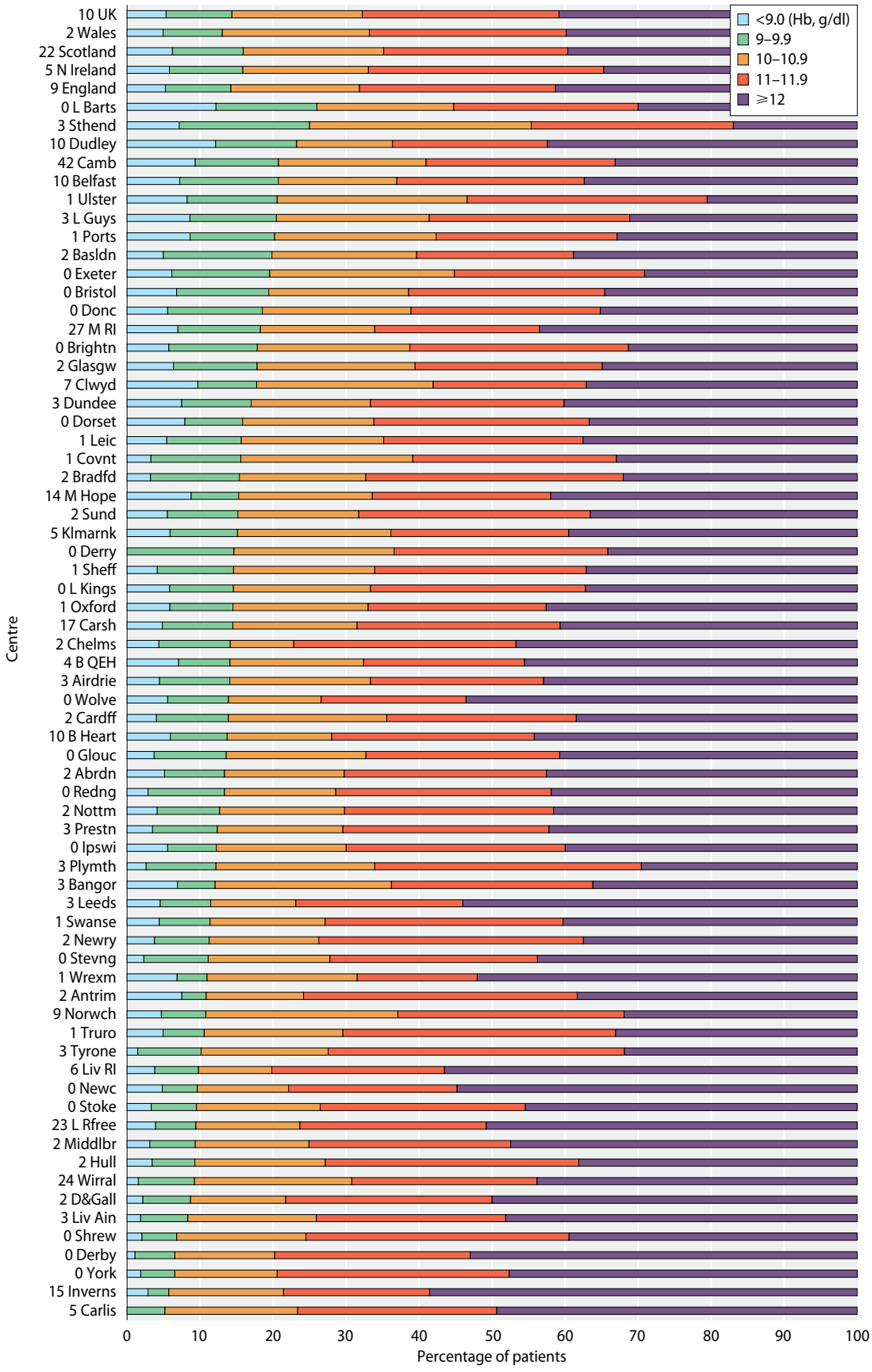

Fig. 9.10. Distribution of haemoglobin in patients treated with HD

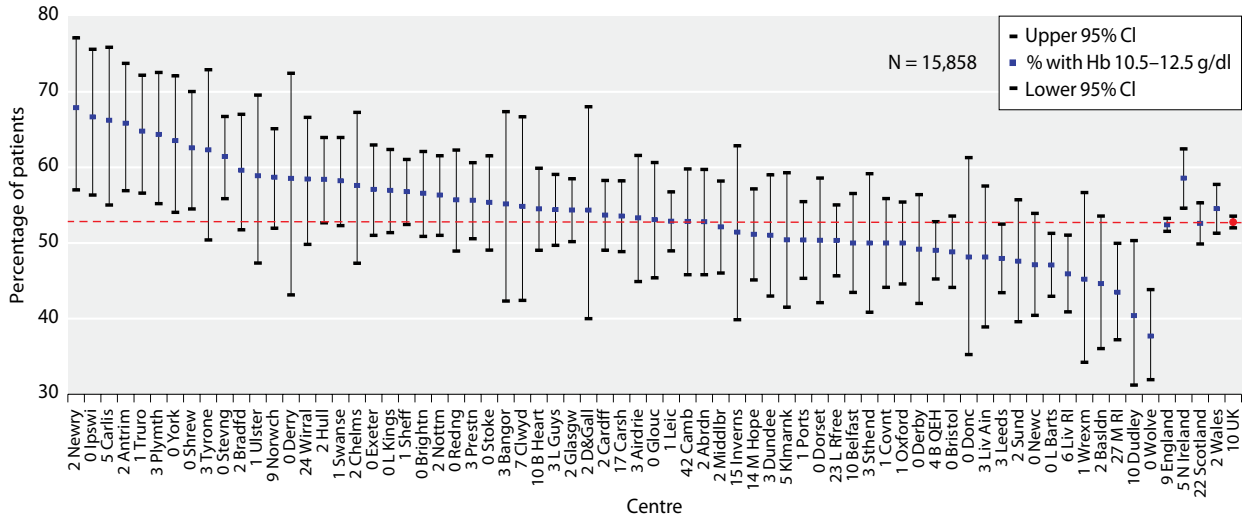

Fig. 9.11. Percentage of HD patients with Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl

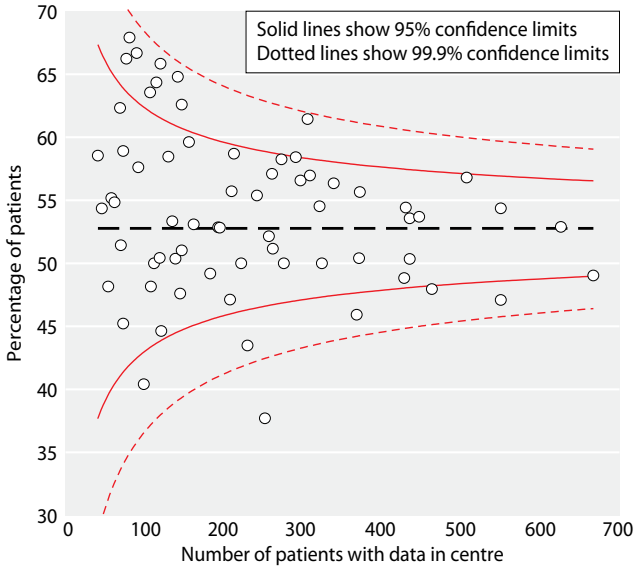

Fig. 9.12. Funnel plot of percentage of HD patients with Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl

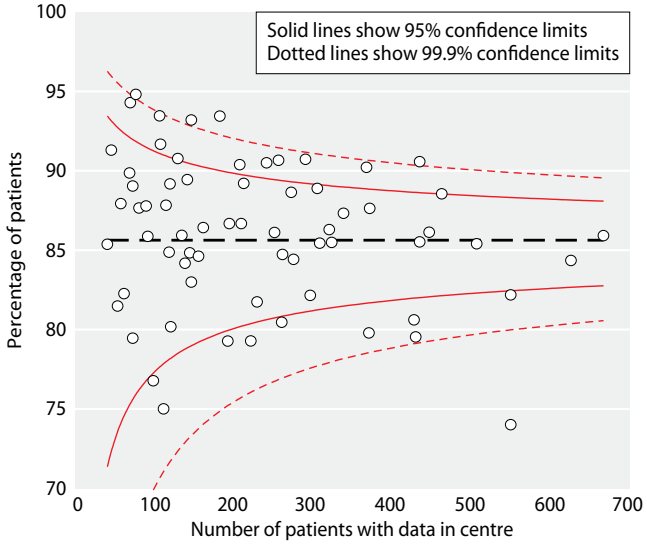

Fig. 9.13. Funnel plot of percentage of HD patients with Hb $\geqslant$10 g/dl

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
Derry	41	85	59	Newc	208	90	47
D & Gall	46	91	54	Redng	210	87	56
Donc	54	81	48	Norwch	213	89	59
Bangor	58	88	55	Belfast	222	79	50
Clwyd	62	82	55	M RI	230	82	43
Tyrone	69	90	62	Stoke	242	91	55
Inverns	70	94	51	Wolve	252	86	38
Ulster	73	79	59	Middlbr	257	91	52
Wrexm	73	89	45	Exeter	261	80	57
Carlis	77	95	66	M Hope	262	85	51
Newry	81	88	68	Swanse	273	89	58
Ipswi	90	88	67	Covnt	276	84	50
Chelms	92	86	58	Hull	291	91	58
Dudley	99	77	40	Brightn	297	82	57
York	107	93	64	Stevng	306	89	61
Liv Ain	108	92	48	L Kings	309	85	57
Sthend	112	75	50	B Heart	321	86	55
Plymth	115	88	64	Oxford	324	85	50
Klmarnk	119	85	50	Nottm	339	87	56
Antrim	120	89	66	Liv RI	368	90	46
Basldn	121	80	45	Ports	371	80	50
Wirral	130	91	58	Prestn	372	88	56
Airdrie	135	86	53	Bristol	428	81	49
Dorset	139	84	50	L Guys	430	80	54
Truro	142	89	65	Carsh	435	86	54
Sund	145	85	48	L Rfree	435	91	50
Dundee	147	83	51	Cardff	447	86	54
Shrew	147	93	63	Leeds	463	89	48
Bradfd	156	85	60	Sheff	507	85	57
Glouc	162	86	53	Glasgw	550	82	54
Derby	183	93	49	L Barts	550	74	47
Camb	193	79	53	Leic	626	84	53
Abrdn	195	87	53	B QEH	667	86	49

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	97	12.0	10.6–14.2	11.2–12.9	12.1	1.1	97	93
Airdrie	82							
Antrim	94							
B Heart	97	12.4	9.4–14.9	11.6–13.2	12.3	1.4	93	87
B QEH	86	11.5	9.3–14.0	10.9–12.7	11.7	1.5	92	73
Bangor	100	12.1	10.4–14.5	11.4–13.4	12.3	1.3	97	90
Basldn	100	12.3	11.0–14.6	11.7–13.3	12.5	1.2	100	96
Belfast	96	11.4	10.0–14.4	11.1–12.9	11.8	1.4	96	76
Bradfd	100	11.9	8.9–14.0	10.6–12.5	11.6	1.6	89	67
Brightn	100	11.8	10.1–14.5	11.1–12.8	12.0	1.4	96	82
Bristol	100	12.1	9.3–14.9	11.0–12.9	12.0	1.7	85	76
Camb	100	11.9	9.3–13.6	11.3–12.6	11.9	1.3	94	79
Cardff	99	12.2	9.6–14.3	11.2–13.0	12.1	1.5	90	77
Carlis	100							
Carsh	96	11.4	9.5–13.8	10.6–12.5	11.5	1.3	87	67
Chelms	97	12.8	9.9–14.0	12.1–13.3	12.5	1.2	94	91
Clwyd	92							
Covnt	94	12.0	9.4–13.5	11.1–12.8	11.9	1.5	90	75
D & Gall	100							

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
Derby	100	11.8	9.7–13.9	11.2–12.6	11.9	1.3	92	83
Derry	100							
Donc	100	11.8	8.8–14.2	11.1–13.2	12.0	1.6	91	76
Dorset	98	12.1	9.6–13.6	11.1–12.9	11.9	1.2	95	80
Dudley	94	12.3	7.0–15.2	10.5–13.7	12.0	2.3	86	67
Dundee	96	12.0	9.5–13.9	11.2–12.6	11.8	1.4	89	78
Dunfn	17							
Edinb	0							
Exeter	100	11.5	9.7–13.7	10.6–12.1	11.5	1.2	91	73
Glasgw	97	11.6	9.2–14.0	10.8–12.6	11.6	1.4	85	73
Glouc	100	11.9	10.2–13.8	11.0–12.4	11.8	1.0	97	77
Hull	94	12.3	9.2–14.4	11.1–13.1	12.1	1.6	91	81
Inverns	0							
Ipswi	98	11.9	10.1–13.9	10.9–12.6	11.8	1.2	95	73
Klmarnk	95	11.9	8.8–15.1	11.1–12.4	11.9	1.6	93	78
L Barts	99	12.1	9.0–14.8	10.7–13.1	11.9	1.9	86	71
L Guys	98	11.8	8.0–13.8	10.9–12.5	11.5	1.8	83	71
L Kings	100	12.0	9.0–14.3	11.1–12.9	11.9	1.5	93	79
L Rfree	89	11.5	10.2–13.8	11.0–12.3	11.7	1.2	96	76
L West	5							
Leeds	99	12.1	8.8–15.4	11.1–13.1	12.0	1.8	86	80
Leic	99	11.9	8.7–14.4	11.1–12.8	11.8	1.6	89	77
Liv Ain	n/a							
Liv RI	92	12.1	9.6–14.0	11.1–12.9	12.0	1.4	92	81
M Hope	95	11.9	9.2–14.6	10.7–13.0	11.8	1.6	91	65
M RI	99	11.9	9.3–14.7	10.9–13.1	12.0	1.7	89	74
Middlbr	92	12.4	10.8–14.2	11.3–13.2	12.3	1.5	96	91
Newc	100	12.0	8.5–13.8	10.8–12.8	11.7	1.6	87	74
Newry	100							
Norwch	96	12.3	9.8–14.5	11.4–13.3	12.3	1.5	93	84
Nottm	100	11.8	9.5–13.9	11.0–12.7	11.8	1.4	92	76
Oxford	100	11.7	9.0–14.2	10.9–13.0	11.8	1.6	86	71
Plymth	84	12.3	9.1–14.0	11.5–13.1	12.1	1.3	94	78
Ports	99	12.1	9.1–15.0	11.0–13.2	12.1	1.7	90	76
Prestn	97	11.7	9.2–14.3	10.7–12.4	11.7	1.5	88	75
Redng	100	11.7	9.3–13.5	10.8–12.1	11.5	1.3	90	70
Sheff	100	11.5	9.1–13.9	10.8–12.5	11.6	1.5	88	70
Shrew	100	12.3	10.2–14.5	11.1–13.0	12.2	1.4	97	82
Stevng	100	12.4	8.7–14.8	11.5–13.2	12.3	1.6	92	84
Sthend	94							
Stoke	100	11.8	8.6–14.0	10.9–13.0	11.7	1.6	89	73
Sund	100							
Swanse	96	11.8	9.6–14.2	11.0–12.8	11.8	1.4	93	76
Truro	100	11.7	10.3–13.8	11.1–12.9	11.9	1.2	96	78
Tyrone	100							
Ulster	100							
Wirral	71	11.7	9.3–13.8	11.0–12.3	11.7	1.3	95	75
Wolve	98	12.6	9.3–14.9	11.7–13.6	12.5	1.6	92	83
Wrexm	90	12.0	10.5–14.4	11.4–12.4	12.0	1.1	96	93
York	100	12.1	10.8–15.1	11.4–13.3	12.5	1.5	100	87
England	**95**	**11.9**	**9.3–14.3**	**11.0–12.9**	**11.9**	**1.5**	**90**	**76**
N Ireland	**97**	**11.6**	**10.0–13.8**	**11.1–12.9**	**11.9**	**1.4**	**96**	**79**
Scotland	**62**	**11.8**	**9.5–14.2**	**11.1–12.7**	**11.8**	**1.5**	**90**	**78**
Wales	**97**	**12.1**	**9.7–14.3**	**11.2–12.9**	**12.0**	**1.4**	**93**	**80**
UK	**93**	**11.9**	**9.3–14.3**	**11.0–12.8**	**11.9**	**1.5**	**91**	**76**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

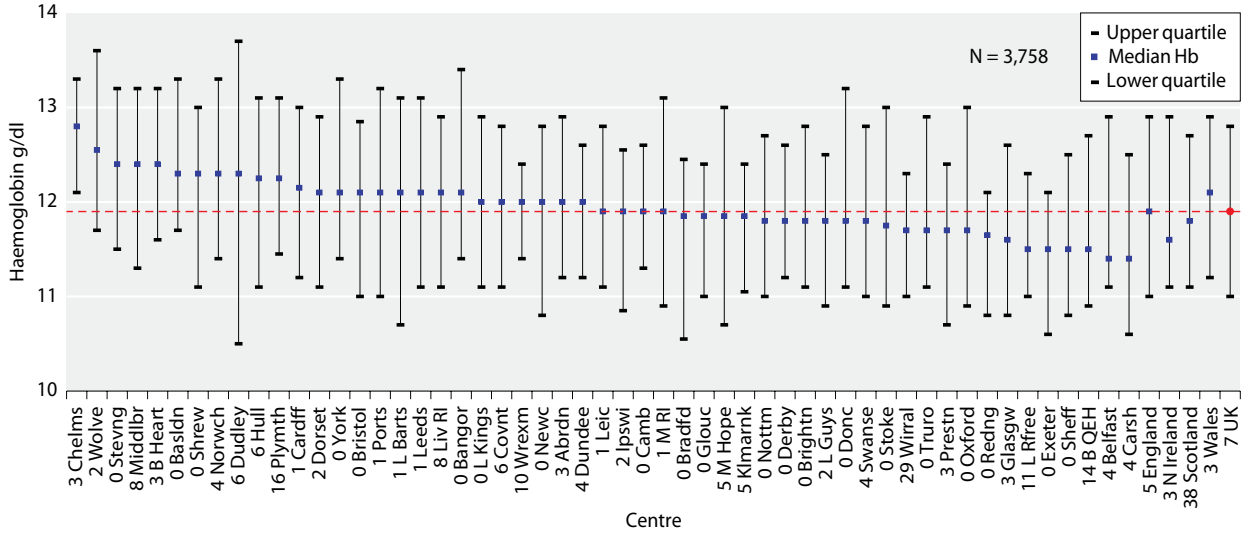

Fig. 9.14. Median haemoglobin in patients treated with PD

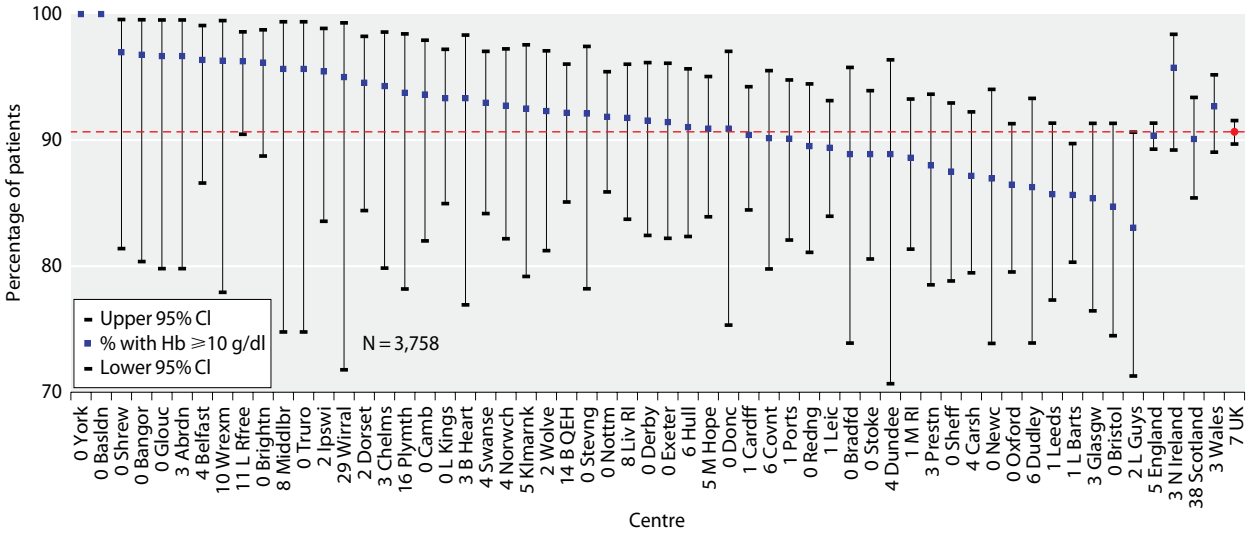

Fig. 9.15. Percentage of PD patients with Hb ⩾10 g/dl

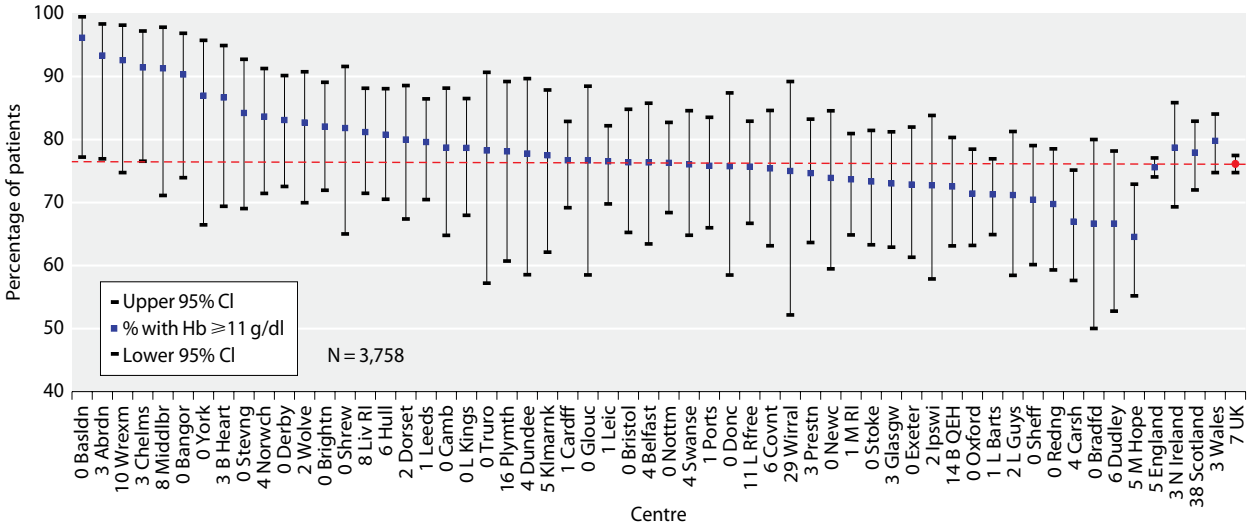

Fig. 9.16. Percentage of PD patients with Hb ⩾11 g/dl

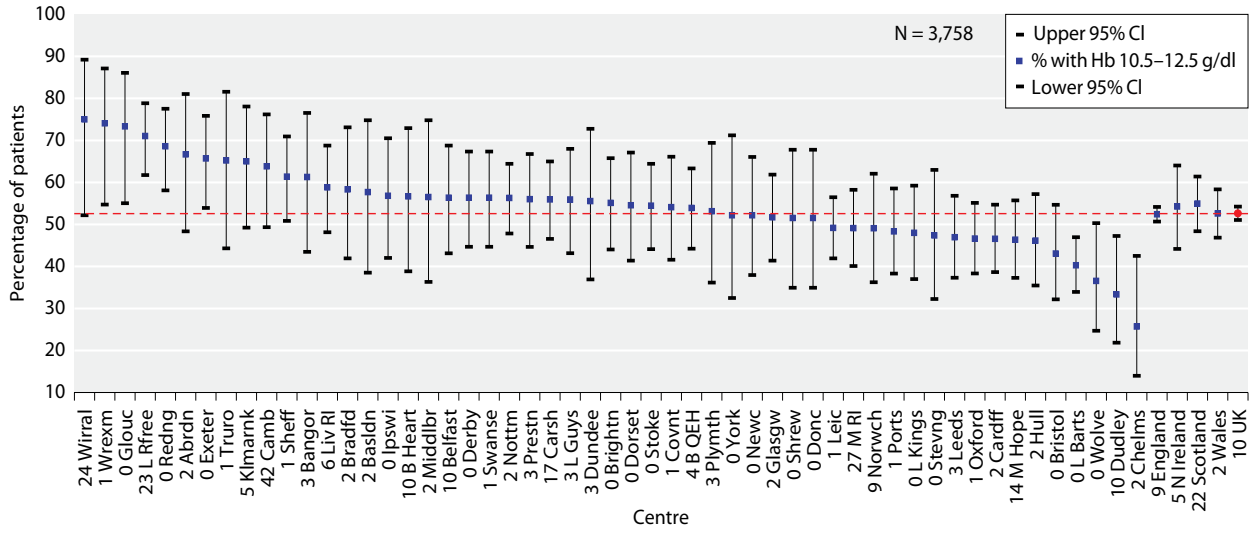

Fig. 9.17. Percentage of PD patients with Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl

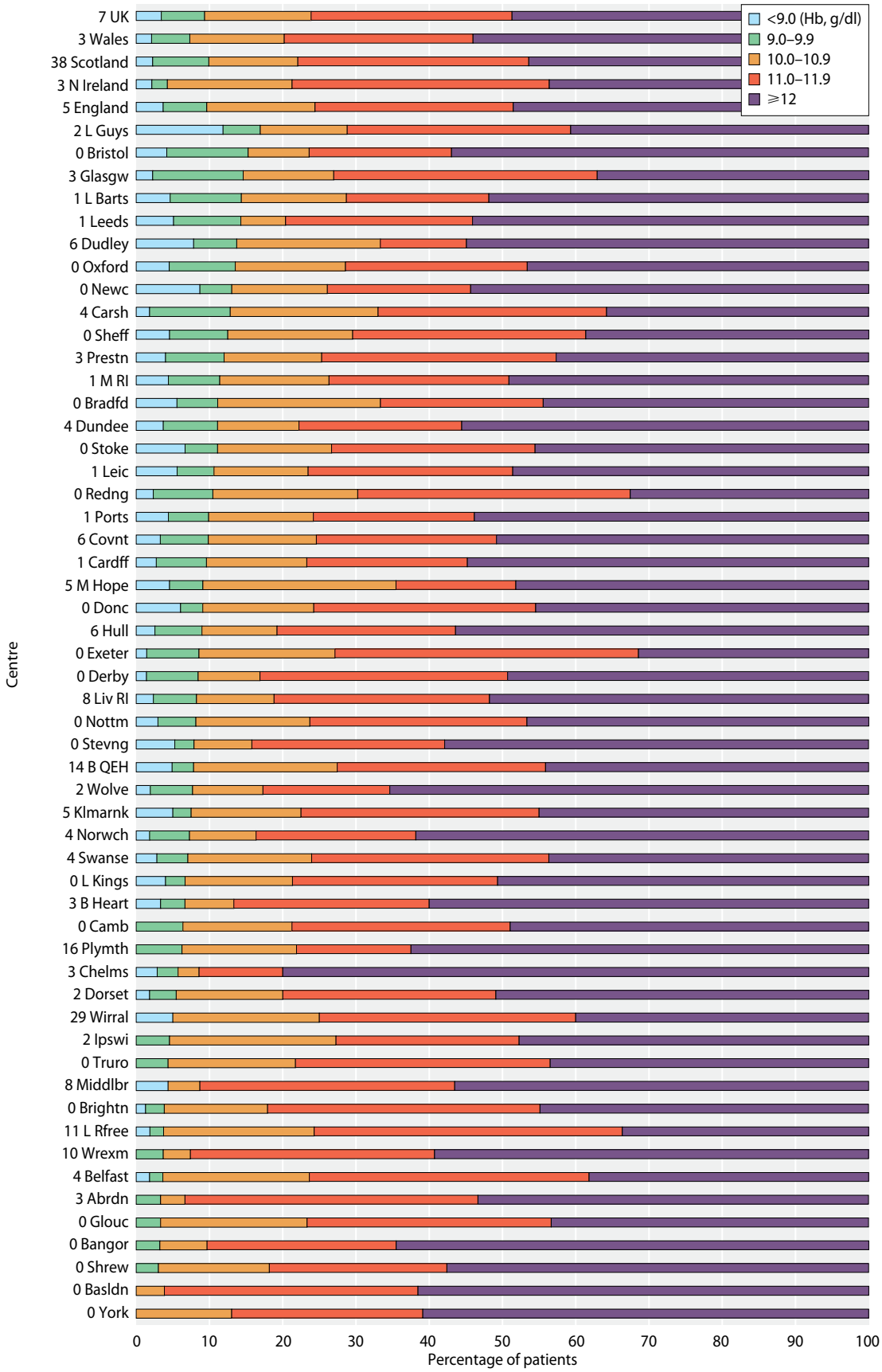

Fig. 9.18. Distribution of haemoglobin in patients treated with PD

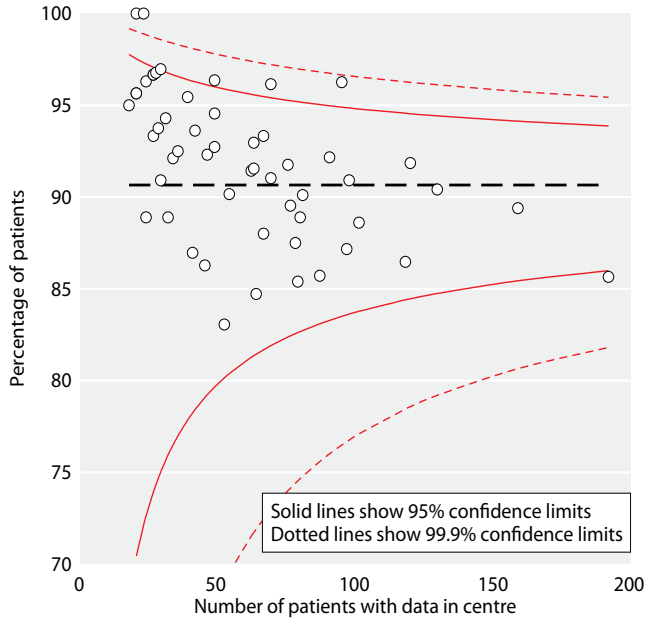

Fig. 9.19. Funnel plot of percentage of PD patients with Hb ⩾10 g/dl

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
Wirral	20	95	Covnt	61	90
Middlbr	23	96	Exeter	70	91
Truro	23	96	Derby	71	92
York	23	100	Swanse	71	93
Basldn	26	100	Bristol	72	85
Dundee	27	89	L Kings	75	93
Wrexm	27	96	Prestn	75	88
Abrdn	30	97	Brightn	78	96
B Heart	30	93	Hull	78	91
Glouc	30	97	Liv RI	85	92
Bangor	31	97	Redng	86	90
Plymth	32	94	Sheff	88	88
Donc	33	91	Glasgw	89	85
Shrew	33	97	Stoke	90	89
Chelms	35	94	Ports	91	90
Bradfd	36	89	Leeds	98	86
Stevng	38	92	B QEH	102	92
Klmarnk	40	93	L Rfree	107	96
Ipswi	44	95	Carsh	109	87
Newc	46	87	M Hope	110	91
Camb	47	94	M RI	114	89
Dudley	51	86	Oxford	133	86
Wolve	52	92	Nottm	135	92
Belfast	55	96	Cardff	146	90
Dorset	55	95	Leic	179	89
Norwch	55	93	L Barts	216	86
L Guys	59	83			

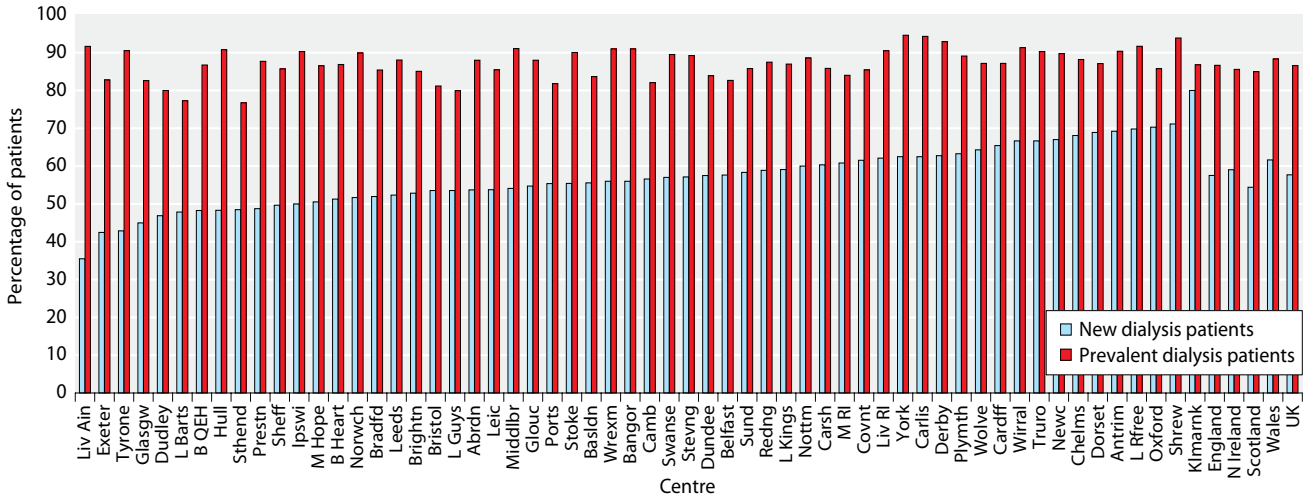

Fig. 9.20. Percentage of new and prevalent dialysis patients with Hb $\geqslant$10 g/dl

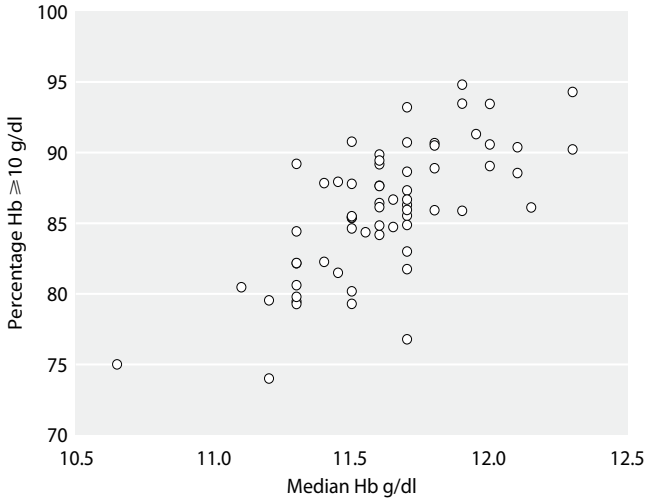

Fig. 9.21. Percentage of HD patients with Hb $\geqslant$10 g/dl plotted against median haemoglobin

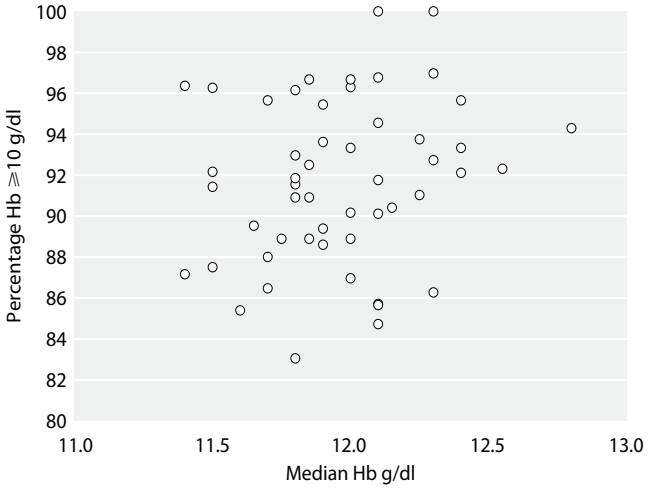

Fig. 9.23. Percentage of PD patients with Hb$\geqslant$10 g/dl plotted against median haemoglobin

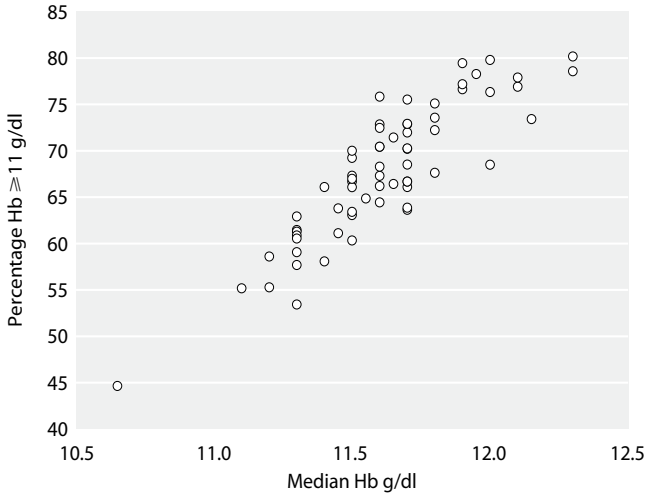

Fig. 9.22. Percentage of HD patients with Hb $\geqslant$11 g/dl plotted against median haemoglobin

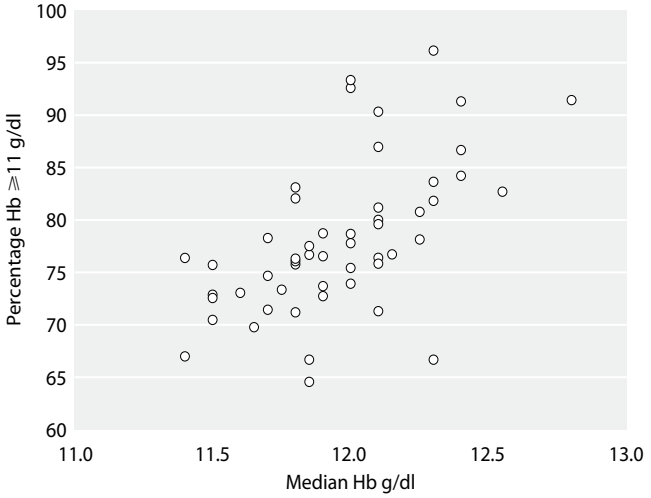

Fig. 9.24. Percentage of PD patients with Hb $\geqslant$11 g/dl plotted against median haemoglobin

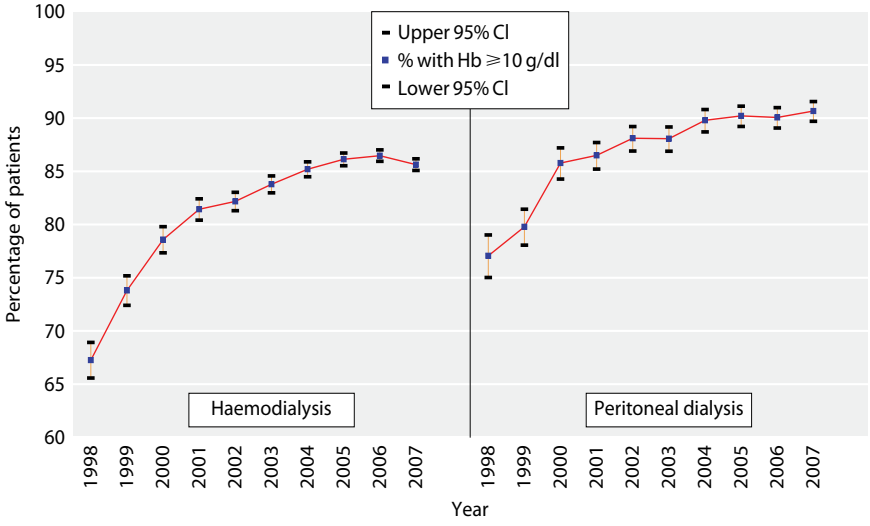

Figure 9.25. Percentage of prevalent HD and PD patients (1998–2007) with Hb ⩾10 g/dl

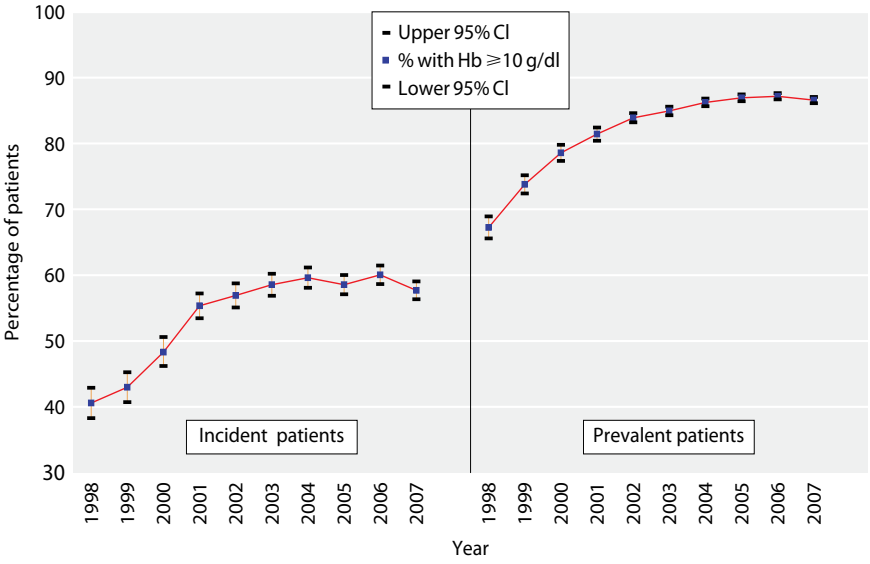

Figure 9.26. Percentage of incident and prevalent dialysis patients (1998–2007) with Hb ⩾10 g/dl

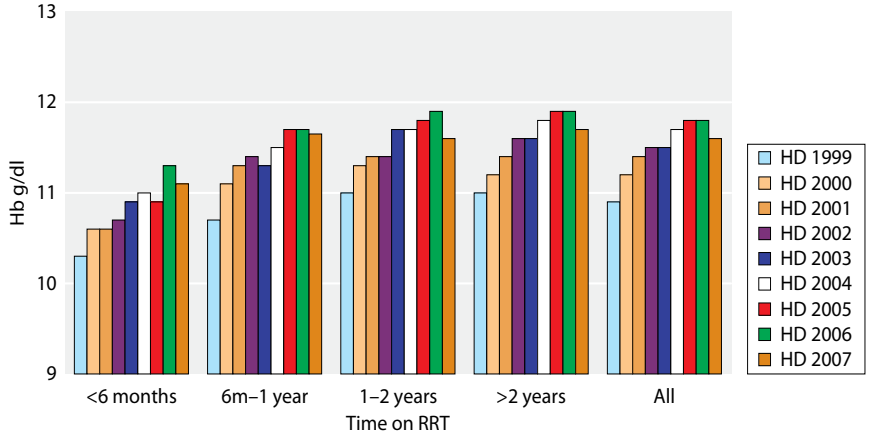

Figure 9.27. Median haemoglobin plotted by length of time on RRT (HD patients)

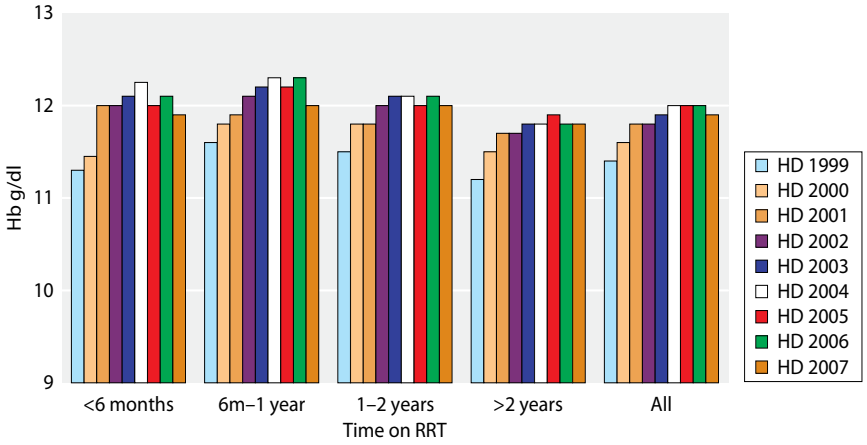

Figure 9.28. Median haemoglobin plotted by length of time on RRT (PD patients)

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. For Scotland a lack of an automated biochemistry link to the renal IT system is thought to account for the low rate of return. In other cases of missing data, renal centres may 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.

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 $\geqslant 800\,\mu g/L$ 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 are given in figures 9.29 and 9.30 respectively. The percentage of patients with a serum ferritin $\geqslant 100\,\mu g/L$, $\geqslant 200\,\mu g/L$ and $\geqslant 800\,\mu g/L$ 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 $\geqslant 100\,\mu g/L$ for HD patients and all but 5 centres achieved >90% compliance. The PD population had a lower median ferritin value (255 µg/L, IQR 143–411 vs. 417 µg/L, IQR 270–598 for HD). All but 5 centres achieved greater than 90% compliance for serum ferritin $\geqslant 100\,\mu g/L$ in the PD population.

Changes in ferritin 2000–2007

The compliance with guidelines for ferritin in the HD and PD populations has remained stable over the last 5 years at approximately 95% and 85% respectively. The serial values are shown in figure 9.37. The difference 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 increased during the first year in patients treated with HD and during the first 2 years in those treated with PD (figures 9.39 and 9.40). After 2 years the levels remained stable in both groups of patients.

Table 9.6. Completeness of ferritin returns

Centre	HD %	PD %	Centre	HD %	PD %
Abrdn	0	0	L Rfree	79	96
Airdrie	0	0	L West	80	70
Antrim	98	100	Leeds	98	99
B Heart	93	97	Leic	89	95
B QEH	97	87	Liv Ain	96	n/a
Bangor	95	100	Liv RI	91	92
Basldn	98	100	M Hope	60	93
Belfast	96	96	M RI	73	100
Bradfd	99	100	Middlbr	96	92
Brightn	98	99	Newc	100	100
Bristol	100	100	Newry	96	100
Camb	72	100	Norwch	87	93
Cardff	96	97	Nottm	99	100
Carlis	95	100	Oxford	98	97
Carsh	81	96	Plymth	97	100
Chelms	100	97	Ports	95	90
Clwyd	93	92	Prestn	100	99
Covnt	98	89	Redng	100	100
D & Gall	0	0	Sheff	99	100
Derby	100	99	Shrew	100	100
Derry	100	100	Stevng	99	95
Donc	98	76	Sthend	98	94
Dorset	100	96	Stoke	100	99
Dudley	100	87	Sund	97	100
Dundee	1	0	Swanse	99	96
Dunfn	0	0	Truro	99	100
Edinb	1	0	Tyrone	96	100
Exeter	100	100	Ulster	100	100
Glasgw	0	0	Wirral	63	71
Glouc	98	100	Wolve	99	96
Hull	98	93	Wrexm	86	13
Inverns	0	0	York	100	100
Ipswi	100	82	**England**	**93**	**96**
Klmarnk	0	0	**N Ireland**	**97**	**98**
L Barts	100	99	**Scotland**	**0**	**0**
L Guys	97	98	**Wales**	**96**	**88**
L Kings	100	100	**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	98	447	108–1010	298–613	95.0
B Heart	93	233	44–718	137–356	86.1
B QEH	97	365	156–684	286–459	96.6
Bangor	95	411	102–920	278–581	96.5
Basldn	98	337	97–651	262–408	94.2
Belfast	96	556	114–1151	318–782	96.2
Bradfd	99	462	130–984	310–611	98.7
Brightn	98	450	144–942	298–633	97.9
Bristol	100	417	104–849	243–575	95.8
Camb	72	328	54–693	217–430	93.7
Cardff	96	423	109–962	283–612	95.0
Carlis	95	442	269–1011	358–587	100.0
Carsh	81	322	91–671	240–427	94.3
Chelms	100	666	301–1360	543–804	100.0
Clwyd	93	372	178–854	276–554	98.4
Covnt	98	293	82–847	183–427	91.2
Derby	100	323	113–712	217–494	97.3
Derry	100	593	196–1145	341–751	95.1
Donc	98	390	145–910	283–639	98.1
Dorset	100	441	189–856	303–553	98.6
Dudley	100	334	48–837	173–496	87.3
Exeter	100	289	105–645	207–374	95.0
Glouc	98	451	128–1013	301–608	97.5
Hull	98	381	180–719	296–491	98.3
Ipswi	100	341	78–904	195–498	93.3
L Barts	100	404	125–803	295–540	97.3
L Guys	97	365	92–820	231–533	94.7
L Kings	100	527	211–1108	382–700	99.0
L Rfree	79	449	23–1414	179–690	83.5
L West	80	573	225–1201	438–767	97.7
Leeds	98	463	111–912	338–614	95.3
Leic	89	351	94–862	219–502	94.0
Liv Ain	96	450	61–1013	307–675	94.4
Liv RI	91	511	118–1386	346–785	95.8
M Hope	60	465	89–1282	262–653	94.0
M RI	73	371	97–838	237–499	94.8
Middlbr	96	368	72–1425	193–706	92.8
Newc	100	466	242–1200	364–629	98.6
Newry	96	620	162–1694	394–1032	97.5
Norwch	87	564	177–1205	360–779	98.5
Nottm	99	542	226–964	446–656	97.7
Oxford	98	325	98–810	219–445	94.3
Plymth	97	430	140–1183	331–573	96.6
Ports	95	196	35–706	104–334	76.4
Prestn	100	656	183–1643	430–940	97.1
Redng	100	441	166–844	311–583	98.6
Sheff	99	424	117–929	288–581	95.9
Shrew	100	200	46–727	116–302	81.6
Stevng	99	374	114–823	256–539	98.0
Sthend	98	335	169–737	245–433	96.5
Stoke	100	870	315–1907	604–1277	99.6

Table 9.7. Continued

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
Sund	97	447	168–909	326–588	99.3
Swanse	99	352	88–835	207–528	93.0
Truro	99	468	190–1407	347–616	98.6
Tyrone	96	723	276–1623	507–924	98.5
Ulster	100	570	114–1395	385–847	96.0
Wirral	63	579	238–1501	411–807	99.1
Wolve	99	468	204–915	380–564	97.6
Wrexm	86	258	104–583	196–367	96.9
York	100	522	205–821	448–629	97.2
England	**93**	**413**	**100–1061**	**269–592**	**94.9**
N Ireland	**97**	**563**	**121–1284**	**347–816**	**96.3**
Wales	**96**	**389**	**99–899**	**247–555**	**94.9**
E, W & NI	**93**	**417**	**101–1067**	**270–598**	**95.0**

Table 9.8. Ferritin in PD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
Antrim	100				
B Heart	97	186	30–867	96–307	73.3
B QEH	87	196	41–509	109–329	78.6
Bangor	100	367	41–946	253–495	93.6
Basldn	100	205	51–562	134–362	84.6
Belfast	96	276	63–938	134–506	85.5
Bradfd	100	268	23–838	170–371	88.9
Brightn	99	372	157–964	273–487	100.0
Bristol	100	259	35–685	175–356	86.1
Camb	100	238	98–803	163–376	93.6
Cardff	97	150	30–513	80–260	60.8
Carlis	100				
Carsh	96	180	44–449	115–260	81.7
Chelms	97	277	29–567	163–376	88.6
Clwyd	92				
Covnt	89	192	57–661	139–310	87.9
Derby	99	265	92–562	167–363	94.3
Derry	100				
Donc	76	222	57–515	117–324	76.0
Dorset	96	301	90–619	206–382	88.9
Dudley	87	186	35–601	113–284	89.4
Exeter	100	197	25–516	126–279	82.9
Glouc	100	267	78–766	188–360	90.0
Hull	93	346	76–836	261–484	93.5
Ipswi	82	257	76–860	167–387	91.9
L Barts	99	280	54–768	145–464	85.7
L Guys	98	160	41–700	102–232	78.0
L Kings	100	239	61–575	148–392	85.3

Table 9.8. Continued

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
L Rfree	96	281	24–785	136–470	80.0
L West	70	257	135–1021	205–511	97.8
Leeds	99	223	43–711	138–397	86.7
Leic	95	287	42–762	195–445	87.7
Liv Ain	n/a				
Liv RI	92	259	64–918	134–454	84.7
M Hope	93	240	48–1061	151–408	87.0
M RI	100	130	22–443	83–235	65.2
Middlbr	92	225	46–735	152–404	87.0
Newc	100	320	110–776	238–456	97.8
Newry	100				
Norwch	93	346	45–1179	175–548	79.3
Nottm	100	289	84–613	192–413	93.3
Oxford	97	228	40–773	127–345	80.6
Plymth	100	191	18–703	97–296	73.7
Ports	90	208	42–737	126–323	83.1
Prestn	99	242	56–876	162–489	89.5
Redng	100	417	170–1017	306–568	98.8
Sheff	100	255	78–610	166–398	89.8
Shrew	100	226	32–709	129–416	78.8
Stevng	95	186	32–775	119–353	80.6
Sthend	94				
Stoke	99	484	94–1283	305–708	93.3
Sund	100				
Swanse	96	228	23–710	96–360	73.2
Truro	100	279	116–381	185–313	95.7
Tyrone	100				
Ulster	100				
Wirral	71	535	272–1017	424–717	100.0
Wolve	96	186	19–679	102–390	76.5
Wrexm	13				
York	100	344	75–668	246–522	91.3
England	**96**	**259**	**46–775**	**149–418**	**86.2**
N Ireland	**98**	**270**	**52–934**	**130–451**	**83.2**
Wales	**88**	**189**	**29–648**	**88–341**	**68.6**
E, W & NI	**95**	**255**	**42–775**	**143–411**	**84.8**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
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	12.5	7.7–19.7		
B Heart	3.0	1.6–5.5	6.7	1.7–23.1
B QEH	3.0	1.9–4.6	1.9	0.5–7.4
Bangor	7.0	2.7–17.3	6.5	1.6–22.4
Basldn	0.8	0.1–5.6	0.0	
Belfast	23.0	18.0–28.8	10.9	5.0–22.2
Bradfd	11.4	7.3–17.4	5.6	1.4–19.7
Brightn	10.0	7.0–14.0	5.2	2.0–13.0
Bristol	6.3	4.4–9.1	1.4	0.2–9.2
Camb	2.5	1.1–5.5	6.4	2.1–18.0
Cardff	11.4	8.8–14.8	2.1	0.7–6.3
Carlis	10.4	5.3–19.4		
Carsh	2.6	1.4–4.6	0.9	0.1–6.2
Chelms	25.5	17.7–35.3	0.0	
Clwyd	8.1	3.4–18.0		
Covnt	5.8	3.6–9.3	3.5	0.9–12.8
Derby	4.4	2.2–8.5	1.4	0.2–9.5
Derry	22.0	11.8–37.1		
Donc	17.0	9.1–29.5	0.0	
Dorset	5.8	2.9–11.1	1.9	0.3–12.0
Dudley	6.4	3.1–12.8	2.1	0.3–13.6
Exeter	3.5	1.8–6.5	1.4	0.2–9.5
Glouc	12.6	8.3–18.7	3.3	0.5–20.2
Hull	3.8	2.1–6.7	5.2	2.0–13.0
Ipswi	6.7	3.0–14.1	8.1	2.6–22.3
L Barts	4.9	3.4–7.1	4.6	2.5–8.4
L Guys	5.8	3.9–8.4	0.0	
L Kings	17.2	13.4–21.8	2.7	0.7–10.0
L Rfree	18.7	15.4–22.6	3.5	1.3–8.9
L West	21.0	18.3–23.9	8.9	3.4–21.4
Leeds	8.8	6.6–11.8	4.1	1.5–10.4
Leic	6.0	4.3–8.3	3.5	1.6–7.6
Liv Ain	15.0	9.4–23.0	n/a	n/a
Liv RI	23.7	19.6–28.4	8.2	4.0–16.3
M Hope	16.3	11.6–22.4	6.5	3.1–13.0
M RI	6.6	4.0–10.6	0.9	0.1–5.9
Middlbr	20.4	15.9–25.9	4.4	0.6–25.2
Newc	14.9	10.7–20.4	4.4	1.1–15.8
Newry	40.0	29.9–51.1		
Norwch	23.3	18.0–29.6	13.2	6.4–25.2
Nottm	8.8	6.2–12.3	0.7	0.1–5.1
Oxford	4.4	2.6–7.3	3.1	1.2–8.0
Plymth	11.2	6.6–18.4	2.6	0.4–16.5
Ports	3.7	2.1–6.2	3.6	1.2–10.6
Prestn	35.8	31.1–40.7	7.9	3.6–16.5
Redng	6.2	3.7–10.4	11.6	6.4–20.3
Sheff	9.3	7.0–12.1	3.4	1.1–10.0
Shrew	4.8	2.3–9.7	3.0	0.4–18.6
Stevng	6.6	4.3–10.0	0.0	
Sthend	2.7	0.9–7.9		
Stoke	56.2	49.9–62.3	16.9	10.4–26.1
Sund	12.5	8.0–19.0		
Swanse	5.5	3.3–8.9	2.8	0.7–10.6
Truro	14.8	9.8–21.6	0.0	

Table 9.9. Continued

Centre	HD		PD	
	% ferritin ⩾ 800 µg/L	95% CI	% ferritin ⩾ 800 µg/L	95% CI
Tyrone	39.7	28.8–51.7		
Ulster	29.7	20.5–41.1		
Wirral	25.9	18.5–35.0	20.0	7.7–42.8
Wolve	6.8	4.3–10.6	2.0	0.3–12.7
Wrexm	3.1	0.8–11.7		
York	6.5	3.2–13.1	0.0	
England	**11.1**	**10.6–11.7**	**4.3**	**3.7–5.1**
N Ireland	**25.7**	**22.4–29.3**	**8.4**	**4.3–15.9**
Wales	**8.5**	**6.8–10.5**	**2.7**	**1.3–5.5**
E, W & NI	**11.6**	**11.1–12.1**	**4.3**	**3.7–5.1**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

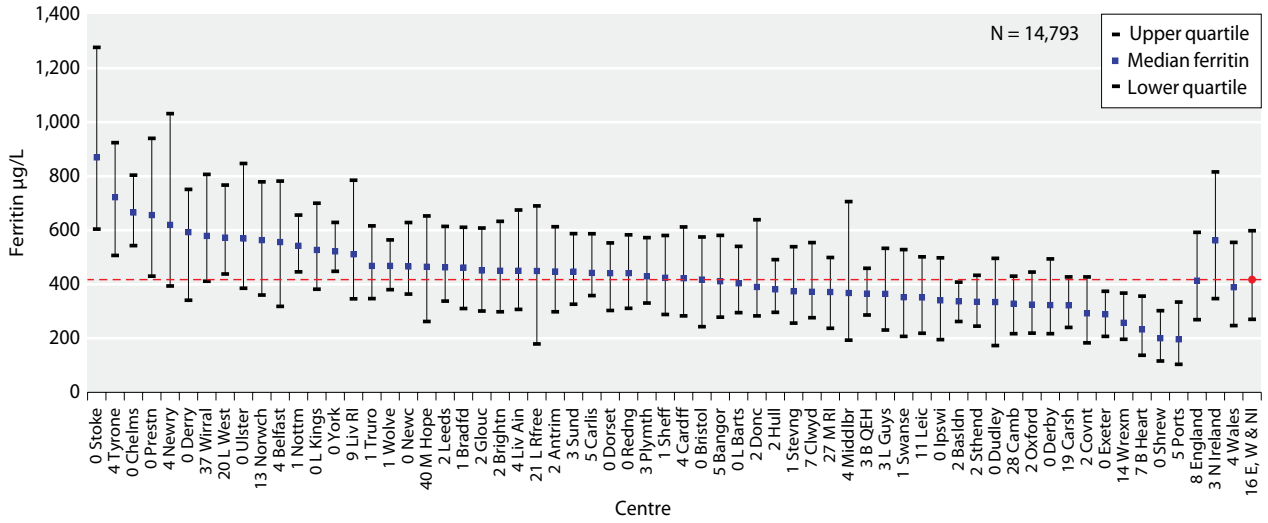

Fig. 9.29. Median ferritin in patients treated with HD

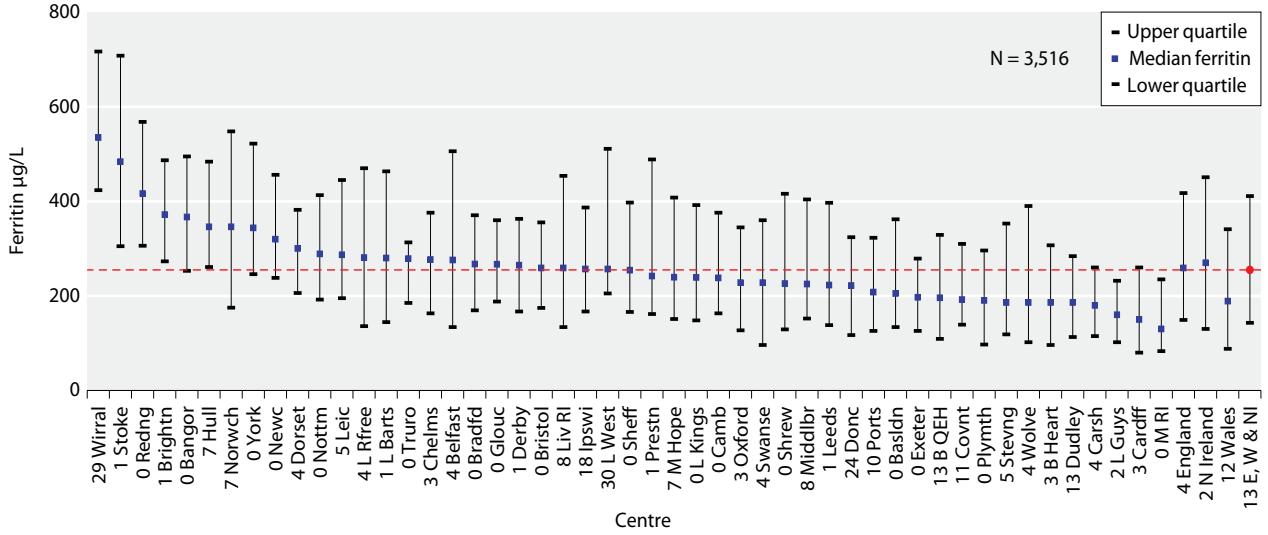

Fig. 9.30. Median ferritin in patients treated with PD

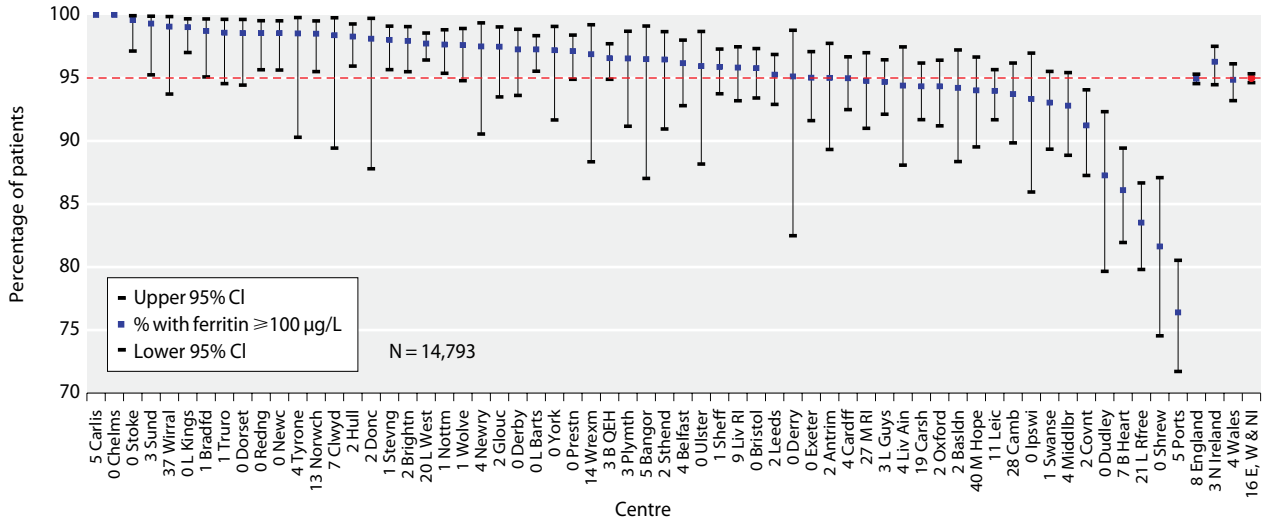

Fig. 9.31. Percentage of HD patients with ferritin ⩾100 µg/L

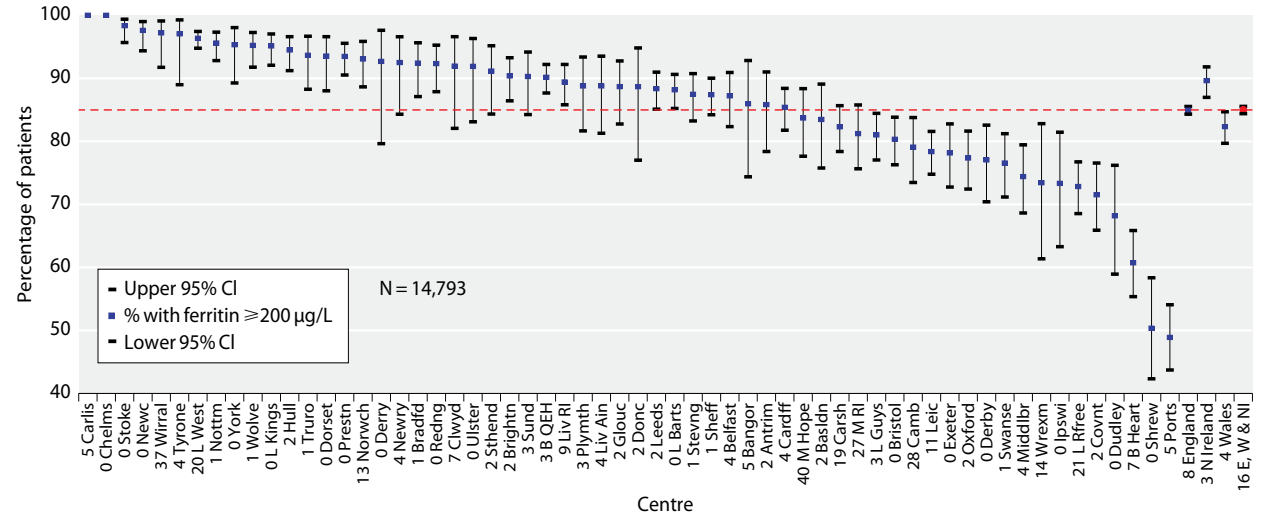

Fig. 9.32. Percentage of HD patients with ferritin ⩾200 µg/L

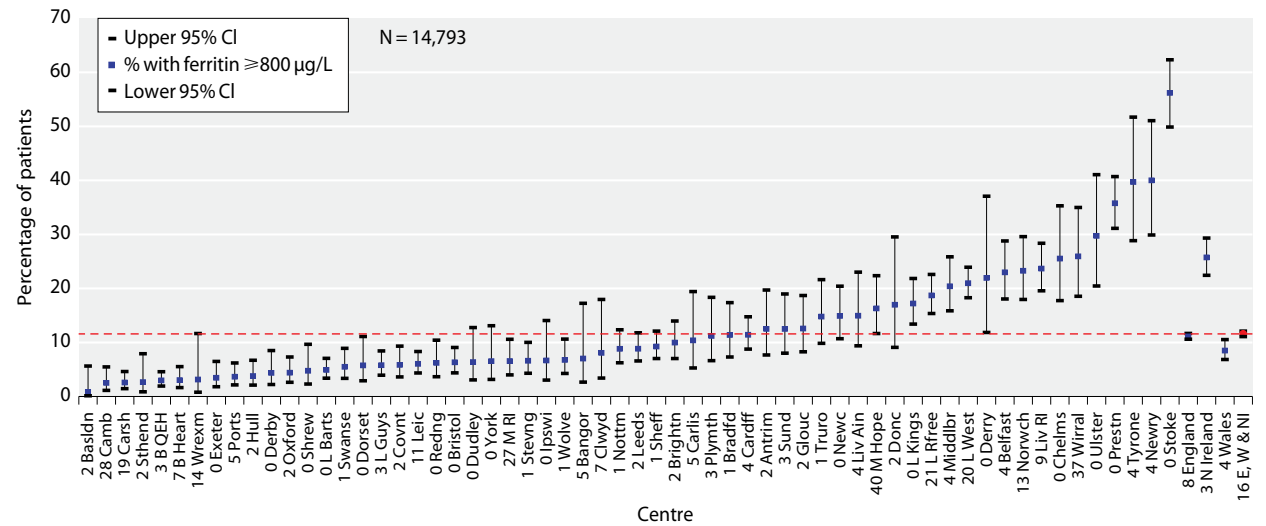

Fig. 9.33. Percentage of HD patients with ferritin ⩾800 µg/L

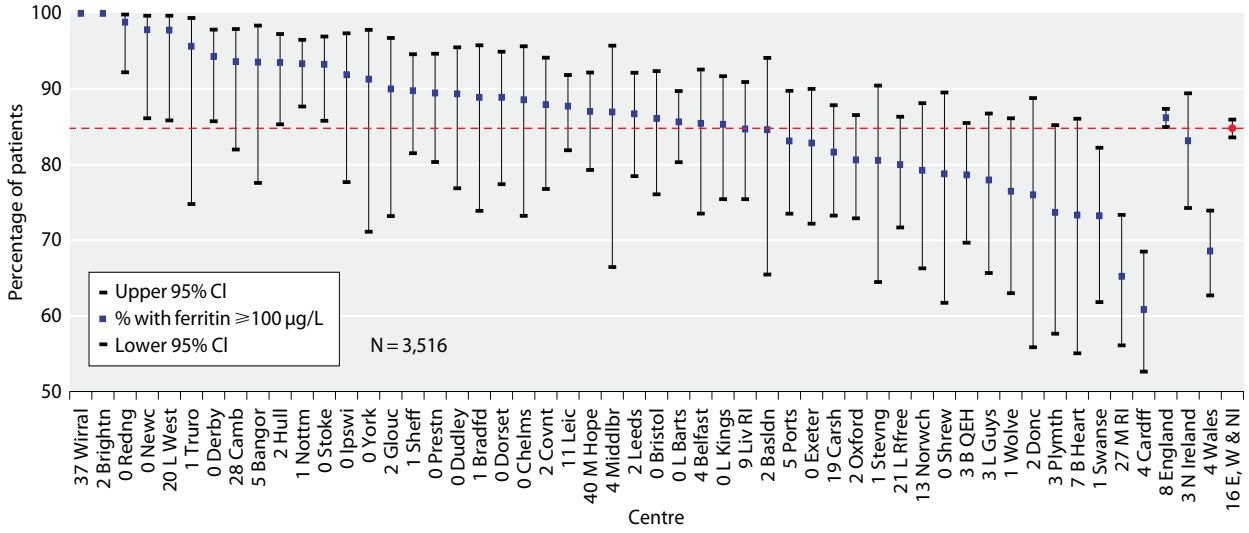

Fig. 9.34. Percentage of PD patients with ferritin ⩾100 µg/L

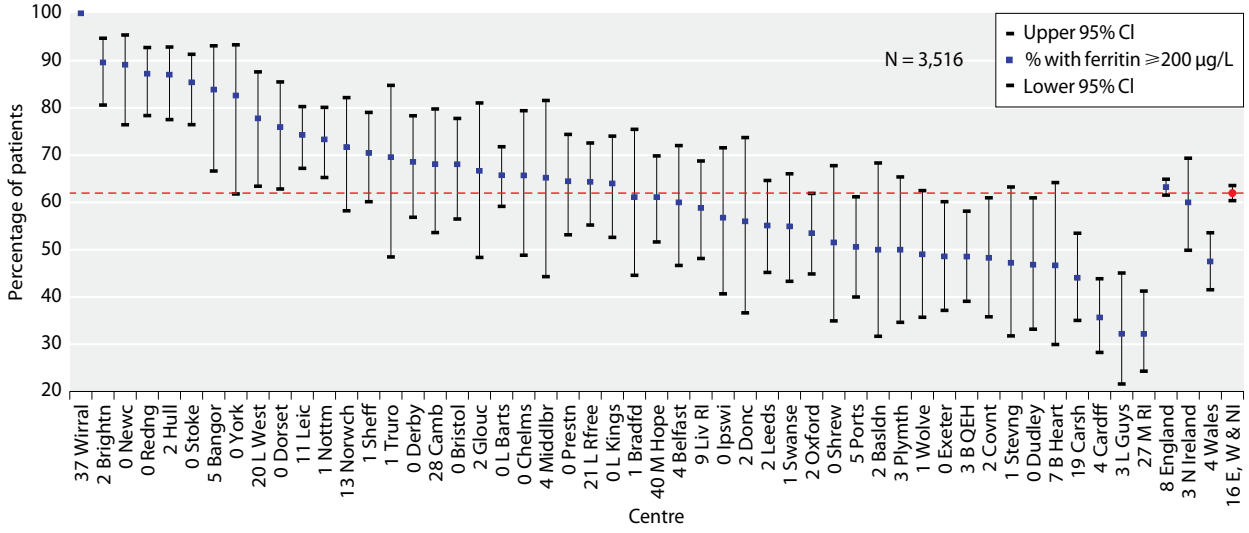

Fig. 9.35. Percentage of PD patients with ferritin ⩾200 µg/L

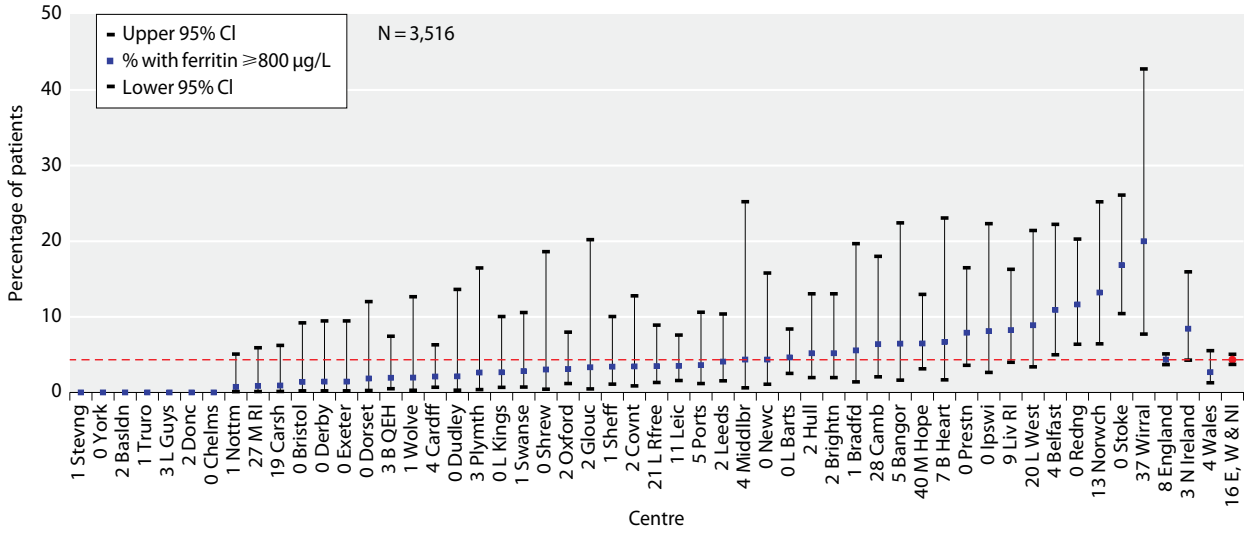

Fig. 9.36. Percentage of PD patients with ferritin ⩾800 µg/L

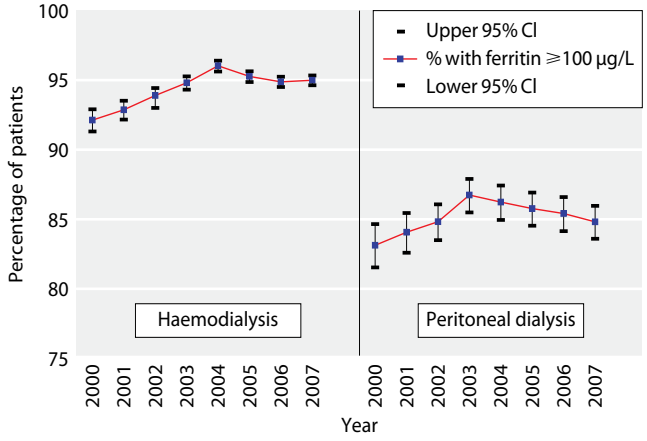

Fig. 9.37. Proportion of patients with ferritin ⩾100 µg/L (2000–2007)

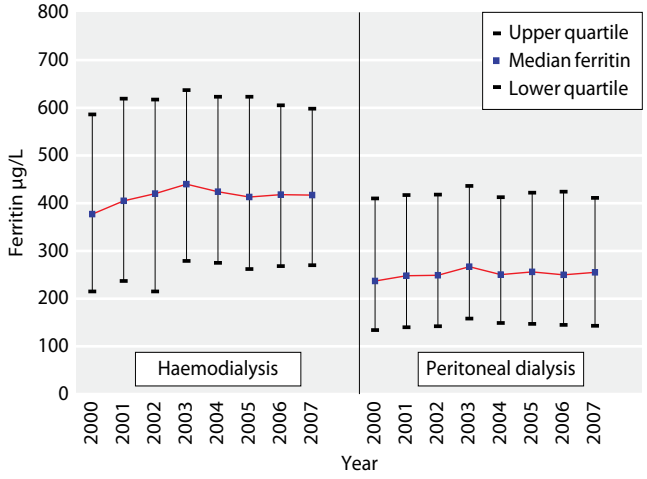

Fig. 9.38. Median ferritin (2000–2007)

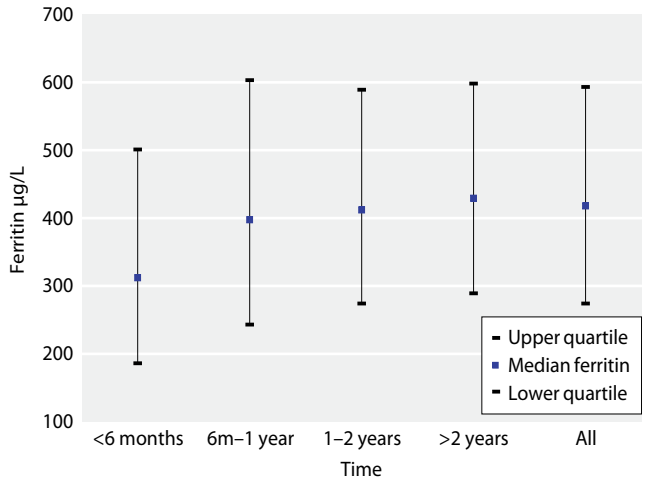

Fig. 9.39. Median ferritin by length of time on RRT in patients treated with HD

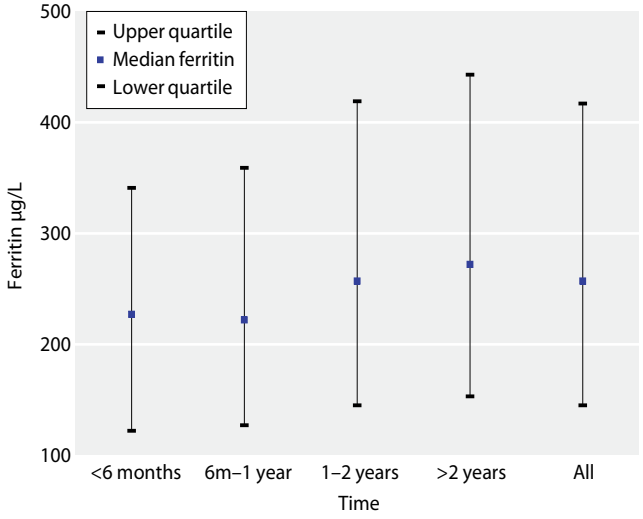

Fig. 9.40. Median ferritin by length of time on RRT in patients treated with PD

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.

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 or alternatively they were anaemic but still not receiving an ESA for whatever reason.

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

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	98	9,267	8,000	100	3
B Heart	82	9,500	8,000	95	16
Bangor	90	10,093	8,000	100	9
Basldn	94	8,845	8,000	100	5
Belfast	90	7,803	6,000	100	7
Bradfd	91	6,804	5,000	100	9
Bristol	96	10,144	8,000	100	4
Chelms	96	9,651	8,000	77	1
Covnt	93	11,661	10,000	93	5
Derry	98	7,725	4,500	100	2
Dorset	94	12,277	12,000	100	6
Dudley	81	6,372	6,000	77	16
Exeter	93	8,806	8,000	96	6
Glouc	94	10,508	9,000	95	5
Ipswi	96	10,529	8,500	100	4
Leeds	92	8,227	6,000	98	6
Leic	97	8,957	7,500	100	2
Liv RI	89	9,640	8,000	94	5
Middlbr	85	6,317	6,000	88	13
Newry	90	5,376	4,000	100	10
Norwch	81	8,989	8,000	74	12
Oxford	93	9,985	8,000	100	6
Plymth	92	10,216	9,000	93	7
Prestn	92	9,740	10,000	85	6
Redng	93	6,000	6,000	100	7
Sheff	91	9,894	8,000	97	8
Shrew	96	9,504	8,000	90	3
Sthend	97	12,117	12,000	96	1
Sund	90	11,684	10,000	95	8
Swanse	85	9,022	8,000	90	13
Truro	99	8,691	6,000	100	1
Tyrone	90	9,603	9,000	100	7
Ulster	100	7,095	5,000	100	0
Wolve	93	9,285	8,000	97	6
Wrexm	89	9,614	8,000	75	7
York	96	9,301	6,000	100	4
England	**92**	**9,449**	**8,000**	**95**	**6**
N Ireland	**93**	**7,890**	**6,000**	**100**	**5**
Wales	**87**	**9,296**	**8,000**	**89**	**11**
E, W & NI	**92**	**9,299**	**8,000**	**96**	**7**

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	69				
Bangor	77	4,975	4,000	100	23
Belfast	75	4,207	3,000	100	22
Bradfd	81	7,010	6,000	100	19
Bristol	74	5,525	4,000	100	26
Camb	70	6,882	5,000	67	28
Cardff	78			93	21
Chelms	89	6,231	4,500	100	9
Clwyd	69				
Covnt	82	8,849	6,000	100	18
Derry	75				
Dorset	84	6,404	4,000	100	16
Dudley	87	5,540	6,000	100	14
Exeter	84	5,413	4,000	100	16
Glouc	80	4,987	3,346	100	20
Ipswi	73	5,224	4,000	100	27
Leeds	69	6,900	4,000	100	31
Leic	84	4,708	4,000	100	16
Liv RI	76	7,838	6,000	100	18
Norwch	67	4,351	2,800	75	29
Oxford	92	7,250	6,000	83	5
Plymth	82	6,129	6,000	100	13
Prestn	73			67	21
Redng	86			100	14
Sheff	68	7,390	6,000	100	32
Shrew	79	5,042	4,000	100	21
Sund	90				
Swanse	76	7,927	6,000	100	23
Truro	91	4,804	4,000	100	9
Ulster	100				
Wolve	74	4,513	4,000	75	25
York	74	5,571	4,000		26
England	**75**	**6,138**	**4,000**	**94**	**19**
N Ireland	**75**	**4,190**	**3,000**	**100**	**22**
Wales	**77**	**6,936**	**6,000**	**95**	**22**
E, W & NI	**75**	**6,101**	**4,000**	**94**	**20**

Blank cells denote centres excluded from analyses due to low patient numbers or missing dosage data

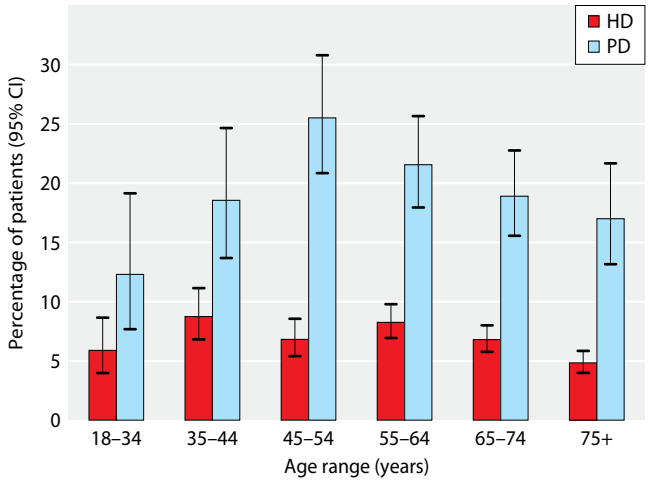

Fig. 9.41. Percentage of whole cohort who are not on ESA and have Hb ⩾10 g/dl, by age group and treatment modality

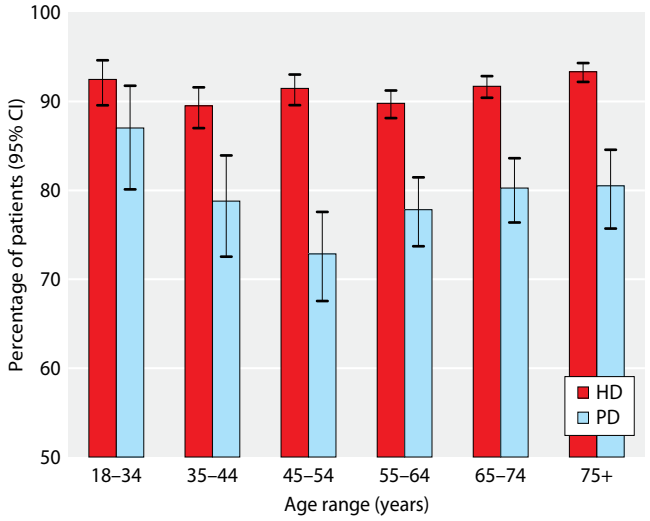

Fig. 9.42. Percentage of dialysis patients on ESA, by age group and treatment modality

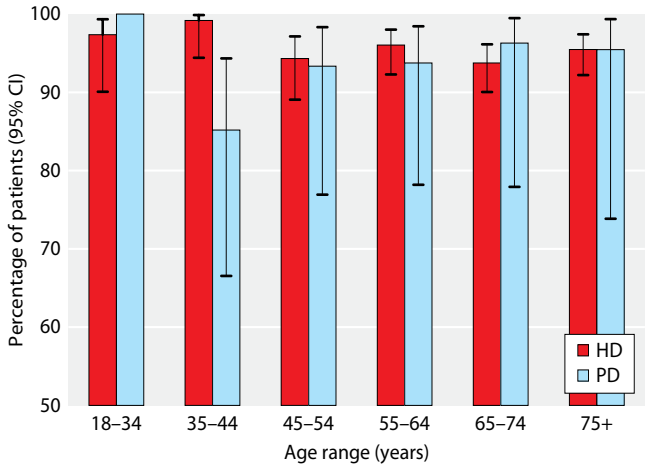

Fig. 9.43. Percentage of patients with Hb <10 g/dl who are on ESA, by age group and treatment modality

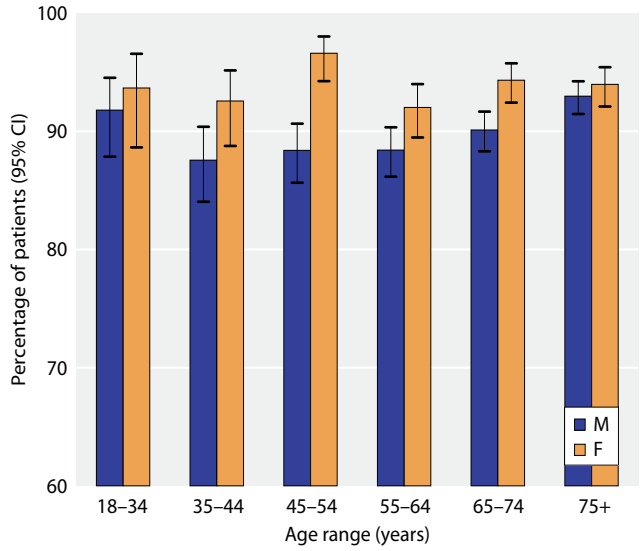

Fig. 9.44. Prescription of ESA by age and gender in patients treated with HD

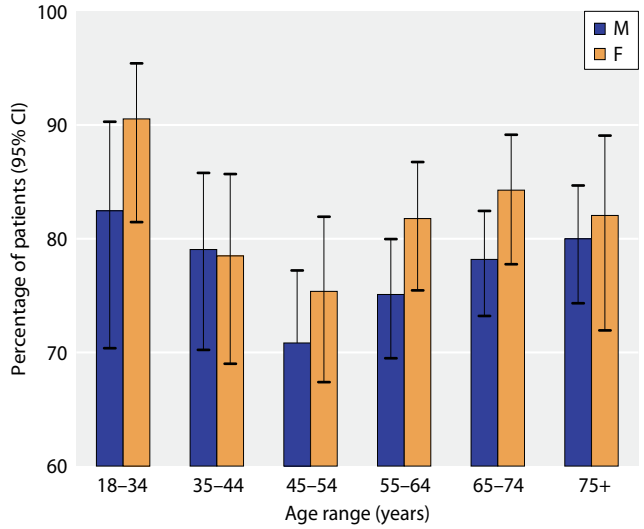

Fig. 9.45. Prescription of ESA by age and gender in patients treated with PD

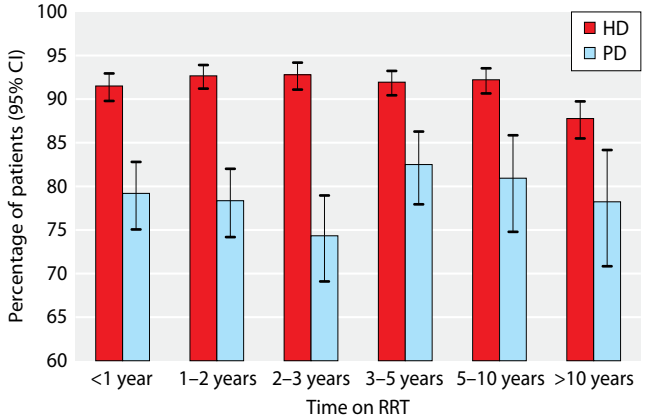

Fig. 9.46. Percentage of patients on ESA by time on RRT

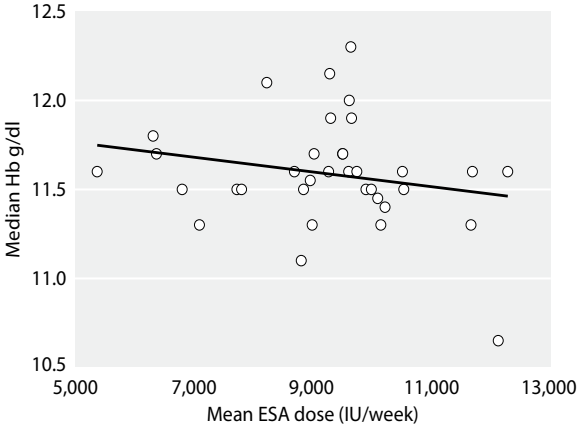

Fig. 9.47. Median Hb versus mean ESA dose in patients treated with HD

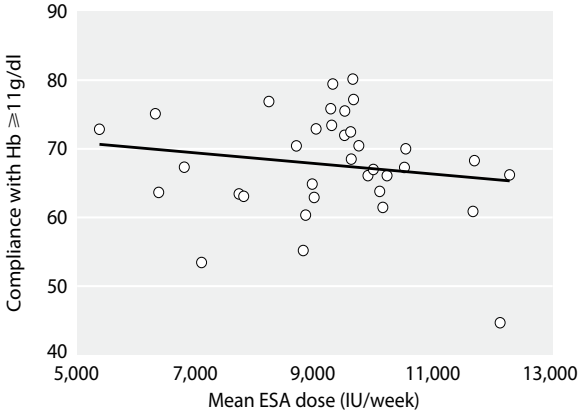

Fig. 9.48. Compliance with European Best Practice Guidelines versus mean ESA dose in patients treated with HD

a cross-sectional analysis at the final quarter of 2007. 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 mean weekly ESA dose by treatment modality.

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 (86% and 91% respectively). Achieving compliance whilst also complying with the NICE guidelines published in 2006 and the 4th edition of the RA Clinical Practice Guidelines 2006 recommended outcome Hb of between 10.5 and 12.5 g/dl requires careful positioning of the median outcome Hb for each centre and also would require 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 52 centres achieving >85% compliance with Hb ⩾10.0 g/dl, only 11 centres achieved ⩾60% compliance with Hb between 10.5 and 12.5 g/dl. The

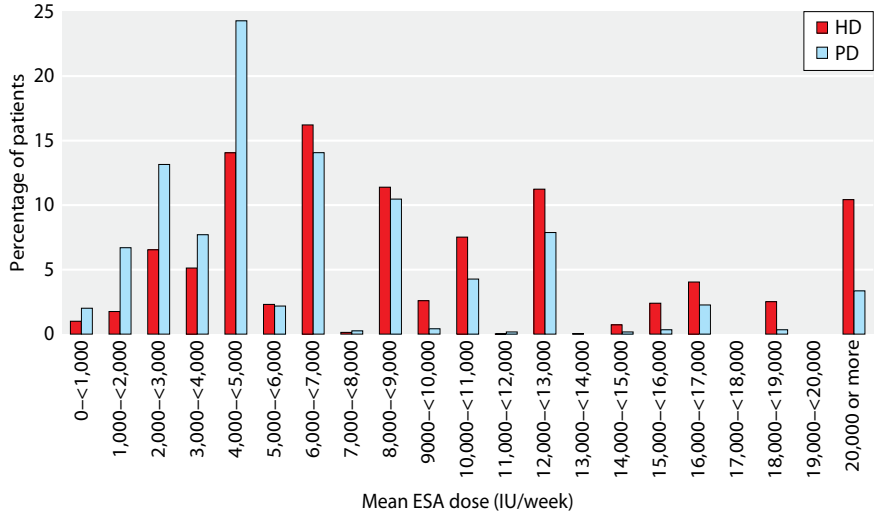

Figure 9.49. Frequency distribution of mean weekly ESA dose

presentation of funnel plots for compliance with Hb $\geqslant$10.0 g/dl and Hb between 10.5 and 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. In last year's report the need to avoid improving compliance with the NICE guidelines at the expense of the Hb $\geqslant$10.0 g/dl minimum standard was highlighted. This year's report confirms maintained UK compliance with more than 85% Hb $\geqslant$10.0 g/dl for dialysis patients. The use of 10.5–12.5 g/dl alone would infer equivalent risk of Hb >12.5 g/dl as for <10.5 g/dl. The NICE guidance on limiting upper Hb was primarily a health economic decision and not on the grounds of safety. The evidence for improving Hb $\geqslant$10 g/dl remains unchanged.

Iron stores as reflected by ferritin outcome have remained in a steady state 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 was 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. Fifty-one centres achieved $\geqslant$50% compliance with Hb between 10.5–12.5 g/dl for HD patients compared with 35 in last year's report. The overall UK compliance with this range has also improved from 48% to 53%.

Conflict of interest: none

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Chapter 10
Biochemistry profile of patients receiving dialysis in the UK in 2007: 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 audit measures for prevalent haemodialysis (HD) and peritoneal dialysis (PD) cohorts in 2007. The biochemical variables studied were phosphate, adjusted calcium, parathyroid hormone, bicarbonate and total cholesterol. In addition longitudinal analyses were performed (2000–2007) to show changes in achievement of clinical performance measures over time. ***Results:*** Serum phosphate was between 1.1–1.8 mmol/L in 53% of HD and 64% of PD patients. Since 2003 there has been annual improvement in phosphate control for both HD and PD patients, largely through a reduction in phosphate >1.8 mmol/L. PD patients this year also showed a reduction in the percentage with a low phosphate. Adjusted calcium was between 2.2–2.6 mmol/L in 73% of HD and 78% of PD patients. Parathyroid hormone was between 16–32 pmol/L in 25% of HD and 27% of PD patients. The audit measure for bicarbonate was achieved in 71% of HD and 50% of PD patients. There was inter-centre variation for all variables studied. ***Conclusions:*** The UKRR consistently demonstrates inter-centre variation in achievement of biochemical clinical audit measures. Understanding the causes of this variation is an important part of improving the care of dialysis patients in the UK.

Introduction

The UKRR collected routine biochemical data from clinical information systems in renal centres in England, Wales and Northern Ireland. 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 [2]. 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 (although a draft version was available for some time prior to this) [1]. Audit data for 2007 therefore spanned the adoption of these guidelines which included revision of some of the audit measures. 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) needed 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. The format of data presentation has been revised compared to previous UKRR reports [2]. To supplement these performance analyses, summary statistical data enhanced understanding of the population characteristics of each centre and longitudinal analyses demonstrated changes over time.

Methods

These analyses relate to biochemical variables in the prevalent dialysis cohort in England, Wales and Northern Ireland in 2007. The cohort studied were patients prevalent on dialysis treatment on 31/12/07. HD and PD cohorts were analysed separately.

The biochemical variables analysed were phosphate, calcium, parathyroid hormone, bicarbonate and cholesterol. The method of data collection and validation by the UKRR has been described elsewhere [3]. For each quarter of 2007 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 [2]. The audit measure for adjusted calcium in the 4th edition of the Renal Association Clinical Practice Guidelines depends on a local reference range [1]. To enable comparative audit the UKRR has continued to use adjusted calcium between 2.2–2.6 mmol/L as an audit measure. There are also 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 upper laboratory value as the audit measure. This equates to 16–32 pmol/L and is comparable to KDOQI (15–31 pmol/L) [2, 4, 5]. The measure used for serum bicarbonate in the PD cohort was 25–29 mmol/L (the same as previous years) as the new audit measure specifies that serum bicarbonate should be maintained in the 'normal range'. A summary of the current Renal Association audit measures and conversion factors to SI units are given in table 10.1.

Quarterly values were extracted from the database for the last two quarters of 2007 for calcium, bicarbonate and phosphate, the last three quarters for iPTH and the entire year for cholesterol. Patients who did not have these data were excluded from the analyses. 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' [6]. 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 analyses were performed for some data to calculate overall changes in achievement of a performance measure annually from 2000 to 2007. All data were unadjusted for case-mix.

Results

Mineral and bone parameters

Phosphate

The 4th edition of the Renal Association Clinical Practice Guidelines states:

Table 10.1. Summary of clinical audit measures and conversion factors from SI units

Biochemical variable	Clinical audit measure	Conversion factor from SI units
Phosphate	1.1–1.8 mmol/L	mg/dl = mmol/L × 3.1
Calcium	Normal range (ideally <2.5 mmol/L)	mg/dl = mmol/L × 4
Parathyroid hormone	2–4 times upper limit of normal	ng/L = pmol/L × 9.5
Bicarbonate	HD patients: 20–26 mmol/L PD patients: normal range	mg/dl = mmol/L × 6.1
Cholesterol	No audit measure	mg/dl = mmol/L × 38.6

'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 90% complete for HD patients and 95% complete for PD patients overall although there was considerable variation between centres. Data from HD patients in Coventry and London West and PD patients in London West were not included as there was a problem with data extraction (tables 10.2 and 10.4).

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 below, within and above the range specified by the clinical performance measure (figures 10.1–10.12). Fifty three percent (CI 53–54%) of HD patients and 64% (CI 62–66%) of PD patients achieved a phosphate between 1.1–1.8 mmol/L (tables 10.3 and 10.5). The proportion of HD patients with hyperphosphataemia was 31% (CI 31–32%) compared to 33% in 2006 and the proportion with hypophosphataemia was 15% (CI 15–16%) compared to 13% in 2006 (table 10.3 and figure 10.13). The proportion of PD patients with hyperphosphataemia was 26% (CI 24–27%) compared to 25% in 2006 and the proportion with hypophosphataemia was 10% (CI 9–11%) compared to 12% in 2006 (table 10.5 and figure 10.13).

Adjusted Calcium

The 4th edition of the Renal Association Clinical Practice Guidelines states:

Table 10.2. Summary statistics for phosphate in all haemodialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99.2	122	1.55	0.51	1.48	1.18	1.81
B Heart	93.6	334	1.71	0.51	1.66	1.34	2.02
B QEH	95.7	662	1.63	0.49	1.59	1.31	1.89
Bangor	96.7	58	1.64	0.45	1.62	1.24	2.03
Basldn	98.4	121	1.66	0.52	1.58	1.30	1.97
Belfast	96.3	237	1.60	0.54	1.55	1.20	1.84
Bradfd	99.4	158	1.62	0.54	1.52	1.25	1.95
Brightn	99.7	297	1.53	0.50	1.51	1.18	1.81
Bristol	100.0	428	1.72	0.52	1.68	1.38	2.00
Camb	56.0	186	1.58	0.57	1.54	1.17	1.83
Cardff	97.1	442	1.63	0.51	1.58	1.28	1.96
Carlis	95.1	77	1.82	0.49	1.78	1.49	2.07
Carsh	84.6	444	1.66	0.57	1.61	1.28	1.94
Chelms	100.0	94	1.58	0.49	1.53	1.18	1.92
Clwyd	94.0	63	1.45	0.53	1.40	1.10	1.73
Covnt	0.0	0					
Derby	100.0	183	1.63	0.56	1.58	1.25	1.93
Derry	100.0	41	1.73	0.66	1.64	1.23	2.01
Donc	100.0	54	1.68	0.63	1.60	1.20	2.10
Dorset	100.0	139	1.63	0.51	1.57	1.28	2.00
Dudley	86.4	95	1.61	0.57	1.58	1.28	1.93
Exeter	99.2	260	1.64	0.53	1.56	1.27	1.90
Glouc	99.4	161	1.62	0.48	1.56	1.28	1.95
Hull	97.7	291	1.51	0.58	1.49	1.12	1.84
Ipswi	100.0	90	1.64	0.48	1.62	1.27	1.91
L Barts	99.8	550	1.63	0.53	1.61	1.29	1.91
L Guys	96.6	429	1.48	0.50	1.50	1.10	1.80
L Kings	100.0	309	1.51	0.46	1.45	1.16	1.81
L Rfree	82.2	465	1.50	0.57	1.43	1.08	1.86
L West	35.7	351					
Leeds	97.5	463	1.59	0.52	1.52	1.25	1.91
Leic	98.9	626	1.68	0.49	1.64	1.33	1.97

Table 10.2. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Liv Ain	98.2	109	1.59	0.52	1.56	1.21	1.91
Liv RI	93.1	366	1.59	0.53	1.53	1.22	1.84
M Hope	85.9	262	1.57	0.60	1.46	1.14	1.91
M RI	70.4	221	1.59	0.58	1.51	1.19	1.94
Middlbr	98.5	257	1.72	0.57	1.64	1.35	2.02
Newc	100.0	208	1.60	0.56	1.56	1.23	1.86
Newry	98.8	82	1.62	0.54	1.53	1.21	1.88
Norwch	90.1	210	1.63	0.51	1.54	1.29	1.88
Nottm	98.3	339	1.58	0.52	1.50	1.20	1.90
Oxford	99.1	323	1.59	0.52	1.57	1.20	1.90
Plymth	98.3	117	1.75	0.55	1.67	1.36	2.03
Ports	99.2	370	1.79	0.58	1.74	1.43	2.14
Prestn	99.5	381	1.68	0.54	1.61	1.30	2.00
Redng	100.0	210	1.38	0.45	1.39	1.01	1.69
Sheff	99.0	507	1.72	0.48	1.66	1.38	2.02
Shrew	97.3	143	1.92	0.60	1.83	1.49	2.27
Stevng	94.8	291	1.71	0.51	1.62	1.35	1.99
Sthend	97.4	112	1.60	0.52	1.53	1.19	1.91
Stoke	99.6	241	1.54	0.54	1.50	1.11	1.80
Sund	96.0	142	1.66	0.57	1.59	1.28	1.99
Swanse	99.3	273	1.54	0.53	1.47	1.17	1.84
Truro	99.3	142	1.74	0.49	1.67	1.46	1.93
Tyrone	97.2	69	1.66	0.48	1.60	1.30	1.96
Ulster	100.0	74	1.58	0.43	1.52	1.24	1.88
Wirral	94.2	161	1.50	0.54	1.40	1.12	1.80
Wolve	99.6	252	1.58	0.60	1.51	1.15	1.87
Wrexm	98.7	73	1.45	0.50	1.47	1.15	1.71
York	100.0	107	1.66	0.54	1.54	1.32	1.91
England	**88.7**	**12,738**	**1.62**	**0.54**	**1.57**	**1.25**	**1.91**
N Ireland	**98.0**	**625**	**1.60**	**0.53**	**1.54**	**1.23**	**1.88**
Wales	**97.6**	**909**	**1.58**	**0.52**	**1.52**	**1.21**	**1.89**
E, W & NI	**89.6**	**14,272**	**1.61**	**0.54**	**1.56**	**1.24**	**1.91**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

Table 10.3. Percentage of haemodialysis patients within, below and above the range for phosphate (1.1–1.8 mmol/L) in 2007

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	122	56.6	47.7	65.1	18.0	12.2	25.9	25.4	18.5	33.9
B Heart	334	54.5	49.1	59.8	9.0	6.4	12.6	36.5	31.5	41.8
B QEH	662	60.9	57.1	64.5	10.0	7.9	12.5	29.2	25.8	32.7
Bangor	58	50.0	37.4	62.6	8.6	3.6	19.1	41.4	29.5	54.3
Basldn	121	53.7	44.8	62.4	14.1	8.9	21.4	32.2	24.5	41.1
Belfast	237	55.7	49.3	61.9	17.3	13.0	22.7	27.0	21.7	33.0
Bradfd	158	51.3	43.5	59.0	13.9	9.4	20.2	34.8	27.8	42.6
Brightn	297	54.2	48.5	59.8	20.2	16.0	25.2	25.6	21.0	30.9
Bristol	428	51.4	46.7	56.1	10.1	7.5	13.3	38.6	34.1	43.3
Camb	186	54.3	47.1	61.3	18.3	13.4	24.5	27.4	21.5	34.3
Cardff	442	52.5	47.8	57.1	14.7	11.7	18.3	32.8	28.6	37.3
Carlis	77	46.8	36.0	57.9	6.5	2.7	14.7	46.8	36.0	57.9

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
Carsh	444	52.0	47.4	56.6	13.7	10.8	17.3	34.2	30.0	38.8
Chelms	94	56.4	46.2	66.0	14.9	9.0	23.6	28.7	20.5	38.7
Clwyd	63	55.6	43.2	67.3	23.8	14.9	35.8	20.6	12.4	32.4
Derby	183	52.5	45.2	59.6	14.2	9.9	20.1	33.3	26.9	40.5
Derry	41	41.5	27.6	56.9	14.6	6.7	29.0	43.9	29.7	59.2
Donc	54	50.0	37.0	63.0	14.8	7.6	26.9	35.2	23.7	48.7
Dorset	139	54.7	46.4	62.8	11.5	7.2	18.0	33.8	26.4	42.1
Dudley	95	52.6	42.6	62.4	14.7	8.9	23.4	32.6	24.0	42.7
Exeter	260	55.8	49.7	61.7	14.2	10.5	19.0	30.0	24.7	35.9
Glouc	161	57.1	49.4	64.6	11.8	7.7	17.8	31.1	24.4	38.6
Hull	291	47.1	41.4	52.8	24.4	19.8	29.7	28.5	23.6	34.0
Ipswi	90	60.0	49.6	69.6	8.9	4.5	16.8	31.1	22.4	41.4
L Barts	550	53.3	49.1	57.4	15.1	12.3	18.3	31.6	27.9	35.6
L Guys	429	61.5	56.8	66.0	18.7	15.2	22.6	19.8	16.3	23.9
L Kings	309	55.3	49.8	60.8	19.4	15.4	24.2	25.2	20.7	30.4
L Rfree	465	45.2	40.7	49.7	27.3	23.5	31.5	27.5	23.7	31.8
Leeds	463	52.7	48.1	57.2	16.4	13.3	20.1	30.9	26.8	35.2
Leic	626	54.8	50.9	58.7	8.5	6.5	10.9	36.7	33.1	40.6
Liv Ain	109	55.1	45.6	64.1	16.5	10.7	24.7	28.4	20.8	37.6
Liv RI	366	54.4	49.2	59.4	18.6	14.9	22.9	27.1	22.8	31.8
M Hope	262	44.7	38.7	50.7	23.3	18.6	28.8	32.1	26.7	38.0
M RI	221	50.7	44.1	57.2	18.6	14.0	24.2	30.8	25.0	37.2
Middlbr	257	47.1	41.1	53.2	13.6	9.9	18.4	39.3	33.5	45.4
Newc	208	56.3	49.4	62.8	15.9	11.5	21.5	27.9	22.2	34.4
Newry	82	57.3	46.4	67.5	13.4	7.6	22.6	29.3	20.5	40.0
Norwch	210	55.2	48.5	61.8	11.9	8.2	17.0	32.9	26.8	39.5
Nottm	339	61.1	55.8	66.1	13.6	10.3	17.6	25.4	21.0	30.3
Oxford	323	53.9	48.4	59.2	16.7	13.0	21.2	29.4	24.7	34.6
Plymth	117	47.0	38.2	56.1	10.3	5.9	17.2	42.7	34.1	51.8
Ports	370	47.6	42.5	52.7	9.2	6.6	12.6	43.2	38.3	48.3
Prestn	381	50.7	45.7	55.7	12.3	9.4	16.0	37.0	32.3	42.0
Redng	210	50.0	43.3	56.7	30.5	24.6	37.0	19.5	14.7	25.4
Sheff	507	52.1	47.7	56.4	8.1	6.0	10.8	39.8	35.7	44.2
Shrew	143	43.4	35.5	51.6	3.5	1.5	8.1	53.2	45.0	61.2
Stevng	291	56.0	50.3	61.6	7.9	5.3	11.6	36.1	30.8	41.8
Sthend	112	51.8	42.6	60.9	14.3	8.9	22.1	33.9	25.8	43.2
Stoke	241	57.7	51.4	63.8	19.1	14.6	24.5	23.2	18.3	29.0
Sund	142	49.3	41.2	57.5	15.5	10.4	22.4	35.2	27.8	43.4
Swanse	273	54.6	48.6	60.4	18.3	14.2	23.4	27.1	22.2	32.7
Truro	142	54.9	46.7	62.9	7.0	3.8	12.6	38.0	30.4	46.3
Tyrone	69	56.5	44.7	67.7	7.3	3.1	16.3	36.2	25.8	48.1
Ulster	74	59.5	48.0	70.0	12.2	6.5	21.8	28.4	19.3	39.6
Wirral	161	59.0	51.3	66.3	17.4	12.3	24.0	23.6	17.7	30.8
Wolve	252	48.4	42.3	54.6	22.6	17.9	28.2	29.0	23.7	34.9
Wrexm	73	56.2	44.7	67.0	23.3	15.0	34.3	20.6	12.8	31.3
York	107	52.3	42.9	61.6	13.1	7.9	20.9	34.6	26.2	44.1
England	**12,738**	**53.2**	**52.3**	**54.0**	**15.4**	**14.8**	**16.0**	**31.5**	**30.7**	**32.3**
N Ireland	**625**	**55.7**	**51.8**	**59.5**	**15.0**	**12.5**	**18.1**	**29.3**	**25.8**	**33.0**
Wales	**909**	**53.5**	**50.2**	**56.7**	**16.7**	**14.4**	**19.3**	**29.8**	**26.9**	**32.9**
E, W & NI	**14,272**	**53.3**	**52.5**	**54.1**	**15.4**	**14.9**	**16.0**	**31.3**	**30.5**	**32.0**

Table 10.4. Summary statistics for phosphate in peritoneal dialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	16					
B Heart	97	31	1.43	0.32	1.40	1.20	1.59
B QEH	86	118	1.56	0.46	1.53	1.23	1.81
Bangor	100	31	1.46	0.37	1.44	1.09	1.75
Basldn	100	26	1.50	0.38	1.42	1.25	1.67
Belfast	96	57	1.63	0.46	1.62	1.28	1.99
Bradfd	100	36	1.58	0.48	1.56	1.19	1.86
Brightn	100	78	1.43	0.34	1.43	1.21	1.62
Bristol	100	72	1.70	0.45	1.68	1.42	2.00
Camb	100	47	1.36	0.33	1.40	1.12	1.56
Cardff	99	147	1.62	0.43	1.55	1.34	1.85
Carlis	100	11					
Carsh	97	113	1.59	0.41	1.57	1.34	1.85
Chelms	97	36	1.57	0.31	1.50	1.36	1.80
Clwyd	92	13					
Covnt	86	65	1.51	0.45	1.45	1.17	1.82
Derby	100	71	1.50	0.31	1.47	1.26	1.67
Derry	100	4					
Donc	100	33	1.63	0.46	1.50	1.40	1.80
Dorset	96	56	1.47	0.34	1.45	1.23	1.75
Dudley	94	54	1.59	0.44	1.50	1.33	1.82
Exeter	100	70	1.50	0.36	1.46	1.24	1.73
Glouc	100	30	1.72	0.41	1.72	1.49	2.03
Hull	95	83	1.63	0.39	1.60	1.40	1.83
Ipswi	98	45	1.68	0.46	1.63	1.32	1.89
L Barts	100	218	1.53	0.43	1.49	1.24	1.76
L Guys	98	60	1.50	0.40	1.50	1.30	1.80
L Kings	99	75	1.55	0.43	1.50	1.27	1.75
L Rfree	95	120	1.54	0.39	1.48	1.29	1.81
L West	2	64					
Leeds	99	99	1.57	0.51	1.49	1.21	1.80
Leic	99	180	1.62	0.50	1.51	1.30	1.87
Liv Ain	n/a	n/a					
Liv RI	91	92	1.59	0.44	1.58	1.29	1.75
M Hope	95	116	1.54	0.43	1.54	1.25	1.79
M RI	100	115	1.62	0.45	1.56	1.26	1.96
Middlbr	92	25	1.61	0.39	1.53	1.39	1.84
Newc	100	46	1.76	0.43	1.69	1.45	1.98
Newry	100	13					
Norwch	96	57	1.54	0.39	1.50	1.24	1.79
Nottm	100	135	1.56	0.40	1.50	1.30	1.80
Oxford	100	133	1.63	0.50	1.55	1.34	1.84
Plymth	100	38	1.55	0.46	1.45	1.28	1.73
Ports	83	92	1.83	0.44	1.83	1.46	2.08
Prestn	99	77	1.68	0.44	1.68	1.42	1.97
Redng	100	86	1.41	0.36	1.36	1.18	1.56
Sheff	100	88	1.71	0.41	1.65	1.48	1.91
Shrew	94	33	1.71	0.51	1.67	1.36	1.93
Stevng	97	38	1.56	0.33	1.54	1.33	1.81
Sthend	94	18					
Stoke	100	90	1.61	0.40	1.60	1.30	1.80
Sund	100	10					
Swanse	96	74	1.49	0.40	1.47	1.23	1.69
Truro	100	23	1.70	0.41	1.57	1.37	2.09
Tyrone	100	5					
Ulster	100	2					
Wirral	68	28					
Wolve	98	53	1.55	0.44	1.49	1.27	1.72
Wrexm	90	30	1.68	0.42	1.56	1.46	1.85
York	96	23	1.56	0.31	1.60	1.31	1.81
England	**95**	**3,143**	**1.58**	**0.43**	**1.29**	**1.53**	**1.81**
N Ireland	**97**	**94**	**1.61**	**0.41**	**1.28**	**1.62**	**1.90**
Wales	**97**	**286**	**1.58**	**0.42**	**1.32**	**1.53**	**1.83**
E, W & NI	**95**	**3,523**	**1.58**	**0.43**	**1.30**	**1.53**	**1.82**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

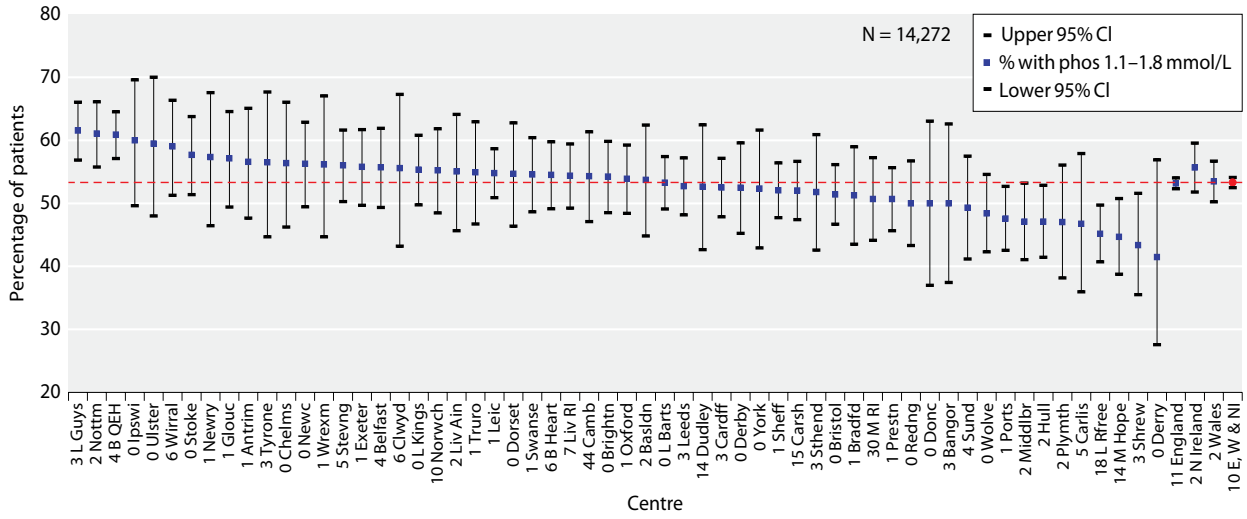

Fig. 10.1. Percentage of haemodialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2007

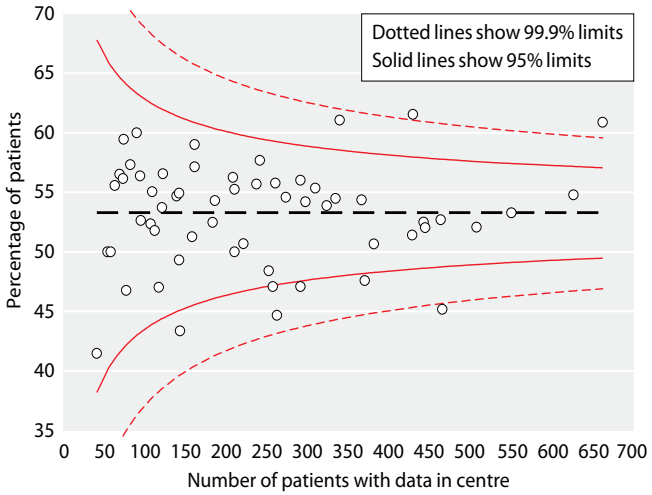

Fig. 10.2. Funnel plot of percentage of haemodialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2007

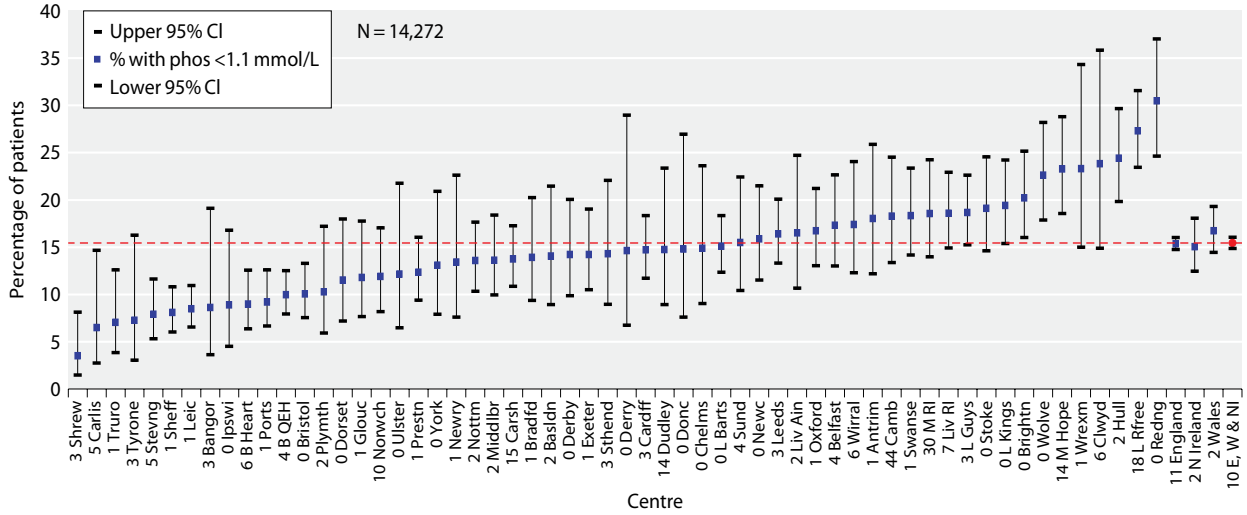

Fig. 10.3. Percentage of haemodialysis patients with phosphate <1.1 mmol/L by centre in 2007

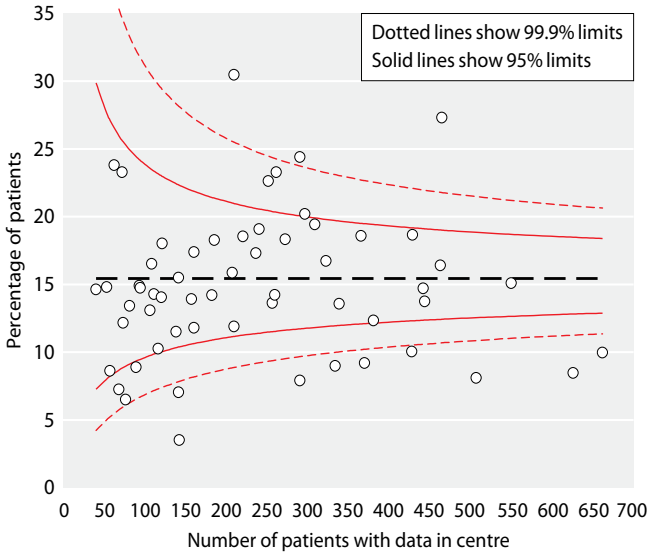

Fig. 10.4. Funnel plot of percentage of haemodialysis patients with phosphate <1.1 mmol/L by centre in 2007

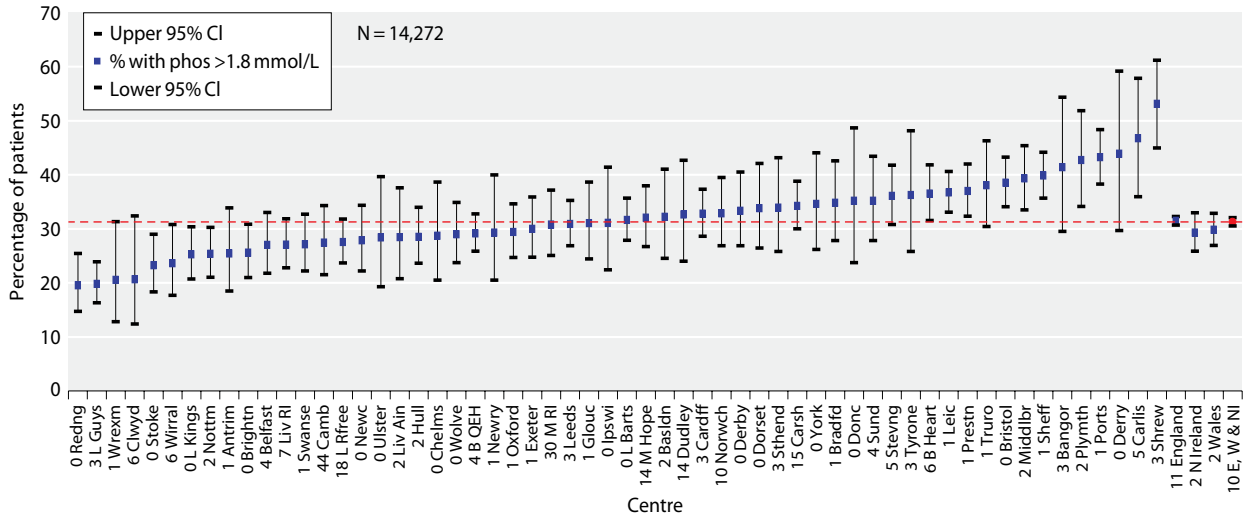

Fig. 10.5. Percentage of haemodialysis patients with phosphate >1.8 mmol/L by centre in 2007

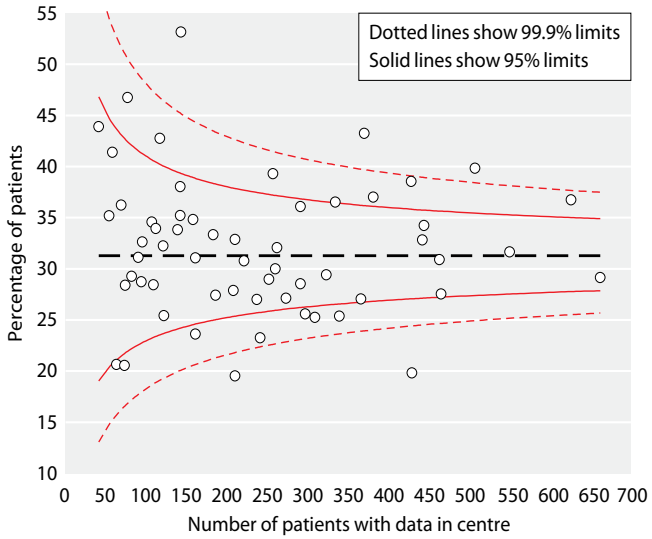

Fig. 10.6. Funnel plot of percentage of haemodialysis patients with phosphate >1.8 mmol/L by centre in 2007

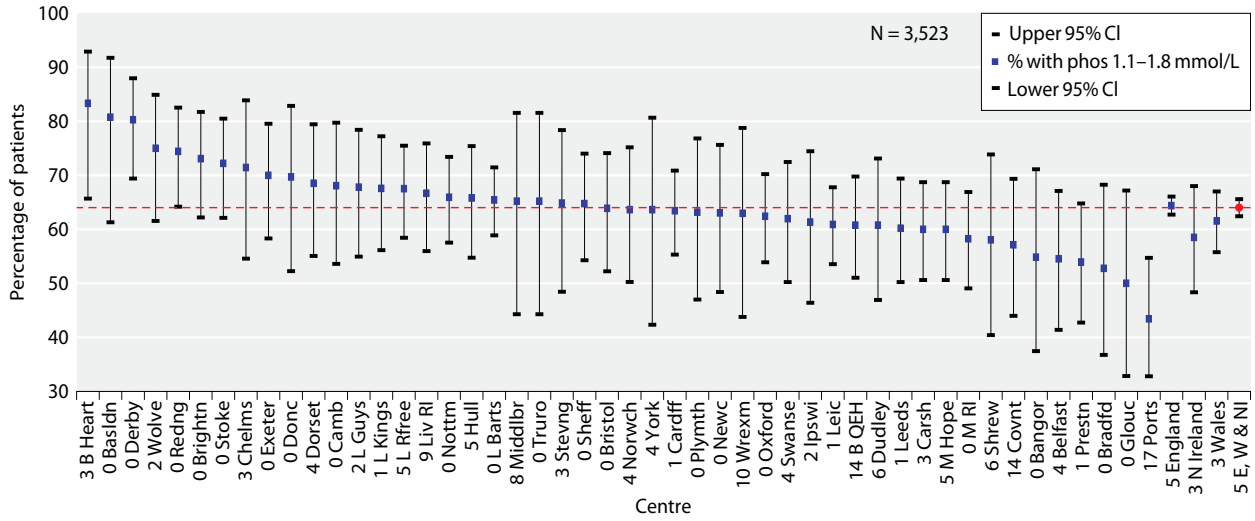

Fig. 10.7. Percentage of peritoneal dialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2007

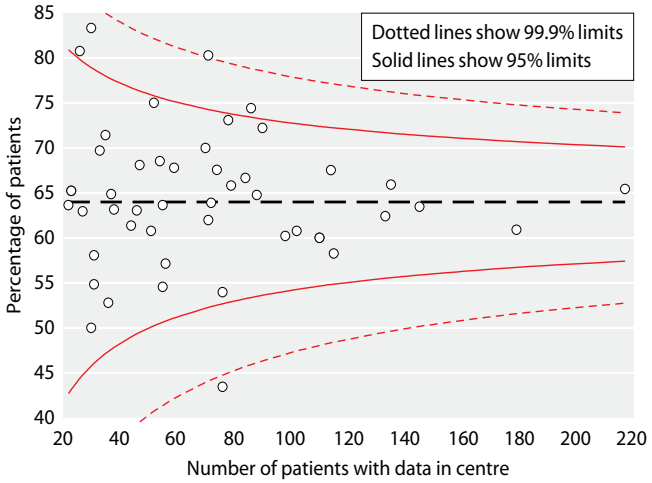

Fig. 10.8. Funnel plot of percentage of peritoneal dialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2007

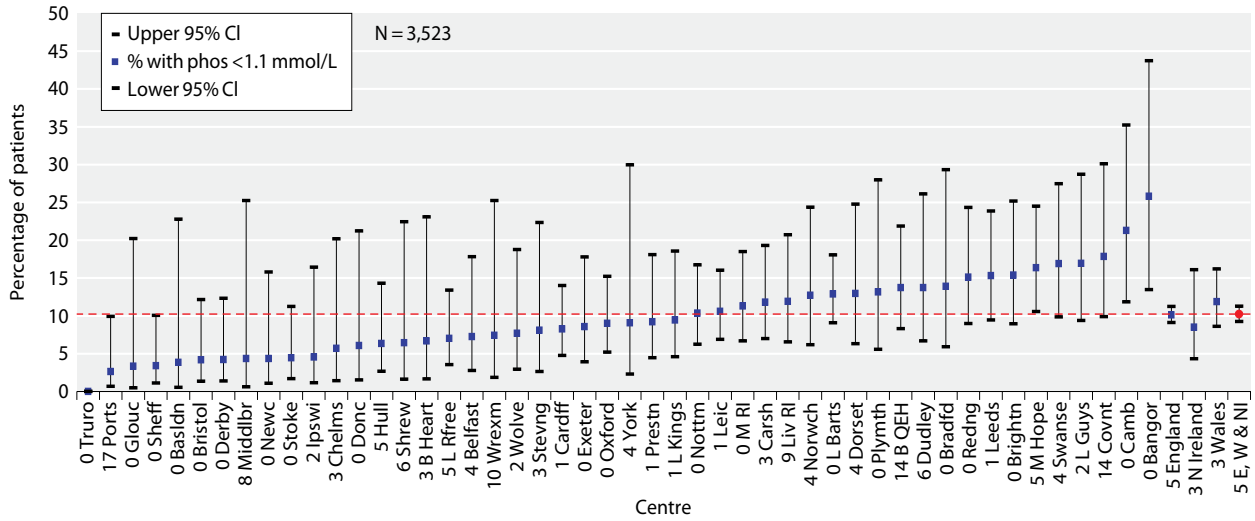

Fig. 10.9. Percentage of peritoneal dialysis patients with phosphate <1.1 mmol/L by centre in 2007

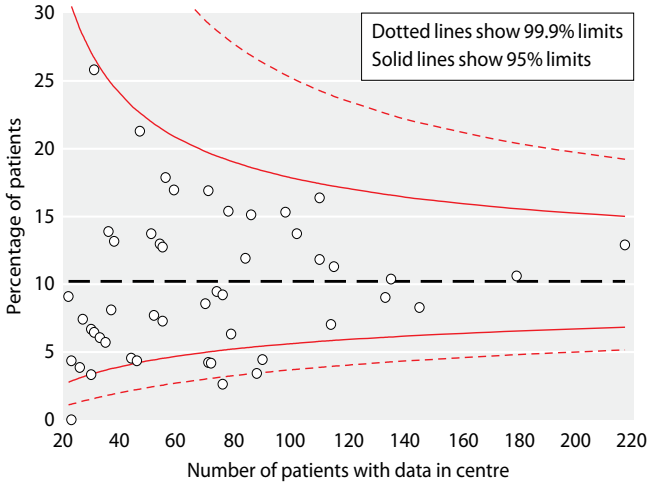

Fig. 10.10. Funnel plot of percentage of peritoneal dialysis patients with phosphate <1.1 mmol/L by centre in 2007

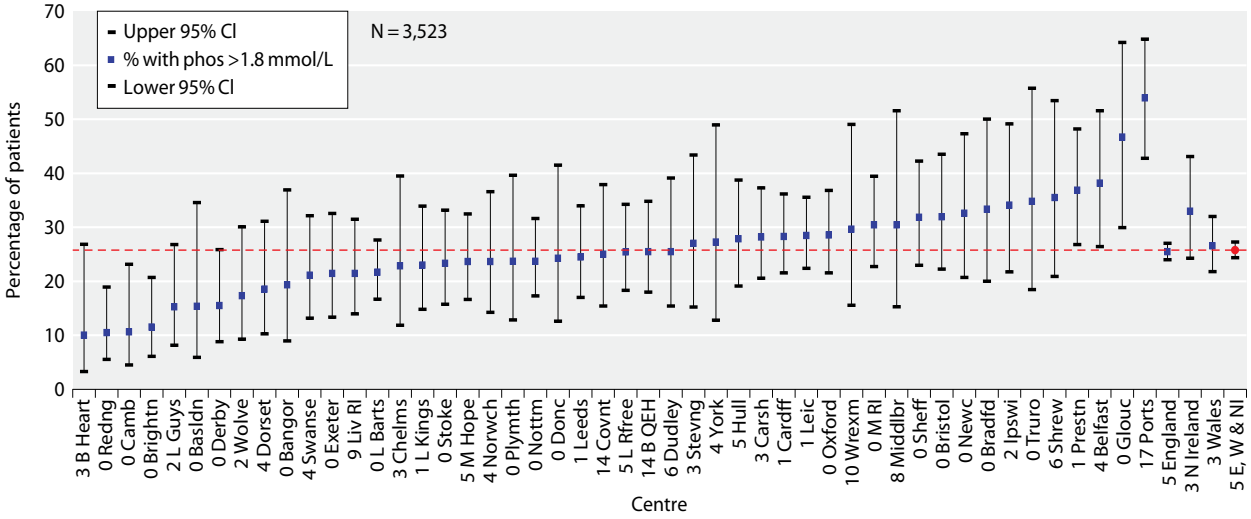

Fig. 10.11. Percentage of peritoneal dialysis patients with phosphate >1.8 mmol/L by centre in 2007

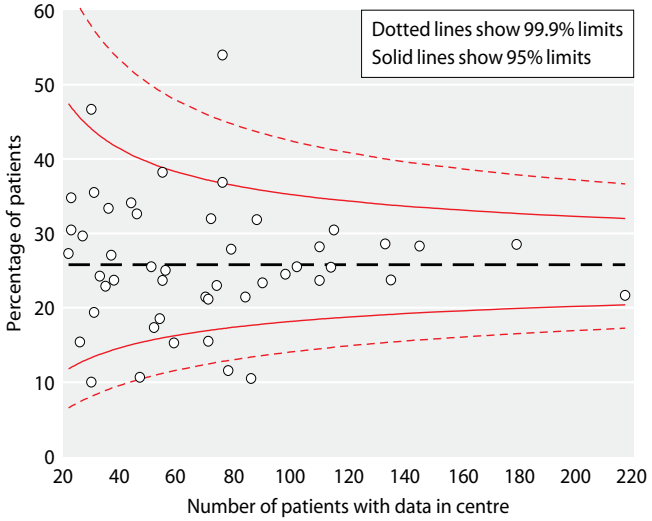

Fig. 10.12. Funnel plot of percentage of peritoneal dialysis patients with phosphate above the range (>1.8 mmol/L) by centre in 2007

Table 10.5. Percentage of peritoneal dialysis patients within, below and above the range for phosphate (1.1–1.8 mmol/L) in 2007

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	30	83.3	65.7	92.9	6.7	1.7	23.1	10.0	3.3	26.8
B QEH	102	60.8	51.0	69.8	13.7	8.3	21.9	25.5	18.0	34.8
Bangor	31	54.8	37.4	71.1	25.8	13.5	43.7	19.4	9.0	36.9
Basldn	26	80.8	61.3	91.8	3.9	0.5	22.8	15.4	5.9	34.5
Belfast	55	54.6	41.4	67.1	7.3	2.8	17.8	38.2	26.4	51.6
Bradfd	36	52.8	36.8	68.3	13.9	5.9	29.3	33.3	20.0	50.0
Brightn	78	73.1	62.2	81.7	15.4	9.0	25.2	11.5	6.1	20.7
Bristol	72	63.9	52.2	74.1	4.2	1.4	12.1	31.9	22.2	43.5
Camb	47	68.1	53.6	79.8	21.3	11.9	35.2	10.6	4.5	23.1
Cardff	145	63.5	55.3	70.9	8.3	4.8	14.0	28.3	21.6	36.1
Carsh	110	60.0	50.6	68.7	11.8	7.0	19.3	28.2	20.6	37.3
Chelms	35	71.4	54.6	83.9	5.7	1.4	20.2	22.9	11.9	39.5
Covnt	56	57.1	44.0	69.4	17.9	9.9	30.1	25.0	15.4	37.9
Derby	71	80.3	69.4	88.0	4.2	1.4	12.3	15.5	8.8	25.9
Donc	33	69.7	52.3	82.9	6.1	1.5	21.2	24.2	12.6	41.5
Dorset	54	68.5	55.1	79.5	13.0	6.3	24.8	18.5	10.3	31.1
Dudley	51	60.8	46.9	73.1	13.7	6.7	26.1	25.5	15.4	39.1
Exeter	70	70.0	58.3	79.6	8.6	3.9	17.8	21.4	13.4	32.6
Glouc	30	50.0	32.8	67.2	3.3	0.5	20.2	46.7	29.9	64.2
Hull	79	65.8	54.8	75.4	6.3	2.7	14.3	27.9	19.1	38.7
Ipswi	44	61.4	46.4	74.5	4.6	1.1	16.4	34.1	21.7	49.1
L Barts	217	65.4	58.9	71.5	12.9	9.1	18.1	21.7	16.7	27.6
L Guys	59	67.8	54.9	78.4	17.0	9.4	28.7	15.3	8.1	26.8
L Kings	74	67.6	56.2	77.2	9.5	4.6	18.5	23.0	14.8	33.9
L Rfree	114	67.5	58.4	75.5	7.0	3.6	13.4	25.4	18.3	34.2
Leeds	98	60.2	50.2	69.4	15.3	9.4	23.9	24.5	17.0	34.0
Leic	179	60.9	53.6	67.8	10.6	6.9	16.0	28.5	22.4	35.5
Liv RI	84	66.7	56.0	75.9	11.9	6.5	20.7	21.4	13.9	31.5
M Hope	110	60.0	50.6	68.7	16.4	10.6	24.5	23.6	16.6	32.5
M RI	115	58.3	49.1	66.9	11.3	6.7	18.5	30.4	22.7	39.4
Middlbr	23	65.2	44.3	81.6	4.4	0.6	25.2	30.4	15.3	51.5
Newc	46	63.0	48.4	75.6	4.4	1.1	15.8	32.6	20.7	47.3
Norwch	55	63.6	50.3	75.2	12.7	6.2	24.4	23.6	14.3	36.6
Nottm	135	65.9	57.5	73.4	10.4	6.2	16.8	23.7	17.3	31.6
Oxford	133	62.4	53.9	70.2	9.0	5.2	15.2	28.6	21.5	36.8
Plymth	38	63.2	47.0	76.8	13.2	5.6	28.0	23.7	12.8	39.6
Ports	76	43.4	32.8	54.7	2.6	0.7	9.9	54.0	42.7	64.8
Prestn	76	54.0	42.7	64.8	9.2	4.5	18.1	36.8	26.8	48.2
Redng	86	74.4	64.2	82.5	15.1	9.0	24.3	10.5	5.5	18.9
Sheff	88	64.8	54.3	74.0	3.4	1.1	10.0	31.8	23.0	42.2
Shrew	31	58.1	40.4	73.9	6.5	1.6	22.4	35.5	20.9	53.4
Stevng	37	64.9	48.5	78.4	8.1	2.6	22.3	27.0	15.2	43.4
Stoke	90	72.2	62.1	80.5	4.4	1.7	11.3	23.3	15.7	33.2
Swanse	71	62.0	50.2	72.5	16.9	9.9	27.5	21.1	13.2	32.1
Truro	23	65.2	44.3	81.6	0.0	0.0	0.0	34.8	18.4	55.7
Wolve	52	75.0	61.6	84.9	7.7	2.9	18.8	17.3	9.3	30.0
Wrexm	27	63.0	43.8	78.8	7.4	1.9	25.3	29.6	15.6	49.0
York	22	63.6	42.3	80.7	9.1	2.3	30.0	27.3	12.8	48.9
England	**3,143**	**64.4**	**62.7**	**66.1**	**10.1**	**9.1**	**11.2**	**25.5**	**24.0**	**27.0**
N Ireland	**94**	**58.5**	**48.3**	**68.0**	**8.5**	**4.3**	**16.1**	**33.0**	**24.3**	**43.1**
Wales	**286**	**61.5**	**55.8**	**67.0**	**11.9**	**8.6**	**16.2**	**26.6**	**21.8**	**32.0**
E, W & NI	**3,523**	**64.0**	**62.4**	**65.6**	**10.2**	**9.3**	**11.3**	**25.8**	**24.4**	**27.2**

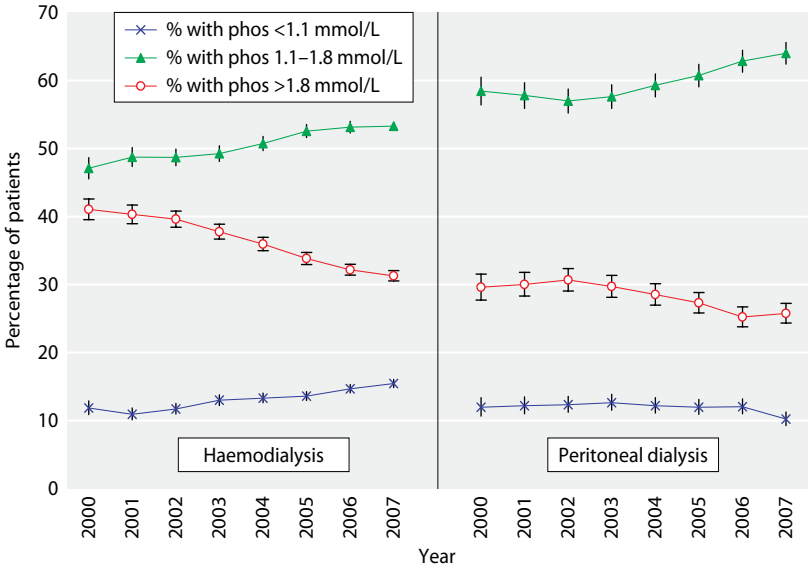

Fig. 10.13. Longitudinal change in percentage of patients with phosphate <1.1 mmol/L, 1.1–1.8 mmol/L and >1.8 mmol/L by dialysis modality 2000–2007

'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 kept below 2.5 mmol/L.' (Module 2: Complications) [1]

The audit measure for calcium in the 4th edition of the Renal Association clinical practice guidelines does not specify a lower limit for calcium and advises that adjusted calcium should be ideally within the normal range. For this reason the UKRR has continued to use 2.2–2.6 mmol/L as an audit measure for 2007 data. The guideline does however recommend that adjusted calcium should be <2.5 mmol/L. The UKRR is considering using 2.2–2.5 mmol/L as the audit measure for adjusted calcium in subsequent analyses. The data for adjusted calcium were 91% complete for HD patients and 96% complete for PD patients overall although there was between centre variation. Data from HD patients in London West were not included as there was a problem with data extraction (tables 10.6 and 10.8). Seventy three percent (CI 72–73%) of HD patients and 78% (CI 77–80%) of PD patients achieved adjusted calcium between 2.2–2.6 mmol/L (tables 10.7 and 10.9). The proportion of HD patients with hypercalcaemia was 7% (CI 7–8%) compared to 9% in 2006 and the proportion with hypocalcaemia was 20% (CI 20–21%) compared to 17% in 2006 (table 10.7). The proportion of PD patients with hypercalcaemia was 9% (CI 8–10%) compared to 25% in 2006 and the proportion with hypocalcaemia was 13% (CI 12–14%) compared to 10% in 2006 (table 10.9 and figure 10.26).

As was the case for phosphate, there was between centre variation in unadjusted analyses for the proportion of patients below, within and above the range specified by the clinical performance measure (figures 10.14–10.25). There was greater variation in the proportion of patients within range for adjusted calcium compared to phosphate most notably for HD patients. The funnel plot shows a greater number of centres outlying the 3SD limit i.e. there is over dispersion.

Table 10.6. Summary statistics for adjusted calcium in haemodialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	122	2.35	0.16	2.32	2.26	2.46
B Heart	94	334	2.28	0.21	2.28	2.17	2.39
B QEH	96	666	2.30	0.19	2.31	2.20	2.42
Bangor	95	57	2.37	0.19	2.34	2.26	2.45
Basldn	98	121	2.41	0.15	2.40	2.32	2.52
Belfast	96	237	2.32	0.19	2.31	2.20	2.42
Bradfd	99	158	2.42	0.16	2.44	2.34	2.50
Brightn	71	211	2.29	0.19	2.31	2.17	2.42

Table 10.6. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Bristol	100	428	2.47	0.18	2.47	2.37	2.57
Camb	56	186	2.32	0.21	2.28	2.18	2.45
Cardff	97	442	2.35>	0.19	2.35	2.23	2.46
Carlis	95	77	2.24	0.22	2.28	2.08	2.41
Carsh	85	444	2.27	0.21	2.27	2.15	2.40
Chelms	100	94	2.30	0.18	2.30	2.19	2.40
Clwyd	94	63	2.37	0.15	2.38	2.28	2.46
Covnt	98	275	2.24	0.21	2.23	2.09	2.37
Derby	100	183	2.40	0.16	2.39	2.29	2.52
Derry	100	41	2.44	0.15	2.43	2.36	2.55
Donc	100	54	2.37	0.19	2.37	2.24	2.45
Dorset	99	137	2.32	0.22	2.33	2.20	2.47
Dudley	90	99	2.37	0.25	2.35	2.24	2.51
Exeter	99	260	2.34	0.19	2.34	2.23	2.47
Glouc	100	162	2.39	0.17	2.37	2.26	2.50
Hull	98	291	2.39	0.18	2.39	2.30	2.51
Ipswi	100	90	2.41	0.17	2.40	2.32	2.50
L Barts	100	550	2.29	0.21	2.29	2.17	2.42
L Guys	97	429	2.32	0.19	2.32	2.21	2.43
L Kings	100	309	2.29	0.16	2.29	2.19	2.38
L Rfree	83	467	2.27	0.18	2.28	2.17	2.38
L West	43	425					
Leeds	97	463	2.39	0.17	2.38	2.28	2.49
Leic	99	625	2.36	0.19	2.35	2.24	2.47
Liv Ain	98	109	2.38	0.17	2.38	2.30	2.49
Liv RI	94	368	2.39	0.20	2.38	2.26	2.51
M Hope	86	262	2.29	0.19	2.27	2.16	2.41
M RI	70	221	2.27	0.21	2.28	2.15	2.38
Middlbr	99	258	2.35	0.21	2.35	2.23	2.49
Newc	100	208	2.37	0.15	2.35	2.28	2.46
Newry	99	82	2.28	0.17	2.29	2.20	2.40
Norwch	91	211	2.44	0.13	2.42	2.34	2.52
Nottm	98	339	2.36	0.17	2.36	2.26	2.46
Oxford	99	323	2.38	0.20	2.36	2.26	2.49
Plymth	98	117	2.28	0.24	2.28	2.16	2.45
Ports	99	370	2.36	0.18	2.36	2.25	2.47
Prestn	99	381	2.27	0.20	2.27	2.15	2.39
Redng	100	210	2.29	0.18	2.31	2.20	2.40
Sheff	99	507	2.32	0.17	2.34	2.23	2.43
Shrew	99	145	2.37	0.20	2.40	2.20	2.50
Stevng	95	293	2.38	0.17	2.38	2.27	2.48
Sthend	97	112	2.35	0.16	2.37	2.25	2.47
Stoke	100	242	2.42	0.19	2.41	2.32	2.54
Sund	96	142	2.45	0.20	2.45	2.33	2.55
Swanse	99	273	2.30	0.19	2.29	2.18	2.41
Truro	99	142	2.38	0.17	2.38	2.26	2.50
Tyrone	97	69	2.39	0.14	2.38	2.31	2.47
Ulster	100	74	2.45	0.15	2.45	2.35	2.53
Wirral	94	161	2.37	0.17	2.36	2.27	2.46
Wolve	99	250	2.32	0.18	2.31	2.20	2.41
Wrexm	99	73	2.45	0.17	2.44	2.34	2.54
York	89	95	2.33	0.13	2.34	2.25	2.43
England	**91**	**13,004**	**2.34**	**0.21**	**2.34**	**2.22**	**2.46**
N Ireland	**98**	**625**	**2.35**	**0.18**	**2.35**	**2.24**	**2.46**
Wales	**98**	**908**	**2.34**	**0.19**	**2.34**	**2.23**	**2.46**
E, W & NI	**91**	**14,537**	**2.34**	**0.21**	**2.34**	**2.22**	**2.46**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

Table 10.7. Percentage of haemodialysis patients within, below and above the range for adjusted calcium (2.2–2.6 mmol/L) in 2007

Centre	N	% adjusted Ca 2.2–2.6 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca >2.6 mmol/L	Lower 95% CI	Upper 95% CI
Antrim	122	79.5	71.4	85.8	14.8	9.5	22.2	5.7	2.8	11.6
B Heart	334	65.0	59.7	69.9	29.3	24.7	34.5	5.7	3.7	8.8
B QEH	666	70.7	67.2	74.1	23.7	20.7	27.1	5.6	4.1	7.6
Bangor	57	75.4	62.7	84.9	10.5	4.8	21.5	14.0	7.2	25.6
Basldn	121	86.8	79.5	91.7	6.6	3.3	12.7	6.6	3.3	12.7
Belfast	237	68.4	62.2	74.0	24.1	19.0	29.9	7.6	4.8	11.7
Bradfd	158	85.4	79.1	90.1	5.1	2.6	9.8	9.5	5.8	15.2
Brightn	211	63.5	56.8	69.7	31.8	25.8	38.3	4.7	2.6	8.6
Bristol	428	75.9	71.7	79.8	3.5	2.1	5.7	20.6	17.0	24.7
Camb	186	64.0	56.8	70.6	29.0	23.0	36.0	7.0	4.1	11.7
Cardff	442	73.5	69.2	77.4	19.5	16.0	23.4	7.0	5.0	9.8
Carlis	77	55.8	44.7	66.5	40.3	29.9	51.5	3.9	1.3	11.4
Carsh	444	59.9	55.3	64.4	35.6	31.3	40.2	4.5	2.9	6.9
Chelms	94	67.0	56.9	75.8	26.6	18.7	36.4	6.4	2.9	13.5
Clwyd	63	82.5	71.2	90.1	11.1	5.4	21.5	6.4	2.4	15.7
Covnt	275	50.2	44.3	56.1	45.5	39.7	51.4	4.4	2.5	7.5
Derby	183	84.2	78.1	88.8	7.7	4.6	12.5	8.2	5.0	13.2
Derry	41	82.9	68.3	91.6	4.9	1.2	17.5	12.2	5.2	26.1
Donc	54	79.6	66.8	88.4	11.1	5.1	22.6	9.3	3.9	20.4
Dorset	137	69.3	61.1	76.5	24.1	17.7	32.0	6.6	3.5	12.1
Dudley	99	64.7	54.8	73.4	20.2	13.4	29.3	15.2	9.4	23.6
Exeter	260	71.9	66.2	77.1	21.2	16.6	26.5	6.9	4.4	10.7
Glouc	162	84.0	77.5	88.8	8.6	5.2	14.1	7.4	4.3	12.6
Hull	291	79.7	74.7	84.0	11.3	8.2	15.5	8.9	6.2	12.8
Ipswi	90	74.4	64.5	82.4	11.1	6.1	19.4	14.4	8.6	23.3
L Barts	550	64.7	60.6	68.6	29.8	26.1	33.8	5.5	3.8	7.7
L Guys	429	72.7	68.3	76.7	22.1	18.5	26.3	5.1	3.4	7.7
L Kings	309	71.2	65.9	76.0	26.9	22.2	32.1	1.9	0.9	4.3
L Rfree	467	64.2	59.8	68.5	32.6	28.5	36.9	3.2	2.0	5.3
Leeds	463	79.9	76.0	83.3	11.9	9.2	15.2	8.2	6.0	11.1
Leic	625	74.4	70.8	77.7	16.2	13.5	19.3	9.4	7.4	12.0
Liv Ain	109	82.6	74.3	88.6	10.1	5.7	17.3	7.3	3.7	14.0
Liv RI	368	71.7	66.9	76.1	15.8	12.4	19.9	12.5	9.5	16.3
M Hope	262	61.1	55.0	66.8	32.8	27.4	38.7	6.1	3.8	9.7
M RI	221	60.6	54.0	66.9	33.0	27.2	39.5	6.3	3.8	10.4
Middlbr	258	69.8	63.9	75.1	20.2	15.7	25.5	10.1	7.0	14.4
Newc	208	85.1	79.6	89.3	8.7	5.5	13.3	6.3	3.7	10.5
Newry	82	74.4	63.9	82.7	24.4	16.3	34.8	1.2	0.2	8.2
Norwch	211	88.6	83.6	92.3	2.4	1.0	5.6	9.0	5.8	13.7
Nottm	339	81.4	76.9	85.2	12.4	9.3	16.3	6.2	4.1	9.3
Oxford	323	74.0	68.9	78.5	14.6	11.1	18.8	11.5	8.4	15.4
Plymth	117	58.1	49.0	66.7	32.5	24.6	41.5	9.4	5.3	16.2
Ports	370	81.1	76.8	84.8	12.4	9.4	16.2	6.5	4.4	9.5
Prestn	381	63.5	58.6	68.2	33.6	29.0	38.5	2.9	1.6	5.1
Redng	210	71.9	65.5	77.6	24.8	19.4	31.1	3.3	1.6	6.8
Sheff	507	78.3	74.5	81.7	18.7	15.6	22.4	3.0	1.8	4.9
Shrew	145	82.8	75.7	88.1	10.3	6.3	16.5	6.9	3.8	12.3
Stevng	293	78.2	73.1	82.5	12.6	9.3	16.9	9.2	6.4	13.1
Sthend	112	83.0	74.9	88.9	13.4	8.2	21.0	3.6	1.4	9.1
Stoke	242	74.8	68.9	79.9	9.5	6.4	13.9	15.7	11.6	20.9
Sund	142	77.5	69.9	83.6	8.5	4.9	14.3	14.1	9.3	20.8
Swanse	273	66.7	60.9	72.0	28.2	23.2	33.8	5.1	3.1	8.5
Truro	142	73.9	66.1	80.5	13.4	8.7	20.0	12.7	8.1	19.2
Tyrone	69	89.9	80.2	95.1	7.3	3.1	16.3	2.9	0.7	10.9

Table 10.7. Continued

Centre	N	% adjusted Ca 2.2–2.6 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca >2.6 mmol/L	Lower 95% CI	Upper 95% CI
Ulster	74	82.4	72.1	89.5	4.1	1.3	11.8	13.5	7.4	23.3
Wirral	161	80.8	73.9	86.1	13.0	8.7	19.2	6.2	3.4	11.2
Wolve	250	71.2	65.3	76.5	23.2	18.4	28.8	5.6	3.3	9.2
Wrexm	73	79.5	68.7	87.2	4.1	1.3	12.0	16.4	9.6	26.8
York	95	83.2	74.3	89.4	14.7	8.9	23.4	2.1	0.5	8.0
England	**13,004**	**72.3**	**71.5**	**73.0**	**20.4**	**19.7**	**21.1**	**7.3**	**6.9**	**7.8**
N Ireland	**625**	**76.3**	**72.8**	**79.5**	**16.8**	**14.1**	**19.9**	**6.9**	**5.1**	**9.2**
Wales	**908**	**72.7**	**69.7**	**75.5**	**19.7**	**17.3**	**22.4**	**7.6**	**6.1**	**9.5**
E, W & NI	**14,537**	**72.5**	**71.7**	**73.2**	**20.2**	**19.6**	**20.9**	**7.3**	**6.9**	**7.8**

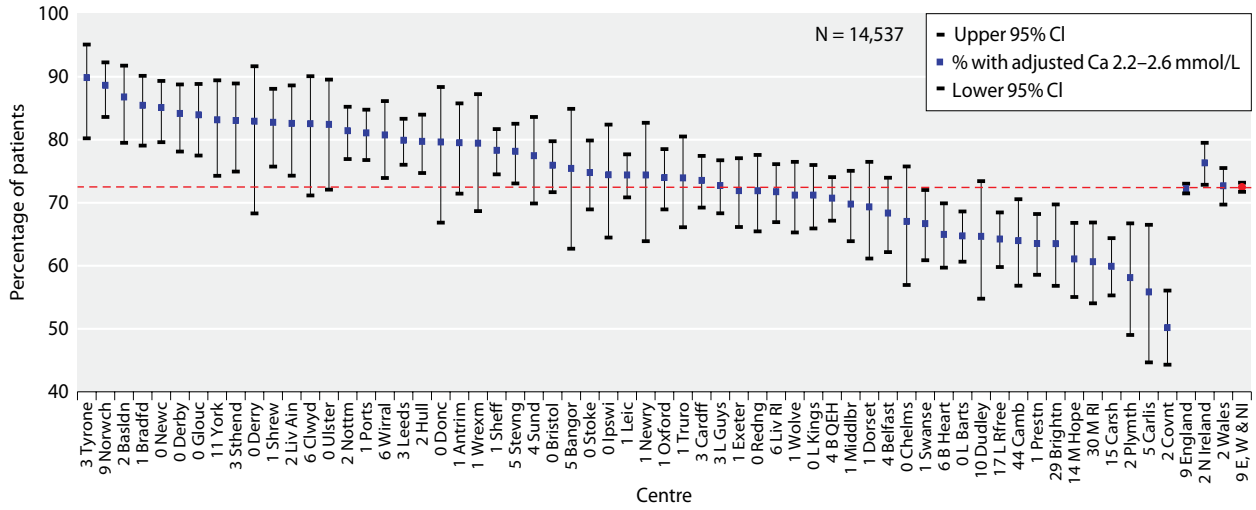

Fig. 10.14. Percentage of haemodialysis patients with adjusted calcium 2.2–2.6 mmol/L by centre in 2007

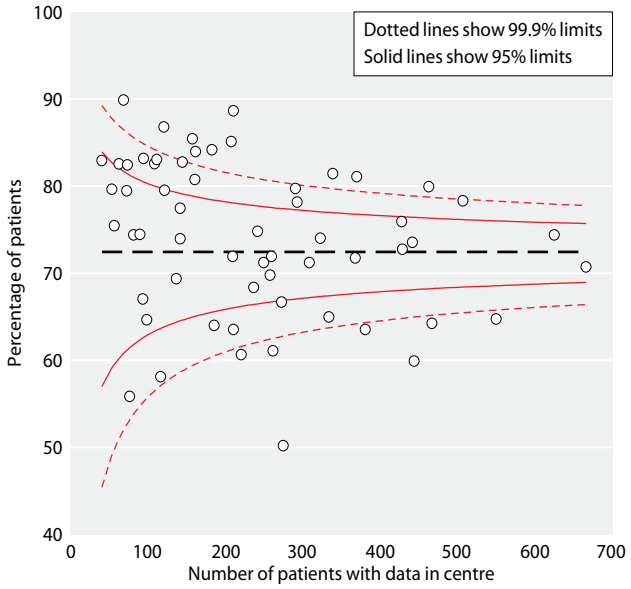

Fig. 10.15. Funnel plot of percentage of haemodialysis patients with adjusted calcium 2.2–2.6 mmol/L by centre in 2007

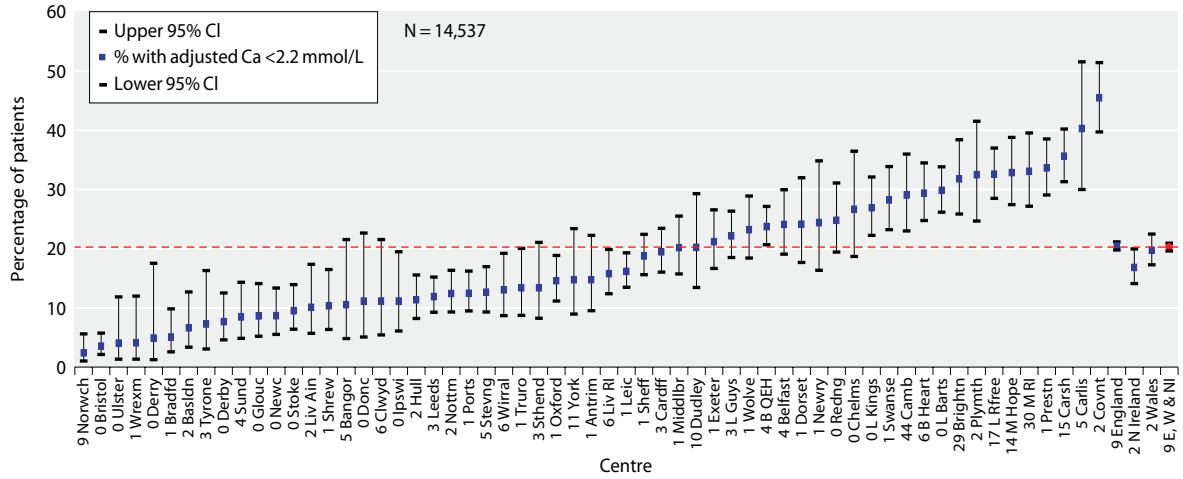

Fig. 10.16. Percentage of haemodialysis patients with adjusted calcium <2.2 mmol/L by centre in 2007

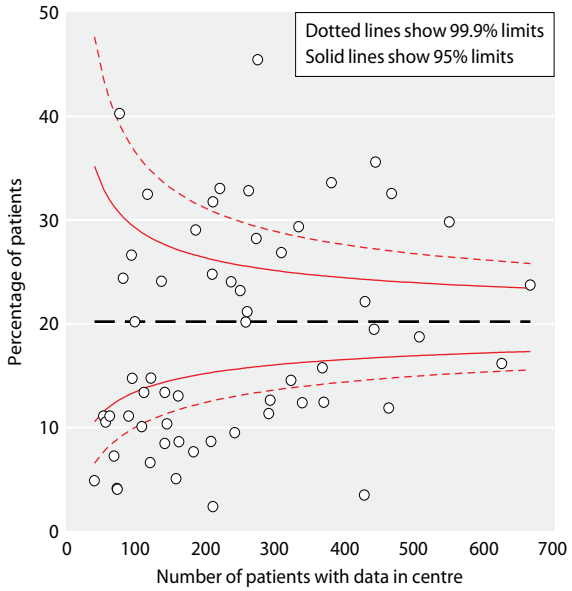

Fig. 10.17. Funnel plot of percentage of haemodialysis patients with adjusted calcium <2.2 mmol/L by centre in 2007

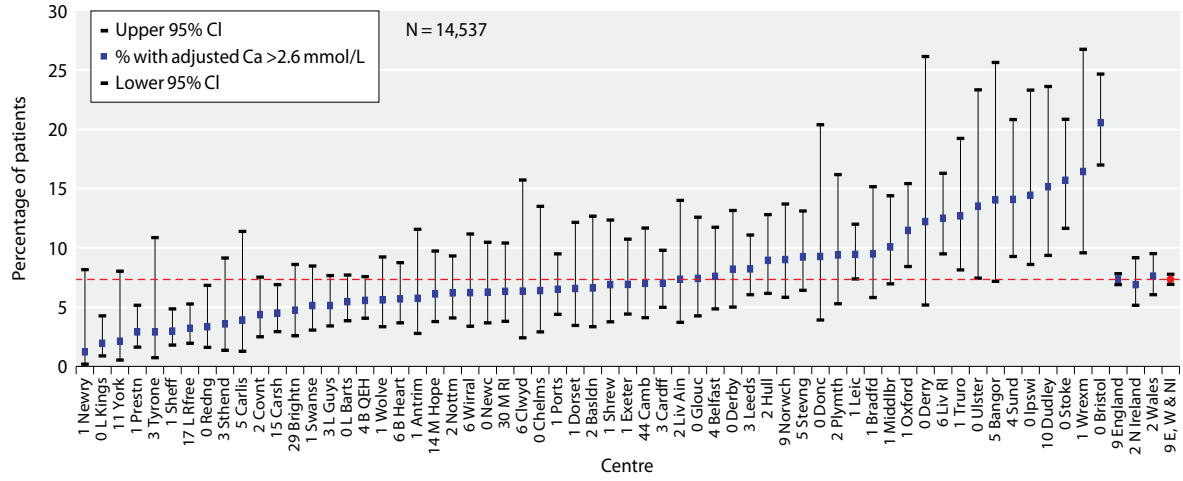

Fig. 10.18. Percentage of haemodialysis patients with adjusted calcium >2.6 mmol/L by centre in 2007

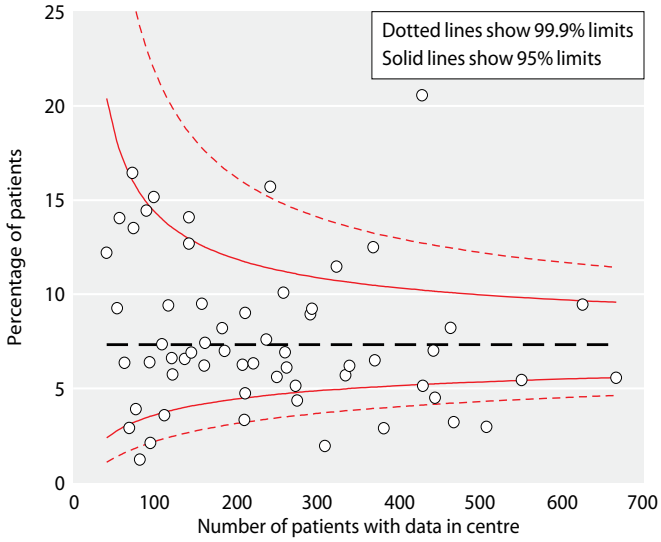

Fig. 10.19. Funnel plot of percentage of haemodialysis patients with adjusted calcium >2.6 mmol/L by centre in 2007

Table 10.8. Summary statistics for adjusted calcium in peritoneal dialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	97	30	2.36	0.11	2.36	2.28	2.41
B QEH	86	102	2.33	0.15	2.32	2.22	2.41
Bangor	100	31	2.39	0.19	2.44	2.32	2.50
Basldn	100	26	2.37	0.13	2.38	2.31	2.46
Belfast	96	55	2.35	0.16	2.31	2.25	2.45
Bradfd	100	36	2.43	0.15	2.43	2.35	2.51
Brightn	100	78	2.39	0.16	2.39	2.29	2.49
Bristol	100	72	2.47	0.16	2.48	2.39	2.55
Camb	100	47	2.32	0.17	2.31	2.18	2.45
Cardff	99	145	2.35	0.16	2.33	2.26	2.43
Carlis	100	11					
Carsh	97	110	2.28	0.18	2.28	2.15	2.38
Chelms	97	35	2.39	0.15	2.38	2.26	2.52
Clwyd	92	12					
Covnt	92	60	2.26	0.17	2.26	2.15	2.33
Derby	100	71	2.40	0.14	2.40	2.32	2.49
Derry	100	4					
Donc	100	33	2.39	0.15	2.40	2.29	2.53
Dorset	100	56	2.38	0.15	2.38	2.26	2.48
Dudley	94	51	2.38	0.19	2.34	2.26	2.48
Exeter	100	70	2.32	0.15	2.30	2.22	2.41
Glouc	100	30	2.40	0.15	2.43	2.29	2.49

Table 10.8. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Hull	95	79	2.48	0.14	2.46	2.40	2.56
Ipswi	98	44	2.44	0.14	2.44	2.37	2.52
L Barts	100	217	2.37	0.20	2.34	2.24	2.47
L Guys	98	59	2.37	0.14	2.38	2.26	2.45
L Kings	99	74	2.29	0.14	2.29	2.22	2.36
L Rfree	95	114	2.35	0.19	2.35	2.24	2.46
L West	5	3					
Leeds	99	98	2.39	0.14	2.40	2.31	2.50
Leic	99	179	2.42	0.16	2.42	2.32	2.53
Liv Ain	n/a	0					
Liv RI	92	85	2.45	0.18	2.42	2.32	2.59
M Hope	95	110	2.28	0.17	2.29	2.17	2.39
M RI	100	115	2.31	0.16	2.32	2.23	2.41
Middlbr	92	23	2.30	0.22	2.37	2.24	2.41
Newc	100	46	2.43	0.20	2.43	2.27	2.56
Newry	100	13					
Norwch	96	55	2.44	0.13	2.47	2.37	2.53
Nottm	100	135	2.46	0.14	2.46	2.38	2.54
Oxford	100	133	2.40	0.19	2.42	2.31	2.52
Plymth	100	38	2.45	0.17	2.48	2.34	2.55
Ports	83	76	2.40	0.19	2.39	2.29	2.51
Prestn	99	76	2.38	0.17	2.38	2.24	2.50
Redng	100	86	2.37	0.15	2.37	2.27	2.47
Sheff	100	88	2.40	0.15	2.41	2.31	2.50
Shrew	94	31	2.43	0.21	2.40	2.30	2.60
Stevng	100	38	2.42	0.16	2.39	2.34	2.54
Sthend	94	17					
Stoke	100	90	2.51	0.18	2.49	2.42	2.59
Sund	100	10					
Swanse	96	71	2.28	0.14	2.27	2.20	2.36
Truro	100	23	2.36	0.14	2.33	2.27	2.48
Ulster	100	2					
Wirral	68	19					
Wolve	98	52	2.33	0.16	2.31	2.25	2.40
Wrexm	90	27	2.45	0.14	2.43	2.34	2.52
York	96	22	2.36	0.12	2.38	2.29	2.46
England	**95**	**3,153**	**2.38**	**0.18**	**2.38**	**2.27**	**2.49**
N Ireland	**97**	**94**	**2.35**	**0.16**	**2.32**	**2.25**	**2.45**
Wales	**97**	**286**	**2.34**	**0.16**	**2.33**	**2.25**	**2.44**
E, W & NI	**96**	**3,533**	**2.38**	**0.18**	**2.38**	**2.27**	**2.48**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

Table 10.9. Percentage of peritoneal dialysis patients within, below and above the range for adjusted calcium (2.2–2.6 mmol/L) in 2007

Centre	N	% adjusted Ca 2.2–2.6 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca >2.6 mmol/L	Lower 95% CI	Upper 95% CI
B Heart	30	90.0	73.2	96.7	6.7	1.7	23.1	3.3	0.5	20.2
B QEH	102	74.5	65.2	82.0	18.6	12.2	27.4	6.9	3.3	13.7
Bangor	31	93.6	77.6	98.4	6.5	1.6	22.4	0.0	0.0	0.0
Basldn	26	88.5	69.7	96.2	7.7	1.9	26.1	3.9	0.5	22.8
Belfast	55	81.8	69.4	89.9	10.9	5.0	22.2	7.3	2.8	17.8
Bradfd	36	77.8	61.5	88.5	5.6	1.4	19.7	16.7	7.7	32.5
Brightn	78	82.1	71.9	89.1	10.3	5.2	19.2	7.7	3.5	16.1
Bristol	72	77.8	66.8	85.9	2.8	0.7	10.4	19.4	11.9	30.2
Camb	47	70.2	55.8	81.5	25.5	15.1	39.8	4.3	1.1	15.5
Cardff	145	79.3	72.0	85.1	15.2	10.2	22.0	5.5	2.8	10.6
Carsh	110	60.0	50.6	68.7	34.6	26.3	43.9	5.5	2.5	11.6
Chelms	35	85.7	70.0	93.9	5.7	1.4	20.2	8.6	2.8	23.4
Covnt	60	56.7	44.0	68.5	38.3	27.0	51.1	5.0	1.6	14.4
Derby	71	83.1	72.6	90.1	9.9	4.8	19.3	7.0	3.0	15.8
Donc	33	87.9	71.8	95.4	9.1	3.0	24.7	3.0	0.4	18.6
Dorset	56	91.1	80.3	96.2	5.4	1.7	15.3	3.6	0.9	13.2
Dudley	51	76.5	63.0	86.1	7.8	3.0	19.1	15.7	8.0	28.4
Exeter	70	70.0	58.3	79.6	22.9	14.5	34.1	7.1	3.0	16.0
Glouc	30	83.3	65.7	92.9	6.7	1.7	23.1	10.0	3.3	26.8
Hull	79	86.1	76.6	92.1	1.3	0.2	8.4	12.7	7.0	22.0
Ipswi	44	84.1	70.2	92.2	4.6	1.1	16.4	11.4	4.8	24.5
L Barts	217	71.0	64.6	76.6	15.7	11.4	21.1	13.4	9.5	18.6
L Guys	59	86.4	75.2	93.1	10.2	4.6	20.8	3.4	0.9	12.6
L Kings	74	77.0	66.1	85.2	20.3	12.6	30.9	2.7	0.7	10.2
L Rfree	114	77.2	68.6	84.0	17.5	11.6	25.6	5.3	2.4	11.2
Leeds	98	84.7	76.2	90.6	10.2	5.6	17.9	5.1	2.1	11.7
Leic	179	79.3	72.8	84.6	8.9	5.6	14.1	11.7	7.8	17.3
Liv RI	85	72.9	62.6	81.3	7.1	3.2	14.8	20.0	12.8	29.8
M Hope	110	66.4	57.1	74.6	31.8	23.8	41.1	1.8	0.5	7.0
M RI	115	78.3	69.8	84.9	19.1	12.9	27.4	2.6	0.8	7.8
Middlbr	23	82.6	61.8	93.3	17.4	6.7	38.2	0.0	0.0	0.0
Newc	46	65.2	50.6	77.5	15.2	7.4	28.6	19.6	10.5	33.5
Norwch	55	90.9	80.0	96.2	5.5	1.8	15.6	3.6	0.9	13.4
Nottm	135	88.2	81.5	92.6	2.2	0.7	6.7	9.6	5.7	15.9
Oxford	133	76.7	68.8	83.1	12.0	7.5	18.7	11.3	6.9	17.9
Plymth	38	79.0	63.2	89.1	5.3	1.3	18.8	15.8	7.3	31.0
Ports	76	77.6	66.9	85.6	10.5	5.4	19.7	11.8	6.3	21.2
Prestn	76	76.3	65.5	84.5	14.5	8.2	24.3	9.2	4.5	18.1
Redng	86	86.1	77.0	91.9	9.3	4.7	17.5	4.7	1.8	11.7
Sheff	88	86.4	77.5	92.1	6.8	3.1	14.4	6.8	3.1	14.4
Shrew	31	80.7	63.1	91.0	6.5	1.6	22.4	12.9	4.9	29.7
Stevng	38	76.3	60.4	87.2	5.3	1.3	18.8	18.4	9.0	33.9
Stoke	90	74.4	64.5	82.4	3.3	1.1	9.8	22.2	14.8	32.0
Swanse	71	77.5	66.3	85.7	21.1	13.2	32.1	1.4	0.2	9.3
Truro	23	78.3	57.2	90.7	8.7	2.2	28.9	13.0	4.3	33.6
Wolve	52	76.9	63.6	86.4	15.4	7.9	27.9	7.7	2.9	18.8
Wrexm	27	88.9	70.7	96.4	0.0	0.0	0.0	11.1	3.6	29.3
York	22	90.9	70.0	97.7	9.1	2.3	30.0	0.0	0.0	0.0
England	**3,153**	**78.0**	**76.5**	**79.4**	**12.9**	**11.8**	**14.1**	**9.1**	**8.1**	**10.1**
N Ireland	**94**	**77.7**	**68.2**	**85.0**	**13.8**	**8.2**	**22.4**	**8.5**	**4.3**	**16.1**
Wales	**286**	**81.1**	**76.2**	**85.2**	**14.3**	**10.7**	**18.9**	**4.6**	**2.7**	**7.7**
E, W & NI	**3,533**	**78.3**	**76.9**	**79.6**	**13.1**	**12.0**	**14.2**	**8.7**	**7.8**	**9.7**

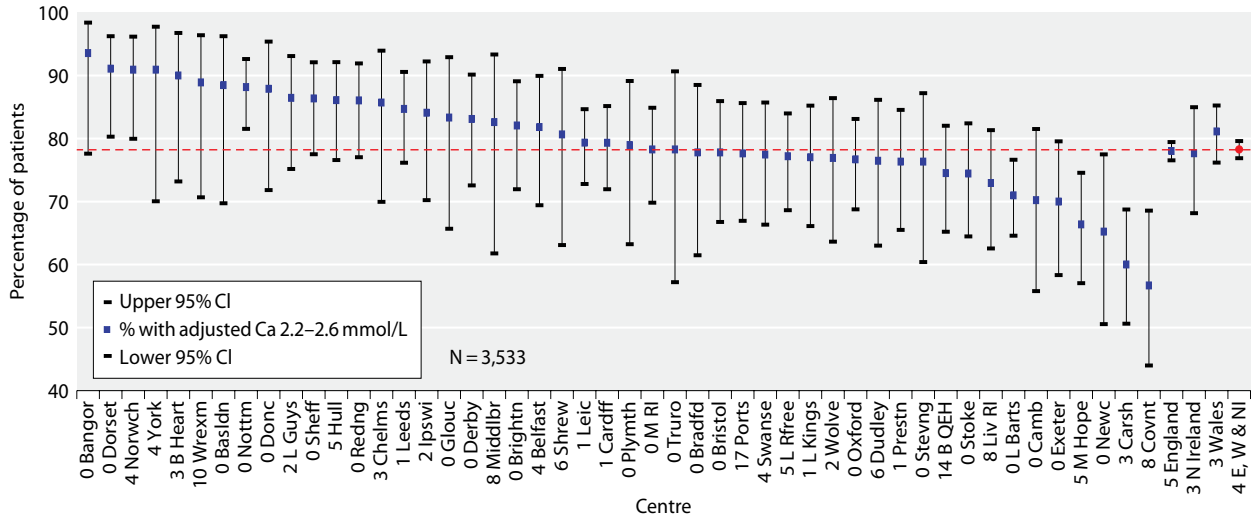

Fig. 10.20. Percentage of peritoneal dialysis patients with adjusted calcium 2.2–2.6 mmol/L by centre in 2007

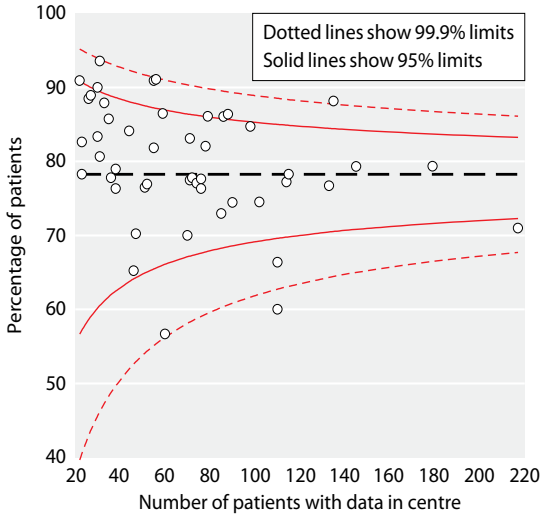

Fig. 10.21. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium 2.2–2.6 mmol/L by centre in 2007

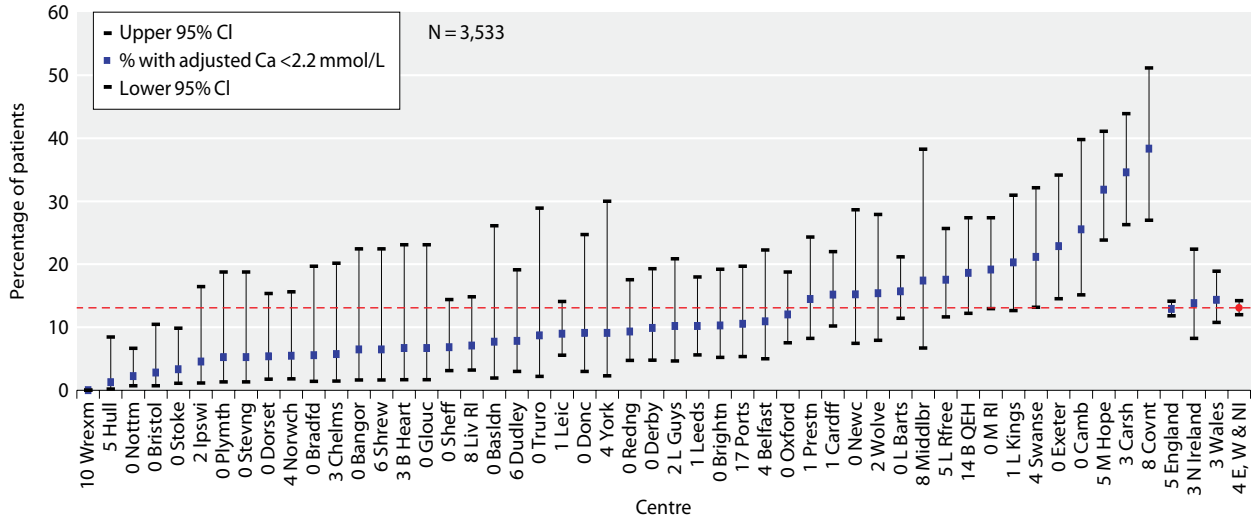

Fig. 10.22. Percentage of peritoneal dialysis patients with adjusted calcium <2.2 mmol/L by centre in 2007

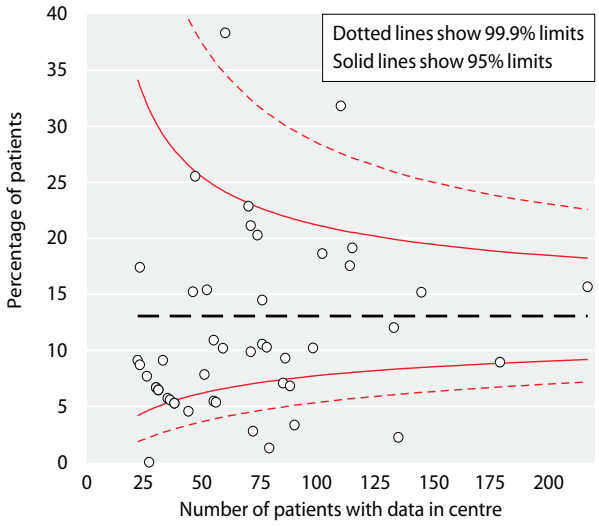

Fig. 10.23. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium <2.2 mmol/L by centre in 2007

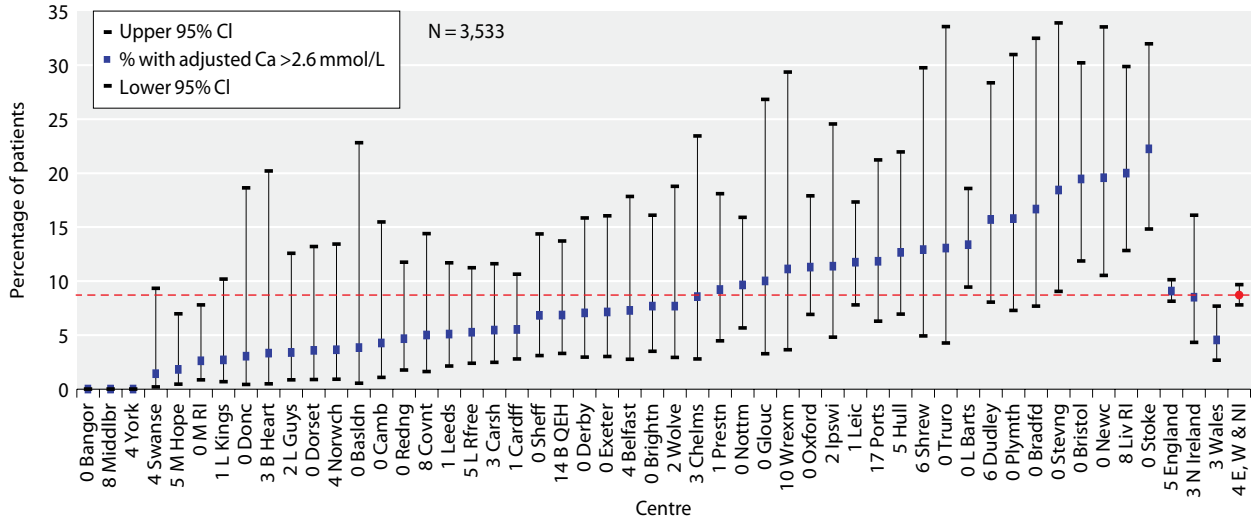

Fig. 10.24. Percentage of peritoneal dialysis patients with adjusted calcium >2.6 mmol/L by centre in 2007

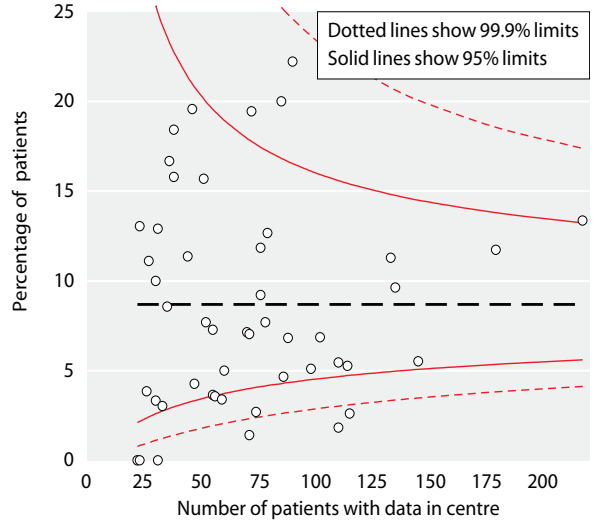

Fig. 10.25. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium >2.6 mmol/L by centre in 2007

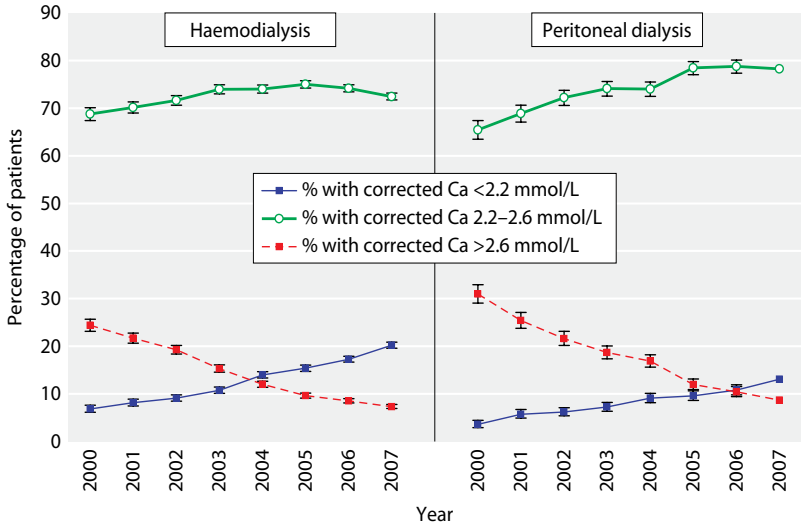

Fig. 10.26. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.6 mmol/L and >2.6 mmol/L by dialysis modality 2000–2007

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]

The data for parathyroid hormone were 82% complete for HD patients and 84% complete for PD patients overall although there was between centre variation (tables 10.10 and 10.12). Twenty five percent (CI 24–26%) of HD patients and 27% (26–29%) of PD patients achieved a parathyroid hormone between 16–32 pmol/L (tables 10.11 and 10.13). The proportion of HD patients with a parathyroid hormone above the upper limit of the range was 40% (CI 40–41%) and the proportion with parathyroid hormone below the lower limit of the range was 35% (CI 34–36%) (table 10.11). The proportion of PD patients with parathyroid hormone above the upper limit of the range was 40% (CI 39–42%) and the proportion with parathyroid hormone below the lower limit of the range was 33% (CI 31–34%) (table 10.13). The proportion of dialysis patients achieving the Renal Association audit measure has reduced considerably with the introduction of a lower specification of the audit measure. Again there was between centre variation in unadjusted analyses for the proportion of patients below, within and above the range specified by the clinical performance measure (figures 10.27–10.38).

Table 10.10. Summary statistics for PTH in haemodialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	122	32.7	33.9	22.7	11.8	41.7
B Heart	86	308	41.5	38.8	29.7	15.7	56.7
B QEH	62	428	24.1	15.3	22.7	11.2	36.5
Bangor	95	57	27.5	32.0	20.3	8.1	34.1
Basldn	98	121	43.4	49.0	29.9	13.8	49.8
Belfast	92	227	40.7	35.8	29.8	15.2	53.6
Bradfd	98	156	37.9	43.1	22.5	8.9	49.2
Brightn	96	287	44.5	45.3	32.5	12.6	58.8
Bristol	97	413	29.3	32.3	18.5	8.3	39.2
Camb	48	160					
Cardff	90	411	27.2	32.6	17.6	4.6	36.5
Carlis	94	76	41.8	39.9	31.6	14.2	51.3

Table 10.10. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Carsh	30	158					
Chelms	98	92	42.3	44.5	26.6	16.4	53.2
Clwyd	88	59	34.1	38.3	22.0	10.0	40.0
Covnt	80	224	62.9	71.3	42.0	16.5	81.0
Derby	99	182	29.4	34.9	18.3	10.8	34.4
Derry	100	41	36.5	22.4	34.8	19.8	46.1
Donc	100	54	50.3	52.9	28.8	9.2	71.4
Dorset	87	121	34.1	29.8	27.0	12.4	44.7
Dudley	76	84	54.3	102.8	23.2	9.3	47.3
Exeter	94	245	22.6	32.0	12.2	4.7	26.0
Glouc	98	159	28.2	35.7	17.4	9.2	31.0
Hull	90	269	30.6	34.9	17.0	6.7	43.4
Ipswi	99	89	35.6	40.3	21.7	11.7	41.7
L Barts	99	546	49.3	51.7	33.1	14.0	64.2
L Guys	96	427	47.4	44.5	35.0	15.8	67.0
L Kings	2	5					
L Rfree	79	448	36.2	36.7	25.0	13.0	46.5
L West	24	238					
Leeds	95	450	27.3	27.3	18.2	10.1	34.8
Leic	96	610	39.7	39.9	28.8	9.7	57.7
Liv Ain	76	84	29.8	36.9	18.5	9.0	31.5
Liv RI	90	355	39.9	39.2	27.0	15.0	52.0
M Hope	80	245	34.8	44.1	18.3	8.0	37.4
M RI	65	203	42.0	38.9	32.8	12.2	56.8
Middlbr	90	234	54.7	90.9	29.8	14.5	60.0
Newc	98	204	32.9	30.1	23.5	13.0	40.9
Newry	96	80	56.3	57.2	38.5	16.3	73.8
Norwch	84	196	39.3	39.0	26.7	16.2	44.8
Nottm	97	333	48.0	50.5	31.9	15.6	62.6
Oxford	93	303	46.7	48.3	31.7	14.1	62.2
Plymth	71	84	43.2	47.7	28.0	8.7	59.3
Ports	83	311	43.8	49.9	26.3	9.0	59.9
Prestn	96	368	35.5	34.2	24.0	11.9	48.5
Redng	97	204	23.0	22.8	17.8	6.7	32.8
Sheff	98	502	51.0	47.7	37.3	17.2	69.6
Shrew	95	140	36.0	34.8	24.9	12.6	41.7
Stevng	96	296	47.8	43.3	38.0	19.0	57.0
Sthend	92	106	56.6	47.9	44.3	22.6	80.5
Stoke	97	234	41.5	41.9	28.7	14.2	51.9
Sund	97	144	25.3	27.9	14.3	6.6	33.5
Swanse	97	266	43.9	127.5	20.2	9.2	52.9
Truro	99	142	32.1	35.3	22.9	10.6	40.5
Tyrone	96	68	43.2	30.7	34.8	22.9	58.0
Ulster	100	74	36.4	32.2	25.1	13.8	46.7
Wirral	64	109	40.6	40.4	28.1	14.3	53.2
Wolve	99	251	25.8	35.8	14.1	6.2	30.5
Wrexm	91	67	24.2	28.5	12.9	5.5	34.7
York	98	105	31.7	36.5	21.8	11.2	35.7
England	**80**	**11,508**	**38.9**	**44.8**	**25.2**	**11.2**	**49.7**
N Ireland	**96**	**612**	**40.6**	**37.9**	**28.6**	**15.2**	**52.8**
Wales	**92**	**860**	**32.6**	**76.2**	**18.5**	**6.8**	**40.1**
E, W & NI	**82**	**12,980**	**38.6**	**47.2**	**24.9**	**11.0**	**49.3**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

Table 10.11. Percentage of haemodialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2007

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	122	30.3	22.8	39.0	36.9	28.8	45.8	32.8	25.1	41.6
B Heart	308	27.3	22.6	32.5	26.3	21.7	31.5	46.4	40.9	52.0
B QEH	428	33.6	29.3	38.3	34.6	30.2	39.2	31.8	27.5	36.3
Bangor	57	22.8	13.7	35.4	43.9	31.7	56.9	33.3	22.4	46.4
Basldn	121	27.3	20.1	35.9	29.8	22.3	38.5	43.0	34.5	51.9
Belfast	227	26.0	20.7	32.1	27.3	21.9	33.5	46.7	40.3	53.2
Bradfd	156	25.6	19.4	33.1	37.2	30.0	45.0	37.2	30.0	45.0
Brightn	287	19.2	15.0	24.1	30.3	25.3	35.9	50.5	44.8	56.3
Bristol	413	25.4	21.5	29.9	44.3	39.6	49.1	30.3	26.0	34.9
Cardff	411	24.3	20.4	28.7	47.0	42.2	51.8	28.7	24.5	33.3
Carlis	76	25.0	16.6	35.9	27.6	18.8	38.7	47.4	36.5	58.5
Chelms	92	34.8	25.8	45.0	23.9	16.3	33.7	41.3	31.7	51.6
Clwyd	59	23.7	14.6	36.2	40.7	29.0	53.6	35.6	24.5	48.5
Covnt	224	16.1	11.8	21.5	24.6	19.4	30.6	59.4	52.8	65.6
Derby	182	29.1	23.0	36.1	43.4	36.4	50.7	27.5	21.5	34.4
Derry	41	34.2	21.4	49.7	12.2	5.2	26.1	53.7	38.5	68.1
Donc	54	22.2	13.1	35.2	31.5	20.6	44.9	46.3	33.6	59.5
Dorset	121	24.8	17.9	33.3	32.2	24.5	41.1	43.0	34.5	51.9
Dudley	84	23.8	15.9	34.1	36.9	27.3	47.7	39.3	29.5	50.1
Exeter	245	19.2	14.7	24.6	60.4	54.2	66.3	20.4	15.8	25.9
Glouc	159	30.2	23.6	37.8	45.9	38.3	53.7	23.9	17.9	31.1
Hull	269	18.6	14.4	23.7	48.7	42.8	54.7	32.7	27.4	38.6
Ipswi	89	30.3	21.7	40.6	32.6	23.7	43.0	37.1	27.7	47.5
L Barts	546	20.5	17.3	24.1	28.2	24.6	32.1	51.3	47.1	55.5
L Guys	427	21.3	17.7	25.5	25.3	21.4	29.6	53.4	48.7	58.1
L Rfree	448	31.0	26.9	35.5	31.0	26.9	35.5	38.0	33.6	42.5
Leeds	450	29.1	25.1	33.5	42.9	38.4	47.5	28.0	24.0	32.3
Leic	610	19.7	16.7	23.0	34.9	31.2	38.8	45.4	41.5	49.4
Liv Ain	84	33.3	24.1	44.0	41.7	31.6	52.4	25.0	16.9	35.3
Liv RI	355	30.1	25.6	35.1	26.8	22.4	31.6	43.1	38.0	48.3
M Hope	245	23.3	18.4	29.0	46.5	40.4	52.8	30.2	24.8	36.2
M RI	203	21.2	16.1	27.3	28.1	22.3	34.7	50.7	43.9	57.6
Middlbr	234	26.1	20.9	32.1	27.8	22.4	33.9	46.2	39.9	52.6
Newc	204	30.4	24.5	37.0	34.3	28.1	41.1	35.3	29.0	42.1
Newry	80	17.5	10.7	27.4	25.0	16.7	35.6	57.5	46.5	67.8
Norwch	196	35.7	29.3	42.7	23.5	18.1	29.9	40.8	34.2	47.8
Nottm	333	24.0	19.7	28.9	26.1	21.7	31.1	49.9	44.5	55.2
Oxford	303	20.8	16.6	25.7	29.4	24.5	34.8	49.8	44.2	55.4
Plymth	84	19.1	12.0	28.9	35.7	26.2	46.5	45.2	35.0	55.9
Ports	311	19.0	15.0	23.7	37.9	32.7	43.5	43.1	37.7	48.7
Prestn	368	28.8	24.4	33.6	32.6	28.0	37.6	38.6	33.8	43.7
Redng	204	25.5	20.0	31.9	48.0	41.3	54.9	26.5	20.9	33.0
Sheff	502	21.1	17.8	24.9	23.7	20.2	27.6	55.2	50.8	59.5
Shrew	140	27.9	21.1	35.9	33.6	26.3	41.8	38.6	30.9	46.9
Stevng	296	32.8	27.7	38.3	13.9	10.4	18.3	53.4	47.7	59.0
Sthend	106	22.6	15.7	31.6	17.0	11.0	25.4	60.4	50.8	69.2
Stoke	234	28.2	22.8	34.3	28.6	23.2	34.8	43.2	37.0	49.6
Sund	144	18.1	12.6	25.2	55.6	47.4	63.5	26.4	19.8	34.2
Swanse	266	23.3	18.6	28.8	41.4	35.6	47.4	35.3	29.8	41.3
Truro	142	25.4	18.9	33.1	38.7	31.1	47.0	35.9	28.5	44.1
Tyrone	68	29.4	19.8	41.3	14.7	8.1	25.2	55.9	44.0	67.2
Ulster	74	28.4	19.3	39.6	31.1	21.6	42.5	40.5	30.0	52.0
Wirral	109	33.0	24.9	42.4	26.6	19.2	35.7	40.4	31.6	49.8
Wolve	251	20.7	16.2	26.2	55.8	49.6	61.8	23.5	18.7	29.2
Wrexm	67	14.9	8.2	25.6	58.2	46.2	69.4	26.9	17.6	38.7
York	105	28.6	20.8	37.9	41.0	32.0	50.6	30.5	22.4	39.9
England	**11,508**	**24.7**	**23.9**	**25.5**	**34.5**	**33.6**	**35.4**	**40.8**	**39.9**	**41.7**
N Ireland	**612**	**27.0**	**23.6**	**30.6**	**27.0**	**23.6**	**30.6**	**46.1**	**42.2**	**50.0**
Wales	**860**	**23.1**	**20.4**	**26.1**	**45.5**	**42.2**	**48.8**	**31.4**	**28.4**	**34.6**
E, W & NI	**12,980**	**24.7**	**24.0**	**25.5**	**34.9**	**34.0**	**35.7**	**40.4**	**39.6**	**41.3**

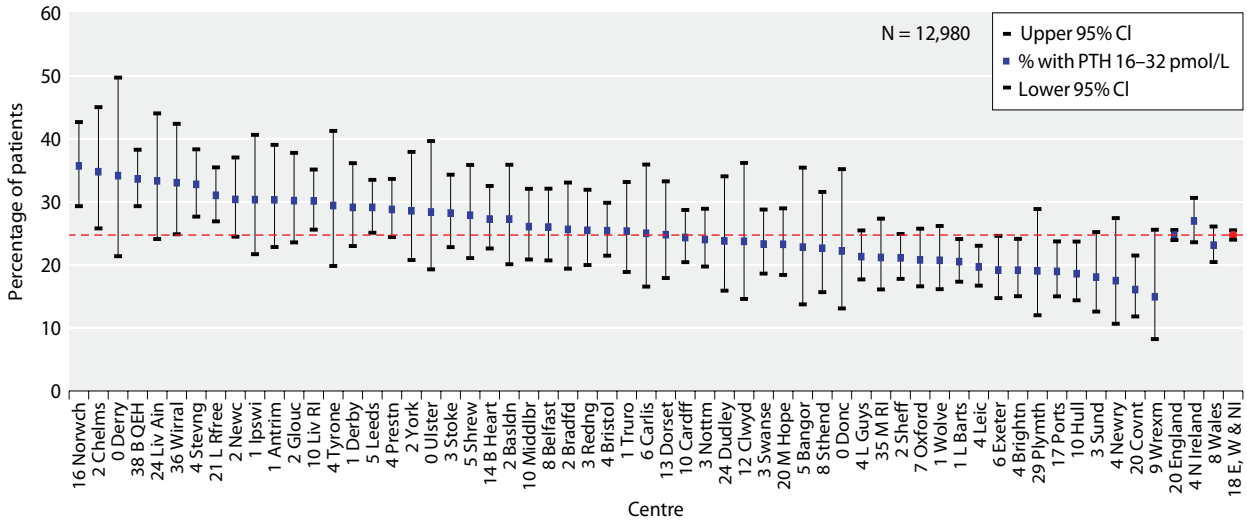

Fig. 10.27. Percentage of haemodialysis patients with PTH 16–32 pmol/L by centre in 2007

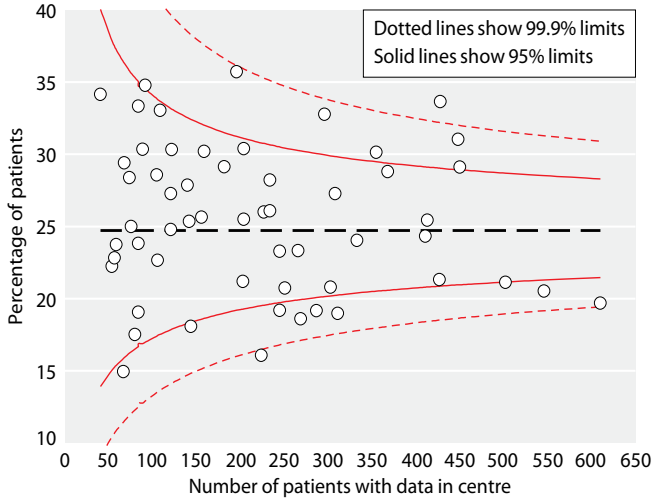

Fig. 10.28. Funnel plot of percentage of haemodialysis patients with PTH 16–32 pmol/L by centre in 2007

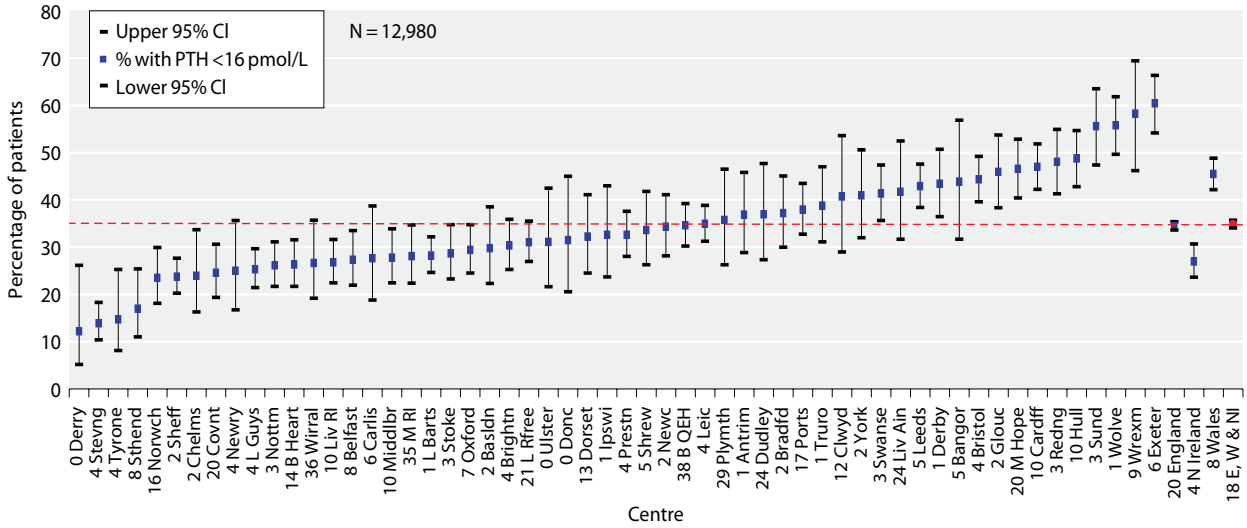

Fig. 10.29. Percentage of haemodialysis patients with PTH <16 pmol/L by centre in 2007

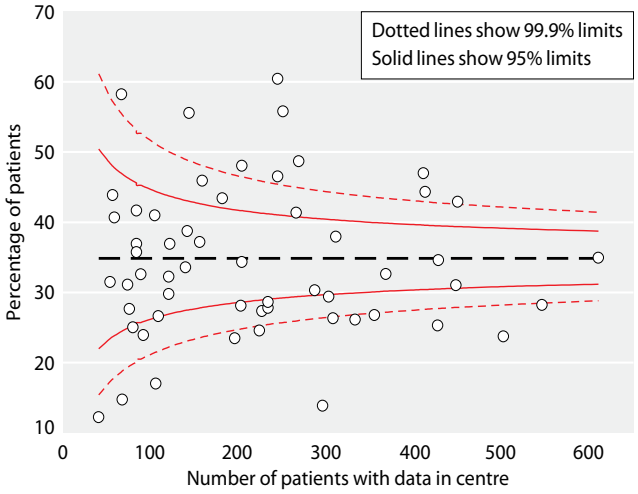

Fig. 10.30. Funnel plot of percentage of haemodialysis patients with PTH <16 pmol/L by centre in 2007

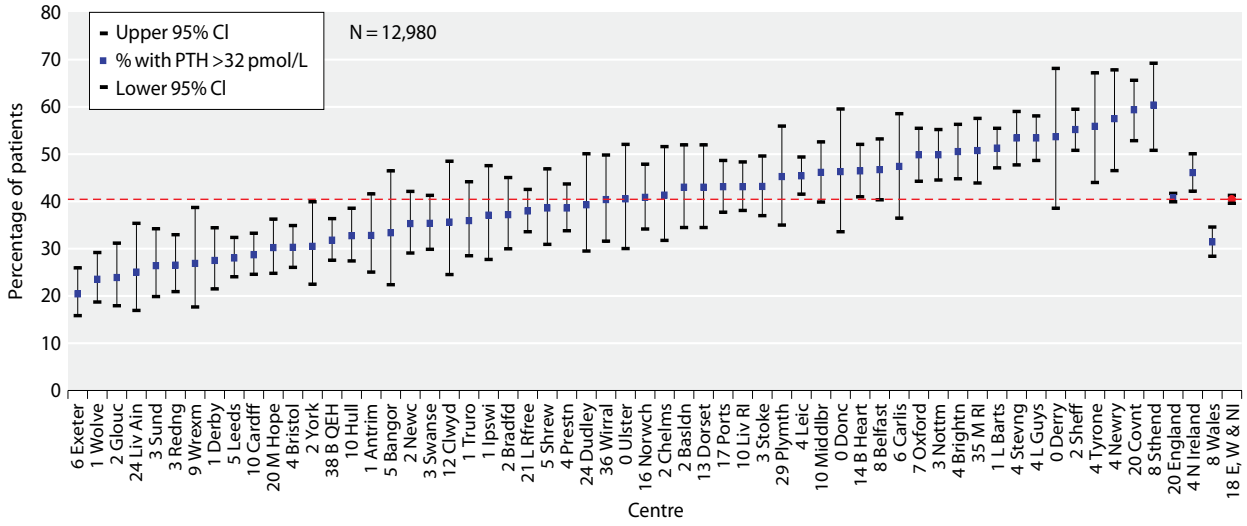

Fig. 10.31. Percentage of haemodialysis patients with PTH >32 pmol/L by centre in 2007

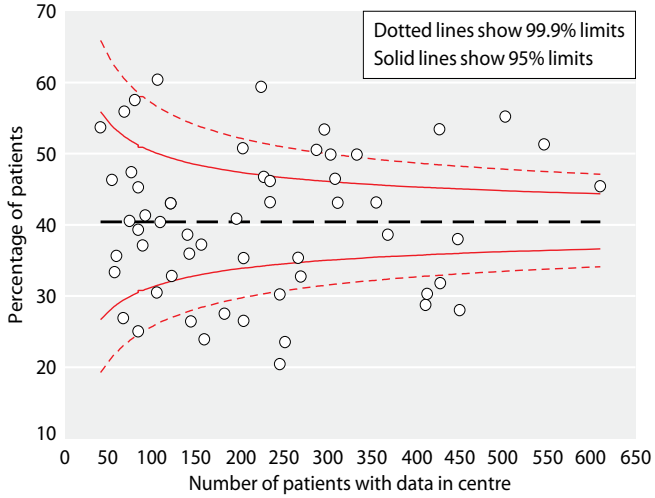

Fig. 10.32. Funnel plot of percentage of haemodialysis patients with PTH >32 pmol/L by centre in 2007

Table 10.12. Summary statistics for PTH in peritoneal dialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	81	25	30.0	35.2	16.7	11.3	29.8
B QEH	73	86	22.1	16.3	18.9	8.2	36.2
Bangor	100	31	27.5	32.0	16.8	7.4	28.6
Basldn	100	26	43.3	28.3	34.6	21.9	65.7
Belfast	93	53	54.6	36.7	47.4	22.4	79.7
Bradfd	89	32	45.2	47.6	37.6	14.2	52.6
Brightn	97	76	34.2	30.6	26.7	14.8	44.4
Bristol	96	69	44.6	48.7	24.2	10.5	56.2
Camb	96	45	34.0	30.4	25.5	15.3	39.7
Cardff	97	143	51.9	41.4	40.4	21.5	67.2
Carlis	100	11					
Carsh	7	8					
Chelms	94	34	35.9	27.4	33.2	20.2	40.9
Clwyd	77	10					
Covnt	77	50	31.3	34.2	19.0	10.0	42.0
Derby	99	70	22.4	19.1	18.2	10.2	28.6
Derry	75	3					
Donc	45	15					
Dorset	86	48	22.0	25.2	13.8	7.1	21.9
Dudley	74	40	46.3	43.0	31.9	15.7	66.9
Exeter	99	69	24.8	20.6	19.9	9.0	30.3
Glouc	87	26	22.6	18.4	20.1	12.1	28.0
Hull	69	57	29.4	41.9	19.1	8.7	30.8
Ipswi	96	43	41.9	37.1	32.2	19.5	53.2
L Barts	89	193	32.7	36.6	19.5	9.0	41.0
L Guys	93	56	38.1	37.0	25.1	13.7	51.5
L Kings	1	1					
L Rfree	94	113	26.8	21.1	22.0	12.0	34.0
L West	56	36	41.5	31.6	26.7	18.1	69.6
Leeds	98	97	34.7	33.7	26.4	13.1	47.4
Leic	93	167	41.0	38.1	35.9	15.8	53.9
Liv Ain	n/a	0					
Liv RI	85	78	34.8	31.1	23.0	13.0	50.0
M Hope	86	100	25.0	22.9	19.8	7.0	31.4
M RI	99	114	41.0	31.4	32.2	20.0	57.7
Middlbr	76	19					
Newc	96	44	25.8	24.6	21.2	6.0	36.8
Newry	92	12					
Norwch	74	42	22.5	22.1	16.9	8.5	24.7
Nottm	95	128	31.4	38.4	17.7	8.7	35.3
Oxford	92	123	45.4	42.5	33.7	13.6	61.5
Plymth	61	23	33.0	38.2	21.8	10.0	26.3
Ports	57	52	52.1	51.5	37.1	14.0	68.4
Prestn	97	75	44.4	31.7	35.7	23.4	62.7
Redng	98	84	25.0	21.1	20.1	13.2	29.6
Sheff	85	75	56.1	44.5	49.6	25.8	69.8
Shrew	97	32	25.8	26.2	16.6	8.5	29.2
Stevng	87	33	54.5	45.1	38.0	28.5	66.5
Sthend	72	13					
Stoke	92	83	52.5	50.8	39.7	14.5	69.1
Sund	90	9					
Swanse	95	70	36.8	28.0	29.3	15.8	53.9
Truro	96	22	36.2	55.9	20.0	7.1	51.2
Tyrone	100	5					
Ulster	100	2					
Wirral	64	18					
Wolve	92	49	27.4	40.0	17.7	9.8	25.7
Wrexm	77	23	36.7	46.6	20.5	7.1	43.3
York	96	22	26.2	25.1	20.1	7.3	31.6
England	**83**	**2,731**	**35.2**	**35.8**	**24.1**	**11.9**	**46.9**
N Ireland	**93**	**90**	**44.3**	**34.8**	**32.2**	**19.9**	**64.7**
Wales	**94**	**277**	**44.5**	**41.1**	**33.5**	**15.3**	**58.7**
E, W & NI	**84**	**3,098**	**36.3**	**36.4**	**25.0**	**12.2**	**48.0**

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 2007

Centre	N	% PTH 16–32 pmol/L	Lower 5% 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	32.0	16.9	52.2	44.0	26.3	63.4	24.0	11.2	44.2
B QEH	86	26.7	18.5	37.1	45.4	35.2	55.9	27.9	19.5	38.3
Bangor	31	29.0	15.9	47.1	48.4	31.7	65.5	22.6	11.2	40.4
Basldn	26	30.8	16.2	50.6	15.4	5.9	34.5	53.9	35.1	71.6
Belfast	53	28.3	17.8	41.8	9.4	4.0	20.7	62.3	48.6	74.2
Bradfd	32	18.8	8.7	35.9	28.1	15.3	45.8	53.1	36.1	69.4
Brightn	76	39.5	29.2	50.8	26.3	17.7	37.3	34.2	24.5	45.5
Bristol	69	18.8	11.3	29.8	37.7	27.1	49.6	43.5	32.3	55.3
Camb	45	37.8	24.9	52.6	26.7	15.8	41.3	35.6	23.1	50.4
Cardff	143	18.9	13.3	26.1	18.2	12.7	25.4	62.9	54.7	70.5
Chelms	34	29.4	16.6	46.6	17.7	8.2	34.1	52.9	36.5	68.8
Covnt	50	22.0	12.6	35.5	44.0	31.0	57.9	34.0	22.3	48.1
Derby	70	31.4	21.7	43.2	47.1	35.8	58.8	21.4	13.4	32.6
Dorset	48	20.8	11.6	34.6	62.5	48.2	74.9	16.7	8.6	29.9
Dudley	40	25.0	14.0	40.5	25.0	14.0	40.5	50.0	35.0	65.0
Exeter	69	34.8	24.5	46.7	40.6	29.7	52.5	24.6	15.9	36.1
Glouc	26	50.0	31.7	68.3	30.8	16.2	50.6	19.2	8.2	38.7
Hull	57	31.6	20.9	44.7	43.9	31.7	56.9	24.6	15.1	37.3
Ipswi	43	27.9	16.6	43.0	20.9	11.3	35.6	51.2	36.6	65.6
L Barts	193	22.3	17.0	28.7	41.5	34.7	48.5	36.3	29.8	43.3
L Guys	56	33.9	22.8	47.2	30.4	19.8	43.5	35.7	24.3	49.0
L Rfree	113	34.5	26.3	43.7	36.3	28.0	45.5	29.2	21.6	38.2
L West	36	27.8	15.7	44.4	25.0	13.6	41.5	47.2	31.7	63.3
Leeds	97	24.7	17.2	34.3	32.0	23.5	41.9	43.3	33.8	53.3
Leic	167	19.8	14.4	26.5	25.2	19.2	32.3	55.1	47.5	62.5
Liv RI	78	28.2	19.4	39.2	34.6	24.9	45.8	37.2	27.2	48.4
M Hope	100	36.0	27.2	45.8	40.0	30.9	49.9	24.0	16.6	33.3
M RI	114	30.7	22.9	39.7	19.3	13.1	27.6	50.0	40.9	59.1
Newc	44	27.3	16.2	42.1	40.9	27.5	55.8	31.8	19.8	46.8
Norwch	42	31.0	18.9	46.3	47.6	33.2	62.5	21.4	11.5	36.3
Nottm	128	27.3	20.3	35.7	44.5	36.2	53.2	28.1	21.0	36.5
Oxford	123	21.1	14.8	29.2	27.6	20.5	36.2	51.2	42.4	59.9
Plymth	23	52.2	32.5	71.2	30.4	15.3	51.5	17.4	6.7	38.2
Ports	52	17.3	9.3	30.0	26.9	16.6	40.5	55.8	42.2	68.6
Prestn	75	28.0	19.0	39.2	14.7	8.3	24.6	57.3	46.0	68.0
Redng	84	45.2	35.0	55.9	34.5	25.2	45.3	20.2	13.0	30.2
Sheff	75	17.3	10.3	27.6	14.7	8.3	24.6	68.0	56.7	77.5
Shrew	32	31.3	17.7	49.0	46.9	30.6	63.9	21.9	10.8	39.3
Stevng	33	24.2	12.6	41.5	9.1	3.0	24.7	66.7	49.2	80.5
Stoke	83	18.1	11.2	27.8	25.3	17.1	35.7	56.6	45.8	66.8
Swanse	70	27.1	18.0	38.7	27.1	18.0	38.7	45.7	34.5	57.4
Truro	22	22.7	9.8	44.4	40.9	22.8	61.8	36.4	19.3	57.7
Wolve	49	32.7	21.1	46.8	44.9	31.7	58.9	22.5	12.9	36.2
Wrexm	23	13.0	4.3	33.6	47.8	28.8	67.5	39.1	21.8	59.8
York	22	36.4	19.3	57.7	40.9	22.8	61.8	22.7	9.8	44.4
England	**2,731**	**27.4**	**25.8**	**29.1**	**33.9**	**32.1**	**35.7**	**38.7**	**36.9**	**40.6**
N Ireland	**90**	**34.4**	**25.4**	**44.8**	**15.6**	**9.4**	**24.6**	**50.0**	**39.8**	**60.2**
Wales	**277**	**21.3**	**16.9**	**26.5**	**26.7**	**21.8**	**32.2**	**52.0**	**46.1**	**57.8**
E, W & NI	**3,098**	**27.1**	**25.5**	**28.6**	**32.7**	**31.1**	**34.4**	**40.3**	**38.5**	**42.0**

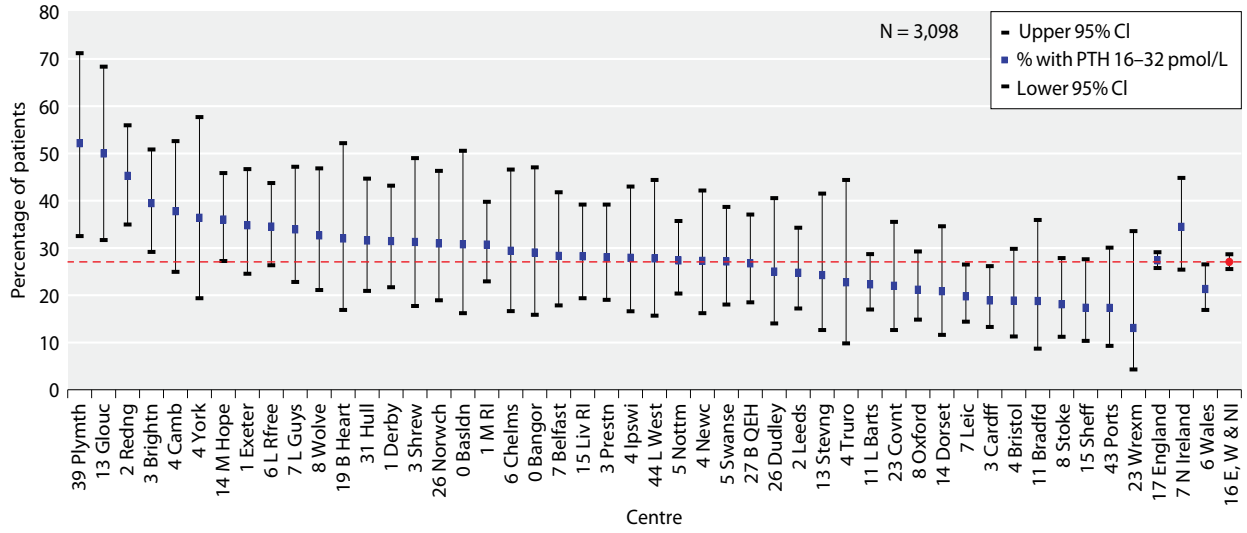

Fig. 10.33. Percentage of peritoneal dialysis patients with PTH 16–32 pmol/L by centre in 2007

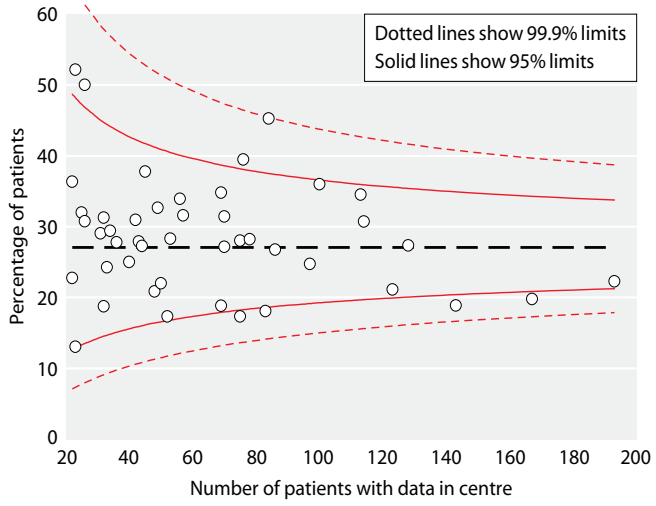

Fig. 10.34. Funnel plot of percentage of peritoneal dialysis patients with PTH 16–32 pmol/L by centre in 2007

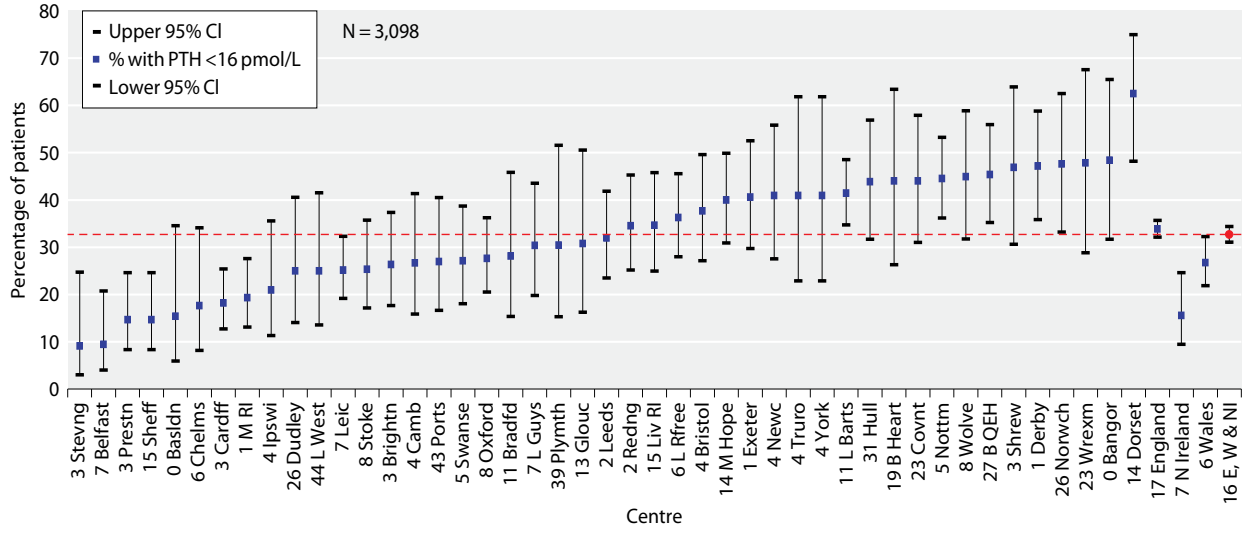

Fig. 10.35. Percentage of peritoneal dialysis patients with PTH <16 pmol/L by centre in 2007

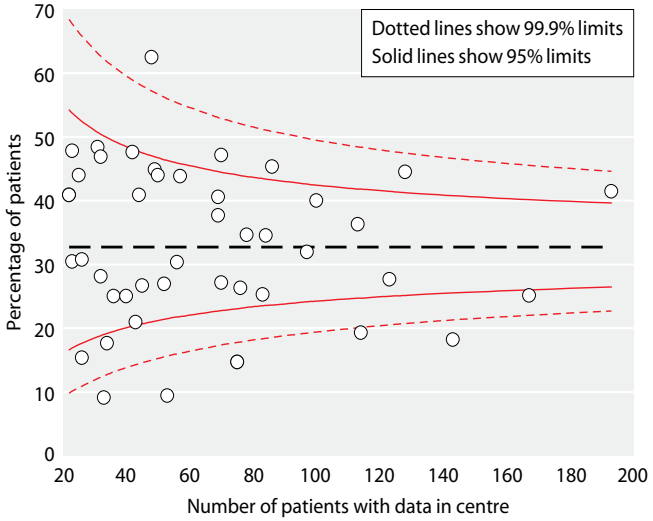

Fig. 10.36. Funnel plot of percentage of peritoneal dialysis patients with PTH <16 pmol/L by centre in 2007

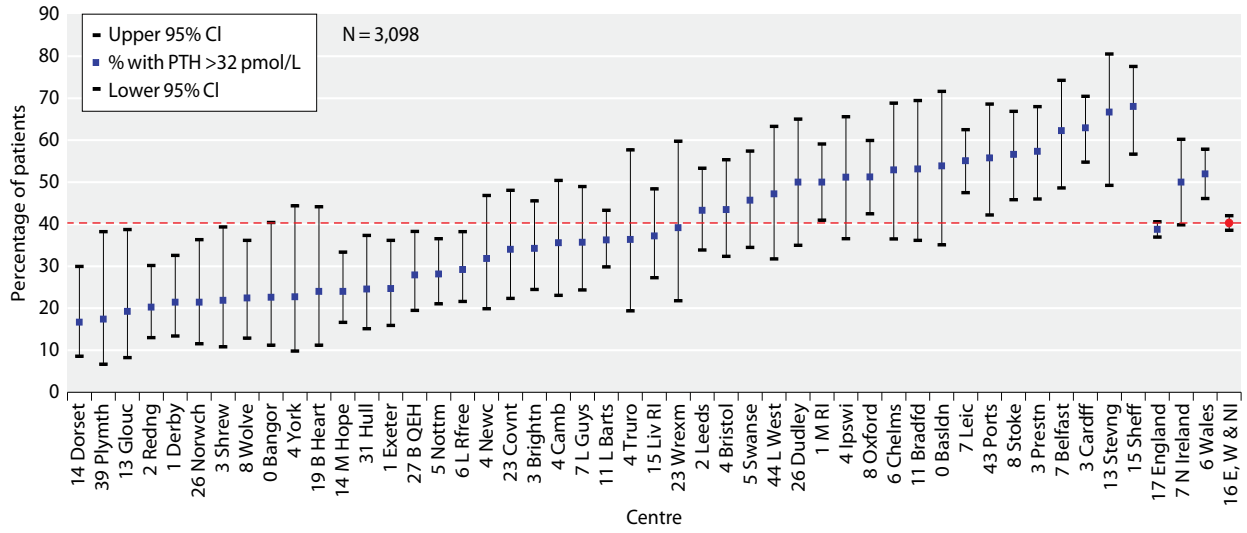

Fig. 10.37. Percentage of peritoneal dialysis patients with PTH >32 pmol/L by centre in 2007

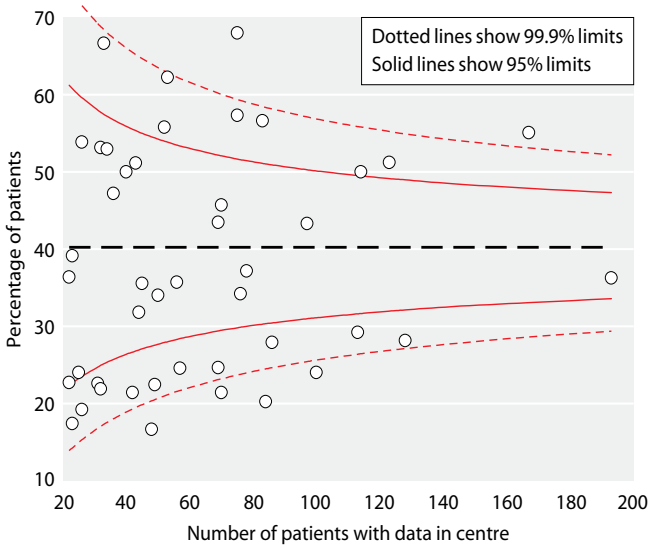

Fig. 10.38. Funnel plot of percentage of peritoneal dialysis patients with PTH >32 pmol/L by centre in 2007

Discussion – Mineral and bone parameters

There were convincing observational data that hyperphosphataemia was associated with increased mortality in dialysis patients but the data linking calcium and parathyroid hormone to patient survival were less clear [7–11]. A recent cohort study has demonstrated that simultaneous achievement of all three audit measures does appear to be associated with better outcomes [12].

The UKRR has consistently demonstrated between centre variation in achievement of audit measures for bone and mineral parameters but little is understood about the causes of this 'centre effect'. The complexity of the clinical processes required to manage mineral and bone disorders is probably further confounded by case mix. Finally it is important to consider data quality and the potential for measurement bias particularly in light of the variability in assay methods across the UK for calcium and parathyroid hormone. However, detecting these centre level differences is an important step in understanding the factors associated with exceptional performance.

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]

Results and discussion

Bicarbonate data were 82% complete for HD patients and 81% complete for PD patients (tables 10.14 and 10.16). Seventy one percent (CI 70–72%) of HD patients and 50% (CI 49–52%) of PD patients achieved the audit measure for bicarbonate and there was inter-centre variation for both HD and PD (tables 10.15 and 10.17, figures 10.39 and 10.40). There was even greater between centre variation in the proportion of patients with bicarbonate values above and below the specified range for the audit measure (tables 10.15 and 10.17). The UKRR previously conducted a limited survey into the possible underlying causes of this variation. The study predominantly looked at measures of sample processing and of dialysis treatment. It did not adjust for case mix

Table 10.14. Summary statistics for bicarbonate in haemodialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	119	24	2.7	24	22	26
B Heart	93	317	25	2.7	25	23	26
B QEH	93	630	24	3.4	24	22	26
Bangor	96	53	23	2.3	23	22	24
Basldn	98	121	21	2.6	22	20	23
Belfast	96	230	24	3.0	24	22	26
Bradfd	99	157	22	2.9	22	20	24
Brightn	100	274	23	2.7	23	21	25
Bristol	100	398	23	2.5	23	22	25
Camb	52	169	24	3.4	24	22	26
Cardff	76	346	20	3.4	20	18	23
Carlis	95	77	23	2.2	23	22	24
Carsh	83	436	26	4.0	26	23	29
Chelms	100	94	25	2.9	25	23	27
Clwyd	92	61	25	3.5	25	23	26
Covnt	40	109					
Derby	99	172	23	3.0	23	21	25
Derry	100	41	21	1.9	22	20	22
Donc	100	54	22	2.7	22	21	24
Dorset	100	137	26	3.1	26	24	27
Dudley	88	95	25	3.3	25	23	27
Exeter	99	258	22	2.5	23	21	24
Glouc	100	162	25	2.4	25	24	26
Hull	97	278	22	2.9	22	20	24
Ipswi	100	86	21	3.0	21	18	23
L Barts	100	540	24	2.9	24	22	26

Table 10.14. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
L Guys	84	351	24	3.0	24	22	26
L Kings	0	0					
L Rfree	82	452	24	3.0	24	23	26
L West	21	201					
Leeds	97	445	22	2.9	21	20	23
Leic	90	551	23	3.0	23	21	25
Liv Ain	98	107	22	2.7	22	21	24
Liv RI	94	363	23	3.1	23	21	24
M Hope	1	2					
M RI	66	180	24	3.8	24	22	27
Middlbr	97	252	24	3.0	24	23	26
Newc	100	200	23	3.3	23	21	25
Newry	99	82	25	2.6	25	23	27
Norwch	92	207	21	2.5	22	20	23
Nottm	76	254	24	3.5	24	22	26
Oxford	99	302	22	3.5	22	20	24
Plymth	99	117	23	3.2	23	21	25
Ports	99	370	23	2.7	23	21	25
Prestn	83	302	23	3.0	24	22	26
Redng	100	210	25	3.1	25	23	27
Sheff	99	473	25	2.9	25	23	26
Shrew	100	146	22	3.2	22	20	24
Stevng	95	293	22	3.1	22	20	24
Sthend	97	112	23	2.6	23	21	25
Stoke	1	2					
Sund	97	142	23	2.8	23	21	24
Swanse	99	259	21	3.4	21	18	23
Truro	99	136	23	2.6	23	21	25
Tyrone	97	68	24	3.0	24	22	26
Ulster	100	73	19	1.9	20	18	21
Wirral	94	159	24	3.5	24	22	26
Wolve	100	252	21	3.5	21	19	23
Wrexm	99	73	22	2.8	22	21	25
York	100	106	24	3.1	24	22	26
England	**81**	**11,251**	**23**	**3.3**	**23**	**21**	**25**
N Ireland	**98**	**613**	**23**	**3.2**	**23**	**21**	**26**
Wales	**87**	**792**	**21**	**3.6**	**21**	**19**	**24**
E, W & NI	**82**	**12,656**	**23**	**3.4**	**23**	**21**	**25**

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 2007

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	119	76.5	68.0	83.2	5.0	2.3	10.8	18.5	12.5	26.5
B Heart	317	66.9	61.5	71.8	5.4	3.4	8.5	27.8	23.1	33.0
B QEH	630	69.5	65.8	73.0	9.5	7.5	12.1	21.0	18.0	24.3
Bangor	53	77.4	64.2	86.7	9.4	4.0	20.7	13.2	6.4	25.2
Basldn	121	76.9	68.5	83.5	23.1	16.5	31.5	0.0	0.0	0.0
Belfast	230	75.2	69.2	80.4	7.0	4.3	11.1	17.8	13.4	23.3
Bradfd	157	80.3	73.3	85.8	12.7	8.4	18.9	7.0	3.9	12.2
Brightn	274	77.4	72.0	81.9	11.0	7.8	15.2	11.7	8.4	16.1
Bristol	398	84.2	80.3	87.4	7.5	5.3	10.6	8.3	6.0	11.4
Camb	169	66.9	59.4	73.5	8.9	5.4	14.2	24.3	18.4	31.3

Table 10.15. Continued

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
Cardff	346	50.0	44.8	55.3	45.7	40.5	50.9	4.3	2.6	7.1
Carlis	77	85.7	76.0	91.9	6.5	2.7	14.7	7.8	3.5	16.3
Carsh	436	51.4	46.7	56.0	3.4	2.1	5.6	45.2	40.6	49.9
Chelms	94	62.8	52.6	71.9	3.2	1.0	9.4	34.0	25.2	44.2
Clwyd	61	73.8	61.4	83.3	3.3	0.8	12.2	23.0	14.1	35.1
Derby	172	77.3	70.5	83.0	10.5	6.7	16.0	12.2	8.1	18.0
Derry	41	78.1	62.9	88.2	22.0	11.8	37.1	0.0	0.0	0.0
Donc	54	79.6	66.8	88.4	11.1	5.1	22.6	9.3	3.9	20.4
Dorset	137	59.9	51.4	67.7	3.7	1.5	8.5	36.5	28.9	44.9
Dudley	95	60.0	49.9	69.3	2.1	0.5	8.0	37.9	28.7	48.0
Exeter	258	87.6	83.0	91.1	10.5	7.3	14.8	1.9	0.8	4.6
Glouc	162	75.9	68.8	81.9	1.2	0.3	4.8	22.8	17.0	29.9
Hull	278	76.6	71.3	81.2	20.5	16.2	25.7	2.9	1.5	5.7
Ipswi	86	59.3	48.7	69.1	38.4	28.7	49.0	2.3	0.6	8.8
L Barts	540	76.7	72.9	80.0	7.0	5.2	9.5	16.3	13.4	19.7
L Guys	351	75.5	70.7	79.7	8.3	5.8	11.6	16.2	12.7	20.5
L Rfree	452	70.6	66.2	74.6	5.5	3.8	8.1	23.9	20.2	28.0
Leeds	445	74.6	70.4	78.4	20.0	16.5	24.0	5.4	3.6	7.9
Leic	551	74.4	70.6	77.9	12.0	9.5	15.0	13.6	11.0	16.7
Liv Ain	107	76.6	67.7	83.7	14.0	8.6	22.0	9.4	5.1	16.5
Liv RI	363	75.8	71.1	79.9	13.8	10.6	17.7	10.5	7.7	14.1
M RI	180	63.9	56.6	70.6	8.3	5.1	13.4	27.8	21.7	34.8
Middlbr	252	75.4	69.7	80.3	4.4	2.4	7.7	20.2	15.7	25.7
Newc	200	70.0	63.3	76.0	14.0	9.8	19.5	16.0	11.5	21.8
Newry	82	64.6	53.8	74.2	2.4	0.6	9.2	32.9	23.7	43.8
Norwch	207	77.3	71.1	82.5	21.3	16.2	27.4	1.5	0.5	4.4
Nottm	254	71.3	65.4	76.5	8.7	5.8	12.8	20.1	15.6	25.5
Oxford	302	66.6	61.0	71.7	23.2	18.8	28.3	10.3	7.3	14.2
Plymth	117	72.7	63.9	80.0	17.1	11.3	25.0	10.3	5.9	17.2
Ports	370	78.7	74.2	82.5	11.9	9.0	15.6	9.5	6.9	12.9
Prestn	302	72.2	66.9	77.0	10.9	7.9	15.0	16.9	13.1	21.5
Redng	210	69.5	63.0	75.4	4.3	2.2	8.0	26.2	20.7	32.6
Sheff	473	72.5	68.3	76.4	3.2	1.9	5.2	24.3	20.7	28.4
Shrew	146	70.6	62.7	77.4	23.3	17.1	30.8	6.2	3.2	11.4
Stevng	293	73.4	68.0	78.1	19.5	15.3	24.4	7.2	4.7	10.7
Sthend	112	81.3	73.0	87.4	9.8	5.5	16.9	8.9	4.9	15.8
Sund	142	82.4	75.2	87.8	11.3	7.0	17.6	6.3	3.3	11.7
Swanse	259	56.8	50.7	62.7	38.6	32.9	44.7	4.6	2.7	8.0
Truro	136	84.6	77.5	89.7	6.6	3.5	12.2	8.8	5.1	14.9
Tyrone	68	72.1	60.3	81.4	8.8	4.0	18.3	19.1	11.4	30.2
Ulster	73	54.8	43.3	65.8	45.2	34.2	56.7	0.0	0.0	0.0
Wirral	159	69.2	61.6	75.9	9.4	5.8	15.1	21.4	15.7	28.4
Wolve	252	59.5	53.4	65.4	35.3	29.7	41.4	5.2	3.0	8.7
Wrexm	73	84.9	74.8	91.5	9.6	4.6	18.8	5.5	2.1	13.7
York	106	73.6	64.4	81.1	5.7	2.6	12.0	20.8	14.1	29.5
England	**11,251**	**72.1**	**71.2**	**72.9**	**12.1**	**11.5**	**12.7**	**15.9**	**15.2**	**16.6**
N Ireland	**613**	**71.5**	**67.8**	**74.9**	**11.8**	**9.4**	**14.5**	**16.8**	**14.1**	**20.0**
Wales	**792**	**59.1**	**55.6**	**62.5**	**34.3**	**31.1**	**37.7**	**6.6**	**5.0**	**8.5**
E, W & NI	**12,656**	**71.2**	**70.4**	**72.0**	**13.4**	**12.9**	**14.1**	**15.3**	**14.7**	**16.0**

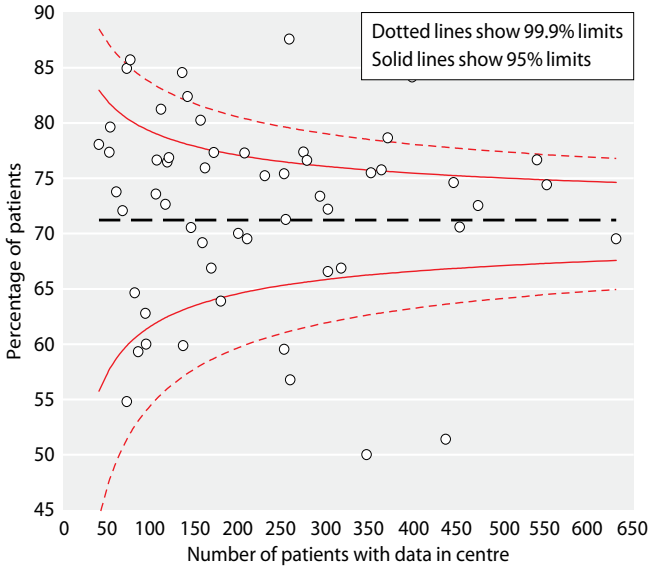

Fig. 10.39. Funnel plot of percentage of haemodialysis patients with bicarbonate 20–26 mmol/L by centre in 2007

Table 10.16. Summary statistics for serum bicarbonate in peritoneal dialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	97	30	26	2.44	26	25	27
B QEH	81	95	26	3.14	26	24	28
Bangor	97	30	26	3.11	26	23	29
Basldn	100	26	26	2.96	26	24	27
Belfast	96	55	27	3.21	27	24	28
Bradfd	100	36	26	2.75	26	24	28
Brightn	97	76	24	2.81	24	23	25
Bristol	100	72	25	2.78	26	24	27
Camb	100	47	28	4.38	28	25	32
Cardff	97	142	22	3.54	22	20	24
Carlis	100	11					
Carsh	94	106	31	3.64	32	29	34
Chelms	97	35	28	2.46	28	26	30
Clwyd	92	12					
Covnt	54	35	25	2.59	25	24	27
Derby	100	71	27	3.57	27	24	29
Derry	100	4					
Donc	39	13					
Dorset	98	55	25	2.91	26	23	27
Dudley	91	49	26	3.00	26	24	28
Exeter	100	70	24	3.36	24	22	27
Glouc	100	30	27	2.37	27	26	28
Hull	95	79	26	2.77	26	24	28
Ipswi	96	43	25	2.77	25	22	27
L Barts	100	217	27	3.01	26	25	28
L Guys	97	58	24	2.87	23	22	26
L Kings	1	1					
L Rfree	95	114	26	3.36	26	24	28
L West	0	0					
Leeds	99	98	25	3.07	25	23	28
Leic	92	166	25	3.31	26	23	28
Liv RI	92	85	24	3.04	24	22	26

Table 10.16. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Liv Ain	n/a	0					
M Hope	0	0					
M RI	100	115	26	2.69	26	24	27
Middlbr	92	23	28	2.74	27	26	29
Newc	100	46	26	2.88	25	24	28
Newry	69	9					
Norwch	96	55	21	2.35	21	20	23
Nottm	18	24					
Oxford	77	103	26	3.65	25	23	28
Plymth	100	38	25	4.02	25	23	27
Ports	68	63	25	2.78	25	24	27
Prestn	83	64	26	3.13	25	23	28
Redng	100	86	26	2.80	26	24	27
Sheff	100	88	27	3.12	27	25	29
Shrew	100	33	26	2.84	27	24	28
Stevng	95	36	27	3.23	27	24	29
Sthend	94	17					
Stoke	0	0					
Sund	100	10					
Swanse	96	71	25	3.78	25	23	27
Truro	96	22	26	3.46	27	26	29
Tyrone	100	5					
Ulster	100	2					
Wirral	68	19					
Wolve	98	52	26	2.92	27	24	28
Wrexm	90	27	24	2.47	25	23	27
York	100	23	26	2.92	26	23	28
England	**80**	**2,635**	**26**	**3.45**	**26**	**24**	**28**
N Ireland	**93**	**90**	**26**	**3.11**	**27**	**24**	**28**
Wales	**96**	**282**	**23**	**3.78**	**24**	**21**	**26**
E, W & NI	**81**	**3,007**	**26**	**3.54**	**26**	**23**	**28**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

Table 10.17. Percentage of peritoneal dialysis patients within, below and above the range for bicarbonate (25–29 mmol/L) in 2007

Centre	N	% bicarb 25–29 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <25 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb >29 mmol/L	Lower 95% CI	Upper 95% CI
B Heart	30	56.7	38.8	72.9	26.7	13.9	45.0	16.7	7.1	34.3
B QEH	95	50.5	40.6	60.4	37.9	28.7	48.0	11.6	6.5	19.7
Bangor	30	46.7	29.9	64.2	43.3	27.1	61.2	10.0	3.3	26.8
Basldn	26	57.7	38.5	74.8	26.9	13.4	46.7	15.4	5.9	34.5
Belfast	55	58.2	44.9	70.4	25.5	15.7	38.5	16.4	8.7	28.6
Bradfd	36	69.4	52.8	82.2	27.8	15.7	44.4	2.8	0.4	17.3
Brightn	76	25.0	16.6	35.9	68.4	57.2	77.9	6.6	2.8	14.9
Bristol	72	62.5	50.8	72.9	34.7	24.7	46.4	2.8	0.7	10.4
Camb	47	48.9	35.1	62.9	17.0	8.8	30.5	34.0	22.0	48.6
Cardff	142	21.8	15.8	29.4	76.1	68.4	82.4	2.1	0.7	6.3
Carsh	106	25.5	18.1	34.6	4.7	2.0	10.8	69.8	60.4	77.8
Chelms	35	62.9	46.0	77.1	8.6	2.8	23.4	28.6	16.1	45.4
Covnt	35	57.1	40.6	72.3	40.0	25.3	56.7	2.9	0.4	17.7
Derby	71	54.9	43.3	66.1	28.2	19.0	39.7	16.9	9.9	27.5

Table 10.17. Continued

Centre	N	% bicarb 25–29 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <25 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb >29 mmol/L	Lower 95% CI	Upper 95% CI
Dorset	55	61.8	48.5	73.6	34.6	23.2	47.9	3.6	0.9	13.4
Dudley	49	38.8	26.3	52.9	44.9	31.7	58.9	16.3	8.4	29.4
Exeter	70	31.4	21.7	43.2	58.6	46.8	69.5	10.0	4.8	19.5
Glouc	30	76.7	58.5	88.5	13.3	5.1	30.6	10.0	3.3	26.8
Hull	79	57.0	45.9	67.4	32.9	23.5	44.0	10.1	5.2	19.0
Ipswi	43	53.5	38.7	67.7	41.9	28.2	56.9	4.7	1.2	16.8
L Barts	217	59.5	52.8	65.8	24.0	18.8	30.1	16.6	12.2	22.1
L Guys	58	41.4	29.5	54.3	58.6	45.7	70.5	0.0	0.0	0.0
L Rfree	114	57.0	47.8	65.8	29.0	21.4	37.9	14.0	8.8	21.7
Leeds	98	54.1	44.2	63.7	34.7	26.0	44.6	11.2	6.3	19.1
Leic	166	50.6	43.0	58.1	38.6	31.5	46.2	10.8	6.9	16.6
Liv RI	85	42.4	32.3	53.0	54.1	43.5	64.4	3.5	1.1	10.4
M RI	115	60.9	51.7	69.4	33.0	25.1	42.1	6.1	2.9	12.2
Middlbr	23	73.9	52.8	87.8	8.7	2.2	28.9	17.4	6.7	38.2
Newc	46	58.7	44.1	71.9	28.3	17.2	42.8	13.0	6.0	26.1
Norwch	55	7.3	2.8	17.8	92.7	82.2	97.2	0.0	0.0	0.0
Oxford	103	47.6	38.1	57.2	39.8	30.8	49.5	12.6	7.5	20.5
Plymth	38	42.1	27.6	58.1	39.5	25.4	55.6	18.4	9.0	33.9
Ports	63	47.6	35.7	59.9	46.0	34.2	58.3	6.4	2.4	15.7
Prestn	64	50.0	38.0	62.0	35.9	25.2	48.3	14.1	7.5	24.9
Redng	86	66.3	55.7	75.5	25.6	17.5	35.8	8.1	3.9	16.1
Sheff	88	65.9	55.4	75.0	19.3	12.4	28.9	14.8	8.8	23.8
Shrew	33	57.6	40.5	73.0	33.3	19.5	50.8	9.1	3.0	24.7
Stevng	36	50.0	34.2	65.8	27.8	15.7	44.4	22.2	11.5	38.5
Swanse	71	52.1	40.6	63.4	38.0	27.5	49.8	9.9	4.8	19.3
Truro	22	63.6	42.3	80.7	22.7	9.8	44.4	13.6	4.5	34.8
Wolve	52	63.5	49.7	75.3	28.9	18.2	42.5	7.7	2.9	18.8
Wrexm	27	48.2	30.4	66.4	48.2	30.4	66.4	3.7	0.5	22.1
York	23	52.2	32.5	71.2	39.1	21.8	59.8	8.7	2.2	28.9
England	**2,635**	**51.8**	**49.9**	**53.7**	**34.8**	**33.0**	**36.6**	**13.4**	**12.1**	**14.7**
N Ireland	**90**	**55.6**	**45.2**	**65.5**	**30.0**	**21.5**	**40.2**	**14.4**	**8.6**	**23.3**
Wales	**282**	**35.5**	**30.1**	**41.2**	**58.9**	**53.0**	**64.5**	**5.7**	**3.5**	**9.1**
E, W & NI	**3,007**	**50.4**	**48.6**	**52.2**	**36.9**	**35.2**	**38.7**	**12.7**	**11.5**	**13.9**

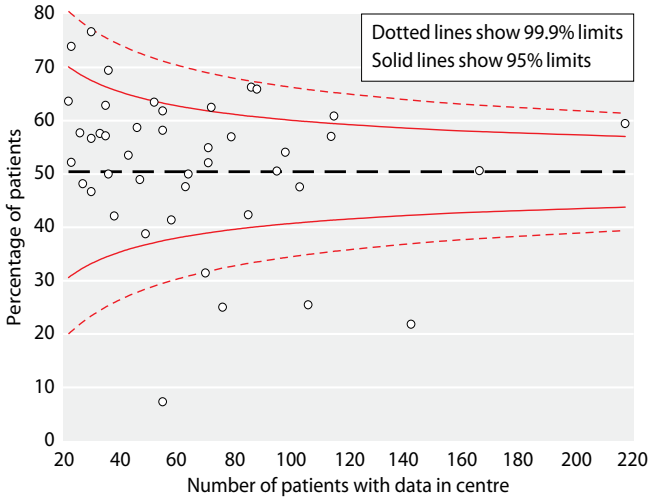

Fig. 10.40. Funnel plot of percentage of peritoneal dialysis patients with bicarbonate 25–29 mmol/L by centre in 2007

and was unable to detect any significant differences between centres. However, it was possible that there may be unmeasured processes including dialysis and oral bicarbonate prescription that might account for the variation observed [13].

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]

Results and discussion

Total cholesterol data were 80% complete for HD patients and 82% complete for PD patients. As there were no specific audit measures for total cholesterol, summary data were presented for each dialysis centre (tables 10.18 and 10.19, figures 10.41 and 10.42). There were a

Table 10.18. Summary statistics for total cholesterol in haemodialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	122	3.7	1.0	3.6	3.1	4.1
B Heart	49	174					
B QEH	91	630	3.9	1.1	3.7	3.2	4.4
Bangor	83	50	3.9	1.1	3.8	3.1	4.7
Basldn	98	121	4.1	1.0	4.0	3.5	4.7
Belfast	85	210	3.9	1.1	3.8	3.1	4.4
Bradfd	78	124	4.2	1.0	4.1	3.5	4.9
Brightn	24	72					
Bristol	93	397	4.1	1.1	4.0	3.3	4.7
Camb	51	169	3.7	1.0	3.5	3.1	4.2
Cardff	89	405	3.9	1.0	3.8	3.1	4.5
Carlis	94	76	4.1	1.0	4.1	3.4	4.7
Carsh	64	334	4.2	1.1	4.1	3.4	4.8
Chelms	98	92	3.5	1.0	3.4	2.8	4.3
Clwyd	31	21					
Covnt	0	0					
Derby	90	165	3.9	1.1	3.7	3.1	4.4
Derry	100	41	3.9	0.9	3.7	3.4	4.2
Donc	83	45	3.8	0.8	3.7	3.3	4.1
Dorset	91	126	4.1	1.0	4.0	3.4	4.7
Dudley	97	107	3.7	1.0	3.5	3.0	4.4
Exeter	90	235	4.1	1.2	4.0	3.2	4.7
Glouc	83	135	4.0	1.0	3.9	3.2	4.4
Hull	86	257	4.2	1.1	4.0	3.5	4.9
Ipswi	89	80	3.9	1.1	3.8	3.1	4.7
L Barts	99	548	3.9	1.0	3.7	3.1	4.5
L Guys	96	425	3.8	1.1	3.7	3.1	4.3
L Kings	95	293	3.9	0.9	3.8	3.3	4.4
L Rfree	84	478	3.9	1.0	3.8	3.2	4.4
L West	78	768	4.4	2.9	3.7	3.1	4.5
Leeds	83	393	3.8	1.0	3.7	3.2	4.3

Table 10.18. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Leic	96	610	3.8	1.0	3.7	3.1	4.4
Liv Ain	60	67	3.8	1.0	3.7	3.0	4.6
Liv RI	8	33					
M Hope	72	220	3.6	1.0	3.5	3.0	4.2
M RI	63	198	3.6	1.0	3.5	2.9	4.2
Middlbr	97	254	4.2	1.2	4.2	3.4	4.8
Newc	90	187	3.8	1.1	3.6	3.1	4.4
Newry	99	82	3.9	1.0	3.7	3.3	4.5
Norwch	88	205	4.1	1.0	4.0	3.4	4.8
Nottm	84	291	3.8	1.0	3.6	3.1	4.3
Oxford	90	293	3.8	1.1	3.7	3.1	4.4
Plymth	83	99	3.9	0.8	3.8	3.3	4.5
Ports	66	248	4.0	1.2	3.9	3.3	4.6
Prestn	99	379	3.9	0.9	3.8	3.2	4.5
Redng	96	201	3.8	1.0	3.7	3.2	4.4
Sheff	95	487	3.9	1.0	3.8	3.2	4.5
Shrew	99	146	3.9	1.0	3.8	3.2	4.5
Stevng	40	124					
Sthend	93	107	4.1	1.0	4.0	3.3	4.6
Stoke	97	235	3.7	0.9	3.6	3.0	4.3
Sund	97	143	3.8	1.0	3.7	3.1	4.4
Swanse	98	270	3.8	1.0	3.6	3.0	4.3
Truro	99	141	3.9	1.1	3.8	3.2	4.4
Tyrone	97	69	4.0	0.9	3.8	3.4	4.4
Ulster	100	74	4.1	1.0	4.0	3.4	4.7
Wirral	86	147	3.7	1.1	3.5	2.9	4.1
Wolve	96	244	3.8	1.0	3.8	3.1	4.5
Wrexm	62	46	3.9	1.0	3.8	3.3	4.4
York	91	97	4.1	1.1	4.0	3.5	4.8
England	**79**	**11,400**	**3.9**	**1.3**	**3.8**	**3.2**	**4.5**
N Ireland	**94**	**598**	**3.9**	**1.0**	**3.7**	**3.2**	**4.4**
Wales	**85**	**792**	**3.8**	**1.0**	**3.7**	**3.1**	**4.5**
E, W & NI	**80**	**12,790**	**3.9**	**1.2**	**3.8**	**3.2**	**4.5**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

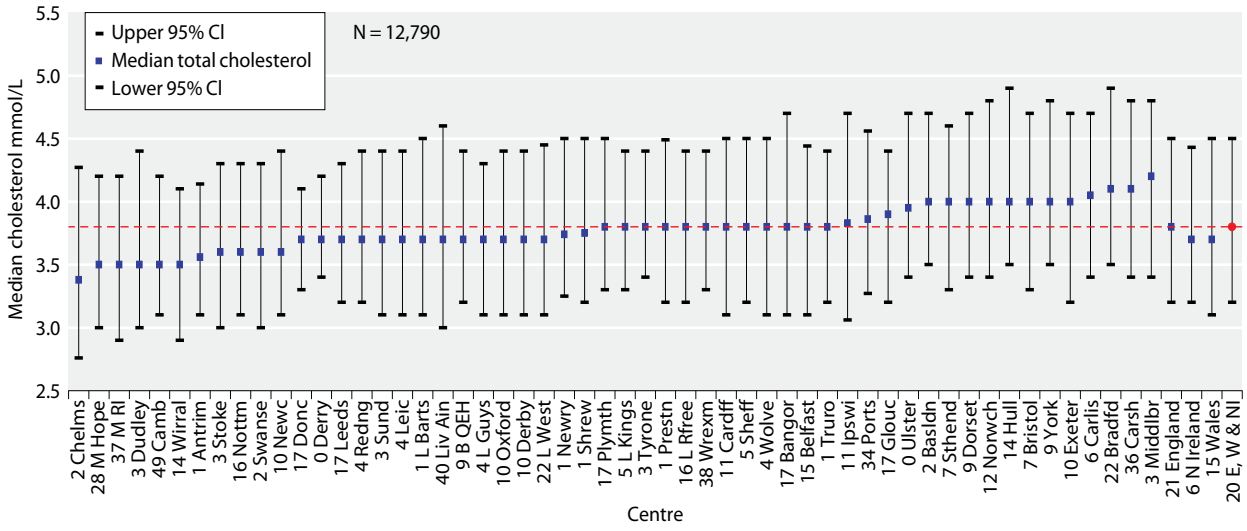

Fig. 10.41. Median total cholesterol in haemodialysis patients by centre in 2007

Table 10.19. Summary statistics for total cholesterol in peritoneal dialysis patients in 2007

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	90	28	4.5	1.1	4.3	3.9	5.3
B QEH	83	98	4.2	1.1	4.2	3.5	4.7
Bangor	87	27	4.8	1.2	4.8	3.9	5.5
Basldn	100	26	4.7	1.0	4.7	4.0	5.4
Belfast	96	55	4.6	1.4	4.2	3.6	5.3
Bradfd	94	34	4.9	1.3	4.6	3.8	5.5
Brightn	62	48	4.4	1.2	4.1	3.6	5.4
Bristol	85	61	4.8	1.6	4.6	3.9	5.5
Camb	100	47	4.2	1.2	4.2	3.2	4.8
Cardff	99	145	4.6	1.3	4.5	3.7	5.3
Carlis	91	10					
Carsh	63	71	5.0	1.1	5.0	4.0	5.6
Chelms	89	32	4.5	1.2	4.4	3.8	5.0
Clwyd	62	8					
Covnt	0	0					
Derby	49	35					
Derry	100	4					
Donc	24	8					
Dorset	89	50	4.5	1.1	4.4	3.6	5.3
Dudley	76	41	4.0	1.2	3.9	3.2	4.6
Exeter	84	59	4.5	1.3	4.4	3.5	5.3
Glouc	93	28	4.9	1.5	4.8	3.8	5.6
Hull	77	64	4.9	1.1	4.8	4.1	5.7
Ipswi	96	43	4.1	0.7	4.0	3.6	4.5
L Barts	98	214	4.4	1.1	4.3	3.6	5.1
L Guys	98	59	4.7	1.3	4.7	3.8	5.3
L Kings	76	57	4.5	1.2	4.5	3.6	5.1
L Rfree	95	114	4.3	1.0	4.2	3.7	4.9
L West	64	41	4.3	1.0	4.1	3.5	5.0
Leeds	96	95	4.4	1.0	4.2	3.6	5.0
Leic	97	174	4.3	1.0	4.2	3.6	4.9
Liv Ain	n/a	0					
Liv RI	0	0					
M Hope	83	96	4.2	1.1	4.1	3.4	5.0
M RI	94	108	4.1	1.1	4.2	3.3	4.8
Middlbr	88	22	5.3	2.0	4.8	4.1	5.6
Newc	100	46	4.4	1.1	4.3	3.7	5.2
Newry	100	13					
Norwch	96	55	4.8	1.3	4.5	3.8	5.7
Nottm	93	126	4.2	1.0	4.1	3.5	4.9
Oxford	86	115	4.7	1.2	4.7	4.0	5.4
Plymth	84	32	4.3	1.1	4.1	3.6	4.8
Ports	37	34					
Prestn	99	76	4.5	1.3	4.2	3.7	5.1
Redng	99	85	4.4	1.1	4.0	3.7	4.8
Sheff	72	63	4.2	1.2	4.0	3.3	5.1
Shrew	100	33	4.6	1.4	4.3	3.4	5.4
Stevng	58	22	4.6	1.4	4.3	3.4	5.8
Sthend	72	13					
Stoke	100	90	3.7	1.4	3.7	2.6	4.6
Sund	60	6					
Swanse	97	72	4.2	1.2	4.3	3.5	4.7
Truro	96	22	4.3	1.3	3.8	3.4	5.1

Table 10.19. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Tyrone	100	5					
Ulster	100	2					
Wirral	68	19					
Wolve	79	42	4.4	1.2	4.3	3.7	5.1
Wrexm	80	24	4.3	1.3	3.9	3.5	5.2
York	83	19					
England	**80**	**2,661**	**4.4**	**1.2**	**4.3**	**3.6**	**5.1**
N Ireland	**97**	**94**	**4.5**	**1.2**	**4.1**	**3.7**	**5.0**
Wales	**94**	**276**	**4.5**	**1.2**	**4.4**	**3.6**	**5.2**
E, W & NI	**82**	**3,031**	**4.4**	**1.2**	**4.3**	**3.6**	**5.1**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

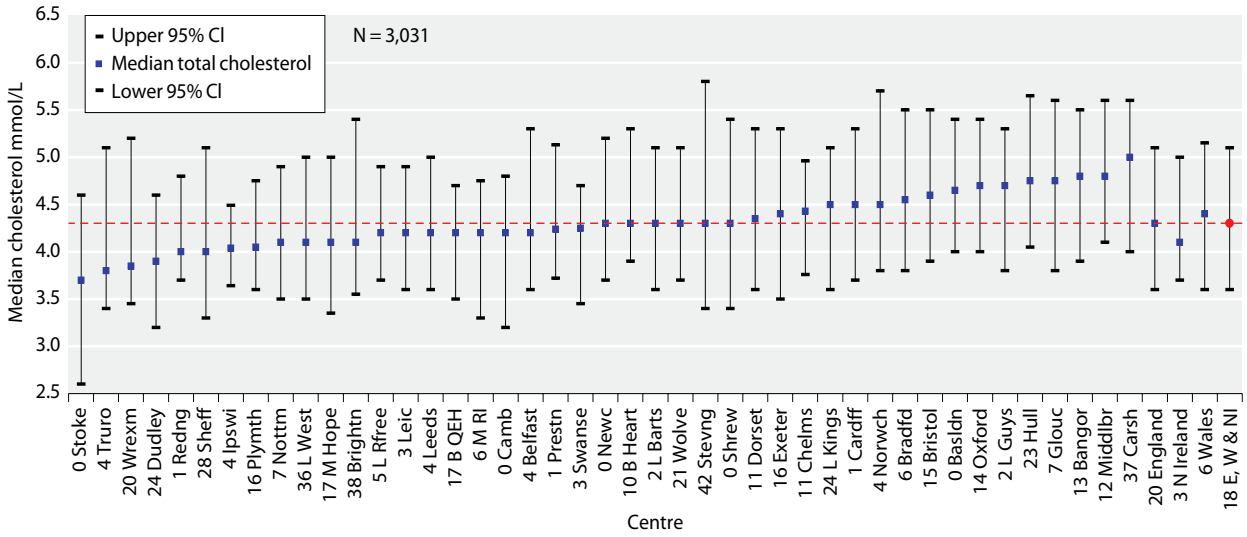

Fig. 10.42. Median total cholesterol in peritoneal dialysis patients by centre in 2007

number of case mix factors (comorbidity, inflammation, malnutrition) which may account for any inter centre variation in addition to differences in prescription of lipid lowering medication and other therapies known to influence lipid level e.g. steroids, sevelamer etc. The UKRR is planning to collect an enhanced dataset with more detailed lipid profiles and prescribing data. In conjunction with the awaited results from the SHARP trial [6] this should provide further information about optimal lipid management in UK dialysis patients.

Conflict of interest: none

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Chapter 11
Blood pressure profile of prevalent patients receiving dialysis in the UK in 2007: national and centre-specific analyses

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Key Words
Blood pressure · Chronic kidney disease · Dialysis · End stage renal disease · Epidemiology · Haemodialysis · Peritoneal dialysis · Transplant

Abstract
Introduction: Blood pressure (BP) control is assessed annually from patients on Renal Replacement Therapy at renal centres in England, Wales and Northern Ireland by the UK Renal Registry. ***Methods:*** Patients alive and receiving RRT on 31st December 2007 with a BP reading in either the fourth or third quarter of 2007 were included. Summary statistics were calculated for each renal centre, nation and renal disease category. Linear regression analyses were performed for prevalent patients between 2000 and 2007. ***Results:*** Significantly more haemodialysis patients achieved the BP standard (44.6% pre-HD and 48.8% post-HD) than peritoneal dialysis (32.8%) or renal transplant patients (26.7%). Median BP fell significantly between 2000 and 2007 for each treatment modality. There was significant variability in BP control between renal centres ($p < 0.0001$) for haemodialysis and transplant patients. Hypertension was significantly more common in haemodialysis patients with vascular disorders such as diabetes and renovascular disease (56.8%) than in glomerulonephritis (51.0%) or tubular disorders (45.1%). The effect was less prominent in peritoneal dialysis and not evident in transplant patients where few achieved the BP standard. ***Conclusion:*** A minority of patients on RRT achieved BP standards in 2007. There remained a significant variation in achievement of standards between renal centres.

Introduction

This chapter reports on BP analyses carried out by the UK Renal Registry (UKRR) for data collected from 60 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 they recommended the BP target should be lowered to <140/90 mmHg pre-dialysis and <130/80 mmHg post-dialysis for haemodialysis patients (HD) and <130/80 mmHg for peritoneal dialysis (PD) and kidney transplant recipients [1]. The recommendations were based on grade C evidence and

to date there are no randomised controlled trials in this area. The targets were in line with other international organisations that set a low BP standard to reduce cardiovascular disease and mortality in the general population. Hypertension affects 90% of patients starting dialysis. Sustained over many years it leads to left ventricular hypertrophy and dilatation. Both cardiac failure and general poor health cause hypotension and these patients are likely to account for early deaths in blood pressure studies. The association between hypertension and mortality is lost unless comorbidity data identifying end organ damage is available but few studies in this field provide relevant comorbidity data.

Several large observational studies have reported U-shaped or reverse J-shaped relationships between systolic blood pressure (SBP) and mortality in HD patients [2, 3]. Higher baseline pre and post-dialysis SBP is associated with low mortality for the first two years and low baseline SBP (<110 mmHg) higher mortality. The reverse is true after three years with better survival rates for baseline SBP <120 mmHg and higher mortality for baseline SBP ⩾150 mmHg [4]. Since adverse effects of hypertension become apparent after three years, a low BP would be expected to benefit fit individuals with a longer life expectancy. It is likely patients with established comorbidity are dying early in these studies and there has been increasing concern that trying to achieve lower BP targets could precipitate hypotension in these high risk patients. Intradialytic hypotension reduces perfusion of the brain and myocardium and is an independent predictor of mortality [5]. An audit of a single dialysis week for 2,630 HD patients in London showed hypotensive episodes requiring saline resuscitation affected 15% of patients at least once and 2% of patients at each dialysis session [6]. Susceptible individuals had been prescribed fewer antihypertensive medications and hypotension occurred more frequently in individuals who were not receiving any antihypertensive medication. Patients with symptomatic hypotension were shown to have lower pre-dialysis diastolic blood pressure (DBP) and lower pulse pressure (PP) despite higher interdialytic weight gains. HD centres with excellent survival rates control BP by combining low salt intake (5 g/day) and reduced dialysate sodium (136–138 mmol/L) with slow ultrafiltration (prolonged or more frequent dialysis) [7, 8]. Currently it is not known whether patients prone to hypotension will benefit more from a higher BP target or from strict sodium balance and slow ultrafiltration.

BP varies over a 24-hour period and alterations in these patterns are associated with target organ damage and cardiovascular disease. HD patients have an attenuated fall in nocturnal BP (non-dippers) and this has been linked to increased left ventricular mass [9]. They also have marked fluctuations in pre-dialysis SBP that are linked to increased mortality [10]. Ambulatory readings are impractical for routine clinical use so statistical models are increasingly employed to help refine the prognostic value of BP measurements obtained in the dialysis unit. A retrospective study of 6,961 incident HD patients analysed pre-dialysis BP readings taken between day 91 and 180 [11]. Both SBP and DBP variability are linked to all cause mortality within the subsequent six months. Statistical modelling in BP survival analyses need to be validated before their findings can be adopted. This is an active area of research for the UKRR.

The association between baseline BP and survival for PD patients is not as clear as there are few large studies. A retrospective study of 1,053 PD patients in the USA showed mortality is increased in the first two years in patients with low SBP (<111 mmHg) [12]. Cardiac failure was reported in 32% of the cohort and may account for this early mortality. The UKRR reports the association of baseline BP and mortality for a cohort of 2,770 PD patients in England and Wales [13]. Change of treatment modality was incorporated as a time dependant variable in the statistical model to prolong the observation period. Higher SBP, DBP, mean arterial pressure (MAP) and PP are associated with low mortality within the first year. The adverse effects of high SBP and PP became apparent after six years. Activation on the renal transplant waiting list within six months of starting dialysis was used as a surrogate marker for low comorbidity. When these 598 listed patients were considered in isolation high SBP had no protective effect against early mortality. Also the adverse effects of high SBP and PP were apparent earlier (years 4 and 5) in these fit individuals than in the main study cohort. The association of BP and survival is more clear cut in transplant patients as several studies show hypertension is associated with increased mortality [14, 15]. One study shows a progressive improvement in graft and patient survival as SBP falls to <120 mmHg [16]. This relationship is also seen in individuals who had never suffered rejection, supporting a direct link between recipient BP and graft function.

Overall, the evidence supports a low BP target for fit individuals on RRT just as low BP benefits the general

population. The focus of this report is the compliance of UK renal centres with the RA BP guidelines.

Methods

All adult patients receiving RRT in the UK on 31st December 2007 were considered. The method of data extraction employed by the UK Renal Registry is described in chapter 15 of this report. The UKRR extracts quarterly laboratory, clinical and demographic data for all patients receiving RRT in England, Northern Ireland and Wales. Data on some variables are sent annually from the Scottish Renal Registry but BP is not currently sent. Therefore no summary statistics have been calculated for Scotland or Scottish renal centres.

Any patient alive and receiving RRT on 31st December 2007 with a valid BP reading in either the fourth or the third quarter of 2007 was included. This includes incident patients starting RRT during 2007 who were still alive on 31st December. The last recorded BP from quarter 4 was used in the analyses, if this was missing, the last recorded BP from quarter 3 was used instead. Patients with no recorded blood pressure readings in the last two quarters were excluded from the study.

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.

Analyses were performed on each RRT modality (HD, PD and transplant recipients). Patients on HD were analysed both by pre-dialysis and post-dialysis blood pressure. Patients were included if they had been on the same modality and at the same renal centre for three months. The blood pressure components analysed include SBP, DBP, MAP and PP. The data were analysed to calculate summary statistics (mean, median, maximum, minimum). Standard deviation and quartile ranges were also found. Median BP with inter-quartile ranges (IQRs) are presented for each analysis. In addition to this, the percentage of patients attaining RA Standards for BP (***Pre-haemodialysis BP <140/90 mmHg; Post-haemodialysis, peritoneal dialysis and renal transplant BP <130/80 mmHg***) in each renal centre and each nation was calculated. These are presented in caterpillar plots with 95% confidence intervals.

For the longitudinal analyses, prevalent patients receiving RRT on 31st December of each year between 2000 and 2007 with a BP reading in the final quarter of that year were included.

Finally, the BP analyses (both median BP and percentage attaining RA Standards) were studied by underlying primary renal disease (PRD). The list of primary renal diseases is shown in appendix G. These analyses were repeated after combining diabetic nephropathy and reno-vascular disease into a 'vascular' group, and combining pyelonephritis and polycystic kidney disease into a 'tubular' group. These two combination groups were compared with the existing glomerulonephritis group.

Chi-squared tests were used to test for statistically significant differences between renal centres, nations and primary renal disease groups. A linear regression analysis was used to test longitudinal changes over the last eight years. All statistical analyses were performed using SAS version 9.1.3.

Results

Data completeness

Blood pressure data extractions from 60 centres in England, Northern Ireland and Wales were performed. There were 16,070 BP readings available from a total of 37,720 patients (15,924 HD, 3,699 PD and 18,097 transplant (Tx)). Most centres managed patients treated with HD, PD and renal transplants and the completeness of data returns is listed in table 11.1. There were three centres (Bangor, Liverpool Aintree and Wirral) which did not manage transplant patients and one (Liverpool Aintree) without PD patient follow up. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

BP data was complete in 60% of haemodialysis patients (pre-HD), 56% post-HD, 40% of PD patients and 31% of transplant recipients. Consistently high levels (>80%) of BP data returns from the three modalities of RRT were obtained from only 12 centres and there were 12 centres where no BP data were 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 transmission of recorded data to the UKRR is not known.

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 16,070 out of 37,720 patients were analysed. The results shown for HD patients are post-dialysis readings. Median systolic and diastolic blood pressures were lower in HD patients than in PD and transplant patients (SBP: 128 (HD), 132 (PD) and 135 mmHg (Tx); DBP: 68 (HD), 78 (PD) and 79 mmHg (Tx)). Pulse pressure readings in HD patients were greater than in PD and transplant patients (60 (HD), 55 (PD) and 56 mmHg (Tx)).

Haemodialysis

Pre-HD readings from 9,478 out of 15,924 patients and post-HD readings from 8,978 out of 15,924 patients were available for analysis. Due to poor returns, 16 centres were excluded from the pre-HD centre-specific analyses and 18 centres from the post-HD analyses.

Figure 11.2 illustrates the performance of centres and nations in achieving the previous RA BP standard for pre-HD blood pressure (<140/90 mmHg). Overall, 45% of patients achieved this standard. There was significant variation in achievement between centres (range

Table 11.1. Percentage of patients with complete returns of blood pressure values by modality

Centre	% completed data				Centre	% completed data			
	Pre HD	Post HD	PD	Transplants		Pre HD	Post HD	PD	Transplants
Antrim	97	97	0	19	Liv Ain	3	93	n/a	n/a
B Heart	92	92	0	1	Liv RI	82	81	28	75
B QEH	0	0	0	1	M Hope	0	0	1	0
Bangor	93	93	97	n/a	M RI	0	0	0	0
Basldn	98	98	96	2	Middlbr	97	95	92	49
Belfast	94	92	28	87	Newc	0	0	0	1
Bradfd	2	1	92	90	Newry	99	99	0	2
Brightn	0	0	0	0	Norwch	86	86	0	1
Bristol	100	98	96	81	Nottm	98	98	99	95
Camb	52	52	0	1	Oxford	97	96	67	13
Cardff	7	0	3	94	Plymth	96	0	0	0
Carlis	95	95	0	0	Ports	99	99	78	10
Carsh	66	66	1	0	Prestn	0	0	0	0
Chelms	100	100	94	92	Redng	95	37	99	99
Clwyd	1	4	85	91	Sheff	99	97	100	97
Covnt	99	97	82	65	Shrew	100	98	33	19
Derby	99	99	1	6	Stevng	98	98	0	0
Derry	100	100	100	80	Sthend	97	97	6	0
Donc	11	11	3	0	Stoke	98	98	2	0
Dorset	99	99	91	8	Sund	96	96	0	1
Dudley	88	79	96	56	Swanse	97	97	16	3
Exeter	99	66	96	79	Truro	98	98	83	54
Glouc	96	96	0	0	Tyrone	97	96	100	85
Hull	95	95	55	0	Ulster	99	99	100	100
Ipswi	100	100	89	89	Wirral	89	30	21	n/a
L Barts	0	0	0	0	Wolve	99	98	98	96
L Guys	0	0	0	0	Wrexm	97	96	0	45
L Kings	0	0	1	0	York	100	97	100	85
L Rfree	0	0	0	0	**England**	**59**	**56**	**42**	**27**
L West	8	2	0	0	**N Ireland**	**96**	**95**	**28**	**74**
Leeds	96	93	96	83	**Wales**	**46**	**43**	**20**	**79**
Leic	99	97	97	27	**E, W & NI**	**60**	**56**	**40**	**31**

n/a not applicable

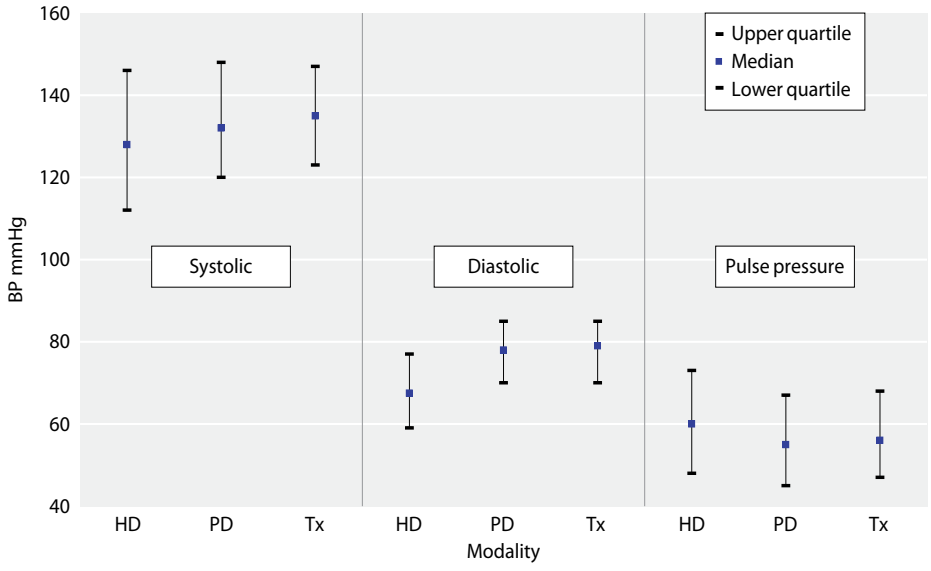

Fig. 11.1. Summary of BP achievements

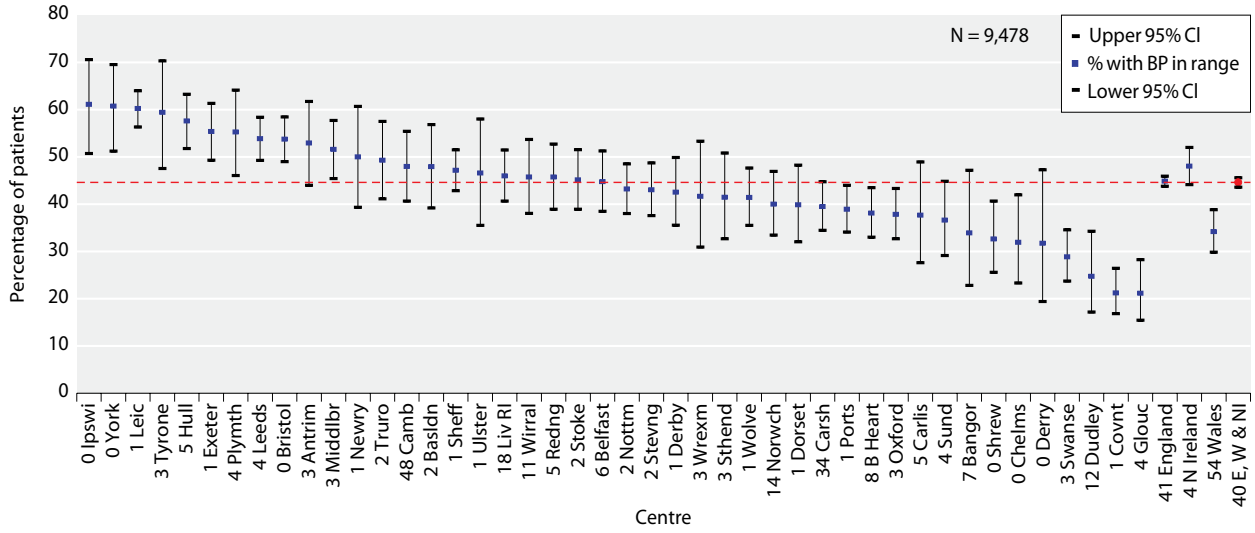

Fig. 11.2. Percentage of patients with BP <140/90 mmHg: pre-HD

21–61%, Chi-Squared test, $p < 0.0001$) and between nations (range 34–48%, $p < 0.0001$).

Figure 11.3 illustrates the performance of centres and nations in achieving the previous RA BP standard for post-HD blood pressure (<130/80 mmHg). Overall, 49% of patients achieved this standard. There was significant variation in achievement between centres (range 25–63%, $p < 0.0001$) and between nations (range 39–50%, $p < 0.0001$).

Figure 11.4 shows the median pre-HD systolic blood pressure by both centre and nation. The median pre-HD SBP for all patients was 141 mmHg. The median pre-HD SBP ranged from 128–158 mmHg between centres and from 141–148 mmHg between nations.

Figure 11.5 illustrates the performance of centres and nations in achieving the previous RA BP standard for pre-HD systolic blood pressure (<140 mmHg). Overall, 47% of patients achieved this standard. There was significant variation in achievement between centres (range 21–68%, $p < 0.0001$) and between nations (range 36–49%, $p < 0.0001$).

Figure 11.6 shows the median post-HD systolic blood pressure by both centre and nation. The median post-HD SBP for all patients was 128 mmHg. The median

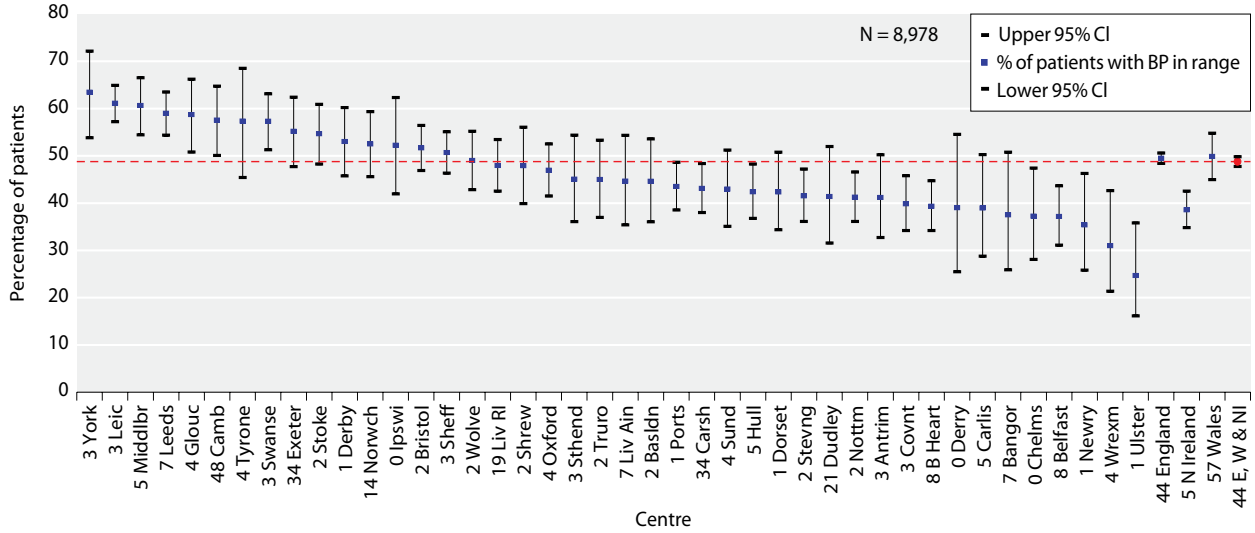

Fig. 11.3. Percentage of patients with BP <130/80 mmHg: post-HD

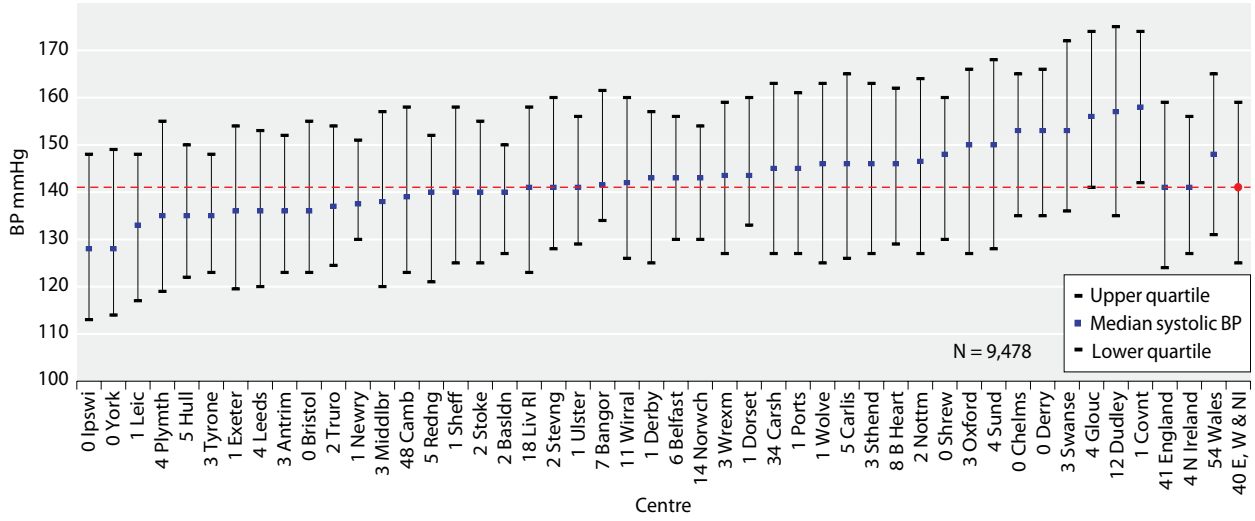

Fig. 11.4. Median systolic BP: pre-HD

post-HD SBP ranged from 119–144 mmHg between centres and from 128–134 mmHg between nations.

Figure 11.7 illustrates the performance of centres and nations in achieving the previous RA BP standard for post-HD systolic blood pressure (<130 mmHg). Overall, 52% of patients achieved this standard. There was significant variation in achievement between centres (range 26–66%, $p < 0.0001$) and between nations (range 41–54%, $p < 0.0001$).

Figure 11.8 shows the median pre-HD diastolic blood pressure by both centre and nation. The median pre-HD DBP for all patients was 74 mmHg. The median pre-HD DBP ranged from 66–81.5 mmHg between centres and from 73–74 mmHg between nations.

Figure 11.9 illustrates the performance of centres and nations in achieving the previous RA BP standard for pre-HD diastolic blood pressure (<90 mmHg). Overall, 85% of patients achieved this standard. There was significant variation in achievement between centres (range 68–98%, $p < 0.0001$) and between nations (range 82–91%, $p < 0.0001$).

Figure 11.10 shows the median post-HD diastolic blood pressure by both centre and nation. The median post-HD DBP for all patients was 67.5 mmHg. The

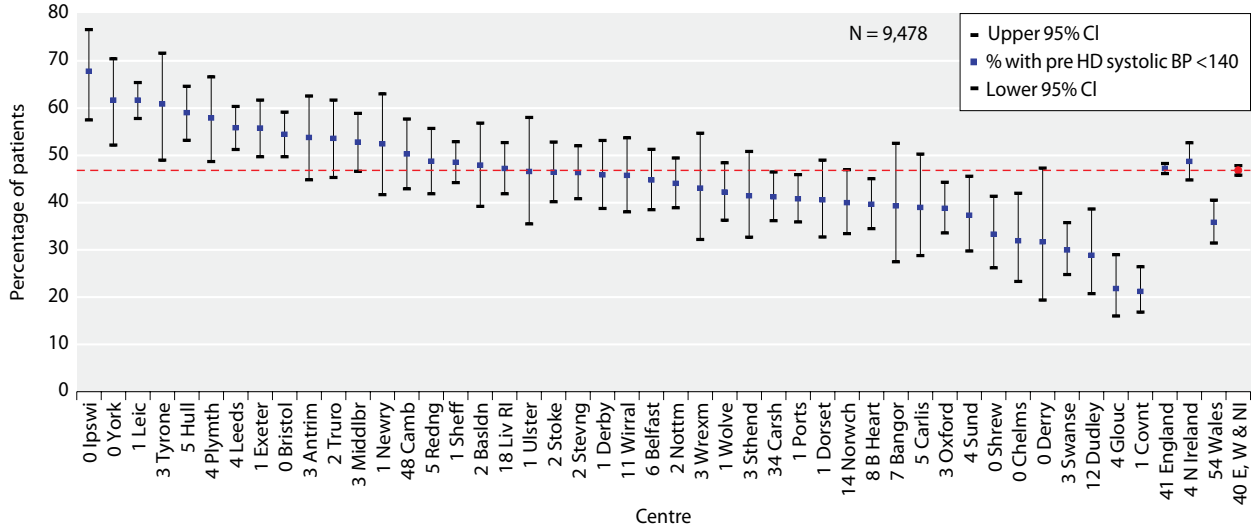

Fig. 11.5. Percentage of patients with systolic BP <140 mmHg: pre-HD

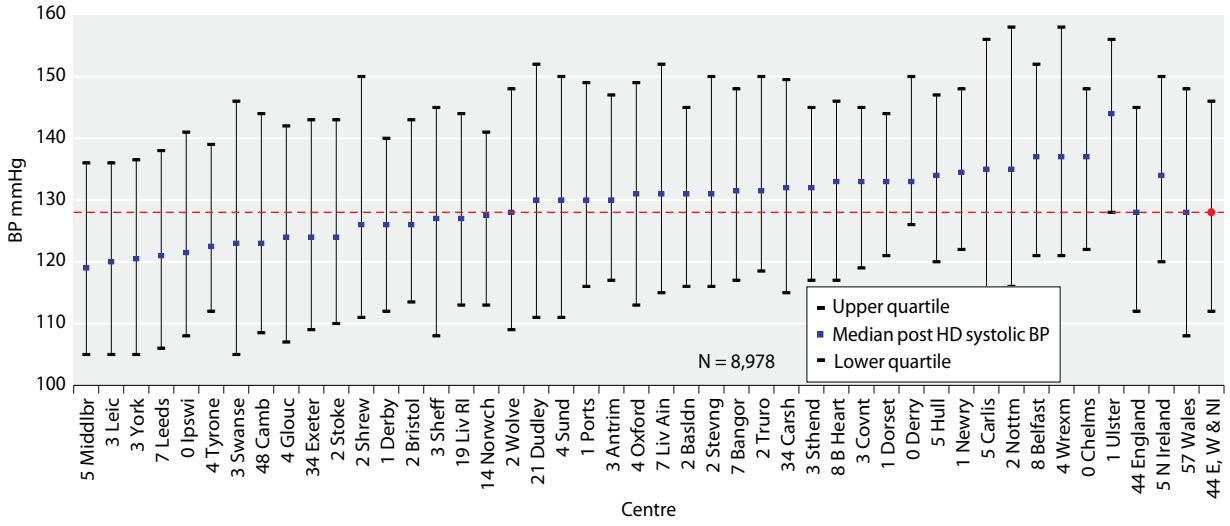

Fig. 11.6. Median systolic BP: post-HD

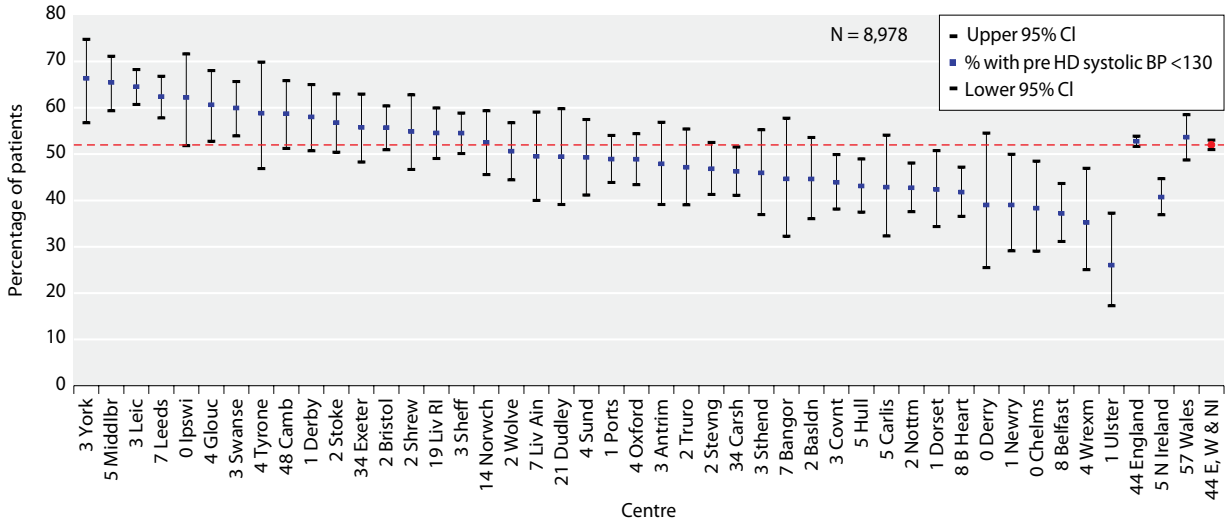

Fig. 11.7. Percentage of patients with systolic BP <130 mmHg: post-HD

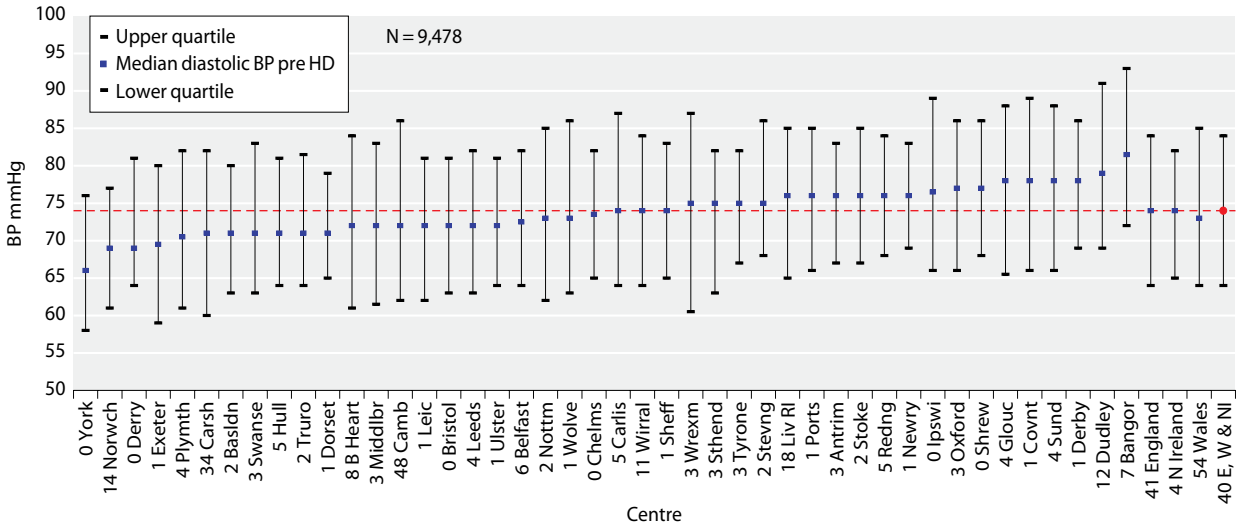

Fig. 11.8. Median diastolic BP: pre-HD

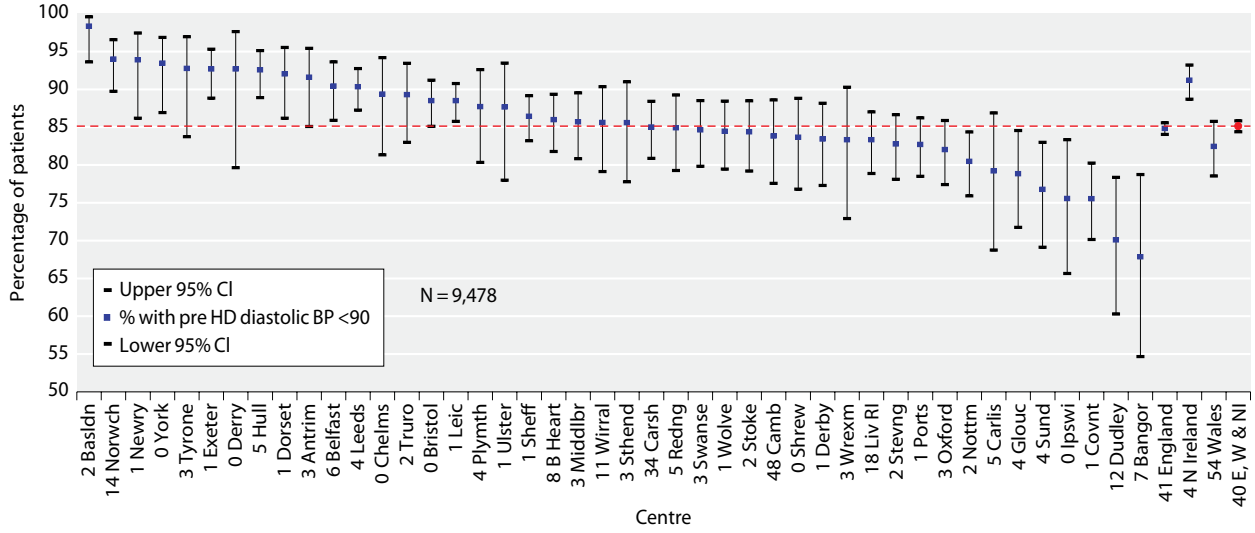

Fig. 11.9. Percentage of patients with diastolic BP <90 mmHg: pre-HD

median post-HD DBP ranged from 61–73.5 mmHg between centres and from 66–71 mmHg between nations.

Figure 11.11 illustrates the performance of centres and nations in achieving the previous RA BP standard for post-HD diastolic blood pressure (<80 mmHg). Overall, 79% of patients achieved this standard. There was significant variation in achievement between centres (range 66–90%, $p < 0.0001$) but not between nations (range 78–81%, $p = 0.55$).

Figure 11.12 shows the median pre-HD pulse pressure by both centre and nation. The median pre-HD PP for all patients was 66 mmHg. The median pre-HD PP ranged from 51–80 mmHg between centres and from 66–71 mmHg between nations.

Figure 11.13 shows the median post-HD pulse pressure by both centre and nation. The median post-HD PP for all patients was 60 mmHg. The median post-HD PP ranged from 49–72 mmHg between centres and from 59–62 mmHg between nations.

Peritoneal dialysis

A total of 1,461 blood pressure readings from 3,699 PD patients were analysed. Thirty eight centres with poor data returns were not included in the centre-specific analyses of PD patients.

Figure 11.14 illustrates the performance of centres and nations in achieving the RA standard for blood pressure control in patients on peritoneal dialysis (<130/

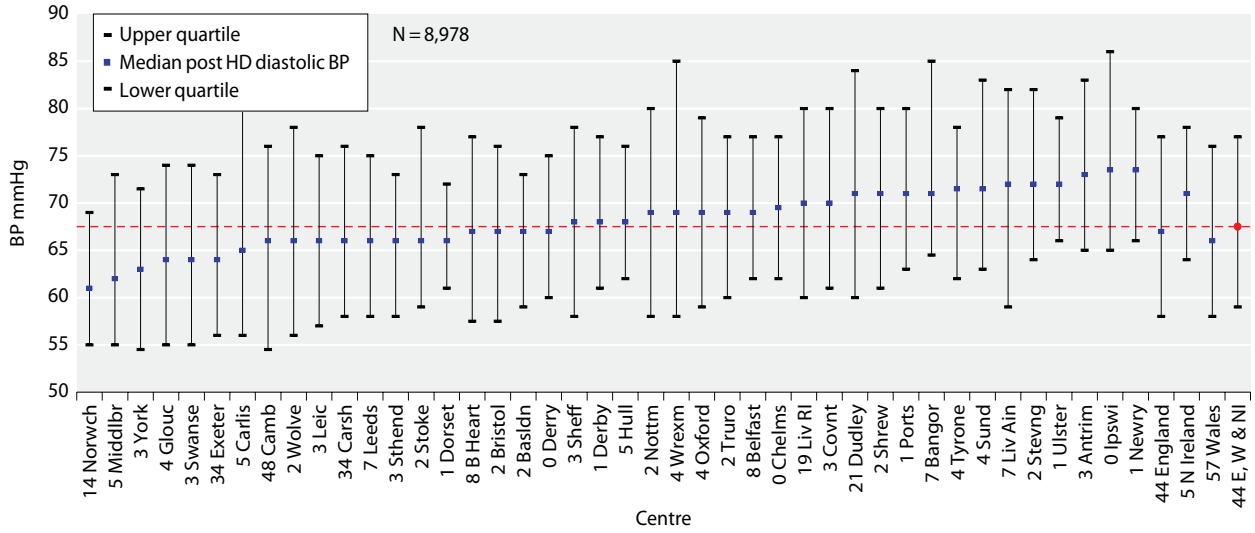

Fig. 11.10. Median diastolic BP: post-HD

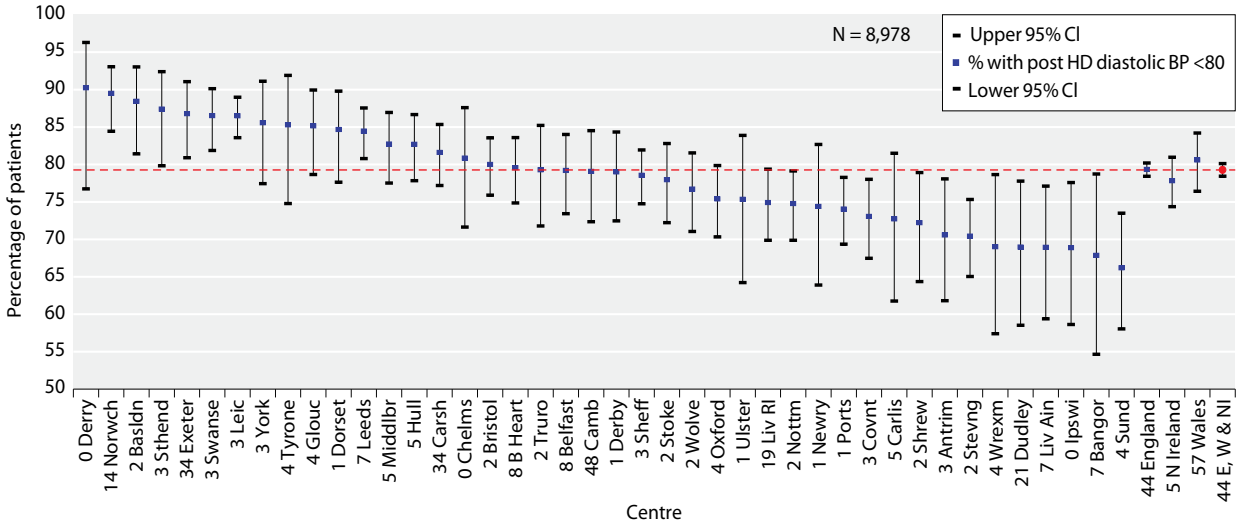

Fig. 11.11. Percentage of patients with diastolic BP <80 mmHg: post-HD

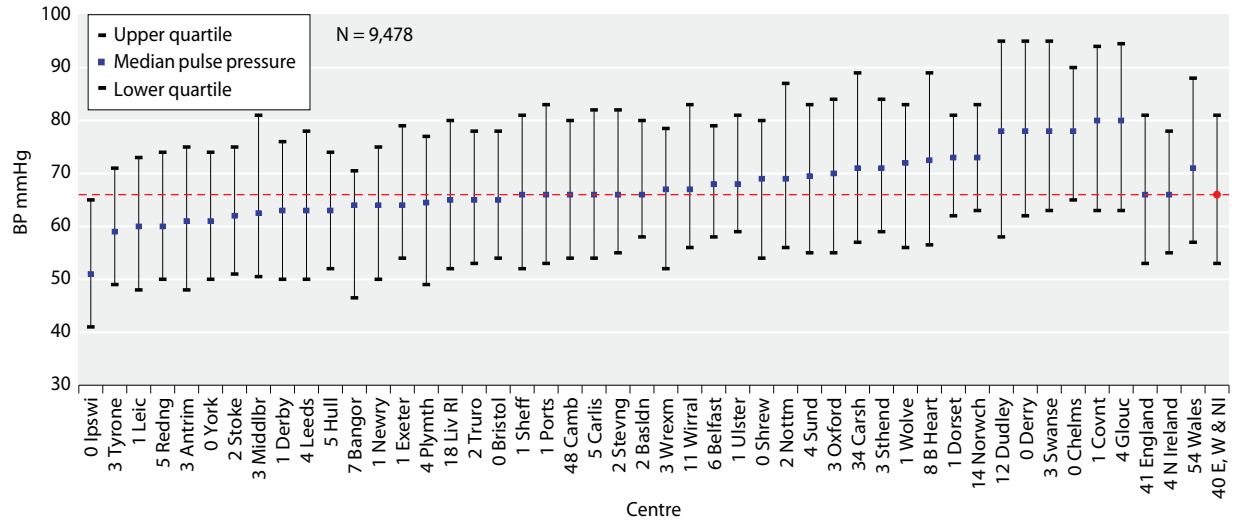

Fig. 11.12. Median PP: pre-HD

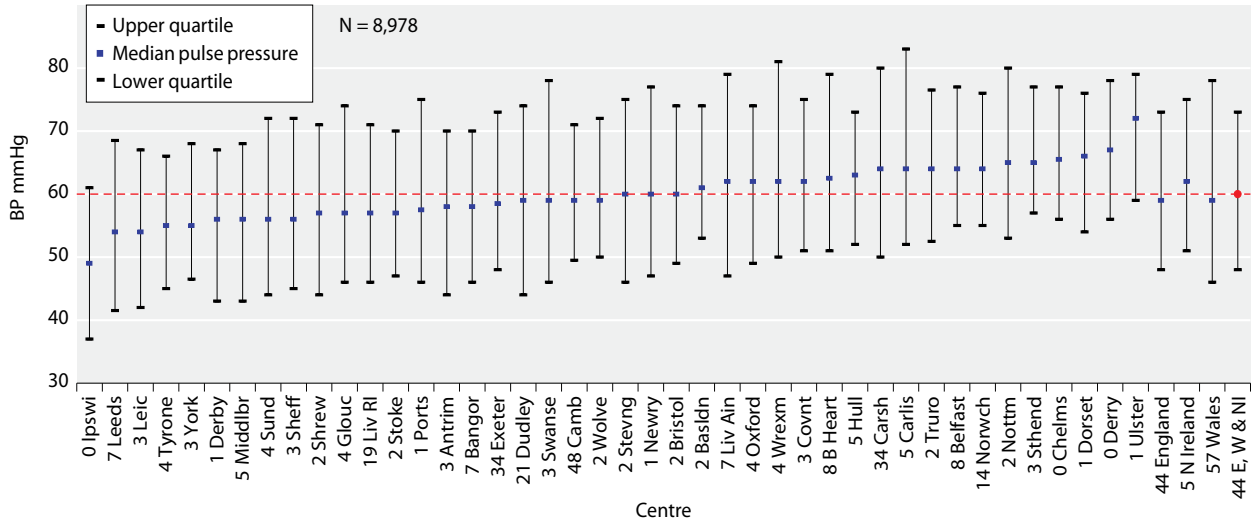

Fig. 11.13. Median PP: post-HD

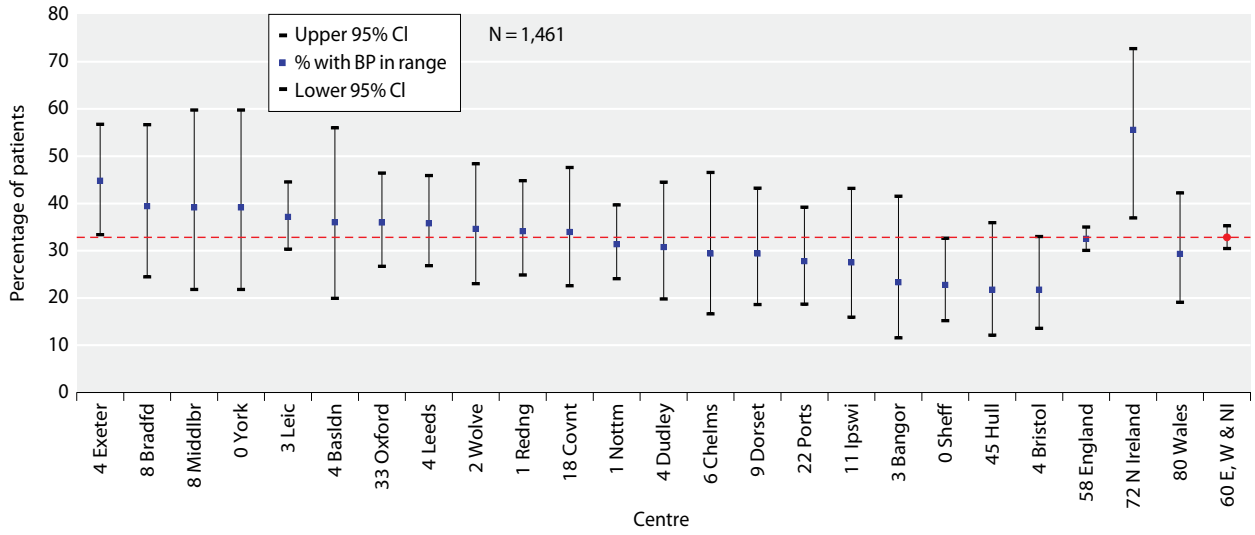

Fig. 11.14. Percentage of patients with BP <130/80: PD

80 mmHg). Overall, 33% of PD patients achieved this standard. There was no difference between renal centres achieving this standard (range 22–45%, p = 0.33).

Figure 11.15 shows the median systolic blood pressure in PD patients by both centre and nation. The median SBP for all PD patients was 132 mmHg and ranged from 122–146 mmHg between centres.

Figure 11.16 illustrates the performance of centres and nations in achieving the RA standard for systolic blood pressure control in patients on peritoneal dialysis (<130 mmHg). Overall, 42% of PD patients achieved this standard. The difference between centres in achieving this standard was of borderline significance (range 27–60%, p = 0.018).

Figure 11.17 shows the median diastolic blood pressure in PD patients by both centre and nation. The median DBP for all PD patients was 78 mmHg and ranged from 72–82 mmHg between centres.

Figure 11.18 illustrates the performance of centres and nations in achieving the RA standard for diastolic blood pressure control in patients on peritoneal dialysis (<80 mmHg). Overall, 53% of PD patients achieved this standard and there was no difference between individual centres (range 40–65%, p = 0.07).

Figure 11.19 shows the median pulse pressure in PD patients by both centre and nation. The median PP for all PD patients was 55 mmHg and ranged from 45–63 mmHg between individual centres.

Transplant

A total of 5,630 blood pressure readings from 18,097 transplant recipients were analysed. Thirty eight centres

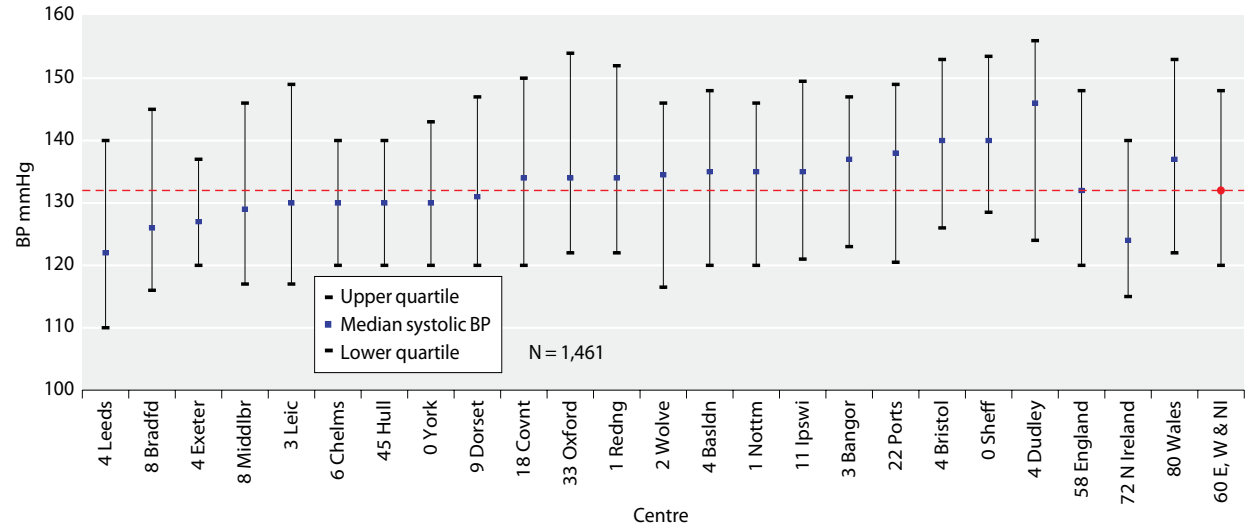

Fig. 11.15. Median systolic BP: PD

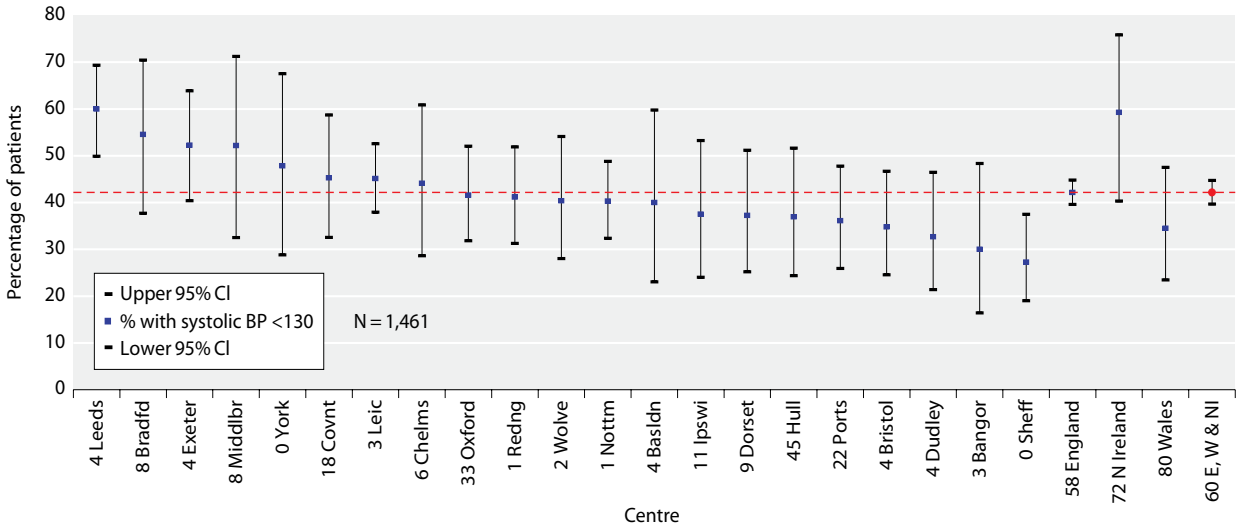

Fig. 11.16. Percentage of patients with systolic BP <130 mmHg: PD

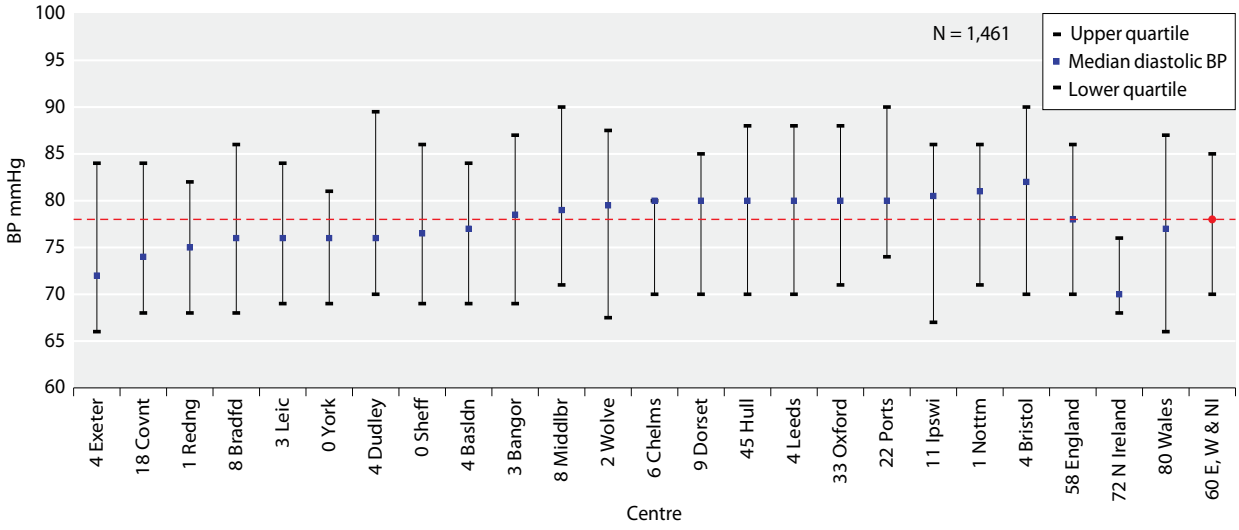

Fig. 11.17. Median diastolic BP: PD

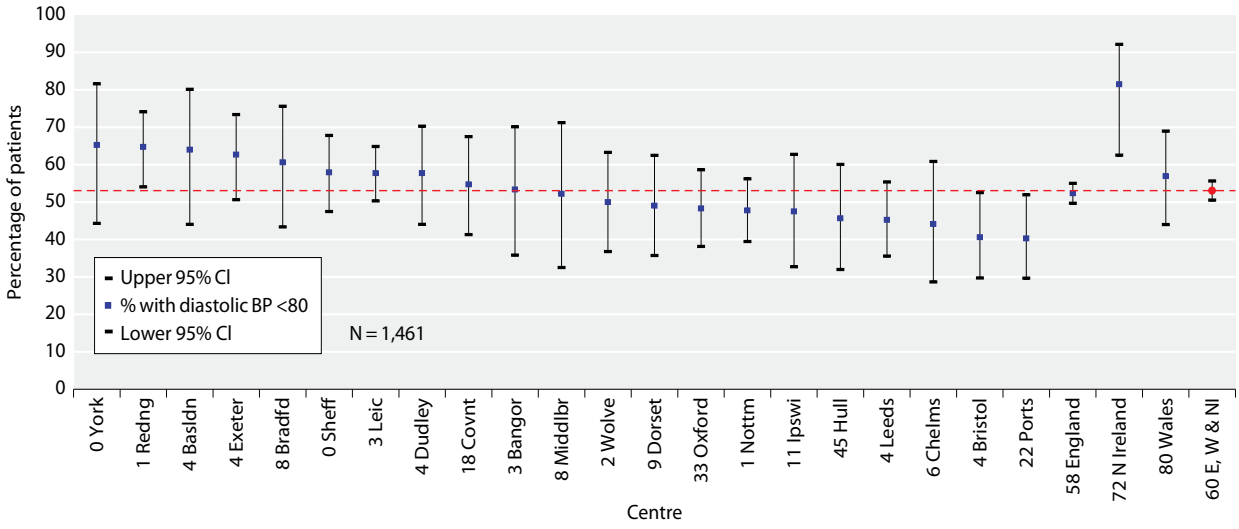

Fig. 11.18. Percentage of patients with diastolic BP <80 mmHg: PD

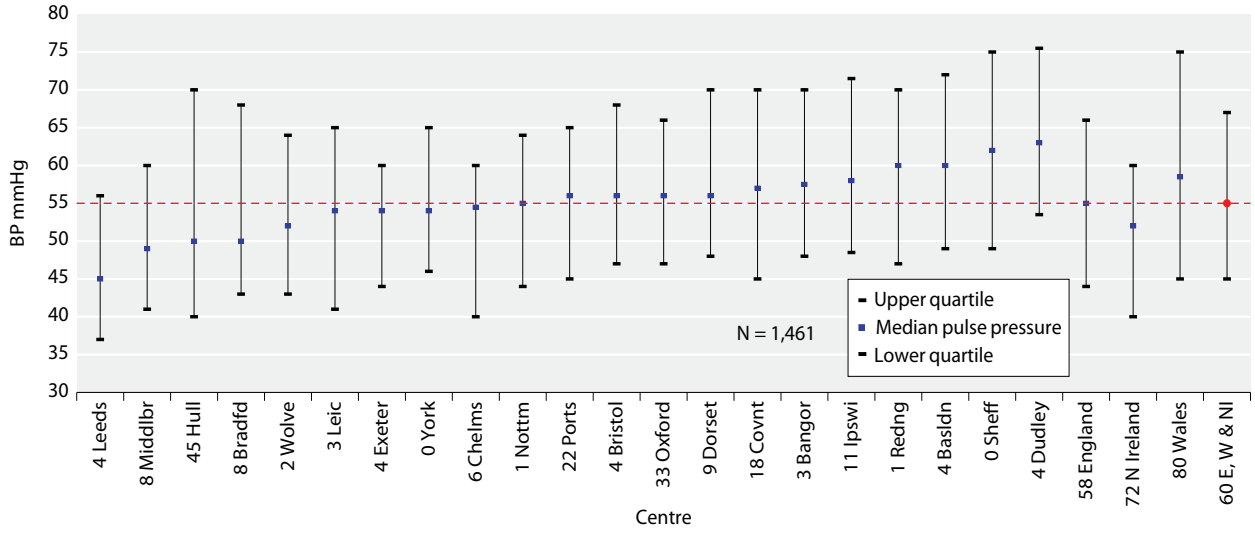

Fig. 11.19. Median PP: PD

with poor data returns have not been included in the centre-specific analyses of renal transplant recipients.

Figure 11.20 illustrates the performance of centres and nations in achieving the RA standard for blood pressure control in kidney transplant recipients (<130/80 mmHg). Overall, 27% of transplant patients achieved this standard but there was significant variation in achievement between centres (range 5–43%, $p < 0.0001$).

Figure 11.21 shows the median systolic blood pressure in transplant recipients by both centre and nation. The median SBP for all transplant patients was 135 mmHg and ranged from 124–142.5 mmHg between centres.

Figure 11.22 illustrates the performance of centres and nations in achieving the RA standard for systolic blood pressure control in kidney transplant recipients (<130 mmHg). Overall, 36% of transplant patients achieved this standard but there was significant variation in achievement between centres (range 21–59%, $p < 0.0001$).

Figure 11.23 shows the median diastolic blood pressure in transplant recipients by both centre and nation. The median DBP for all transplant patients was 79 mmHg and ranged from 70–84 mmHg between centres.

Figure 11.24 illustrates the performance of centres and nations in achieving the RA standard for diastolic blood pressure control in kidney transplant recipients (<80 mmHg). Overall, 51% of transplant patients

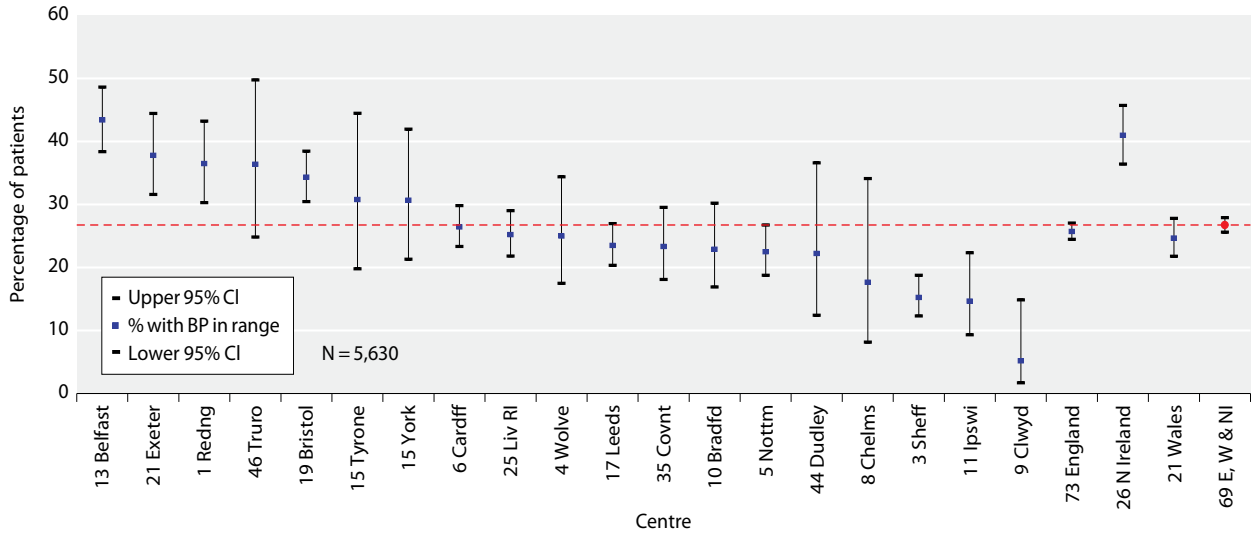

Fig. 11.20. Percentage of patients with BP <130/80: transplant

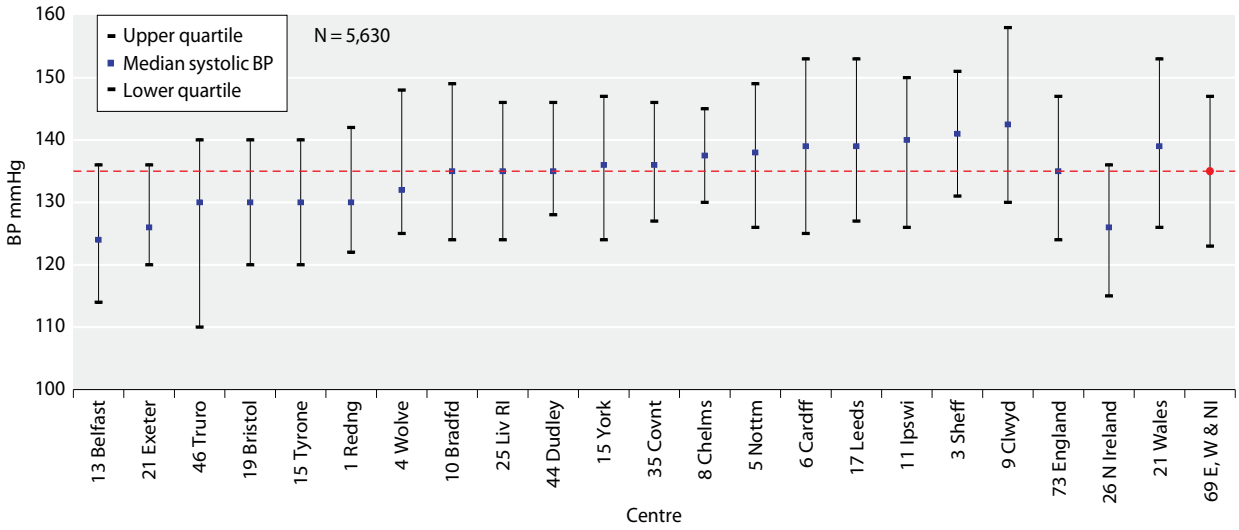

Fig. 11.21. Median systolic BP: transplant

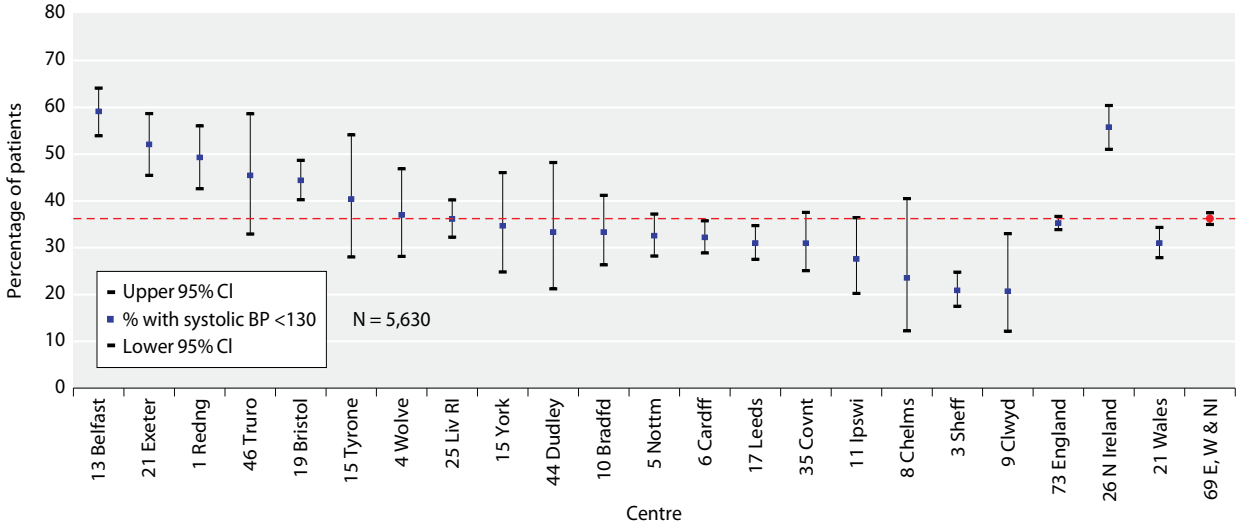

Fig. 11.22. Percentage of patients with systolic BP <130 mmHg: transplant

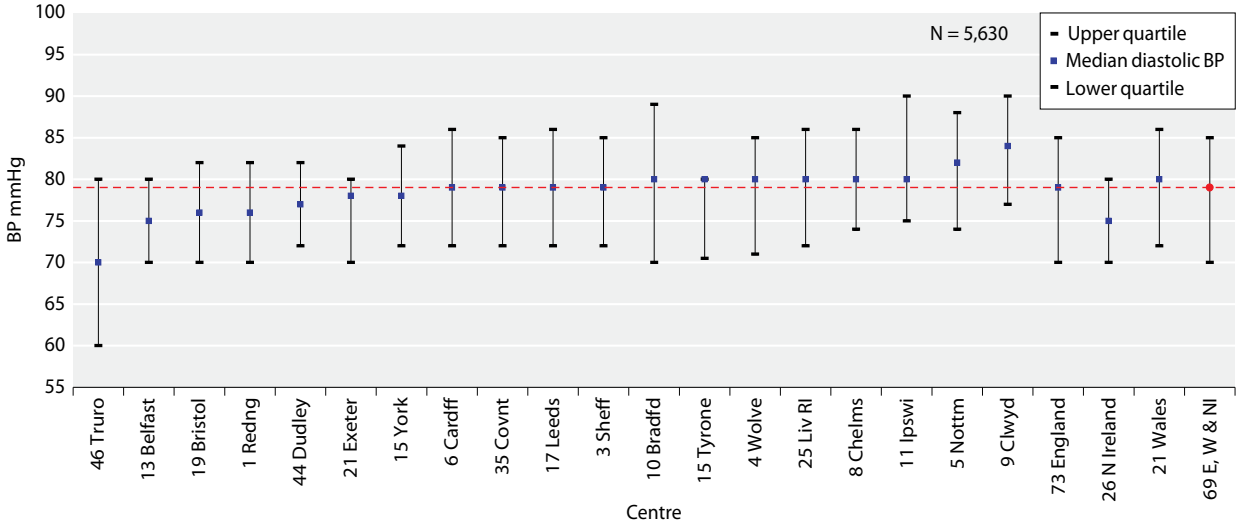

Fig. 11.23. Median diastolic BP: transplant

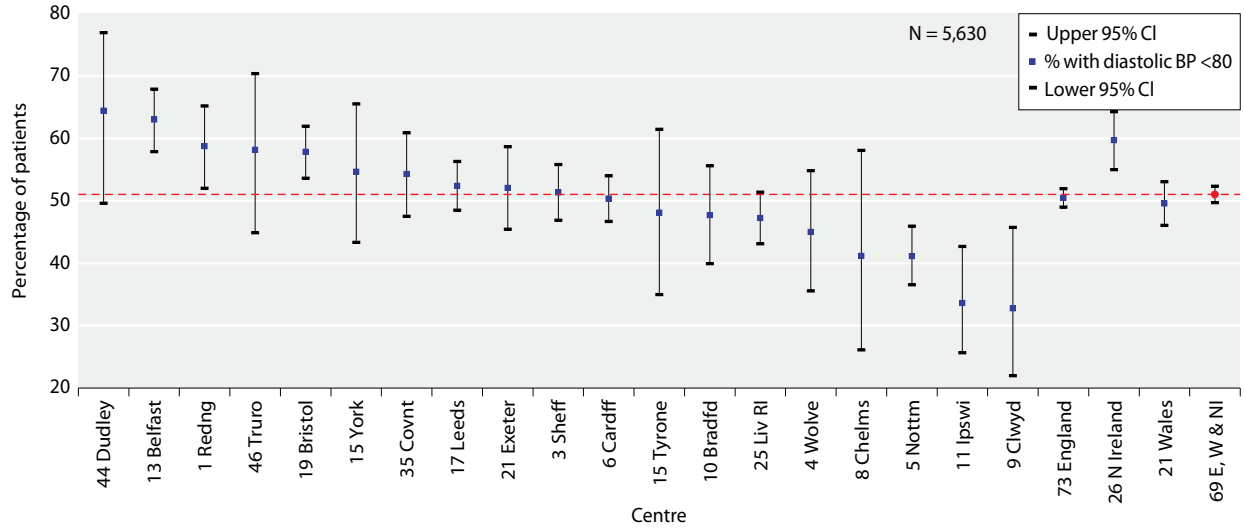

Fig. 11.24. Percentage of patients with diastolic BP <80 mmHg: transplant

achieved this standard but there was significant variation in achievement between centres (range 33–64%, $p < 0.0001$).

Figure 11.25 shows the median pulse pressure in transplant recipients by both centre and nation. The median PP for all transplant patients was 56 mmHg and ranged from 50–61 mmHg between centres.

Blood pressure by primary renal diagnosis

The prevalence of hypertension was assessed for each renal diagnostic category. A renal diagnosis was not available for 5.1% of cases and an uncertain diagnosis recorded for 22.3%. The main diagnostic groups included diabetes (12.9%), glomerulonephritis (15.2%), polycystic kidney disease (9.2%), pyelonephritis (11.9%), renovascular disease (8.8%) and other conditions (14.6%). BP readings within the last two quarters of 2007 were available for between 40 and 47% of patients in each diagnostic category but for only 19.5% of cases with no recorded renal diagnosis.

Figure 11.26 describes the attainment of BP <130/80 mmHg by diagnostic category and RRT modality (post-HD data shown). Significantly more HD patients (than PD or transplant) achieved the BP standard across all diagnostic groups (Chi Squared test, $p < 0.0001$). More PD than transplant patients achieved the BP standard in each diagnostic category except glomerulonephritis ($p < 0.0001$). There was significant

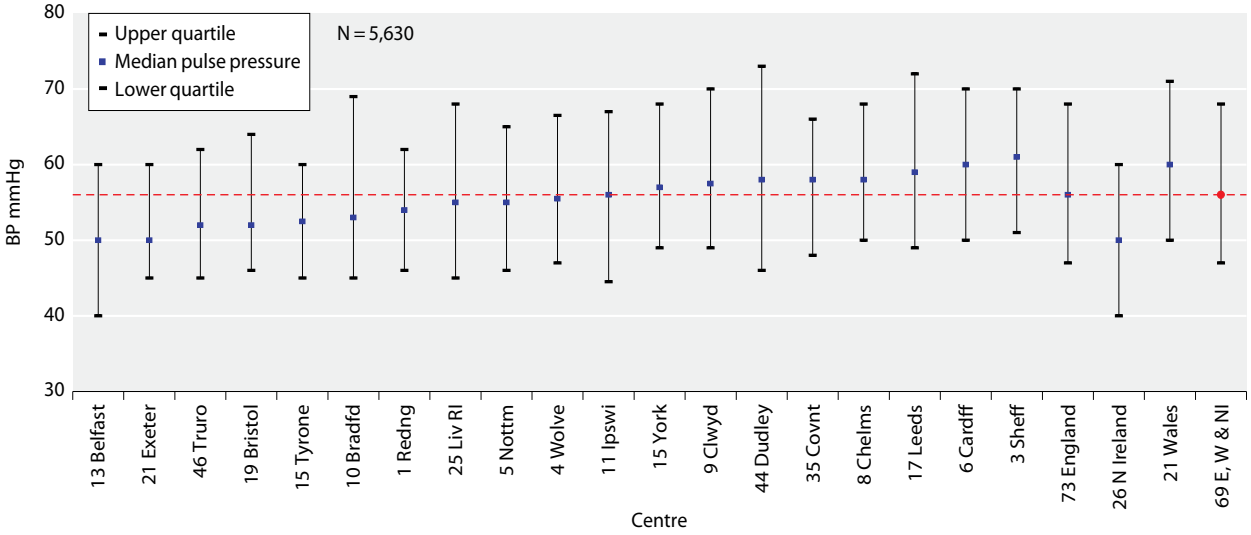

Fig. 11.25. Median PP: transplant

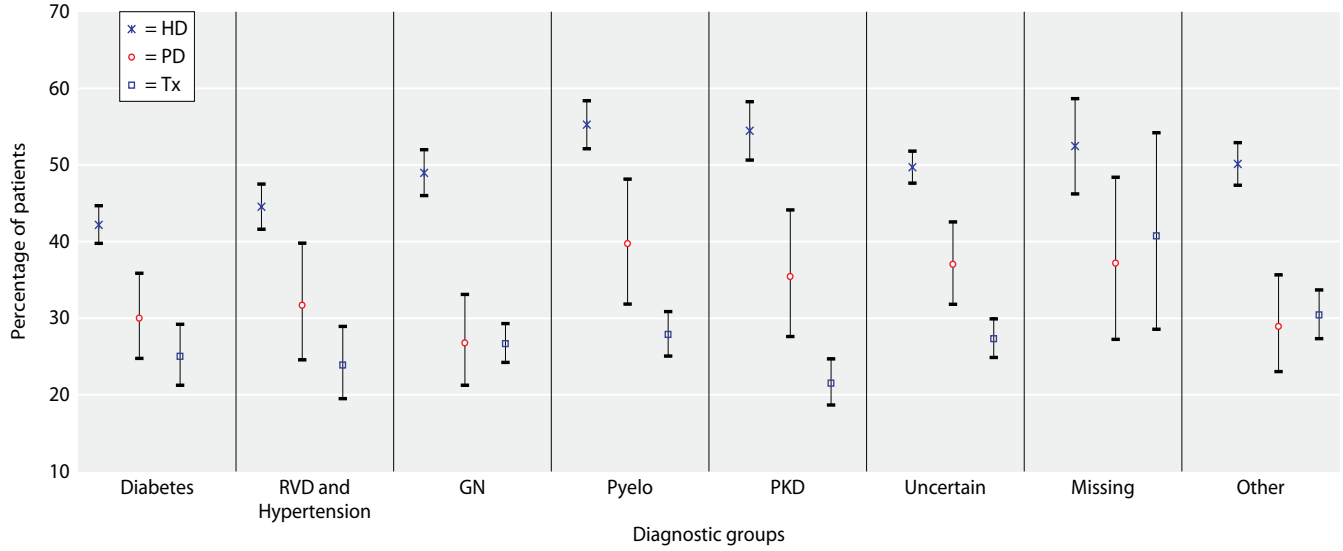

Fig. 11.26. Percentage of patients with BP <130/80 mmHg by primary diagnosis

variation between the individual PRD groups ($p < 0.002$) for HD and transplant patients, although no difference between PRD groups for patients on PD ($p = 0.08$). These patterns are shown in figures 11.26 to 11.31. SBP and PP are significantly higher in vascular disorders (diabetes and renovascular) than glomerulonephritis or tubular disorders.

Longitudinal changes in BP control

All BP recordings from the final quarter of years 2000 to 2007 collected by the UKRR were analysed by RRT modality. The annual median pre-HD, post-HD, PD and transplant readings are shown. Any significance in trend was calculated using a linear regression analysis.

Haemodialysis

47,174 pre-HD BP readings over an eight-year period were analysed. The median SBP fell from 151 mmHg in 2000 (IQR 133–169) to 142 mmHg in 2007 (IQR 125–159). The median DBP fell in the same period from 80 mmHg (IQR 70–90) to 73 mmHg (IQR 64–84). Linear regression analysis showed a significant trend for both SBP and DBP ($p < 0.0001$) (figure 11.32).

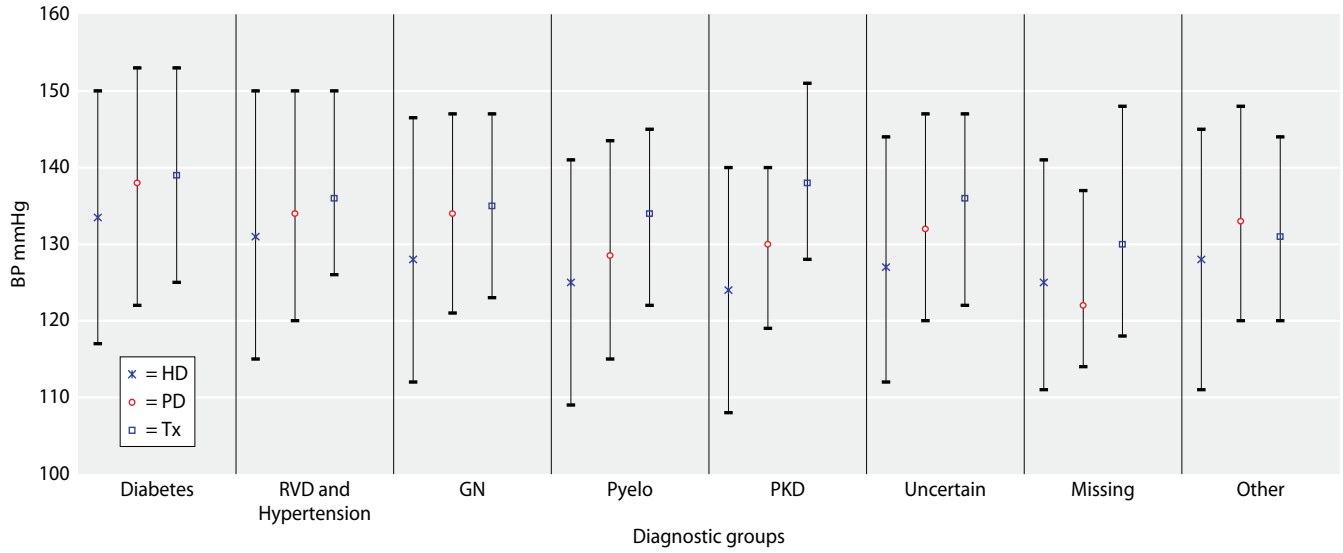

Fig. 11.27. Median systolic BP (IQR) by primary diagnosis

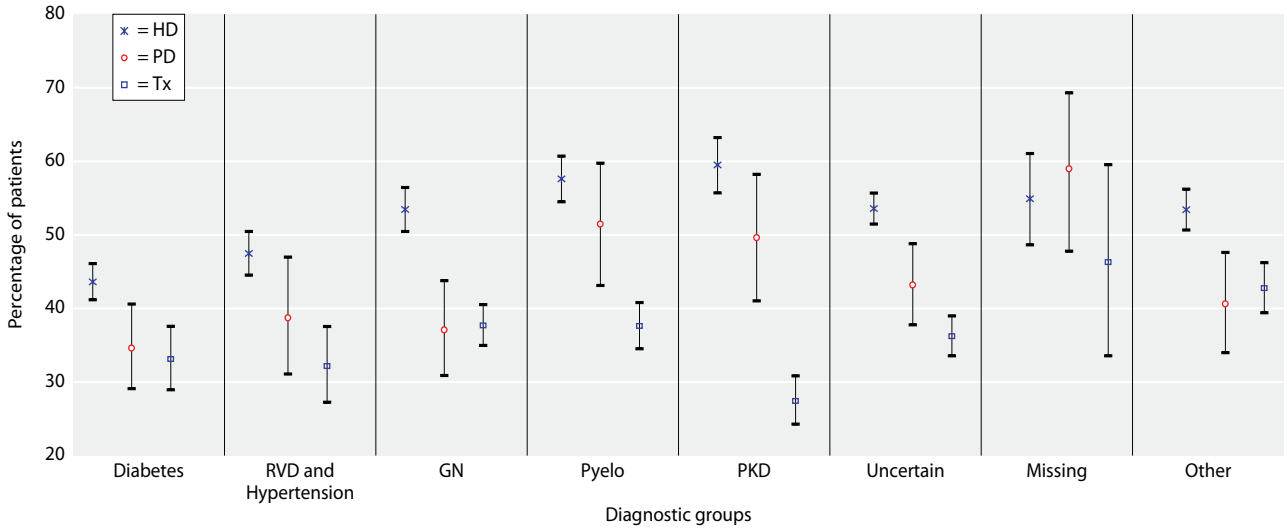

Fig. 11.28. Percentage of patients with systolic BP <130 mmHg by primary diagnosis

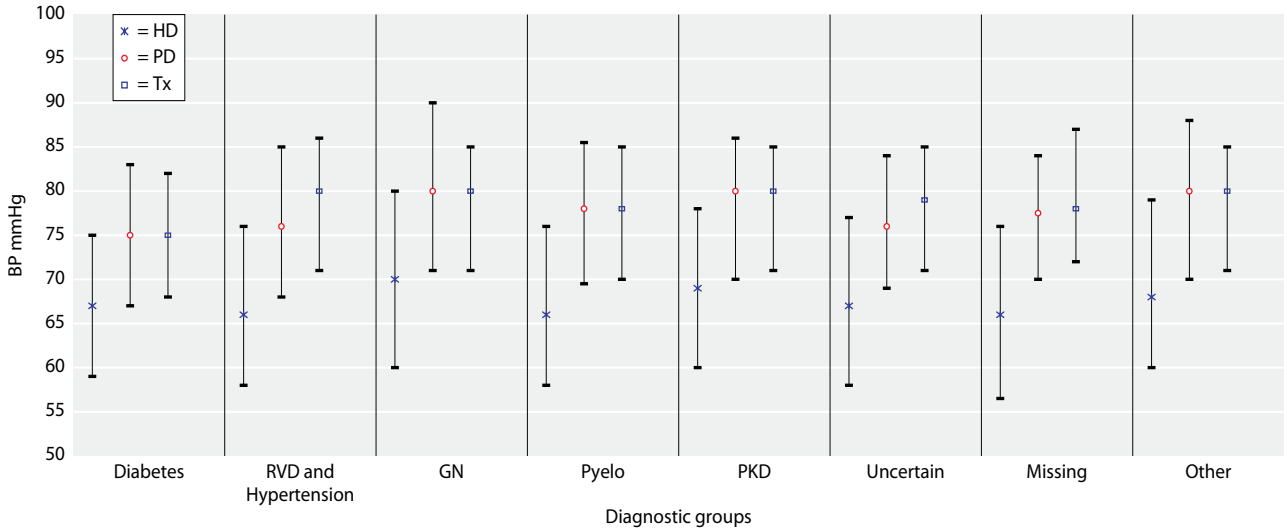

Fig. 11.29. Median diastolic BP (IQR) by primary diagnosis

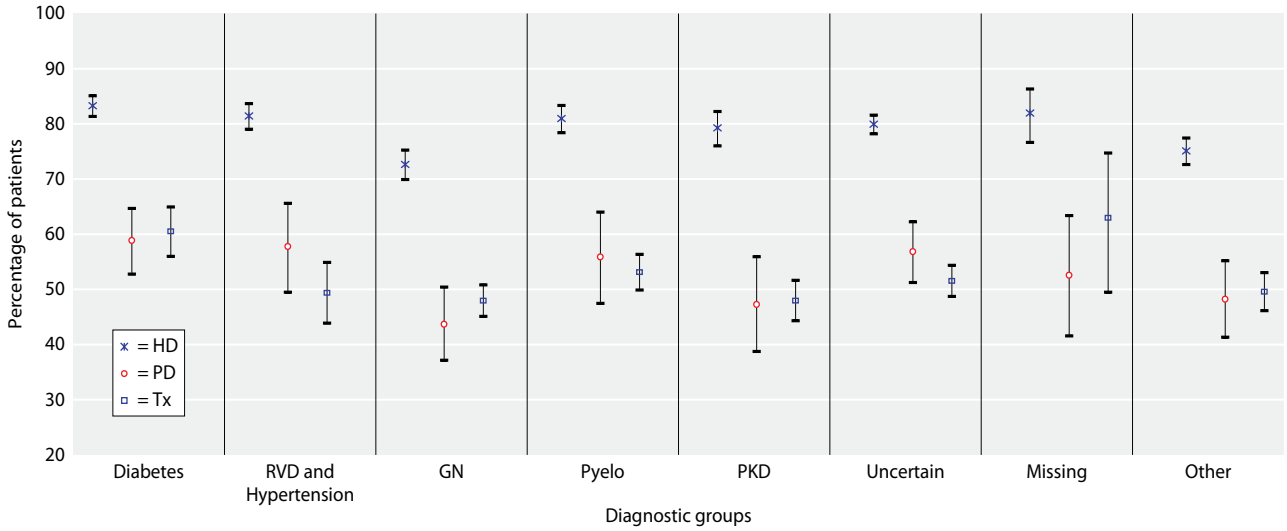

Fig. 11.30. Percentage of patients with diastolic BP <80 mmHg by primary diagnosis

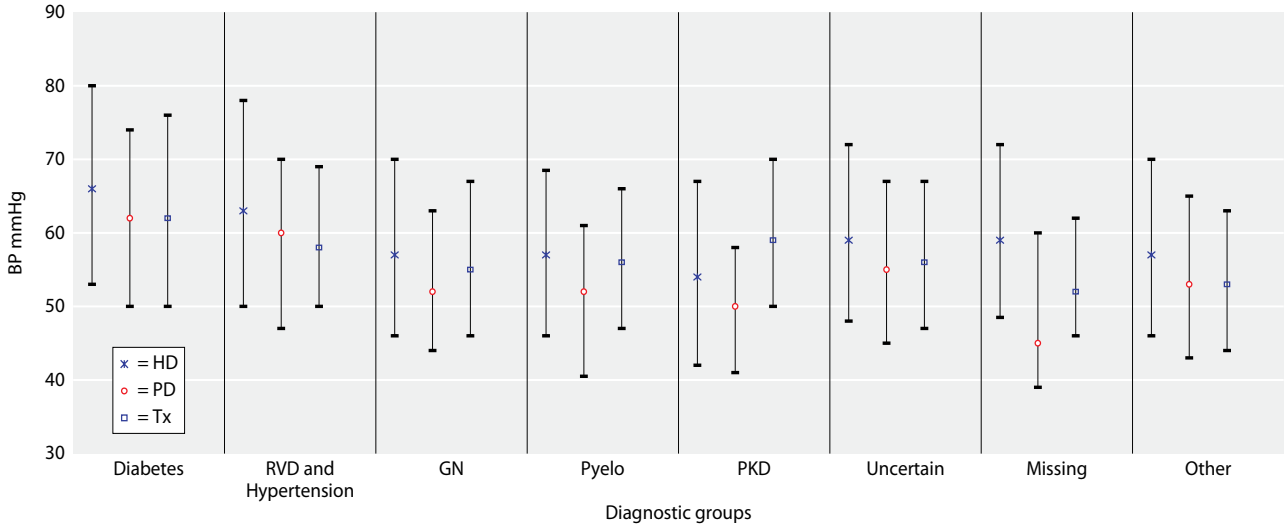

Fig. 11.31. Median PP by primary diagnosis

43,123 post-HD BP readings over an eight year period were analysed. The median SBP fell from 133 mmHg in 2000 (IQR 114–153) to 128 mmHg (IQR 112–146) in 2007. The median DBP fell in the same period from 73 mmHg (IQR 64–83) to 67 mmHg (IQR 59–77). Linear regression analysis showed a significant trend for both SBP and DBP ($p < 0.0001$) (figure 11.33).

Peritoneal dialysis

9,630 prevalent PD patients' BP readings were analysed. The median SBP fell from 141.5 mmHg (IQR 124–160) in 2000 to 132 mmHg (IQR 120–148) in 2007. The median DBP fell in the same period from 80 mmHg (IQR 71–88) to 78 mmHg (IQR 70–86). Linear regression analysis showed a significant trend for both SBP and DBP ($p < 0.0001$) (figure 11.34).

Transplant

26,632 BP readings from transplant patients were analysed. The median SBP fell from 140 mmHg (IQR 128–156) in 2000 to 136 mmHg (IQR 123–148) in 2007. The median DBP fell in the same period from 81 mmHg (IQR 75–88) to 79 mmHg (IQR 70–85). Linear regression analysis showed a significant trend for both SBP and DBP ($p < 0.0001$) (figure 11.35).

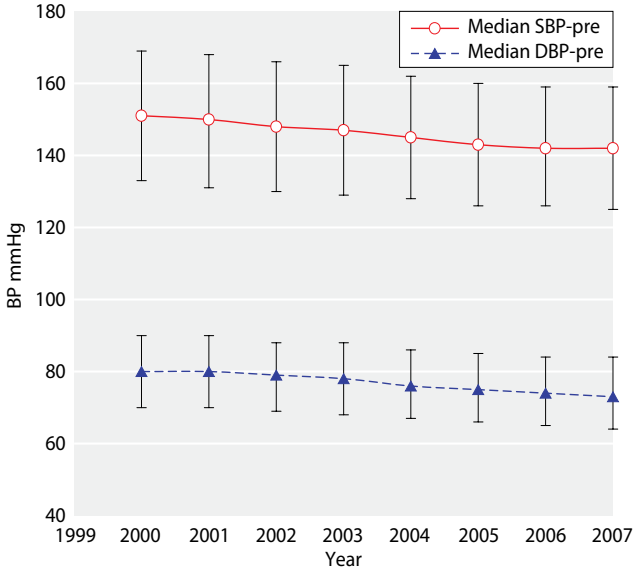

Fig. 11.32. Annual change in median blood pressure 2000–2007: pre-HD

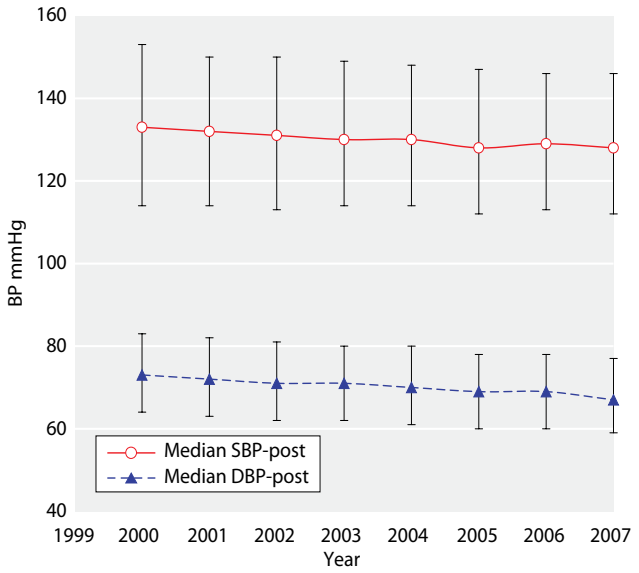

Fig. 11.33. Annual change in median blood pressure 2000–2007: post-HD

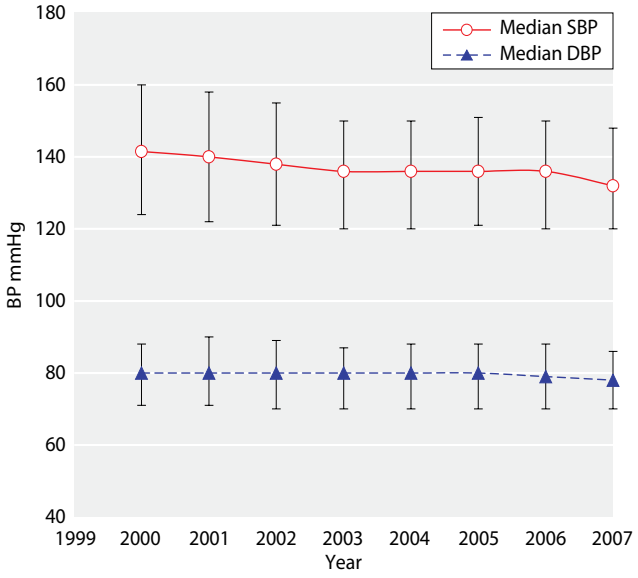

Fig. 11.34. Annual change in median blood pressure 2000–2007: PD

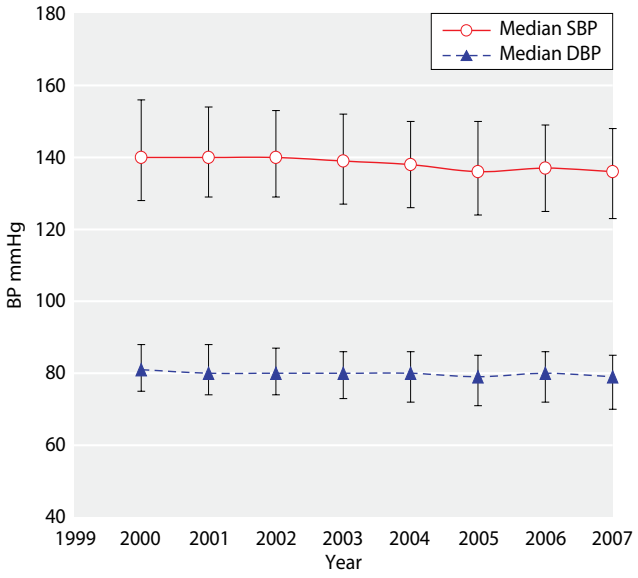

Fig. 11.35. Annual change in median blood pressure 2000–2007: transplant

Discussion

The current study demonstrates that only a minority of patients on RRT in England, Wales and Northern Ireland achieved the RA BP standard in 2007. Significantly more HD patients achieved the standard (on average 44.6% pre-HD and 48.8% post-HD) than PD (32.8%) or transplant patients (26.7%). Although few achieved the recommended BP target, median BP has fallen significantly between 2000 and 2007 for each modality. The incremental changes have been similar each year without additional change following the introduction of new BP standards in 2002. Despite overall improvements there remained significant variability in BP control between different renal centres. This applied only to HD and transplant patients and variations in clinical practice may account for this difference. Blood pressure control was also influenced by the underlying renal disease. In HD patients, hypertension was significantly more common in vascular disorders such as diabetes and renovascular disease than it was in glomerulonephritis and was least common in tubular disorders such as polycystic kidney disease and pyelonephritis. A similar pattern was evident but less pronounced in PD patients whereas the influence of PRD was absent in transplant patients in whom few achieved the BP standard.

Several limitations of this study should be noted. Blood pressure measurements were obtained by various healthcare workers as part of routine patient care rather than using a standardised protocol across renal centres. Manual data entry into IT systems may introduce transcription errors. Missing data may introduce bias although this appeared to occur randomly as significant variability in BP control between centres persisted whether centres with poor returns for PD and transplanted patients were included or excluded from the analysis. Extraction of data that has been entered into local IT systems can also cause problems. An example is highlighted with Liverpool Aintree, as 93% of post-HD BP data and only 3% of pre-HD data were available. Similar problems affected Wolverhampton and Portsmouth while no BP data was available at all for Liverpool Royal Infirmary for several years. Data returns from these centres now exceed 80% following discussions and organizational changes in the centres and UKRR data extraction systems. Adjustments for comorbidity or use of antihypertensive medication could not be performed in this study. Finally, although BP readings were available for less than 50% of patients in each renal diagnostic category, the prevalence of hypertension across diagnostic groups was similar to that previously reported [17].

Blood pressure control is a performance measure that is assessed annually for all UK renal centres. These data show that the BP standard is hard to achieve in the majority of patients using current UK practices. This is not a unique problem for the UK and in line with other epidemiological studies and randomised controlled trials. In Finland 28% of dialysis patients and 23% of renal transplant patients achieve a BP <130/85 mmHg [18] while only 30% of patients achieved this BP at the

start of the HEMO study [19]. The Finnish Registry reports significant variation in BP control across healthcare districts for transplant but not dialysis patients. Some 88% of transplant patients are prescribed antihypertensive medication with no difference in drug use between healthcare districts ($p = 0.366$). By contrast 68% of dialysis patients are prescribed antihypertensive medication with significant variation in drug use ($p < 0.001$). The data do not explain the variation in BP control but do suggest it is not related to drug use.

Revised KDOQI guidelines and the 4th edition of the RA guidelines have dropped specific BP targets for HD patients [20, 21]. In the UK the BP target for PD and transplant patients remains <130/80 mmHg. For HD patients there is evidence that fluid overload increases mortality so both sets of guidelines emphasise control of volume status to optimise BP and survival. The propensity for fluid overload may explain why primary renal disease determines hypertension and survival on dialysis. Restriction of sodium and water intake, use of diuretics and optimising ultrafiltration and sodium removal is emphasised in KDOQI guidelines for HD and PD patients. The RA guidelines indicate similar goals but are less specific about how these might be achieved. If variations in BP control become more marked across UK centres in future the UKRR may need to start auditing dialysis practices. Sodium balance does not feature in BP standards for transplant patients as there is little evidence to support it other than one small study that suggests that dietary sodium restriction may have a dramatic effect [22]. The UKRR has data extending to 10 years of follow up for dialysis and transplant patients. It has moved from solely reporting observational data to statistical modelling in order to map changes that lead to improved survival outcomes. All UK renal centres are encouraged to improve their data returns to facilitate this process.

Conflict of interest: none

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Chapter 12
Epidemiology of Methicillin Resistant Staphylococcus aureus bacteraemia amongst patients receiving Renal Replacement Therapy in England in 2007

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Key Words
Bacteraemia · Dialysis · Vascular access

Abstract
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. Data were recorded on modality of treatment and the type of vascular access in use at diagnosis and in the previous 28 days. From April 2007 until March 2008, 188 discrete episodes of MRSA bacteraemia were reported in patients receiving dialysis for established renal failure. Over the same period 4,448 MRSA bacteraemias were reported in England, indicating that 4.2% of all cases occurred in dialysis patients. Of the 188 episodes, additional data from the renal centres were available in 92 cases (49%). All patients with completed records were on haemodialysis at the time of the bacteraemia. Of those, 65/92 (70.7%) were using venous catheters, the majority tunnelled lines (n = 55, 59.8%), and 2 other cases had used venous catheters in the previous 28 days. The relative risk of MRSA bacteraemia was about 100 fold higher for a dialysis patient in comparison to the general population and 8 fold higher for a patient using a catheter in comparison to a fistula. The mean rate for all patients was 0.92 ± 0.85 episodes/100 prevalent dialysis patients/year but the rate varied between renal centres with a range of 0–3.28. Using just haemodialysis patients as the denominator, the mean was 1.14 ± 0.95 episodes/100 patients/year with a range of 0–3.93. Compared to previous Registry reports, absolute numbers of reported MRSA bacteraemias has fallen by approximately 62% from 2004. Many centres have substantially reduced the numbers of cases. Dialysis patients are at increased risk of MRSA bacteraemia; this is closely associated with the use of venous catheters. The rate of MRSA bacteraemia is falling substantially within the prevalent dialysis

population, but with variation in performance between centres.

Introduction

Previous analyses have shown that around 8% of all episodes of MRSA bacteraemia in the UK occurred in patients with established renal failure (ERF) receiving Renal Replacement Therapy (RRT) [1]. The clinical consequences of bacteraemia in patients receiving RRT are well documented [2–7]. There is evidence that the use of catheters for access to the circulation for haemodialysis is associated with increased risk of bacteraemia [8–10] and that an increased risk of bacteraemia may be a major contributor to the higher mortality associated with late presentation with ERF [11].

Previous reports from the UK Renal Registry (UKRR), generated using paper-based survey methods, showed marked variation in provision of vascular access for haemodialysis across the UK, and electronic recording of vascular access provision has now been developed in the UK to support continuing national audit. Dialysis-specific surveillance of bacteraemia has been shown to be feasible within a large UK renal centre [12].

MRSA bacteraemia is a major problem in UK healthcare, and centres providing dialysis contribute a disproportionately high number of cases [13]. Reporting of all MRSA bacteraemia by acute NHS Trusts to the Health Protection Agency has been mandatory in England since 2001, enabling national surveillance [14, 15]. This report describes the collection of an extended dataset from patients known to have established renal failure.

The term Established Renal Failure used throughout this chapter is synonymous with the terms of 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

All microbiology laboratories in England were required to identify, from the clinical details provided with the sample, all possible instances of MRSA bacteraemia arising in patients undergoing any form of dialysis. Three stages of data completion were required. First, a bacteraemia was identified as being associated with a patient in established renal failure. Second, the record was 'shared' by email alert with the parent renal centre. Third, the renal unit provided additional data on that case, via a web portal.

This process of identification started with completion of a record in the mandatory Healthcare Associated Infection Data Capture System (HCAI-DCS) (previously called Mandatory Enhanced Surveillance System, MESS), an established secure web-based system operated by the Health Protection Agency. The HCAI-DCS collected information on patient identifiers, date the specimen was taken, laboratory where the specimen was processed, the patient's location at the time the sample was taken and whether the patient was an inpatient or outpatient. The system was developed to capture data on whether the patient was on dialysis for acute or established renal failure. When a response indicating that the patient was in ERF was made the user would be prompted to 'share' the record with the renal service. 'Shared' records could be accessed by a designated contact in the renal service who would be informed of a new renal record on the system by an automated email alert. All microbiology laboratories, not just those serving main renal centres or hospitals housing satellite units, were informed about the importance of collection of the extended dataset.

The designated local contact in each renal centre was then required to complete additional fields on each patient with MRSA bacteraemia in ERF via the HCAI-DCS system. This system of data collection was successfully piloted in 8 renal centres prior to inception of the national survey on 1st April 2007. Items collected in these additional fields and the options for completion are summarised in table 12.1 and shown in figure 12.1.

The denominator data used to calculate the rates of MRSA bacteraemia were the numbers of prevalent adult patients receiving haemodialysis or peritoneal dialysis in each centre in the last quarter of 2007, as reported to the UKRR (chapter 4).

Results

The renal component of the HCAI-DCS went live for all centres in England on 1st April 2007. Data are presented from the first year of collection.

During the period April 2007 until March 2008, a total of 196 MRSA bacteraemias were flagged as being associated with individuals with established renal failure receiving dialysis. Eight of these reports were found to be repeat specimens taken within 48 hours from the same patient (but in different NHS Trusts) during the same episode of bacteraemia and were removed from the analysis, leaving a total of 188. This represented 4.2% of the 4,448 MRSA bacteraemia reported in England during this period. Of the 188 episodes, 29 (15%) were not shared with a responsible renal centre, 67 (36%) were shared but not completed

Table 12.1. Data captured in the HCAI-DCS

Data item	Options
Main renal centre responsible for ongoing care	List of all main renal centres
Dialysis centre where the patient receives haemodialysis	List of all dialysis centres affiliated to the main renal centre
Modality of dialysis	Unknown/haemodialysis/haemodiafiltration/peritoneal
Type of access being used	Not applicable/unknown/AVF-simple/AVF-complex/AVG/tunnelled venous catheter J or SC/tunnelled venous catheter – femoral or other/non-tunnelled venous catheter J or SC/non-tunnelled venous catheter – femoral or other
Catheter used in the preceding 28 days	Unknown/yes/no If yes, what type? (Unknown/tunnelled venous catheter J or SC/tunnelled venous catheter – femoral or other/non-tunnelled venous catheter J or SC/non-tunnelled venous catheter – femoral or other)

and 92 (49%) had the renal record completed. Table 12.2 summarises the quarterly data for all episodes, including the total number of MRSA bacteraemias reported across England.

During the same period there were 72 episodes reported in patients recorded as being in acute renal failure. These data were derived from the main HCAI-DCS reports and are not included in further analysis.

Two episodes of MRSA bacteraemia in children receiving dialysis were recorded, but no information was available from the renal centre in either case. These two cases are not included in the centre-specific analyses.

Access and modality

For the 92 completed reports, there were no episodes of MRSA bacteraemia recorded for patients on peritoneal

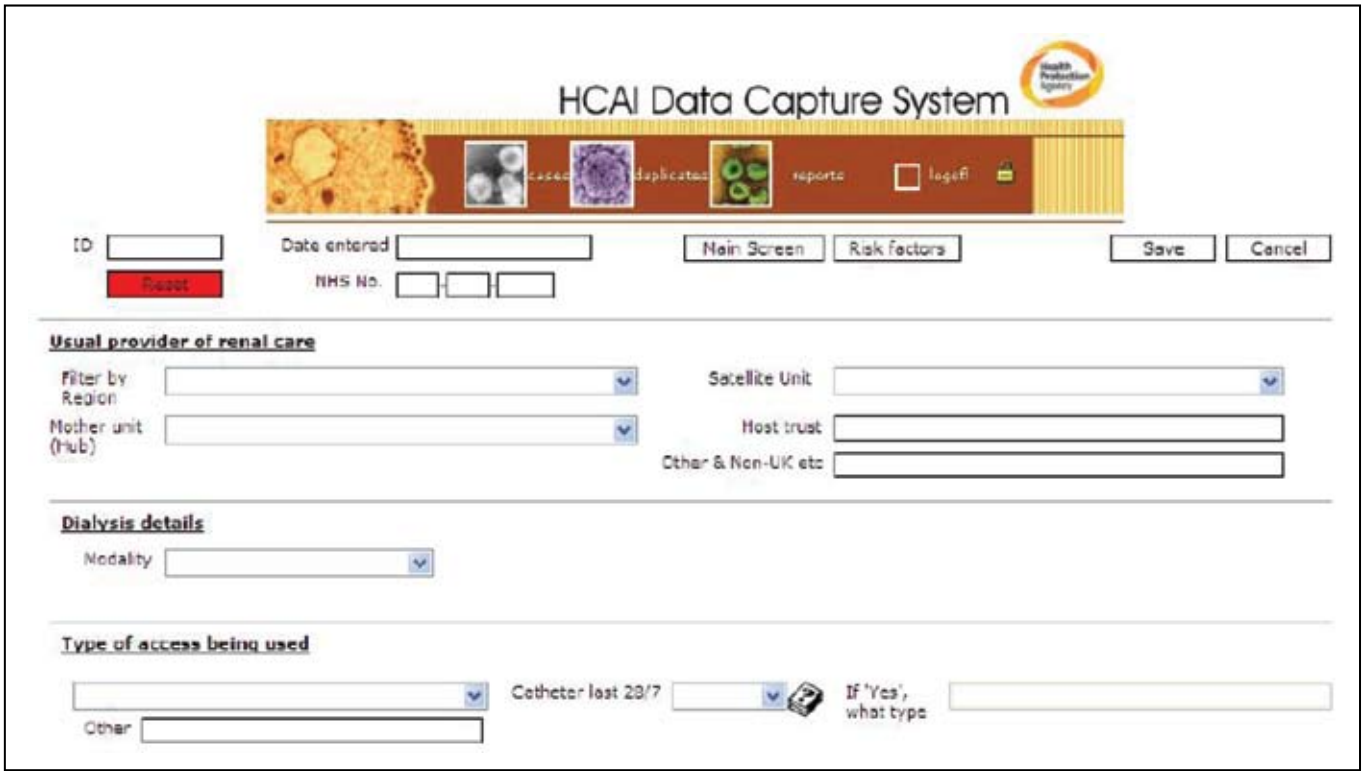

Fig. 12.1. The Renal HCAI-DCS reporting page

Table 12.2. Number of MRSA bacteraemia and the proportion of records shared with and completed by the renal centre in patients in established renal failure (ERF) reported to the MRSA Healthcare Associated Infection Data Capture System (HCAI-DCS)

	Patients with established renal failure		All MRSA reported to HCAI-DCS
Period	N	(%)	N
April 07–June 07 (26 Trusts)	**59**	**(4.5)**	**1,306**
Not shared	10	(17)	
Shared, not completed	17	(29)	
Shared and completed	32	(54)	
July 07–Sept 07 (29 Trusts)	**44**	**(4.1)**	**1,082**
Not shared	7	(16)	
Shared, not completed	14	(32)	
Shared and completed	23	(52)	
Oct 07–Dec 07 (30 Trusts)	**42**	**(3.8)**	**1,091**
Not shared	6	(14)	
Shared, not completed	14	(33)	
Shared and completed	21	(50)	
Jan 08–Mar 08 (25 Trusts)	**43**	**(4.4)**	**969**
Not shared	5	(12)	
Shared, not completed	22	(51)	
Shared and completed	16	(37)	
April 07–Mar 08	*__188__	**(4.2)**	**4,448**
Not shared	29	(15)	
Shared, not completed	67	(36)	
Shared and completed	92	(49)	

* This excludes 8 records where 2 specimens were taken from same patient with ERF within 48 hrs at different Trusts

dialysis. All patients were on haemodialysis or haemodiafiltration, with 2 subjects where the modality was recorded as unknown (table 12.3).

Table 12.4 details the recorded type of access in use at the time of the episode for the 92 completed renal records. Twenty seven patients (29.3%) were using either a fistula (n = 23) or graft (n = 4). The remainder (n = 65, 70.7%) were using venous catheters, the majority of which were tunnelled lines (n = 55, 59.8%). Access type was recorded as unknown in one patient.

If a patient was noted as being on PD, or on HD with a fistula or graft, the use of any venous catheters during the last 28 days was requested. Two patients dialysing on AV grafts at the time of diagnosis of MRSA bacteraemia had used venous catheters in the prior 28 days. Two patients on AV fistulae at the time of diagnosis had an unknown status recorded in this data field. Therefore, at least 67/92 (72.8%) patients were using or had used venous catheters in the 28 days preceding the MRSA bacteraemia. Data collected during a national paper-based census of dialysis centres during 2004 [1] were used to provide a rough estimate of denominator data: on the assumption that the proportion of patients in the UK using catheters (23%) had not changed substantially since that census, and using up-to-date data on total prevalent dialysis

Table 12.3. Modality of dialysis in patients in established renal failure where record shared and completed

	MRSA bacteraemia	
Modality of dialysis	N	(%)
Haemofiltration	3	(3.3)
Haemodialysis	87	(94.6)
Unknown	2	(2.2)
All	92	(100)

Table 12.4. Type of renal access in patients in established renal failure where record shared and completed

	MRSA bacteraemia	
Renal access type	N	(%)
AV – simple	23	(25.0)
AVG	4	(4.4)
Non-tunnelled – femoral	46	(6.5)
Non-tunnelled – jugular or subclavian	4	(4.4)
Tunnelled – femoral	5	(5.4)
Tunnelled – jugular or subclavian	50	(54.3)
All	92	

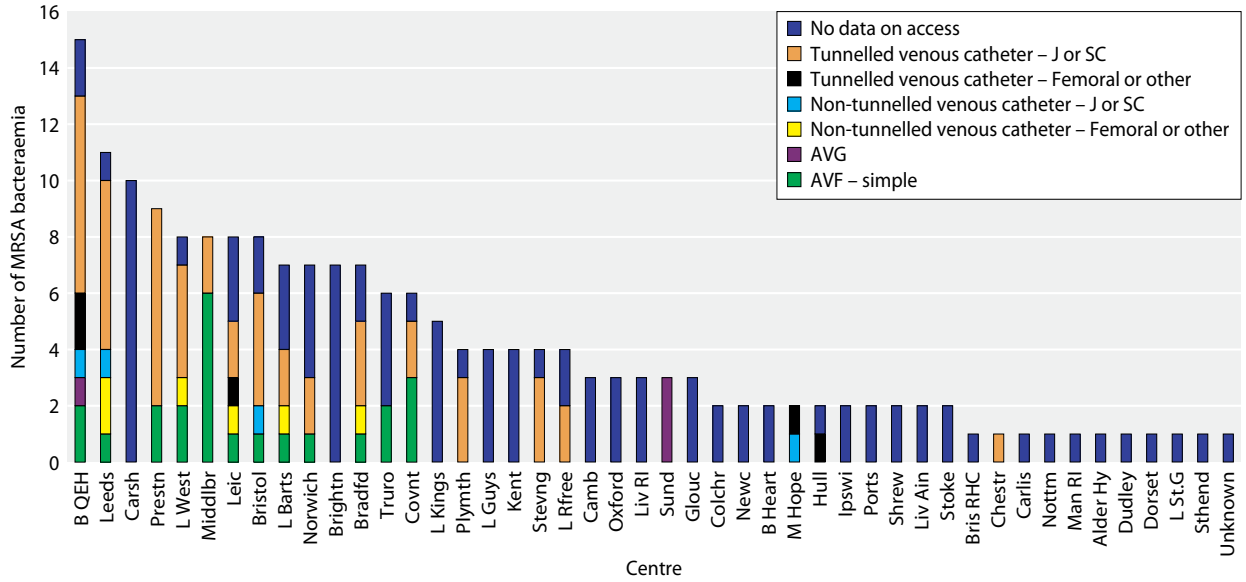

Fig. 12.2. Number of MRSA bacteraemia by access type and renal centre in reporting NHS Trusts (all records N = 188)

patients (n = 20,042), this gave a rate of MRSA bacteraemia of 65/4,611 amongst those dialysing using a catheter and 27/15,431 amongst those using a fistula, graft, or peritoneal dialysis. This suggests the relative risk of MRSA bacteraemia was about 8 fold higher for a patient being dialysed on a venous catheter than via a fistula.

Incident episodes by centre

Fifty acute NHS Trusts reported at least one MRSA bacteraemia in association with a patient with established renal failure on dialysis. Within England, there are 52 distinct renal centres and for the purposes of further analysis, 'unshared' records were allocated to the renal centre thought most likely to be providing long-term supervision of dialysis treatment. The number of MRSA bacteraemia by the type of dialysis access are shown by the renal centre in the reporting NHS Trust (figure 12.2) and for those records where the data was shared with a specific renal centre (figure 12.3).

In calculating the rates of MRSA bacteraemia by renal centre, 3 of the 188 shared records were excluded (two from paediatric units, and one reported by a Trust

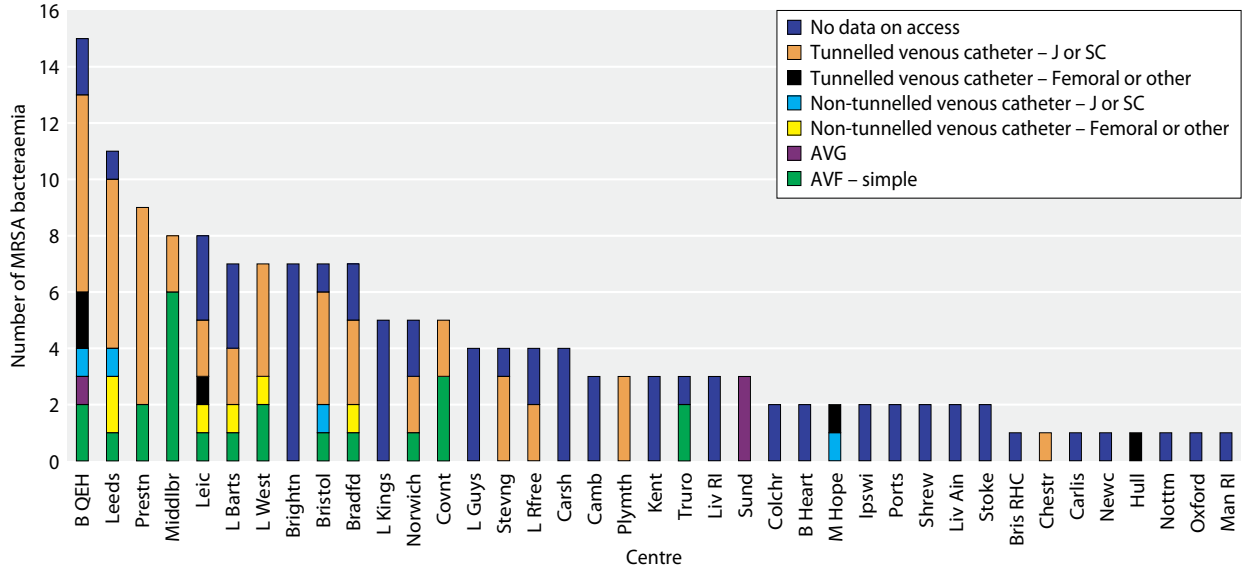

Fig. 12.3. Number of MRSA bacteraemia by renal access type and renal centre (shared records only) N = 159

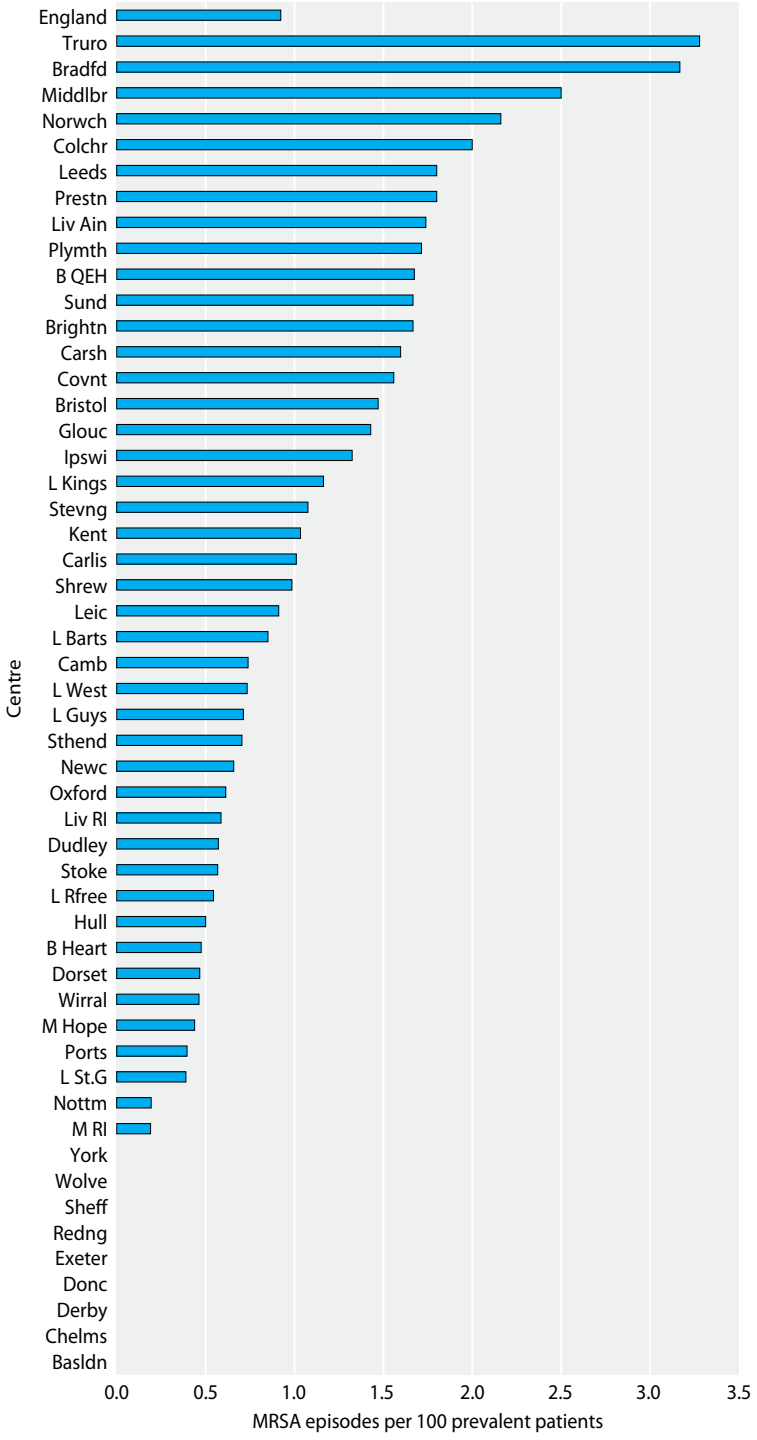

Fig. 12.4. Centre-specific MRSA bacteraemia rates per 100 prevalent dialysis (haemodialysis and peritoneal dialysis) patients

equidistant from two renal centres could not be allocated to a renal centre), resulting in a total of 185 records. Nine centres had no episodes during 2007/8.

Figures 12.4 and 12.5 provide relative rates of infection by centre. Figure 12.4 indicates the rates by renal centre per 100 prevalent dialysis patients (PD and HD), and figure 12.5 the rates per 100 HD patients. The mean rate for all patients was 0.92 ± 0.85 episodes/100 dialysis patients, range 0–3.28. Since all patients with MRSA bacteraemia were on haemodialysis, using just haemodialysis patients as the denominator the mean was 1.14 ± 0.95 episodes/100 patients, range 0–3.93.

The proportion of renal records completed on the HCAI-DCS system was disappointingly only 49%. In most cases, centres either reported on all records or did not report on any records. Preliminary investigation

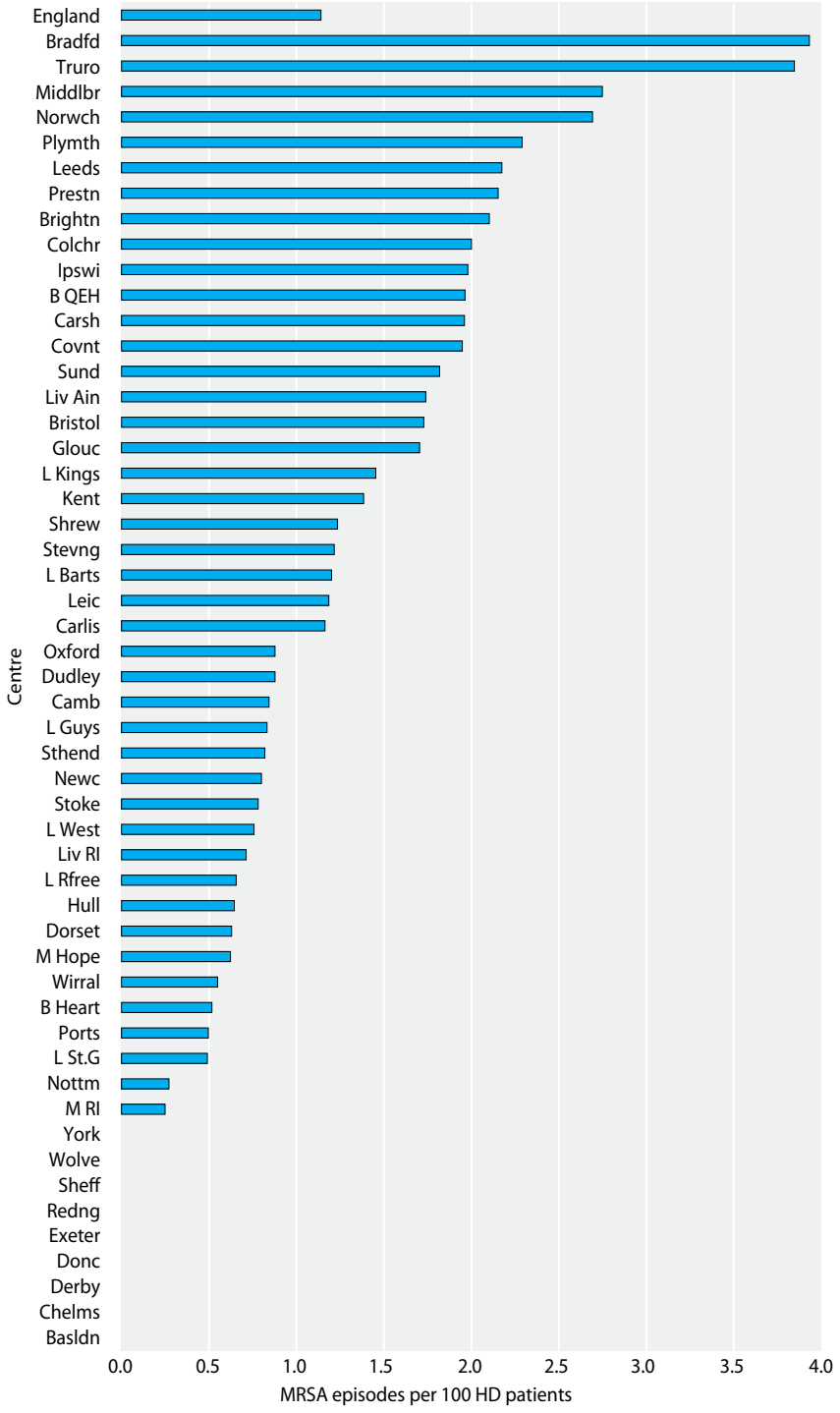

Fig. 12.5. Centre-specific MRSA bacteraemia rate per 100 haemodialysis patients

has identified problems with the system for sending an email alert to the designated infection control lead at the renal centre, with errors in the email addresses causing the alerts not to be delivered and in some cases the emails to have not reached the correct inbox. This suggests that the process of sharing and issuing reminders to complete these data fields requires revision.

Comparison with vascular access survey data

In 2005 the 8th Registry Report produced the results of the National Vascular Access survey, covering the entire United Kingdom. Sixty two centres reported on dialysis access in use in prevalent and incident haemodialysis patients and on *Staphylococcus aureus* bacteraemia rates

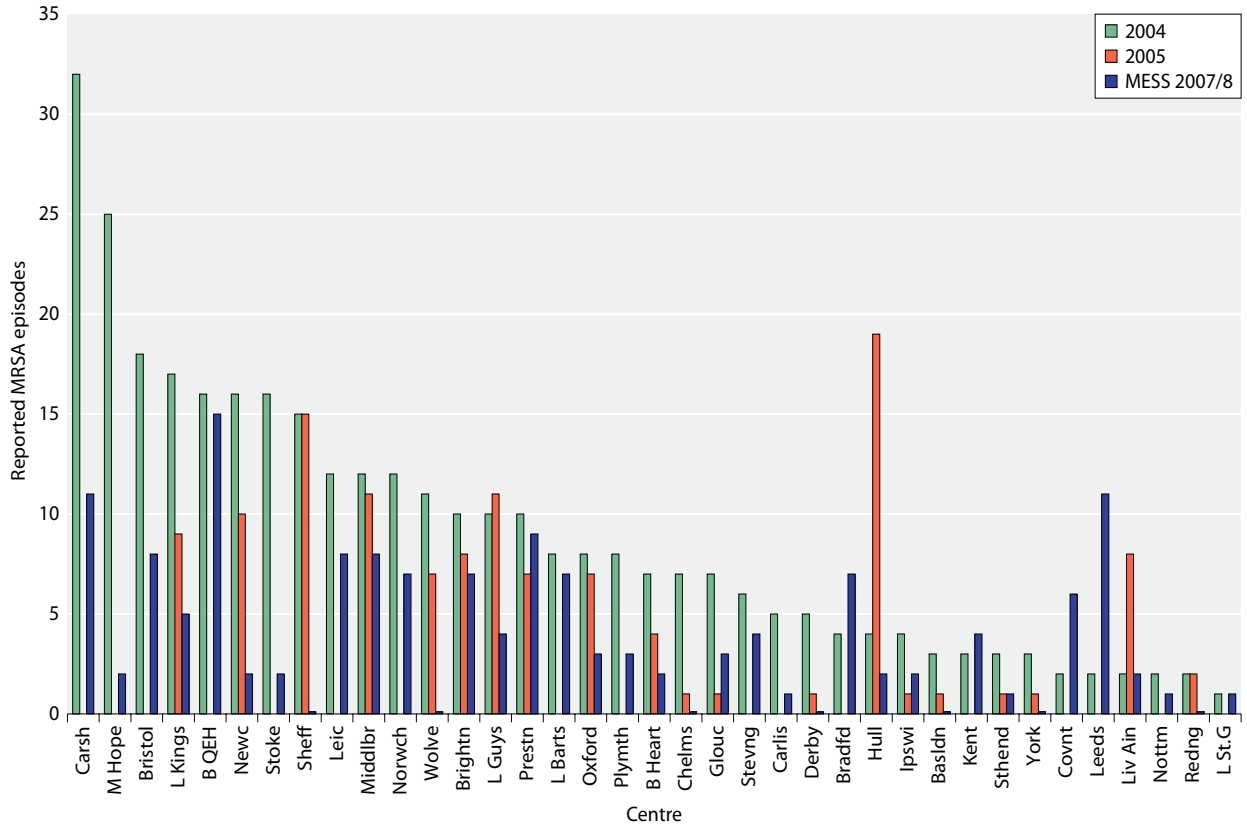

Fig. 12.6. Change in reported MRSA bacteraemia rates in centres that provided data for the previous Registry census

(both total and MRSA) in 2004 [1]. In 2006, 37 centres participated in a follow up survey [13]. While the data were not collected in an identical fashion, comparisons are valuable. In 2005 the 8th Registry Report produced the results of the National Vascular Access survey, covering the entire United Kingdom. Data on MRSA bacteraemias during 2004 were available from 37 English centres, which reported a total of 328 episodes. These centres provided care for 13,644 dialysis patients on 31st December 2004 – giving an overall bacteraemia rate of 2.40 episodes per 100 dialysis patients. This rate was highly likely to be a significant underestimate, given that episodes diagnosed in hospitals other than that housing the renal centre may not have been captured. If these data were representative of England as a whole, given that the current data give an overall rate of 0.92 episodes per 100 dialysis patients, this gives a conservative estimate that there has been a 62% reduction in MRSA bacteraemia rates amongst dialysis patients in England. This compares favourably with a 42% national reduction reported by the HCAI-DCS surveillance system between 2004 and 2008 [16].

Figure 12.6 breaks down episodes by centre, over the 3 reporting periods, for centres that reported data for 2004. Several centres recorded zero rates in 2007 despite high rates in 2004 – these included Basildon, Chelmsford, Derby, Reading, Sheffield, Wolverhampton and York. Several other centres achieved substantial reductions.

Discussion

Mortality due to sepsis in patients on dialysis is 100–300 fold higher than in the general population [2]. MRSA bacteraemia contributed markedly to morbidity and mortality in the UK dialysis population, and reducing MRSA bacteraemia specifically amongst dialysis patients has therefore become a priority for policy-makers as well as for patients and clinicians.

Within England the MRSA surveillance system has provided data on rates of MRSA bacteraemia for all acute NHS Trusts, allowing for performance in relation to infection control to be tracked and improved. The 2005 Registry Report [1] identified MRSA bacteraemia as an important issue for patients receiving dialysis, for whom the relative risk of this infection was 200 compared to the general population. As a consequence of this analysis, the National Clinical Director for Kidney Care set up a collaboration

between the Health Protection Agency and the renal community to improve and enhance the reporting of dialysis associated MRSA bacteraemia.

The first year of data collection has demonstrated issues related to producing a complete dataset, and further work is required to improve the system of 'sharing' records once an MRSA bacteraemia has been diagnosed so as to ensure that the requisite information is provided by the renal centre responsible for the patient's care.

Despite incomplete data several important observations have been made about the MRSA bacteraemia occurring in patients in ERF. First, there was considerable variation in rates of MRSA blood related infections between centres in England. Several centres have reported low or zero rates. How those centres have achieved such results is not covered in this report, but shared learning between centres will be of value to further improve the national picture. It is tempting to speculate on what steps have been taken in centres that had high levels of infection in previous surveys. This may have included the adoption of the High Impact changes for renal catheters [High Impact Intervention No. 3 Renal dialysis catheter care bundle; available at www.dh.gov.uk], or the use of antibiotic catheter restricted locks [17]. Analysis of practice patterns in centres with continuing high rates will be equally instructive.

However, one factor that remains clear is the association with the use of venous catheters. MRSA blood infections within the dialysis population account for 4.2% of all bacteraemias within England. The relative risk for MRSA bacteraemia in a patient on haemodialysis is 100 fold higher than the general population, but for a patient utilizing a venous catheter that risk is 800 fold higher. Consequently, one focus to reducing the risk of infection in a vulnerable population is first to reduce the use of such catheters. If a venous catheter is required, then the risk of infection must be mitigated with meticulous care.

The spotlight on infection control has led to a reduction in infection within the dialysis population. Although comparison with the previous two Renal Registry surveys should be made with caution given the different methodologies, there is evidence of substantial reductions in MRSA bacteraemia. Infection remains a leading cause of mortality in the renal replacement population. If reductions in MRSA are accompanied by parallel reductions in the rates of other infections, one may anticipate survival benefits in future.

Looking forward, the data system will be improved. It will continue to link microbiological data with patient therapy, but a review of the system links should improve data completeness. Second, as part of the Kidney Care national audit [18], data from the HPA, Renal Registry and Hospital Episode Statistics (HES) will allow the linkage of bacteraemia data, hospital episodes and access, to better understand the links between infection, vascular access and morbidity and mortality for dialysis patients. Finally, the National Clinical Director for Kidney Care has established a Healthcare Associated Infections (HCAI) sub group to coordinate strategy in this area.

Summary and Conclusions

The first year of the Renal component of the HCAI-DCS reporting scheme has confirmed the high rate of MRSA bacteraemia amongst patients receiving dialysis in England. Although there is evidence of an overall reduction, there is marked variability between centres in the rate of MRSA bacteraemia. The findings confirm the association of venous catheters and the risk of MRSA blood stream infections amongst patients receiving long term haemodialysis.

Conflict of interest: none

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Chapter 13
Demography of the UK paediatric Renal Replacement Therapy population

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Key Words
Aetiology · Children · Demography · ESRD · Established renal failure · Incidence · Paediatric · Prevalence · Survival

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. ***Results:*** The UK paediatric established renal failure (ERF) population in April 2008 was 875 patients. The prevalence under the age of 16 years was 55 per million age related population (pmp) and the incidence 7.92 pmp. The incidence and prevalence for South Asian and Other ethnic groups were 3 times 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 more common in patients from ethnic minority groups. The spectrum of diseases seen has changed over a generation. Overall 5 year survival for children with ERF was 91.8%. Five year survival of infants starting dialysis was just 62%. Transplanted patients accounted for 74% of the current population. The proportion with grafts from living donors has steadily risen to 34%. 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, 57% 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. The spectrum of diseases seen has already changed over a generation with the treatment of young children with diseases such as congenital nephrosis. The incidence of cystinosis causing ERF was reduced, probably reflecting better early treatment.

Introduction

Knowledge of the demography of a patient population is essential for the planning of services and the assessment of outcomes. 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 and England 10). All centres have facilities for peritoneal dialysis and haemodialysis. Ten of the 13 centres undertake transplantation for children. As part of the development of a national Renal Registry the British Association for Paediatric Nephrology (BAPN) began collecting data on children in 1996. The aim has been to provide a fully integrated data collection programme which would seamlessly merge with the adult data in the UK Renal Registry. Some data is also available from BAPN national audits undertaken in years before the inception of the Paediatric Registry. Whilst the completeness of data collection has varied over the years an attempt was made in April 2008 to capture the whole of the population of children with ERF being treated in centres across the UK for these analyses.

The term ERF used within this chapter is synonymous with the terms of 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

Data collection took place across the UK looking at patient status on 1st April 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. Whilst extensive demographic details were available from 12 centres, the smallest centre (Southampton) was on this occasion only able to provide a total patient number and treatment modality for each patient. Data were then extracted and analysed using Microsoft Excel and statistical analysis was performed using the StatsDirect programme and Fisher's exact test.

Results

The UK paediatric ERF population

The UK paediatric ERF population on 1st April 2008 was 875 patients. One centre of 22 patients could not provide further demographic data. The age and gender distribution of the remaining 853 patients is shown in table 13.1. Overall the gender ratio of males to females was just over 1.5 to 1. Ethnic minority groups composed just over 22% of the population.

Table 13.1. The UK paediatric ERF population on 1st April 2008, by age and gender

	Patients	Male	Female	Ratio	% total
White	664	415	249	1.67:1	77.8
S Asian	144	73	68	1.07:1	16.9
Black	23	16	7	2.29:1	2.7
Other	22	10	12	0.83:1	2.6
Total	**853***	**514**	**336**	**1.53:1**	**100.0**
<18 years	812	491	318	1.54:1	95.2
<15 years	536	327	207	1.58:1	62.8

*gender unknown for 3 patients

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 13.1. The data point for 2008 assumed the proportion of the patients under 15 years of age at Southampton was the same as for the rest of the country. The confidence limits for this number are ±7. Table 13.2 shows a more detailed breakdown of the ERF population according to age. For this analysis the 22 patients for Southampton were excluded. Whilst the total number of patients being treated across the UK continued to gradually increase with time, the proportion under the age of 15 years seems to be on a plateau.

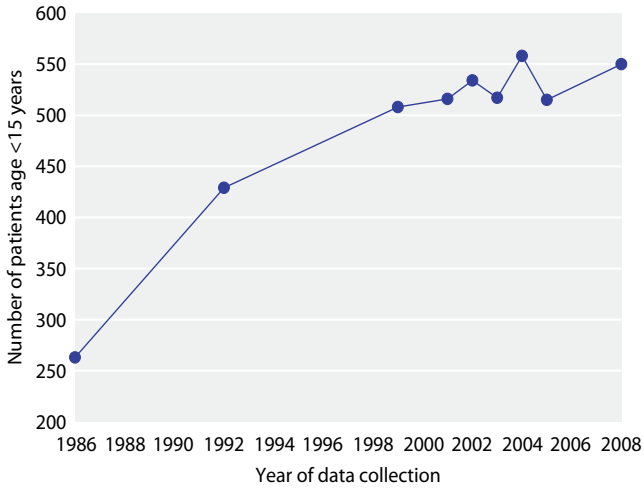

Fig. 13.1. Prevalent patients below 15 years of age on RRT in the UK

Table 13.2. Prevalent paediatric ERF population by age and year of data collection

	Patient population data for the years of (on 1st April)								
Age group (yrs)	1986	1992	1999	2001	2002	2003	2004	2005	2008
0–1.9		16	18	13	14	10	12	14	22
2–4.9		55	46	56	58	56	51	45	68
5–9.9		150	151	146	147	141	166	157	148
10–14.9		208	293	301	315	310	329	299	298
15–19.9			253	274	259	256	244	253	315
Total <15	263	429	508	516	534	517	558	515	536
Total <20			761	790	793	773	802	768	851

The proportion of ethnic minority (EM) patients has increased and when compared to the previous most complete data collection in 2004, this increase was significant ($p = 0.0078$). These data are shown in figure 13.2.

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 13.3 for the years of 2002, 2003, 2004 and 2005 when analyses were undertaken 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 2004 data the proportion under the age of 4 years is significantly larger ($p = 0.0175$).

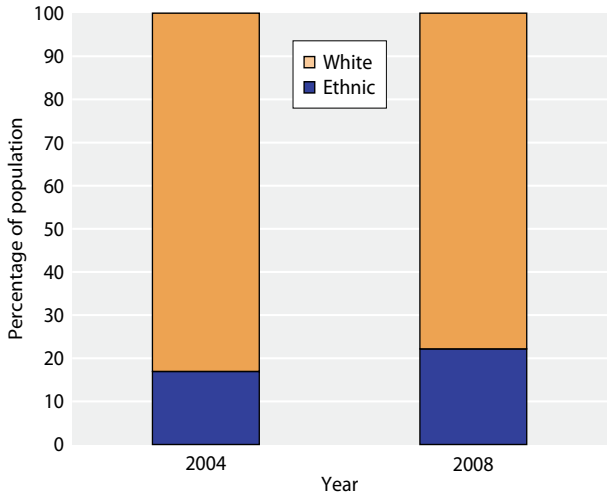

Fig. 13.2. The proportions of prevalent paediatric RRT patients in 2004 and 2008 from ethnic minorities

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 [1]. The overall prevalence of ERF in children under the age of 16 years in the UK was 55 per million age related population. The prevalence was highest at 96.3 pmp in the 12 to 16 year age group. At all ages there was a significant excess of males (table 13.4), which was similar to that found in the adult population. The adult UK Renal Registry is recording additional data on a prevalence rate of 50 pmp in patients aged 16–19 which would potentially increase this rate to 117 pmp. This contrasts with a rate of 230 pmp seen in the 20–24 year age band.

The incidence of ERF (or take on rate of new patients) is shown in table 13.5. Whilst there was quite wide year to year variability in some age bands, the degree of variation in the total under 16 year old cohort was less. The only trend with time seemed to be a decrease in the incidence of ERF in patients between 4 and 8 years. This is visually apparent in figure 13.3.

Whilst the prevalence of ERF rose steadily with age, through continued acceptance onto the programme of new patients and survival of existing patients, the distribution of incidence with age showed a V shaped

Table 13.3. ERF prevalent paediatric population in 4 year age bands

	Patient population for the years of				
Age group (yrs)	2002	2003	2004	2005	2008
0–3.9	49	39	41	36	69
4–7.9	94	103	112	108	92
8–11.9	185	176	173	152	180
12–15.9	294	291	297	321	292
16–19.9	171	164	179	151	218

Table 13.4. Prevalence of ERF per million population by age and gender

	All patients*		Male		Female	
Age group (yrs)	Patients	Prevalence	Patients	Prevalence	Patients	Prevalence
0–3.9	69	23.7	44	29.5	25	17.6
4–7.9	92	34.2	62	45.0	29	22.1
8–11.9	180	62.6	104	70.7	76	54.1
12–15.9	292	96.3	177	113.8	114	77.3
16–19.9	218	67.5	127	76.3	90	57.6
<15	536	50.0	327	59.6	207	39.6
<16	633	55.0	387	65.7	244	43.5

*gender unknown for 3 patients

Table 13.5. Incidence of ERF per million age related population for the last ten years

	Take on rate per million age related population										
Age group (yrs)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean
0–3.9	8.6	6.2	9.3	8.3	9.6	5.5	6.2	5.2	6.9	8.9	7.5
4–7.9	5.9	4.5	5.9	5.6	6.7	6.7	3.0	4.1	4.1	2.6	4.9
8–11.9	8.7	8.0	10.1	10.9	9.4	8.7	3.1	2.8	9.4	4.9	7.6
12–15.9	13.9	12.9	7.9	13.9	14.2	13.2	11.9	7.9	6.9	11.6	11.4
16–19.9	1.9	3.1	5.3	4.0	1.6	2.8	2.2	1.6	1.6	2.2	2.6
<15	9.2	8.0	8.4	9.4	9.9	8.3	6.1	4.7	6.6	6.9	7.8
<16	9.4	8.0	8.3	9.7	10.1	8.6	6.2	5.0	6.9	7.1	7.9

curve with the incidence in the first and third 4 year blocks being similar, a nadir between 4 and 8 years and then a peak at 12 to 16 years. This is demonstrated in figure 13.4.

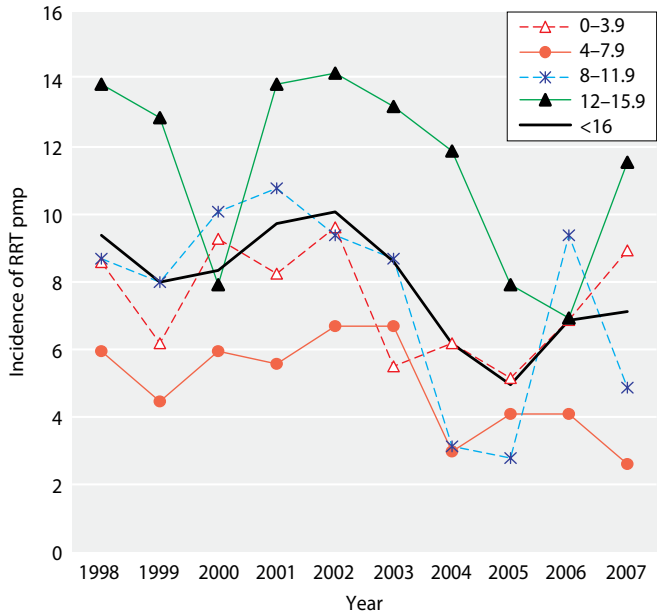

Fig. 13.3. Paediatric incidence of RRT pmp 1998–2007 by age at onset

Both the incidence and prevalence of ERF varied with ethnicity. The South Asian population (patients from the Indian subcontinent) showed a prevalence 2.7 times that of the White population. The incidence of ERF in this group averaged out at 2.5 times that of the White population over the past 10 years. The prevalence and incidence of ERF in the Black population was just slightly

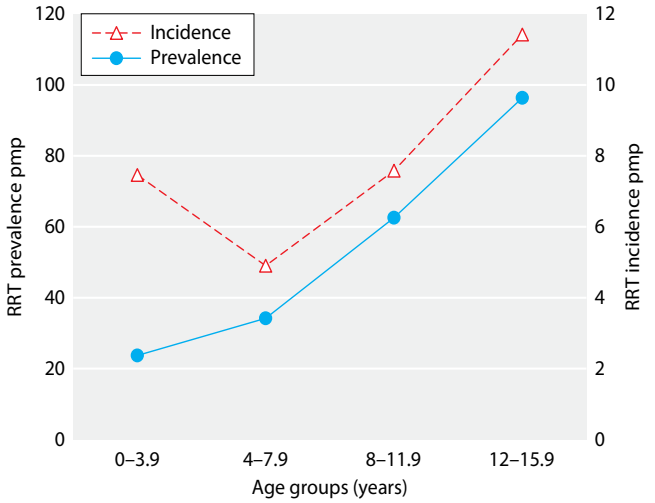

Fig. 13.4. Incidence and prevalence of RRT pmp in 2008 by age

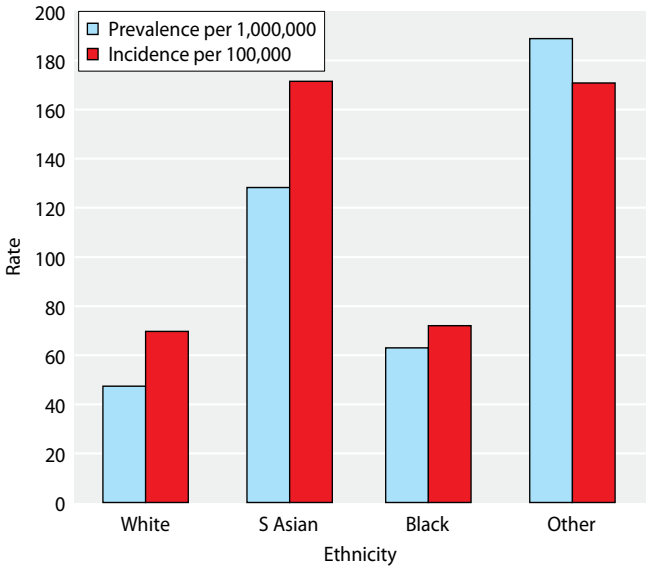

Fig. 13.5. Incidence per 100,000 age related population and prevalence pmp by ethnicity

higher than that of the White population. Those classified as 'Other' had a prevalence 4 times that of the White population and an incidence similar to that of the South Asian population (figure 13.5).

Causes of ERF

The causes of ERF in the paediatric population have been previously outlined [2]. 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 13.6 shows these disease categories for 744 of the 875 current patients (85%) for whom a causative diagnosis was listed. Renal dysplasia with or without vesico-ureteric reflux was the predominant cause accounting for one third of all patients. The combination of glomerulonephritic diseases and obstructive uropathy accounted for another third and the final third was composed of the other 8 categories. The male: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.

When examining the role of ethnicity in the distribution of causes of ERF the proportion of patients from ethnic minority groups varied widely between categories. This is demonstrated in table 13.7. The highest proportion of ethnic minority patients was in the group with an unknown aetiology, these being patients who have presented at or near established renal failure in whom it was not possible to elucidate the underlying cause. At 7.9 pmp, the prevalence of patients with renal failure of unknown aetiology in ethnic minority patients was almost 10 times that of White patients. This excess proportion of ethnic minority patients with no known underlying cause was significant ($p = 0.0003$). Renal dysplastic conditions were significantly under-represented in the ethnic minority groups ($p = 0.0074$). However, this was only because of the higher prevalence of other conditions. The prevalence of renal dysplasia in ethnic minority patients overall at 23.2 pmp is 1.4 times that of the White population. For the South Asian population the prevalence of tubulo-interstitial diseases and congenital nephrosis were much higher than in the White or Black populations. Some of the differences in disease frequencies related to disease inheritance. Table 13.8 shows the numbers and prevalence of patients with recognised inherited disease according to ethnicity. There was a significant increase in the proportion of patients with autosomal recessively

Table 13.6. 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	251	33.7	164	87	1.9
Glomerular diseases	129	17.3	60	69	0.9
Obstructive uropathy	121	16.3	110	11	10.0
Tubulo-interstitial disease	58	7.8	26	32	0.8
Congenital nephrosis	55	7.4	22	33	0.7
Metabolic diseases	31	4.2	13	18	0.7
Renovascular disease	31	4.2	21	10	2.1
Polycystic kidney disease	24	3.2	12	12	1.0
Unknown aetiology	24	3.2	8	16	0.5
Malignancy	14	1.9	6	8	0.8
Drug nephrotoxicity	6	0.8	3	3	1.0

Table 13.7. Diagnostic groups and ethnic distribution of the prevalent ERF paediatric population

	Ethnicity								
	White		S Asian		Black		Other		Percentage ethnic minority
Diagnostic group	N	pmp	N	pmp	N	pmp	N	pmp	
Renal dysplasia ± reflux	213	16.3	26	24.3	6	14.1	6	42.3	15.1
Glomerular diseases	96	7.3	28	26.2	5	11.7	0	0.0	25.6
Obstructive uropathy	99	7.6	17	15.9	3	7.0	2	14.1	18.2
Tubulo-interstitial disease	41	3.1	12	11.2	0	0.0	5	35.2	29.3
Congenital nephrosis	39	3.0	16	15.0	0	0.0	0	0.0	29.1
Metabolic diseases	24	1.8	5	4.7	0	0.0	2	14.1	22.6
Renovascular disease	29	2.2	1	0.9	1	2.3	0	0.0	6.5
Polycystic kidney disease	20	1.5	2	1.9	1	2.3	1	7.0	16.7
Unknown aetiology	11	0.8	9	8.4	2	4.7	2	14.1	54.2
Malignancy	12	0.9	1	0.9	1	2.3	0	0.0	14.3
Drug nephrotoxicity	5	0.4	1	0.9	0	0.0	0	0.0	16.7

inherited diseases in patients from ethnic minority groups ($p = 0.0087$).

To establish whether there was any change in the pattern of disease causing ERF with time the distribution of diagnostic groups in patients between the ages of 0 and 15 years was examined. This was then compared to the distribution of diagnostic groups in a cohort of registered patients whose age would now be between 25 and 40 years. There were 460 current patients under the age of 15 years with diagnoses stated. In addition there were 58 deceased patients, 10 patients transferred to non-UK centres and 17 patients whose whereabouts and outcome were unknown who were registered and had a diagnosis. This gave an under 15 years of age cohort of 545, of whom 330 were male and 215 were female (M:F 1.53). There were 299 patients whose details were on the Paediatric Registry, including a causative diagnosis and who would have been between 25 and 40 years of age at the audit point of 1st April 2008. Males comprised 186 of this cohort (M:F 1.64:1). The distribution of the diagnostic groups is given in table 13.9.

Whilst the proportion of patients with renal dysplasia and/or reflux nephropathy was the same between the two groups it is interesting to note that in the under 15 years of age group just 15 (8%) were primarily categorised as having reflux nephropathy whilst 58 of the 104 patients (56%) in the 15–40 year old age group were classified as having reflux nephropathy ($p < 0.0001$). Similarly, whilst posterior urethral valves is the predominant cause of ERF in both groups a significantly higher proportion of those in the younger cohort (85%) with obstructive uropathy had this as a cause when compared with 62% in the older cohort ($p = 0.0015$). In parallel with this there has been a small but significant reduction in the proportion of patients with neuropathic bladder as a cause of ERF in the younger cohort (5% vs 16%, $p = 0.0435$).

Glomerulonephritis leading to ERF was significantly more common in the older cohort of patients

Table 13.8. Inherited diseases and ethnicity in the prevalent ERF paediatric population

	Ethnicity							
	White		S Asian		Black		Other	
Inheritance	N	pmp	N	pmp	N	pmp	N	Pmp
Autosomal recessive	112	8.5	32	30.0	1	2.3	6	42.3
Autosomal dominant	7	0.5	0	0.0	0	0.0	0	0.0
X linked	9	0.7	0	0.0	0	0.0	0	0.0
Mitochondrial	3	0.2	1	0.9	0	0.0	0	0.0
None or other or undefined	458	35.0	85	79.7	18	42.2	12	84.5

Table 13.9. Distribution of diagnostic groups for patients with ERF in childhood who were aged <15 yrs on 1/4/2008, compared with those who would have been between 15–40 years of age on 1/4/2008

Diagnostic group	Patients <15 yrs	Proportion of total %	Patients 25–40 yrs	Proportion of total %
Renal dysplasia ± reflux	187	34.3	104	34.8
Obstructive uropathy	95	17.4	58	19.4
Glomerular diseases	77	14.1	73	24.4
Tubulo-interstitial disease	31	5.7	23	7.7
Metabolic diseases	16	2.9	24	8.0
Congenital nephrosis	52	9.5	4	1.3
Polycystic kidney disease	24	4.4	4	1.3
Renovascular disease	33	6.1	2	0.7
Malignancy	14	2.6	2	0.7
Drug nephrotoxicity	3	0.6	1	0.3
Unknown aetiology	13	2.4	4	1.3

($p = 0.0002$). Similarly metabolic diseases causing ERF were more common in the older cohort ($p = 0.0019$). The single most common metabolic disease causing ERF in childhood was nephropathic cystinosis. Of the 545 patients in the currently under 15 years of age group, 7 had cystinosis. Of the 299 patients now between 15 and 40 years of age, 21 had cystinosis. Thus the incidence of cystinosis causing ERF in childhood has significantly reduced over a generation ($p < 0.0001$). In contrast the number and proportion of patients with congenital nephrosis, polycystic kidney disease and renovascular disease (mainly cortical necrosis) were all significantly higher in the younger aged cohort (congenital nephrosis $p < 0.0001$, polycystic disease $p = 0.016$, renovascular disease $p < 0.0001$).

There was a difference in ethnicity between the two cohorts. The proportion of ethnic minority patients in the younger cohort was 22.4% as one would expect from the current ERF population statistics whilst the proportion of ethnic minority patients in the older cohort was 18.1% ($p = 0.0139$).

Survival

To assess 5 year survival (and hence mortality) data were extracted from the Registry on patients starting ERF treatment between 1st April 1998 and 1st April 2003. For each patient the subsequent five year period was analysed to determine the 5 year survival. These data are presented in table 13.10. Patients were divided according to 4 year age bands and year of commencement of treatment. It

Table 13.10. Mortality over the first 5 years after starting RRT in the paediatric population

	Year of commencement of ERF treatment								
	1998			1999			2000		
Age (yrs)	Patients	Deaths	Mortality	Patients	Deaths	Mortality	Patients	Deaths	Mortality
0–3.9	25	4	16.0%	18	5	27.8%	27	5	18.5%
4–7.9	16	1	6.3%	12	0	0.0%	16	0	0.0%
8–11.9	25	2	8.0%	23	0	0.0%	29	1	3.5%
12–15.9	42	1	2.4%	39	1	2.6%	24	1	4.2%
<16	108	8	7.4%	92	7	7.6%	96	7	7.3%
	2001			2002			Total 1998–2002		
Age (yrs)	Patients	Deaths	Mortality	Patients	Deaths	Mortality	Patients	Deaths	Mortality
0–3.9	24	3	12.5%	28	9	32.1%	122	26	21.3%
4–7.9	15	2	13.3%	18	2	11.1%	77	5	6.5%
8–11.9	31	1	3.2%	27	1	3.7%	135	5	3.7%
12–15.9	42	3	7.1%	43	0	0.0%	190	6	3.2%
<16	112	9	8.0%	116	12	10.3%	524	43	8.2%

should be noted that not all those over the age of 12 years when starting treatment after 2000 will have had a full 5 year follow up as some will have been transferred to adult centres and deaths may not have been reported back. The overall 5 year survival rate for children starting ERF treatment below the age of 16 years was 91.2%. Mortality was highest for those starting ERF treatment in the first 4 years of life and then declined. Most fatalities occur within the first 36 months of starting treatment but later fatalities also occur and some of those surviving 5 years subsequently died. These data do not take account of patients who, for one reason or another, had not been started on a renal replacement therapy regimen.

Although mortality in those starting RRT between the ages of 4 and 8 years was higher than that for patients starting between 8 and 12 years, this difference did not reach statistical significance. Mortality for those starting RRT within the first four years of life was significantly greater than those starting RRT in the subsequent 8 years of life ($p < 0.0001$). Looking at this group in more detail it was clear that the mortality was highest for those starting dialysis in the first year of life and then declined as the age of treatment commencement rose (figure 13.6).

Current modality of RRT

Of the 875 current patients, some details of treatment modality were available for 847 (96.8%). Of these, 629 (74.3%) had a functioning renal allograft. Peritoneal dialysis was the active modality in 123 (14.5%) and haemodialysis was being used in 92 (10.9%). Three patients were on no active treatment at the time of audit (0.4%), two of these were managing on their residual renal function at the time having previously been on dialysis and one patient was no longer receiving treatment after discussion with the family. This patient had a heavy burden of comorbidity and disability.

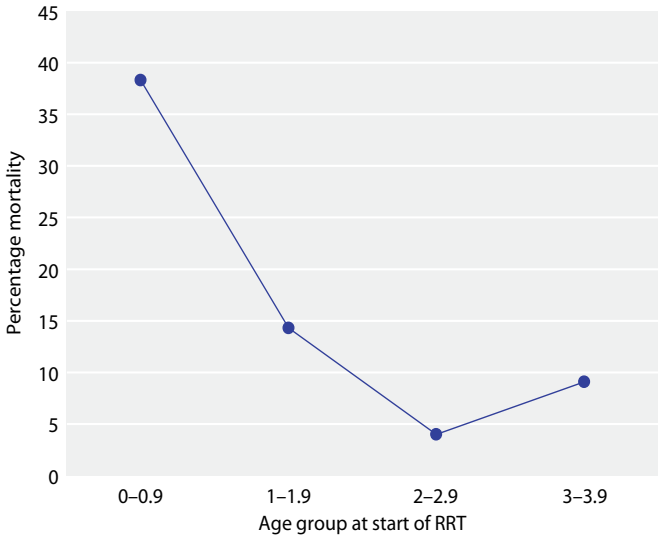

Fig. 13.6. Mortality within 5 years of starting RRT by age at start of RRT

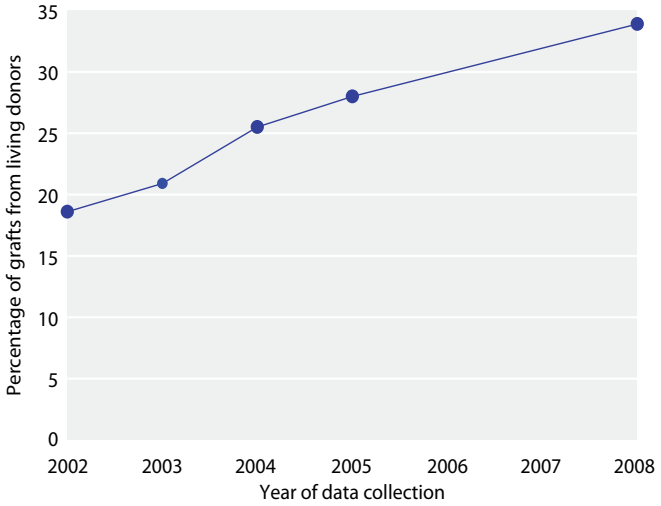

Fig. 13.7. Percentage of prevalent paediatric renal transplant patients with a living donor graft, by year

Of the 629 patients with transplants, the type of allograft was known in 614 (97.6%). Living donation (LD) accounted for 208 grafts (33.9%) and 406 (66.1%) were from deceased donors (DD). The proportion of paediatric patients with allografts from living donors has been steadily increasing as demonstrated in figure 13.7.

Figure 13.8 shows the distribution of LD grafts and DD grafts in different ages of children. A much greater proportion of young children have an LD graft than older children.

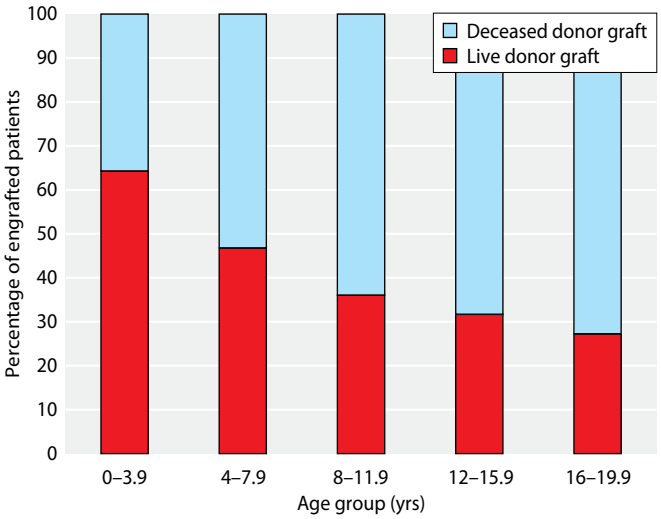

Fig. 13.8. Percentage of engrafted paediatric patients with an LD graft or DD graft by age

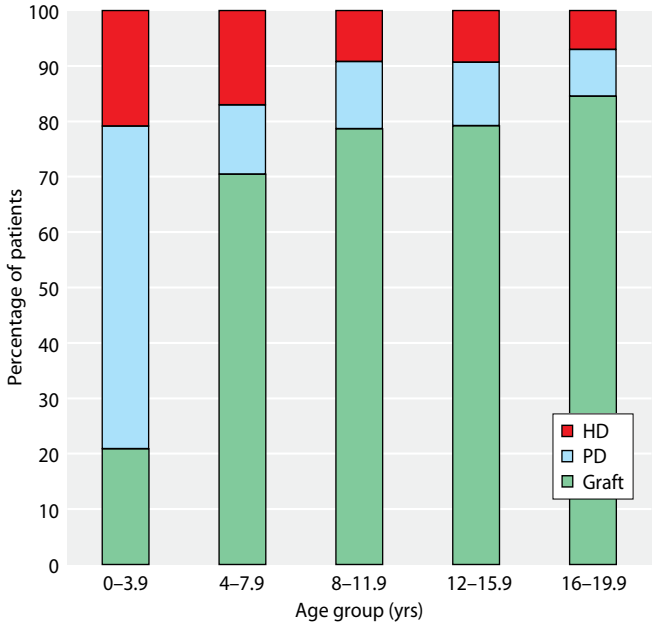

Fig. 13.9. Distribution of RRT modalities by age

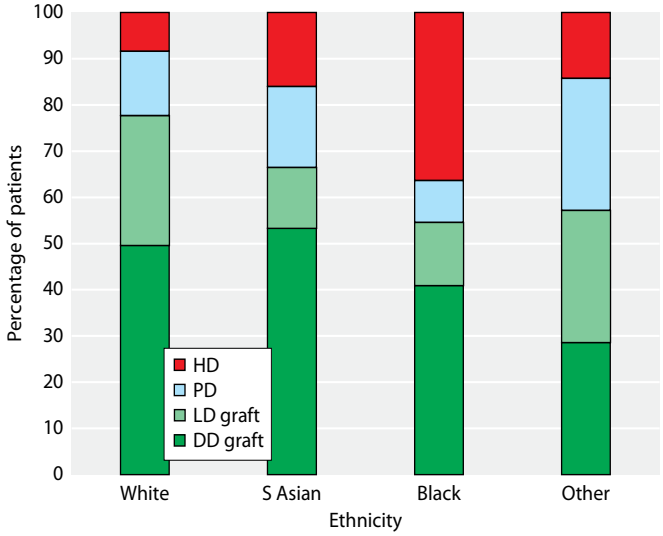

Fig. 13.10. RRT modality by ethnicity

For those on dialysis, 42.8% were having haemodialysis. For those having peritoneal dialysis, the vast majority (85.4%) were being treated with automated peritoneal dialysis (APD), the remainder being on CAPD. Figure 13.9 shows the distribution of all modalities according to age. Only 20% 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 dialysis 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 ($p = 0.0003$). For those who had been engrafted, 36% of White patients had an LD graft compared to 23% of ethnic minority patients ($p = 0.0116$). For those on dialysis, 50% of those from ethnic minority groups were on haemodialysis compared to 38% of White patients ($p = ns$). These data are demonstrated in figure 13.10.

Discussion

ERF paediatric population, incidence and prevalence

Taking into account variation secondary to the completeness of data collection, it is apparent that there was only a slow incremental growth of the paediatric ERF population with time. The incidence and prevalence rates of childhood ERF have not changed significantly from our previous report [2] and were similar to those quoted in the ANZDATA 2007 Registry Report [3]. The increase in the number of patients below 4 years of age in the current data was unlikely to be representative of a change in the population. There was significant year to year variability in the incidence of ERF in this age band because of the small numbers involved and looking at incidence over the past 10 years in table 13.5, there was no clear trend. Comparing incidence rates to previously published rates for both European and non European countries [4], the current UK rates are within the ranges described which vary according to predisposition to particular diseases according to ethnicity and healthcare provision.

Whilst the overall incidence and prevalence have not changed significantly the distribution of the population between those who are White and those from ethnic minority groups has. This was to be expected with the high incidence in these ethnic minority groups. Whilst the largest ethnic minority group of South Asian patients has always shown an incidence about three times that of the White population, the 'Other' group has for the first time in this report shown an even higher incidence. This relates to the fact that the majority of these patients come from an ethnic background where consanguineous marriage is common.

Causes of ERF

Renal dysplasia and related conditions were the most common cause of ERF, accounting for one third of all

patients, in the current population. Glomerular diseases and obstructive uropathy together accounted for a further third. This data appears to be different to our previous report [2] where renal dysplasia accounted for just over 24% of cases and glomerular diseases 22% of cases. In reality however, there has been no change in the causative disease pattern in the population. The analysis in this report looked at the causative diseases in the current population. Our previous report looked at a larger cohort who had presented after 1996. This larger cohort included a number of patients who had been transferred to adult services. As renal dysplasia is a cause of ERF presenting at all ages, but glomerular diseases tend to just present in mid and late childhood the length of time patients with ERF from glomerular disorders spend in paediatric departments is less than that for patients with renal dysplasia. Thus both analyses are correct. Looking in a cross-sectional manner at any time point, a third of children with ERF will have renal dysplasia as a cause. Looking at the number of children passing through paediatric services the proportions with renal dysplasia and glomerular disorders were not dissimilar.

Ethnicity played a significant role in the distribution of diseases causing ERF. A significantly lower proportion of ethnic minority patients had renal dysplasia even though the prevalence was higher than in the White population. This was because diseases associated with autosomal recessive inheritance are significantly more common with a markedly higher prevalence. As the proportion of the ERF population composed of ethnic minority groups increases with time it is likely that the pattern of causative diseases will change. It is noteworthy that 54% of patients who presented late with no definable diagnosis were from ethnic minority groups. This would suggest that there is reduced awareness of problems and delayed contact with healthcare services in these groups.

Examining the distribution of causes of renal failure in the current generation of patients under 15 years of age and comparing it to a generation now between 25 and 40 years of age, showed a number of interesting points. There has been little change in the proportions of the population with renal dysplasia and obstructive uropathy as a cause. However, whilst just 8% of the younger cohort have been classified as having reflux nephropathy, 54% of the older cohort were classified in this way. This could simply be due to a change in the way paediatric nephrologists classify patients presenting with small kidneys and vesico-ureteric reflux. Further analysis of the spectrum of age at presentation, age at commencement of ERF and presence or absence of recurrent urinary sepsis would help define whether there has or has not been a change in the diseases seen. For those with obstructive uropathy the proportion with posterior urethral valves as a cause was significantly higher in the younger cohort. This is likely to represent improved management of neuropathic bladder and acquired obstructive uropathy in the current population together with the survival and acceptance onto RRT programmes of infants with posterior urethral valves who would previously have died.

Glomerular disease was significantly more common as a cause of ERF in the older cohort than the younger generation. There was no evidence to suggest that the incidence of glomerulonephritis has reduced with time. This could suggest that treatment at an early stage for glomerular diseases has improved and fewer are progressing to ERF. Whilst this is possible, this cannot be proven from the data available here. Moreover, the acceptance of infants and very young children onto an RRT programme was not the norm for the generation of the older cohort. This means that they will have had a higher mean age of onset of ERF, and as discussed above, the proportion of patients with glomerular diseases as a cause of ERF in those presenting in later childhood is increased. Thus, whilst more analysis of this phenomenon is required, it is most likely that the decreased proportion of patients with glomerular diseases in the younger cohort is a feature of the distribution of the population rather than an effect of improved treatment for glomerulonephritis.

Contrary to this, metabolic diseases and particularly cystinosis are significantly less common in the younger cohort. There was no evidence to suggest that the incidence of cystinosis is decreasing, indeed, as it is a common disease in communities with a high rate of consanguinity, one might expect it to be increasing [5]. Thus the fall in the numbers of ERF patients with cystinosis between cohorts is likely to be representative of improved diagnosis and treatment for the condition.

Conditions such as congenital nephrosis, recessive polycystic kidney disease and cortical necrosis were significantly under-represented in the older cohort. This was because infants and young children were generally not being accepted onto ERF programmes at that time.

Survival

Little is written about survival for paediatric patients on an ERF programme. This report shows an overall 5 year survival for patients under the age of 16 of 91.8%. As patients starting dialysis over the age of 12 years

could have been transferred to adult centres and died before the five year point and without being registered as deceased this could be a slight overestimate of survival. However, just looking at patients starting RRT below the age of 12 years, 5 year survival is 89.3%. This figure is not dissimilar to those quoted by USRDS [6], though direct comparison is not possible as the USRDS figures are quoted as probabilities by RRT modalities. The highest mortality was in the youngest patients, with almost 40% of patients commencing treatment within the first year of life dying. As described by Wood *et al.* [7], much of the mortality in this group will have been related to comorbidities. The 83–89% survival rate for patients starting dialysis in the first year of life described by Wood *et al.* seems much better than in this report. However, it should be noted that they reviewed one rather than 5 year survival and more importantly, it was not a true cohort study but a selected population. Indeed the survival of infants with ERF in the UK may actually be worse than reported here if there were infants in whom a decision not to embark upon ERF treatment was made and these children were not reported to the Paediatric Registry. Further analysis of these data looking at treatment modality and comorbidities in detail is indicated, possibly with a prospective two year data collection of all infants with ERF (whether or not they were accepted onto a treatment programme) to allow a true prognosis to be given to the families of children presenting with ERF in infancy.

Current RRT modality

The 74.3% of patients whose current RRT modality was a functioning renal allograft was slightly higher than the 71% reported by both ANZDATA [2] and the USRDS [6]. This figure has remained stable over the years of data collection by the Registry. For those without an allograft, peritoneal dialysis remained the most prevalent treatment though the percentage of patients receiving haemodialysis had risen to 43%. This is in keeping with the general trend towards increasing haemodialysis therapy in children described by Warady [8].

The proportion of patients with a graft from a living donor continued to rise indicating a continuing preference for living donation. The steadily decreasing proportion of grafts coming from living donors as patient age increases simply represents the past preference for deceased donor transplantation and the continued survival of these grafts in patients who were young at the time of engraftment.

Patients from ethnic minority groups were significantly more likely to be on dialysis than White patients. This was related to the higher prevalence of blood group B in this population and the different distribution of HLA tissue types, making the chance of getting a good match from the predominantly White deceased donor pool poor. As morbidity and mortality are higher in dialysis compared to engrafted patients [8], an education programme promoting living donation in the ethnic minority population is needed. Live donation from ethnic minorities may remain more difficult than Whites, due to a much higher incidence of CKD and renal failure seen in the adult ethnic minorities when compared to Whites.

Conflict of interest: none

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Chapter 14
UK Renal Registry and international comparisons

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Key Words
Cardiovascular risk factors · Epidemiology · International comparison · Renal Registry

Abstract
Background: The aim of this study is to report Renal Replacement Therapy (RRT) incidence and prevalence rates, the percentage of incident patients with diabetes mellitus as cause of renal disease, the RRT modality mix and the transplant rate in different countries. The number of national or regional registries collecting and reporting data pertaining to traditional cardiovascular (CV) risk factors in prevalent dialysis patients is also examined. ***Methods:*** Data on numbers of incident and prevalent RRT patients in England, Wales, Scotland and Northern Ireland for the year 2007 were collected from the UK Renal Registry (UKRR) database and collated to meet the specifications on the US Renal Data System (USRDS) international data collection form. ***Results:*** In 2007, the incidence and prevalence of RRT in the UK were 110 and 759 per million of the population (pmp) respectively. Incidence of RRT placed the UK 34th out of the 43 countries reporting to the USRDS in 2006. In the majority of reporting countries, 20–44% have diabetes as the primary cause of end stage renal disease. Only the Finnish, Malaysian and US Renal Registries were found to routinely report attainment of cardiovascular risk standards. ***Conclusions:*** A comparison among international renal registries about RRT epidemiology and reporting cardiovascular risk factors in prevalent RRT patients forms an important part of the quality improvement process and often allows for improving standards and performances between reporting countries. Despite the high CV morbidity associated with RRT, few renal registries routinely report data on CV risk management; where data are reported there is little agreement in what represents quality of care, making direct comparison difficult.

Introduction

Globally the number of patients on renal replacement therapy (RRT) with stage 5 chronic kidney disease (CKD) continued to increase. The number of countries with renal registries monitoring these patients, is also increasing. International comparisons of RRT epidemiology allow incidence rates, prevalence rates and transplantation rates to be compared across health care systems. The observed variability in provision, has generated hypotheses for studies to improve understanding of what percentage of the variation was related to either medical or health care organisational differences [1, 2, 3].

The association between CKD and cardiovascular (CV) risk factors, both traditional and non-traditional, has long been recognized [4]. CV risk factors have been

associated with progression of CKD and therefore may be expected to lead to higher rates of RRT. However, there was also the issue of competing risk, with CKD itself an independent predictor for CV disease and therefore also CV death prior to requiring RRT. Patients with stage 5 CKD were at high risk of CV morbidity and mortality [4], with rates in haemodialysis patients varying by age group from 2 (in older patients) to 20 times (in younger patients) higher than those of the general population of the same age [5]. These CV deaths accounted for 30–50% of all deaths on dialysis [5, 6]. Considerable centre-level variation has been demonstrated in attainment of standards for the traditional CV risk factors of blood pressure and cholesterol in the UK [7], but few other national registries routinely collected and reported such data.

The aims of these analyses are to present RRT incidence and prevalence rates for the four UK countries alongside those of a wide range of countries worldwide. Supplementary analyses aim to identify and summarise data from all national and international renal registries reporting attainment of standards data for traditional CV risk factors in relation to KDOQI guidelines for patients on RRT.

Table 14.1. Cardiovascular risk factors and relevant standards in the NKF KDOQI clinical practice guidelines

Traditional cardiovascular risk factors	Clinical practice guidelines
Target blood pressure for CVD reduction in CKD[a]	<130/80 mm Hg
Pre-dialysis blood pressure[b]	<140/90 mmHg
Post-dialysis blood pressure[b]	<130/80 mmHg
Target HbA1c[c]	<7.0%
LDL* [a]	<100 mg/dl (<2.59 mmol/L)

Treatment decisions for dyslipidemia in NKF-KDOQI guidelines and the Adult Treatment Panel III are based on levels of triglycerides, LDL, and non-HDL cholesterol.
[a] Moderate evidence that the practice improves net health outcomes
[b] Weak evidence that the practice improves net health outcomes
[c] Strong evidence that the practice improves net health outcomes
*Adults with stage 5 CKD

Methodology

Epidemiology

The data on incident and prevalent RRT patients in England, Wales, Scotland and Northern Ireland in 2007 were obtained from the UKRR database and collated to meet the specifications on the USRDS international data collection form. The numerators for incidence and prevalence were based on all incident and prevalent patients in England, Wales, Scotland and Northern Ireland and the general population data for the denominators were based on the entire populations of the four UK countries (obtained from the Office for National Statistics). In order to be consistent with the definitions used in the USRDS Report, a day 0 definition of RRT was used for RRT incidence rates. The UK rates quoted included an adjustment for paediatric patients – 2 pmp has been added to the RRT incidence rate and 14 pmp has been added to the RRT prevalence rate.

Data from tables in the USRDS annual data report 2008 were used to review the relative position of the UK countries in RRT incidence, prevalence, modality use and rates of transplantation compared with other international countries [8]. For the majority of countries included in the USRDS international comparison, data were for the year 2006; although for several countries, only data for earlier years were available.

Attainment of standards data

All national and regional renal registries were identified by reviewing international comparison chapters in renal registry annual data reports and following links from the UKRR, European Renal Association (ERA-EDTA) and USRDS website links pages. Where other international registries had websites, these were visited and any reporting of traditional CV risk factors (hypertension, diabetes and dyslipidaemia) were identified.

Data on these CV risk factors for England, Wales and Northern Ireland were obtained from the UKRR database. In the absence of internationally agreed standards for CV risk factors in dialysis patients, the relevant standards in the National Kidney Federation's KDOQI clinical practice guidelines were adopted as the target for optimal management (table 14.1) [9–11].

Results

Incidence of RRT

In 2007, the incidence of RRT in the UK was 111 pmp (figure 14.1). This rate placed the UK 34th out of the 43 countries reporting incidence data to the USRDS for 2006. However, the overall RRT incidence reported for the UK masked a higher rate of 142 pmp in Wales, when compared with 110, 109 and 107 respectively in Scotland, England and Northern Ireland.

The percentage of incident RRT patients with diabetes recorded as the primary renal diagnosis was relatively low in the UK at 20%, when compared with rates of over 40% in 9 out of the 36 countries that were able to report these data to the USRDS. Malaysia had the highest rate of diabetes as the primary renal diagnosis at 58% in 2006 (figure 14.2). Within the UK, Wales had the highest percentage at 34% of incident RRT patients with diabetes recorded as the cause of their renal disease, followed by

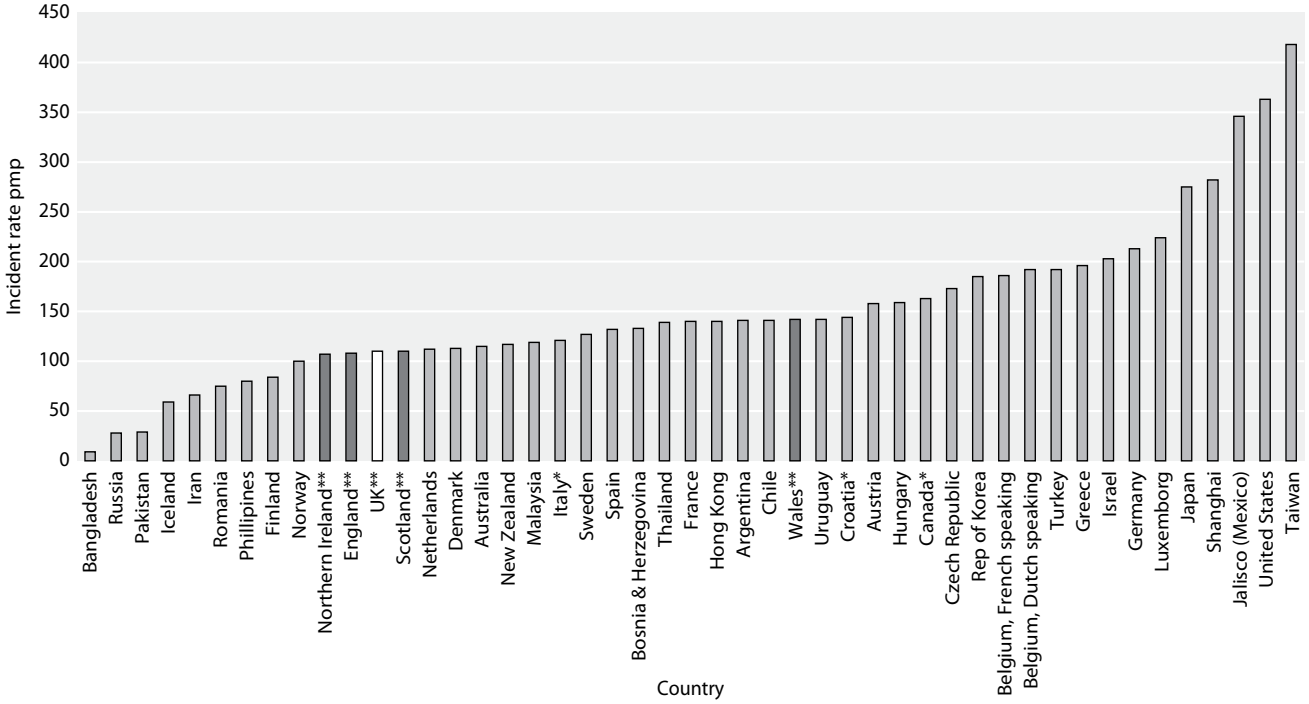

Fig 14.1. Incidence of RRT in different countries (pmp)
*2005 data
**2007 data

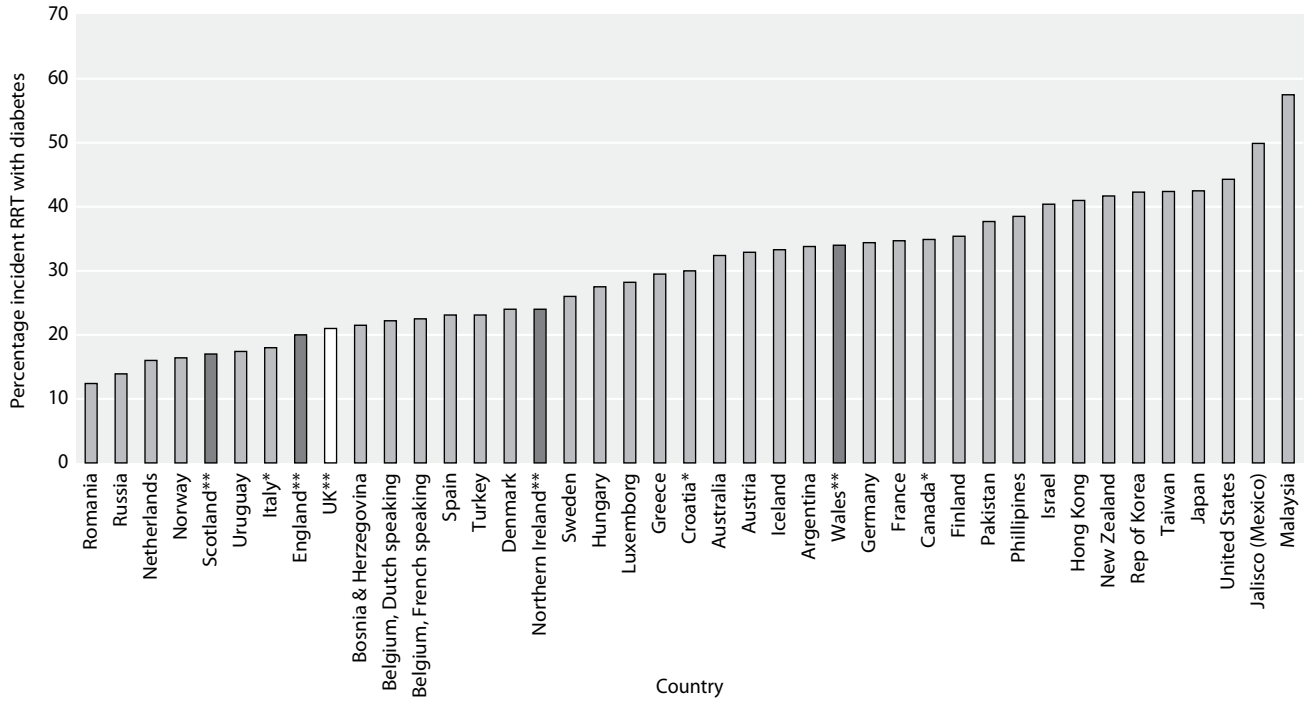

Fig. 14.2. Percentage of incident RRT population with diabetes mellitus as the primary renal diagnosis
*2005 data
**2007 data

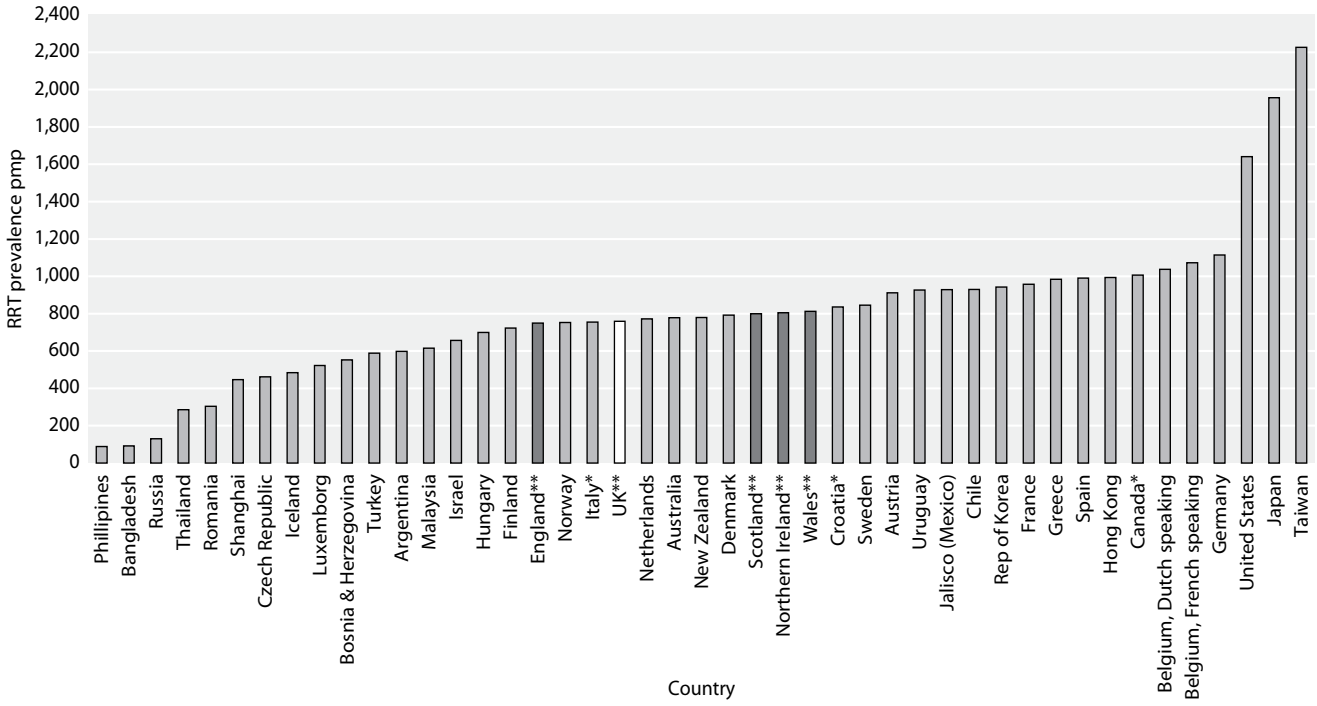

Fig. 14.3. Prevalence of RRT by country
*2005 data
**2007 data

24% in Northern Ireland, 20% in England and 17% in Scotland.

Prevalence of RRT

The RRT prevalence rate of 760 pmp in the UK was 23rd of the 41 countries reporting prevalence data to the USRDS (figure 14.3). Within the UK, rates were lowest in England at 750 pmp and highest in Wales at 812 pmp. Rates of home haemodialysis use were comparable between UK countries at 1.5–2.0% of the prevalent dialysis population. Australia and New Zealand continued to achieve home HD rates as high as 10–16% (figure 14.4).

Transplantation

Considering the number of renal transplants (combined deceased and live donor) performed in each country each year, the UK rate of 36 pmp placed it 15th of 38 countries, considerably lower than Spain, Jalisco (Mexico) and the USA where rates varied between 50–60 pmp (figure 14.5). Transplantation rates in all the four countries have increased compared with the last report with England having the highest transplantation rate at 37 pmp, Wales 35 pmp, Scotland 31 pmp and Northern Ireland 22 pmp.

Attainment of standards

The completeness of data for BP, HbA1c and total cholesterol is included in Tables 14.2 to 14.4. Completeness for HD and PD data from England, Wales and Northern Ireland for cholesterol was more than 80%; levels of data completeness were lower for post dialysis blood pressure and HbA1c.

Within the UK, the percentage of prevalent RRT patients with post-HD blood pressure <130/80 mmHg was 28% in England, 27% in Northern Ireland and 26% in Wales (table 14.2). The only national or regional renal registry reporting blood pressure (BP) in accordance with KDOQI standards was the Finnish Renal Registry which reported a similar figure with 28% of dialysis patients attaining a BP of <130/85.

Adequate diabetic control (defined as HbA1c <7%) in the prevalent HD patients, varied from 39% in Northern Ireland to 51% in England (table 14.3), although the completeness of data was 97% in Northern Ireland compared with 72% in England. Rates of attainment of the HbA1c standard appeared lower in Finland at 35%, who had a similar high rate of data completeness to Northern Ireland. The lower rates of data completeness for HbA1c in many UK centres do not indicate that HbA1c was not being measured, as the control of diabetic

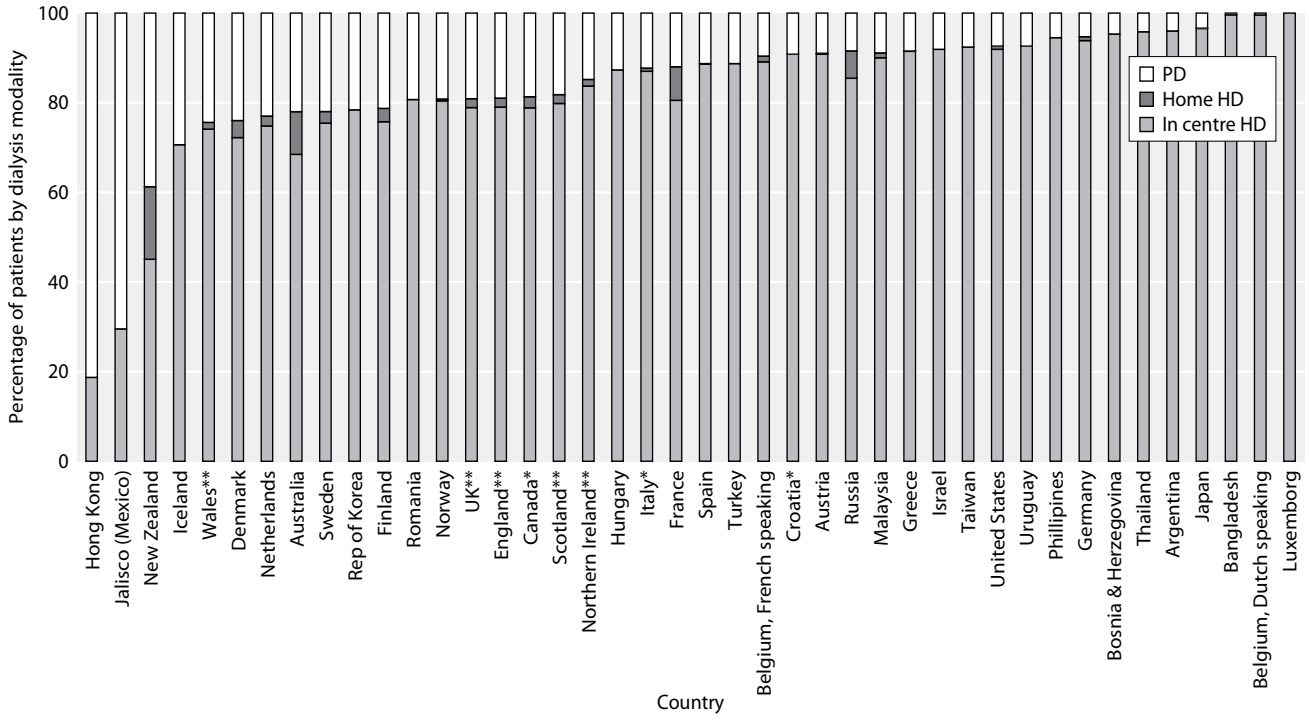

Fig. 14.4. Percentage of prevalent dialysis population by dialysis modality
*2005 data
**2007 data

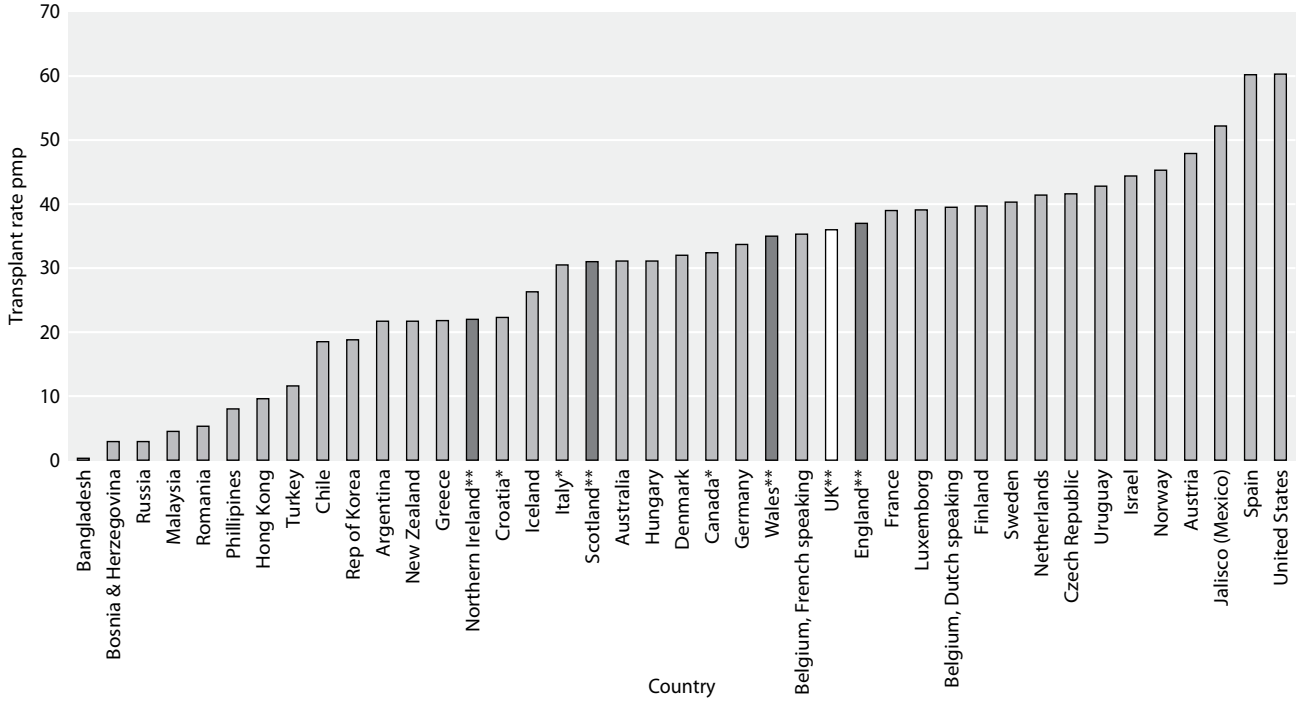

Fig. 14.5. Renal transplant incidence rate by country (pmp)
*2005
**2007

Table 14.2. Percentage of data completeness and achievement of post dialysis BP <130/80 mmHg

	England		N Ireland		Wales		
	HD	PD	HD	PD	HD	PD	Finland dialysis*
Completeness %	57	45	91	21	42	19	98
% BP <130/80	28	30	27	50	26	21	28

*All dialysis patients; cut-off 130/85 mmHg

Table 14.3. Percentage of data completeness (% of patients with primary renal disease of diabetes with HbA1c data) and achievement of HbA1c <7%

	England		N Ireland		Wales		
	HD	PD	HD	PD	HD	PD	Finland dialysis
Completeness %	72	74	97	78	26	36	98
% HbA1c <7%	51	36	39	21	46	55	35

Table 14.4. Percentage of data completeness and total cholesterol <5 mmol/L

	England		N Ireland		Wales		Malaysia*		
	HD	PD	HD	PD	HD	PD	HD	PD	Finland dialysis
Completeness %	80	81	95	96	82	90	n/a	n/a	96
% cholesterol <5 mmol/L	85	73	88	72	87	70	77	58	85

*<5.3 mmol/L

care is often monitored by general practitioners with results not being visible in the secondary care setting.

Generally PD patients achieved poorer control of diabetes than patients on HD. This was probably due to the additional glucose load from the PD fluid.

Information regarding the use of cardio protective medication and smoking among prevalent RRT patients were unavailable from other renal registries. In the USA, 72% of diabetic patients on dialysis were treated with ACE-I or angiotensin receptor blockers and HMG-Co A reductase inhibitors were prescribed in 51% of such patients.

Discussion

In 2007, the incidence of RRT in the UK was 111 pmp using the day 0 definition and after making the adjustment for paediatric patients. This RRT incidence rate placed the UK 34th out of 43 countries reporting to the USRDS in 2006. The overall incidence for the UK masked a higher incidence rate in Wales of 142 pmp. Taiwan had the highest incidence and prevalence of RRT of the 43 countries reporting data to the USRDS at 418 pmp.

The percentage of incident RRT patients with diabetes recorded as the primary renal diagnosis remained relatively low in the UK at 20%, compared with 44–58% in the United States, Jalisco (Mexico) and Malaysia. This overall UK rate again masked considerable variation between nations with 34% of incident RRT patients in Wales being listed as having diabetes as the primary renal diagnosis. While this may reflect a variation in interpretation of whether diabetes was a comorbidity or the primary renal diagnosis, the rate of diabetes mellitus does appear higher in Wales when data from the Welsh Health Survey [12] were compared with data from the Health Survey for England [13]; in Wales, 6% of respondents reported receiving treatment for diabetes mellitus whereas in England 4.3% of males and 3.4% of females reported that they had been given a diagnosis of diabetes by their doctor.

The 2007 RRT prevalence rate of 760 pmp placed the UK 23rd out of the 41 countries reporting to the USRDS. PD utilisation amongst prevalent dialysis patients varied

around the world from 0% in Luxembourg to 81% in Hong Kong. Australia and New Zealand lead the world with regard to home haemodialysis with rates of 9–16%. Despite National Institute for Health and Clinical Excellence guidance promoting home haemodialysis in the UK [14], the percentage of patients on this modality remained at 1.5 to 2% of the prevalent dialysis population.

The renal transplantation rate in the UK continued to improve, with increasing rates of living kidney and non-heart beating donation. However, the 36 new transplants per million of the population performed in 2007 in the UK remained considerably lower than in the United States (60 pmp), Spain (60 pmp) and Jalisco (Mexico) (52 pmp).

There was limited reporting of attainment of CV risk management standards by renal registries around the world. Further, where data were reported there was little consistency in definition adopted to enable international comparisons; the Finnish Registry reported HbA1c data according to the KDOQI standards and only the Finnish and Malaysian Registries reported attainment of cholesterol targets that were comparable (if not KDOQI consistent).

The percentage of prevalent dialysis patients in England, Wales and Northern Ireland achieving the KDOQI post dialysis BP standard (<130/80 mmHg) was low at 25–28%, but these rates were comparable to those reported by the Finish Renal Registry (28% for dialysis patients). Unfortunately the Malaysian Renal Registry reported attainment of pre dialysis blood pressure <140/90 mmHg (25.5% for HD and 53% for PD) and rates were therefore difficult to compare.

Rates of attainment of the diabetes mellitus HbA1c standard appeared much higher in the UK than in Finland, although it was difficult to know how to interpret this given the very different data completeness rates.

The USRDS collected details of a number of CV medication in patients with diabetes on RRT, but these data were not available from other registries. Reports from the Dialysis Outcomes and Practice Patterns Study have demonstrated significant variations (8–41%) in aspirin prescribing between countries [15]. Work is underway at the UKRR to electronically capture prescribed medication on renal IT systems used in dialysis centres, but to date no routinely available information exists on prescription rates for aspirin, beta blockers, HMG-Co A reductase inhibitors or ACE-inhibitors in patients on RRT in the UK.

Another hugely important CV risk is smoking status; this was recorded by many renal registries but often only at initiation of RRT and with no quantification of life-time exposure.

Despite the high CV morbidity associated with RRT, few renal registries routinely report data on CV risk management. Part of the explanation for this is likely to be the labour-intensive, paper-based reporting employed by many registries. Further, where data were reported there was little agreement in what represented quality of care, making direct comparison difficult. Uncertainty arising from apparently negative clinical trials of HMG-Co A reductase inhibitors [16] and paradoxical associations between BP and mortality [17] – reverse epidemiology – is likely to be contributing to this lack of agreement. If an evidence-based consensus could be reached on which quality markers for CV risk management should be reported by renal registries, international benchmarking of this important aspect of care may be achievable.

Conflict of interest: none

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Chapter 15
The UK Renal Registry, UKRR database, validation and methodology

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Key Words
Data validation · Methodology · Renal Registry

Abstract
The UK Renal Registry receives encrypted data extracts quarterly from each centre providing Renal Replacement Therapy (RRT) in England, Wales and Northern Ireland. Summary data is received from the Scottish Renal Registry to allow national statistics to be compiled. Data from patients receiving haemodialysis in satellite units or at home are reported through the main renal centre. Data from patients with functioning kidney transplants are reported through the centre providing routine clinical follow-up. The data are extracted from a variety of IT systems with varying functionality and no common messaging system, necessitating extensive data validation and cleaning prior to analysis. Growing confidence in the analyses since the inception of the Registry in 1995 has allowed de-anonymised centre-specific analyses of all outcomes, including survival, to be published, although incomplete data returns for primary renal diagnosis and comorbidity at start of RRT limit ability to adjust for case-mix.

Introduction

The UK Renal Registry (UKRR) started as a pilot project in 1995 in collaboration with 8 renal centres that operated information systems that reliably captured information on clinical care of patients undergoing Renal Replacement Therapy (RRT). Software was written that allowed information from these systems to be extracted, encrypted, and sent to the UKRR for analysis. The first Annual Report was published in 1998; all Annual Reports can be downloaded from the UKRR's website, www.renalreg.org. Since then, funding has been secured, the dataset has grown, and every adult renal centre in England, Wales and Northern Ireland has a suitable information system in place for submitting data to the UKRR. This chapter builds on previous descriptions of the function of the UKRR [1–4].

The Scottish Renal Registry [5] is funded and functions independently, but submits summary data to the UKRR, enabling the assembly of national information on incidence, prevalence, and outcomes of RRT.

In the early phase of UKRR reporting, centres were anonymised; now, each centre sending data is identified by name in the analyses published in the UKRR's

annual reports, including analyses of centre-specific age-adjusted survival. This chapter describes in detail how these data are obtained, validated, corrected, and analysed.

Organisation of delivery of RRT in the UK

From a history of under-provision [6–10], there has been massive growth in provision of RRT in the UK, driven partly by analyses from early UKRR reports and national surveys [11–16]. RRT for adults is currently provided by 72 centres within the UK and RRT for children is provided by 13 paediatric renal centres. Although since 1997 there has been some amalgamation where there was more than one centre in the same city (e.g. Glasgow 3 centres into 1, Leeds 2 centres into 1, West London 3 centres into 1), there has also been creation of new renal centres (e.g. York previously part of Leeds and Aintree previously part of Liverpool) as satellite dialysis units have expanded to become independent renal centres.

These renal centres are generally based within large district or regional hospitals. All the large and medium sized adult renal centres operate satellite dialysis units (46 out of 72 UK centres), which may be free-standing or based in a hospital or other healthcare setting. Medical supervision of treatment in satellite units is provided by nephrologists based in renal centres. Growth in satellite provision has largely been responsible for the growth in haemodialysis capacity [14]. Satellite units may be either staffed and funded solely through the NHS or operated by commercial providers under contract, either to the local NHS Trust accommodating the parent renal centre, or on an 'Independent Sector Treatment Centre' basis, in which the contract is held by the Secretary of State for Health. In all cases, medical supervision of RRT is provided by nephrologists paid by the NHS based in renal centres. Fully private, non-NHS funded provision of RRT in the UK is used almost exclusively by visitors from abroad. Provision of haemodialysis away from home ('holiday dialysis') is paid for by the parent renal centre, but capacity to accommodate patients needing such treatment varies with some provided by commercial centres. All main renal centres also offer peritoneal dialysis (although this may be provided by an adjacent centre), but only a few satellite dialysis units also provide this treatment modality.

Home haemodialysis programmes are run by 46 adult renal centres, some also accept referrals of suitable patients from neighbouring centres that do not offer this treatment modality.

Of the 72 adult renal centres, 23 also perform kidney transplantation. Patients are referred for transplantation from non-transplanting centres and from within the transplant centre. Non-transplanting centres may refer their patients to more than one transplant centre, usually on geographical grounds. Eight of the transplant centres in the UK are designated supra-regional centres for simultaneous kidney and pancreas transplantation, and accept referrals from neighbouring transplant and non-transplant centres. Allocation of organs retrieved from beating-heart deceased donor transplants is co-ordinated by the Directorate of Organ Donation and Transplantation (ODT, formerly UK Transplant) within NHS Blood and Transplant (NHSBT) according to a nationally agreed organ allocation scheme [17].

Organs retrieved from non-heartbeating donors are allocated according to local agreements, but are all registered with NHSBT, as are all UK based live donor transplants. NHSBT collects detailed information on kidney donors (including demographic information and ischaemic times) and on HLA typing of donors and recipients. Transplants that occur outside the UK are not recorded by NHSBT, although when these patients return to the UK with a functioning transplant, the UK Renal Registry will pick up this modality change and follow their outcomes.

All patients entitled to NHS care are registered with a general practitioner (primary care physician) who co-ordinates care and decides on referral for specialist investigation. The Quality and Outcomes Framework, a payment for performance incentive scheme for primary care in the UK, provides financial incentives for the maintenance in each general practice of a register of patients with CKD 3–5, together with markers relating to blood pressure control and receipt of ACE inhibitors or Angiotensin Receptor Blockers where indicated. National data on practice-level reported prevalence of CKD and on achievement of each quality marker are collated and published using the Quality Management and Analysis System (QMAS) [18] by the NHS Information Centre [18, 19]. National guidelines state that all patients with CKD4 and CKD5 should be discussed with or referred to renal physicians by their primary care physicians [20, 21]. The date of first referral to a nephrologist is included in the dataset for patients receiving RRT by renal centres and is reported to the UKRR. However, data on patients with advanced kidney disease receiving 'conservative', 'palliative', or 'supportive' care,

i.e. those patients with whom an active decision is made not to undertake RRT (usually for reasons of personal choice, frailty, comorbidity or limited life expectancy) are not currently submitted to the UKRR, although a pilot project is under way to extract data on patients with CKD5 from renal centre IT systems.

Information systems in use in renal centres in the UK in 2007–2009

Table 15.1 gives the information system currently in use in each adult renal centre, together with any immediate plans of which the UKRR is aware to move to another system.

The functionality of these systems was studied in a national survey in 2006 [22].

Most of these renal IT systems evolved and now operate semi-independently of other information systems within the hospital accommodating the renal centre, with bespoke software written to allow automatic uploading from laboratory systems (locally based and from other hospitals), from the patient administration data (PAS) and output from haemodialysis machines. This independence from the main hospital IT has allowed flexibility, for instance in the creation of locally specific data screens to support local care pathways, but with the disadvantage that this information is held in a 'silo' not visible to other hospital clinicians who may be involved in the care of these patients. These existing renal systems are currently not integrated with the new generation of electronic patient records (EPR). As healthcare computing in the UK evolves (supported in England by Connecting for Health, in Wales by Informing Healthcare, in Northern Ireland by Health and Social

Table 15.1. IT systems in UK adult renal centres

Adult centre	Current renal IT system	2009 changes
England		
Basildon	Mediqal eMed	
Birmingham QEH	In-house developed	
Birmingham Heartlands	CCL Proton	
Bradford	CCL Proton	
Brighton	CCL Clinical vision	
Bristol	CCL Proton	
Cambridge	In-house developed	
Canterbury	Chi Renalplus	
Carlisle	CCL Proton	
Carshalton	CCL Proton	
Chelmsford	Mediqal eMed	
Colchester	Fresenius	
Coventry	CCL Proton	
Derby	Vitalpulse Vitaldata	
Doncaster	Mediqal eMed	
Dorset	Mediqal eMed	
Dudley	CCL Proton	Mediqal eMed
Exeter	CCL Proton	
Gloucester	CCL Proton	Vitalpulse Vitaldata
Hull	CCL Proton	
Ipswich	Baxter	
Leeds	CCL Proton	
Leicester	CCL Proton	
Liverpool Aintree	CCL Proton	Cybernius Cyberen
Liverpool RI	CCL Proton	Cybernius Cyberen
London St Barts	Renalware	
London St Georges	CCL Clinical vision	
London Guys	CCL Proton	In-house developed
London West	In-house developed	CCL Proton
London Kings	Renalware	
London Royal Free	Renalware	
Manchester Hope	In-house developed	

Table 15.1. Continued

Adult centre	Current renal IT system	2009 changes
Manchester RI	CCL Clinical vision	
Middlesbrough	CCL Proton	
Newcastle	CCL Clinical vision	
Norwich	Mediqal eMed	
Nottingham	CCL Proton	
Oxford	CCL Proton	
Plymouth	CCL Proton	Vitalpulse Vitaldata
Portsmouth	CCL Proton	
Preston	CCL Proton	
Reading	CCL Proton	
Sheffield	CCL Proton	
Shrewsbury	Chi Renalplus	
Southend	CCL Proton	
Stevenage	Chi Renalplus	
Stoke	Cybernius Cyberen	
Sunderland	CCL Proton	
Truro	CCL Proton	
Wirral	In-house developed	
Wolverhampton	CCL Proton	
York	CCL Proton	
Wales		
Bangor	Baxter	
Cardiff	CCL Proton	Vitalpulse Vitaldata
Clwyd	Fresenius	
Swansea	CCL Proton	Vitalpulse Vitaldata
Wrexham	Chi Renalplus	
Northern Ireland		
Antrim	Mediqal eMed	
Belfast	Mediqal eMed	
Derry	Mediqal eMed	
Newry	Mediqal eMed	
Tyrone	Mediqal eMed	
Ulster	Mediqal eMed	
Scotland		
Aberdeen	CCL Clinical vision	
Airdrie	Mediqal eMed	
Dunfermline	CCL Proton	Vitalpulse Vitaldata
Dumfries	CCL Proton	Vitalpulse Vitaldata
Dundee	Mediqal eMed	
Edinburgh	CCL Proton	
Glasgow	CCL Proton	Vitalpulse Vitaldata
Kilmarnock	CCL Proton	Vitalpulse Vitaldata
Inverness	None	Chi Renalplus

Care and in Scotland by NHS Scotland), there is a consensus that the EPR should include all aspects of this functionality, although now it is no longer proposed that this be provided through a single software solution. In England, the contract with Local Service Providers (section 167.2.1) requires that all Trusts support a computer package capable of supporting the UK Renal Registry Dataset.

In 2008 the NHS in England finalised a range of Framework Contracts through open competition to provide additional capacity and capability in the supply of IT services to the NHS. These contracts are not intended to replace the contracts already let for the National Programme for IT. The procurement of the Framework Contracts for Additional Supply Capability and Capacity (ASCC) was initiated with the publication

of an OJEU Notice in March 2007 (the Official Journal of the European Union). The Frameworks will enable the streamlined procurement of IT systems and services from suppliers to cover specialist areas such as renal, coronary heart disease, e-prescribing, critical care, social care, child health etc. (http://www.connectingforhealth.nhs.uk/industry/ascc/appointedlot2).

The UKRR dataset and the National Renal Dataset

In England and Wales, the National Renal Dataset provides the specification of information to be collected by the NHS to support implementation of the National Service Framework for Renal Services, which set out a national policy and ten year plan for care of patients with kidney disease [23, 24], supported by an Information Strategy that included the development of a National Renal Dataset [25, 26], collection of which will be used by kidney care services to assess their achievement of the quality standards and to improve kidney care for patients.

The National Renal Dataset has been approved as a Full Operational Information Standard by the Information Standards Board for Health and Social Care. This is the first approved dataset covering the whole of a specialty. A Dataset Change Notice (DSCN) has been issued to formally notify English NHS Trusts and information system suppliers of this approval [27]. The same dataset is being adopted by the Welsh government. This makes it a legal requirement for Trusts to return the full dataset and obliges system suppliers within the National Programme for IT to enable Trusts to record the data covered by the DSCN. Some parts of the dataset are to be returned electronically to the UKRR: those parts currently returned to NHS Blood and Transplant may continue to be returned using paper returns.

Implementation of the dataset is mandated in two phases,

- collection of 693 data items from May 2009 and
- collection of an additional 188 data items from April 2011.

Data extraction from renal centre information systems

Each centre submits a quarterly data extract to the UKRR. This requires software routines to extract these data items from the information system and transmit them in the required file format. Running these routines is the responsibility of the renal centre, although the UKRR has historically provided advice and support to those centres using the Proton system.

Data validation and error correction

Many of the local renal IT systems have limited field validation at the time of data entry. The UKRR therefore validates all fields that are not free text. The data management staff at the Registry contact the renal centre to discuss missing mandatory items and correction of other data errors. All coded fields are validated against the relevant code table. All numeric fields are checked that they contain only numeric data and are then validated against range checks. The findings of a case-note based validation exercise in all 5 renal centres in Wales were reported in 2005 [4].

Special field checks

1. *The postcode* is validated using a commercial postcoding package (QAS systems), which checks the validity of the postcode against the address fields, with the software automatically correcting the majority of postcode errors. Some cannot be resolved in an automated fashion and these require manual intervention. A correct validated postcode is important as they are used for NHS number tracing and also by the UKRR for PCT mapping and social deprivation scoring.
2. *The NHS number* is a unique numeric identifier for patients in England & Wales (although still not in common usage within renal IT systems). This is stored in the UKRR database as a non-duplicated indexed field. The Registry submits files to the NHS number tracing service and liaises with centres over any data conflicts.
3. *The UK Transplant number* is a unique numeric identifier allocated by UK Transplant to patients that are on the UK transplant waiting list, or who have been transplanted in the UK (although it may be held only at the transplanting centre). This is stored in the UKRR database as a non-duplicated indexed field. The Registry validates these numbers annually with UK Transplant, with this process detecting mis-keyed data entry errors (e.g. 97074 instead of 90774). Renal centres are informed of any mis-keying errors found.

4. *The date of death field* is received from renal centres and in England & Wales also from the NHS Tracing service (validated through links with the Office for National Statistics, (which collects data on all births and deaths in these countries). Any subsequent data arriving after this date (e.g. laboratory or modality change) triggers a validation query.

Avoidance of duplicate patients

The UKRR receives patient data from both dialysis and transplant centres and if the right systems are not in place, it can be very easy for patients to be duplicated on the database.

Where NHS numbers are not sent, identification of duplicate patients is not just a simple process of flagging up patients with the same surname, forename and date of birth. Many patients have their names spelt in a slightly different way on different databases and it is impossible to impose consistency between two sites. In addition, dates of birth can vary (by days or months), and renal centres have been unwilling to change these data, partly perhaps because the local automated laboratory links may fail to load patient data if the date of birth or name is spelt differently from that held in the laboratory systems.

In addition to checking for uniqueness of the NHS number and any UK Transplant number before creation of a new patient record, there is a Soundex database index on names. The Soundex index is used on an annual database check for duplicate patients as it requires a lengthy manual intervention process on all queries.

Logical rules

In addition to simple range checks there are many logical rules e.g.

- a systolic blood pressure lower than the diastolic BP is rejected: this error frequently happens in this manual data entry field when an entry of 140 for example, may be mis-keyed as 14
- inappropriate data for specific treatment modalities: for example, a urea reduction ratio value or length of time on haemodialysis cannot be sent whilst the patient has a modality of peritoneal dialysis
- every patient must have at least one treatment modality entry.

Pragmatic rules

These are more complicated rules that are run on the database after each file load or on an annual data check.

1. There must be new patients starting RRT in every quarterly file received from the renal centre.
2. There must be some deaths in every quarterly file and the total number of deaths over a year should be evenly spread. A lack of deaths registered often represents a software extraction fault rather than an error of logging by the renal centre. An excess of deaths in a given quarter can also be identified and investigated.
3. Completeness for each data item submitted by a centre is compared with completeness in previous data extracts. Data items that have been previously sent from a centre and then become missing for all patients in a subsequent data extract are identified (e.g. ethnicity). This is usually due to local changes in the renal centre IT system. For instance, one site showed a large increase in missing urea reduction ratio data that had arisen from an undetected clerical error in storage of the post-dialysis sample data in the local database.
4. Duplicate notification of a renal transplant from both the transplant and dialysis centre is detected by checking the dates of transplantation. Patients with a second renal transplant within 4 weeks are identified. The date sent by the transplanting centre is always assumed to be the correct date and the duplicate entry is removed.
5. Data returns on the treatment timeline indicating that a patient has undergone transplantation in a non-transplanting centre are rejected and investigated.
6. Missing laboratory data over three consecutive quarters for an individual patient trigger investigation to check that that patient has not died or been transferred for follow-up elsewhere without completion of the appropriate treatment timeline entry.
7. Numerical values for each laboratory variable are compared from quarter to quarter. Identical values in three successive quarters trigger investigation, as this may be due to an error in the extraction software that results in extraction of an earlier value if no later value exists in the local database.
8. Annual prevalent patient numbers are expected to rise. A fall in stock of prevalent patients could be due either to transfer of a significant number of patients to a newly opened neighbouring centre, or to a data extraction problem.
9. Annual incidence rates are compared with previous years' data for each centre. Marked changes in either direction trigger investigation.

Statistical rules

Statistical routines written in the SAS statistical language run further consistency checks on the annual data, for example:

1. Recheck on the final patient numbers.
2. Check the late presentation (referral) statistics. Is the percentage who were first seen by a nephrologist on the same day they started RRT believable? For most centres, up to 5% of new patients fall into this category. However, a few centres have 10% or more. For new patients in 2007 there were 6 centres which had values ranging from 22 to 100% and these were excluded from analysis.
3. Is there a difference between the pre-dialysis and post-dialysis blood pressure? Typically only 1 or 2% of patients have both readings exactly the same. A cut-off of 5% to highlight problems is used, so if both the pre-HD and post-HD systolic and diastolic BPs are identical for more than 5% of a centre's patients for a quarter the data is likely to be invalid and indicates a possible software extraction error.

Statistical analysis

Data are extracted from the main database (without patient name or address identifiers) on an annual basis using SQL routines. These tables are then loaded into SAS, which separates data files into the analysis groups (e.g. incident patients by each year, prevalent patients by year, patients to be used for laboratory analyses, etc).

The majority of the analyses are coded in SAS, other packages (e.g. Stata, MLwin) are used when appropriate.

Governance

The work of the UKRR is prioritised by the UKRR Committee, which reports to the Clinical Affairs Board of the Renal Association, the professional body for nephrologists in the UK. The Chair of the UKRR Committee is appointed by the Trustees of the Renal Association (http://www.renal.org/pages/pages/the-association/memorandum-articles-rules/rules-of-the-association.php). There are two subcommittees focusing on outcomes of dialysis and of transplantation. The business aspects of the UKRR are overseen by the Management Board, comprising the Trustees of the Renal Association together with the Director and General Manager of the UKRR. The Management Board is chaired by the immediate past President of the Renal Association. Suggestions for additional analyses are processed by the subcommittees and Committee. The UKRR provides occasional *ad hoc* analyses for the Department of Health, specialised commissioners and to support local or regional audit.

There is a need for clarity on the role of the Registry's responsibilities under the principles of clinical governance, particularly if an individual renal centre appears to be under-performing on one or more key measures of clinical activity. The process set out below has been agreed by the Clinical Affairs Board of the Renal Association.

The Registry Report is sent to the Chief Executives of all Trusts in which a renal centre is situated, since the responsibility for clinical governance within the Trust lies formally with the Chief Executive.

In the event that Registry analyses of data from a renal centre give rise to professional concern (e.g. mortality or transplantation rates), the data will first be validated internally by the Registry and then the source data checked with the reporting renal centre.

If the findings and analyses are robust and concern appears warranted, the Registry Chairman will notify the President of the Renal Association and will write to explain the findings to the clinical director or specialty lead of the relevant centre, asking that this information be passed to the Chief Executive of the Trust concerned and also to the Clinical Governance lead for that Trust. Written evidence of the internal hospital transfer of information should be received by the Renal Association within 8 weeks. If such evidence is not forthcoming the President will write to the Medical Director and Chief Executive of the Trust. The Renal Association can offer support (in terms of senior members providing advice) if requested by the Medical Director.

Systems and data security

Systems

There are no paper returns to the Renal Registry. The electronic patient data files are all processed on a Linux computer server.

The computer server is located in the North Bristol NHS Trust's purpose built secure computer suite. Physical access to this room is restricted by hospital security protocols to senior IT staff. The Renal Registry has examined the physical security of the facilities and found these satisfactory.

The computer server has its own tape backup system, with the tape rotated on a daily basis by the hospital IT staff. These tapes are stored along with the hospital system backups, in the hospital's fire proof safe.

Access to the system is controlled by the security arrangements already in place to safeguard North Bristol NHS Trust, i.e. the hospital firewall. Access to the UKRR database server is only allowable from within the internal North Bristol NHS Trust network. Only the network hub from the Renal Registry is provided with a network connection through to the Registry computer server.

Data Security and Integrity

All users who are granted access to Renal Registry data have an individual and unique password allocated by the Systems Manager. Each user is assigned a level of security that determines the 'sensitivity' of the data that they can access. Only Registry employees are granted access to the data held by the Registry.

The Systems Manager is the only person who is granted access to the Registry systems at operating system level, all other users have their access controlled by their security level and are 'locked' into a menu system dependant upon that security level.

Any additions, amendments or deletions made to the data are recorded. 'Before' and 'after' images of the data are written together with the user name of the person making the change and the date and time of the change.

All communications involving patient identifiable data are encrypted using the open PGP standard [28], a public/private key system which supports the 256 bit Blowfish algorithm.

For data analysis, identifiable data (e.g. names, addresses, NHS numbers) are not extracted.

Patient confidentiality and the National Health Service Act 2006 section 251 and the Health and Social Care Act 2001: section 60 exemption

The UKRR collects information with patient identifiers including the name, postcode, date of birth, and NHS number. The collection of patient identifiable data without patient consent is regulated by statute National Health Service Act 2006, section 251. This was previously known as The Health and Social Care Act 2001: section 60, this renaming was due to the fact that every 10 years or so, the UK Parliament combines into a single legislative Act all the many Acts relating to the NHS and at the same time this process repeals all the previous NHS legislation.

The UKRR has been granted temporary exemption by the Secretary of State to hold patient identifiable data under section 251 of the National Health Service Act 2006. This exemption allows the registration of identifiable patient information from renal centres without first asking the consent of each individual patient, avoiding a breach of the common law on confidentiality. This exemption is temporary and is reviewed annually.

Patients have the right to ask that their identifiers are not submitted to the UKRR at the time of quarterly data returns and posters explaining this option are displayed in each renal centre.

The collection of patient identifiers enables the UKRR to perform data linkage with external datasets e.g. those held by UKT (for analyses of access to and outcomes from kidney transplantation). Permission for linkages to other datasets requires approval by the monitoring body for section 251 of the NHS Act 2006 (Patient Information Advisory Group) and the Registry is currently investigating linkages to the Health Protection Agency and the Hospital Episode Statistics database.

Caldicott Requirements

There has been recent concern in the UK over loss and insecure access to confidential information. The UK Registry is a recipient of patient identifiable data. The Caldicott guardian's job in each Trust is to make sure that any identifiable patient data that leaves the Trust site is authorised and complies with the Trusts current responsibilities and that the data held externally will remain secure.

The UKRR is registered under the Data Protection Act and this can be verified independently within the Trust using the following website (registration number Z8096557) http://www.esd.informationcommissioner.gov.uk/esd/search.asp.

The Registry also must apply for annual exemption under the NHS Act 2006 section 251 and Trusts may independently verify our listing on the official register using the following link (http://www.advisorybodies.doh.gov.uk/piag/register.htm).

Conflict of interest: none

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Appendix A
The UK Renal Registry statement of purpose

1. Executive summary
2. Introduction
3. Statement of intent
4. Relationships of the UK Renal Registry
5. The role of the UK Renal Registry for patients
6. The role of the UK Renal Registry for nephrologists
7. The role of the UK Renal Registry for Trust managers
8. The role of the UK Renal Registry for commissioning agencies
9. The role of the UK Renal Registry in national quality assurance schemes
10. References and websites

A:1 Executive summary

1.1 The UK Renal Registry (UKRR) was established by the Renal Association to act as a resource in the development of patient care in renal disease.

1.2 The Registry acts as a source of comparative data for audit, benchmarking, planning, policy and research. The collection and analysis of sequential biochemical and haematological data is a unique feature of the Registry.

1.3 Agreements have been made with participating renal centres, which ensure a formal relationship with the Registry and safeguard confidentiality.

1.4 The essence of the agreement is the acceptance of the Renal Registry Data Set Specification (RRDSS) as the basis of data transfer and retention.

1.5 Data is collected quarterly to maintain centre-level quality assurance, with the results being published in an annual report.

1.6 Activity is funded from commissioning agencies by a capitation fee on renal patients.

1.7 The UKRR is responsible, with the express agreement of participants, for providing data to Trusts, Primary Care Trusts (PCTs), commissioning authorities and the European Renal Association–European Dialysis and Transplant Association (ERA–EDTA) Registry.

1.8 The development of the Registry is open to influence from all interested parties, including clinicians, Trusts, commissioning authorities and patient groups.

1.9 The Registry is non-profit making and has a registered charitable status through the Renal Association.

A:2 Introduction

2.1 Registry-based national specialty comparative audit is one of the cornerstones of NHS development. The Renal National Service Framework (NSF), published in two sections in 2004 and 2005, recommended the participation of all renal centres in comparative audit through the Renal Registry, with co-temporaneous documents defining the necessary information strategies [1–4].

2.2 The shape of future national audit will be set not only by conventional medical criteria, but also by NSF recommendations, prompted through the Healthcare Commission (now renamed as the Healthcare Quality Improvement Partnership). The necessary detail is currently the subject of a formal scoping project, in which the Registry is

represented. The final relationship of the Registry to the Healthcare Quality Improvement Partnership has yet to be defined.

2.3 The Chief Executives of Trusts are responsible for clinical governance and audit will be an essential part of that agenda [5].

2.4 Demographic information on patients receiving renal replacement therapy (RRT) throughout Europe was collected from 1965 in the Registry of the ERA–EDTA. This voluntary exercise was conducted on paper and by post, demanded considerable effort and time from participating centres and eventually proved impossible to sustain. Latterly, the incompleteness of UK data returns to the ERA–EDTA made it impossible to build a picture of the activity of RRT in the UK for planning and policy purposes. Subsequently, five ad hoc national data collections from England & Wales were solicited from renal centres in 1992, 1996, 1999, 2002 and 2004 to fill this gap. The UKRR is well placed to put such surveys on a permanent and regular footing and progress towards the inclusion of Chronic Kidney Disease (CKD) is being made.

2.5 Together with the need to know the demographic and structural elements, the NHS has developed a need to underpin clinical activity more rigorously through the scientific evidence base (for example, the Cochrane Initiative) and by quality assurance activity through audit. These initiatives require comprehensive information about the structures, processes and outcomes of RRT, which go well beyond the detail previously compiled by the ERA–EDTA.

2.6 The Registry is recognised as one of the very few high-quality clinical databases available for general use [6]. The collection of data by download of electronic records from routine clinical databases is uncommon, has been highly successful and is being imitated worldwide.

2.7 The Renal Association has made a start in the area of audit by publishing guidelines in 'Renal Standards' documents. It was apparent during the development of the Standards that many of the desirable criteria of clinical performance were uncertain or unknown and that only the accumulated data of practicing renal centres could provide the evidence for advice on best practice and what might be achievable. A common data registration provides the simplest device for such an exercise.

2.8 The continuing emphasis on evidence-based practice is being supported by changes in research funding (Culyer Report and recent national statements), which lean towards collaborative projects and include both basic science and 'health services research' components. It is apparent that an RRT database is invaluable to a wide range of research studies.

2.9 It can be seen that the need for a Registry of RRT has developed for a variety of reasons: international comparisons, national planning, local Trust, PCT and health authority management, standard setting, audit and research. The opportunity for data gathering arises partly from improvements in information technology. Although it was possible to see the need for a national renal database 20 years ago, the circumstances have become ideal for the maintenance of a data repository, supported by the clinical users and resourced for national benchmarking as a routine part of RRT management.

2.10 The provisional expectations of earlier annual reports can now be replaced by confident assertions, built on the experience of nine years of publication, about the role and potential of the UKRR. The integration of the various elements of Renal Association strategy is being pursued through the Clinical Affairs Board (CAB).

A:3 Statement of intent

The Renal Registry provides a focus for the collection and analysis of standardised data relating to the incidence, clinical management and outcome of renal disease. Data will be accepted quarterly according to the RRDSS by automatic downloading from renal centre databases. There will be a core dataset, with optional elements of special interest that may be entered by agreement for defined periods. A report will be published annually to allow a comparative audit of facilities, patient demographics, quality of care and outcome measures. Participation is mandated through the recommendation in the Renal National Service Framework. There will be an early concentration on RRT, including transplantation, with an extension to other nephrological activity over time. The Registry will provide an independent source of data and analysis on national activity in renal disease.

A:4 Relationships of the UK Renal Registry

4.1 The Registry is a registered charity through the Renal Association (No. 2229663). It was established by a committee of the Renal Association, with additional representation from the British Transplantation Society, the British Association for Paediatric Nephrology, the Scottish Renal Registry, Wales and Northern Ireland. There is cross-representation with both the Renal Association Standards and Clinical Trials Committees and the Clinical Affairs Board. The Registry has a Chairman and Honorary Secretary nominated by the Renal Association. The Registry has an observer from the Department of Health, a participant from the National Kidney Federation (NKF) (patients' association), the Royal College of Nursing, the Association for Clinical Biochemistry and a member representing the Health Care Commissioners.

4.2 A number of sub-committees have been instituted as the database and renal centre participation developed, particularly for data analysis and interpretation for the annual report. Further specialised panels may be developed for publications and the dissemination of UKRR analyses.

4.3 The Scottish Renal Registry sends data to the UK Renal Registry for joint reporting and comparison.

4.4 The return of English, Welsh and Northern Ireland data to the EDTA–ERA Registry will be through the Renal Registry. The Scottish Renal Registry already sends data directly to the EDTA–ERA Registry.

4.5 A paediatric database has been developed in collaboration with the UKRR, and the two databases are compatible. These two databases are in the process of being integrated, which will allow long-term studies of renal cohorts over a wide age range.

4.6 Close collaboration has been achieved with the NHS Blood and Transplant organisation – (formerly UK Transplant) giving joint benefits. Data aggregation and integration has led to joint presentations and publications. The description of the entire patient journey in RRT by this means is a source of continuing insight and usefulness.

4.7 The basis of participation for renal centres nationally is an agreement to accept the RRDSS for the transmission and retention of data. This is currently increasing to a core dataset of approximately 400 items and further optional elements, which will be returned on a special understanding with the renal centres for a defined period of reporting.

4.8 The UKRR is part of the team undertaking an investigation into the necessary scope of national audit for the Healthcare Quality Improvement Partnership, in the light of the NSF.

4.9 The retention of patient identifiable information, necessary in particular for the adequate tracing of patients, has been approved by the Patient Information Advisory Group (PIAG), under Section 60 of the Health and Social Care Act. This is pending the introduction of mechanisms that will preserve patient anonymity through encryption of a unique patient identifier.

4.10 It is anticipated that the UKRR will receive data from the Secondary Uses Service (SUS) of the national IT programme, Connecting for Health, when it is fully instituted. The detail of data routing from renal centre clinical systems to the national database has yet to be established.

A:5 The role of the UK Renal Registry for patients

5.1 The goal of the UKRR is to improve care for patients with renal disease. The appropriate use of UKRR information should improve equity of access to care, adequacy of facilities, availability of important but high-cost therapies such as erythrocyte stimulating agents and the efficient use of resources. The continuing comparative audit of the quality of care should facilitate the improvement of care and outcomes of care. It is intended to identify and publish examples of good practice. In such ways, patients will be the ultimate beneficiaries of the exercise.

5.2 A leaflet has been provided, in collaboration with the NKF, by which patients may opt out of the collection of identifiable data by the UKRR if they wish.

5.3 Information from the UKRR will complement the individual records available on 'RenalPatientView' where it is accessible.

A:6 The role of the UK Renal Registry for nephrologists

6.1 The clinical community have become increasingly aware of the need to define and understand their

activities, particularly in relation to national standards and in comparison with other renal centres.

6.2 The UKRR is run by a committee of the Renal Association and therefore by colleagues with similar concerns and experience.

6.3 The Renal Standards documents are designed to give a basis for centre structure and performance, as well as patient-based elements such as case mix and outcomes. It is anticipated that Standards will become increasingly based on research evidence and the Cochrane Collaboration has recently resourced reviews of renal topics, which will support this conversion.

6.4 The UKRR data are available to allow the comparative review of many elements of renal centre practice. Centre data are presented to allow a contrast of individual centre activity and results against national aggregated data. Sophisticated analyses of patient survival for example, are a unique resource to exclude any anomalies of performance and standardise for centre caseload, etc.

6.5 Reports of demographic and treatment variables are available to the participating centres for distribution to Trusts, PCTs, Strategic Health Authorities and Commissioners, as well as Renal networks, as required and agreed with the centre. Reports should facilitate discussion between clinicians, Trust officers and commissioners.

6.6 Customised data reports can be made available by agreement with the Registry Committee. A charge to cover any costs incurred may be requested.

6.7 The UKRR is developing the publication of focused and extended synopses of chapters from the annual Report. These 'dips' will facilitate the appreciation and application of comparative data and will allow wider distribution.

6.8 The Registry Committee welcome suggestions for topics of national audit or research that colleagues feel are of sufficiently widespread interest for the UKRR to undertake.

6.9 The database has been designed to provide research facilities for future participation in national and international trials. Members of the Renal Association and other interested parties are welcome to apply to the Registry Committee to conduct local or national audit and research using the database. All such projects will need the agreement of the Registry Committee and any costs involved will need to be met by the applicants.

6.10 These facilities will be sustainable only through co-operation between nephrologists and the UKRR. There is a need for high-quality and comprehensive data entry at source.

6.11 The sustaining of data collection, organisation and transmission from peripheral sites is not centrally resourced. The lack of clear status for many informatics staff at centre level, the imminent inroads of the national IT programme Connecting for Health, and the potential disruptions of Agenda for Change will be balanced by the development of formal informatics organisations (The UK Council for Health Informatics Professions (UK CHIP) [7], the NHS Faculty of Health Informatics [8] and the Association of ICT Professionals in Health and Social Care (ASSIST) [9].

6.12 Centres will need to develop an 'annual informatics plan', to review the maintenance and improvement of data collection organisation and returns to the UKRR. This will help maintain the accuracy, timeliness and completeness of clinical data and also in parallel, support the career development of informatics staff.

A:7 The role of the UK Renal Registry for Trust managers

7.1 As the basis of the clinical governance initiative, the gathering and presentation of clinical data are regarded as essential parts of routine patient management in the health service.

7.2 One of the principles of health service informatics is that the best data are acquired from clinical information recorded at the point of health care delivery.

7.3 Renal services data entered on local systems by staff directly engaged with patients are likely to be of the highest quality and it is these that the UKRR intends to capture.

7.4 The UKRR provides a cost-effective source of detailed information on renal services.

7.5 The regular reports of the UKRR supply details of patient demographics, treatment numbers, treatment quality and outcomes. Data are compared with both national standards and national performance, for benchmarking and quality assurance. The assessment of contract activity and service delivery is possible through these data returns,

without the need for further costly Trust or commissioner administrative activity. These data should be particularly valuable to contracts managers and those responsible for clinical governance.

7.6 Data are available on centre case mix, infrastructure and facilities.

7.7 Work is progressing on the data capture and analysis from patients with renal disease other than those requiring RRT and will become available in time (e.g. CKD).

7.8 It is anticipated that Trust interests may be served through the participation of a national Trust representative on the Registry Committee.

A:8 The role of the UK Renal Registry for Commissioners of health care

8.1 The commissioners of health care include Regional Specialty Commissioning Groups, the networks or joint renal strategy groups supporting them and the Primary Care Trusts.

8.2 The use of information sources such as the UKRR is advised in the National Renal Review in order to promote benchmarking and quality assurance of renal programmes. The comprehensive tracking of relatively small but costly renal cohorts should be regarded as a routine part of speciality case management.

8.3 The UKRR provides validated, comparative reports of renal centre activity on a regular basis to participating centres. These allow assessment of centre performance across a wide range of variables relating to structure, process and outcome measures.

8.4 There are economies of scale in the performance of audit through the UKRR, since multiple local audits are not required.

8.5 The incidence of RRT treated locally, mortality and renal transplant rates should also be of interest. The assessment of referral and treatment patterns of patients with established (end stage) renal failure by postcode analysis indicates the geographical origin. This information also allows the expression of differences relating to geography, ethnicity and social deprivation. These data may also identify potential unmet need in the population and permit assessment on the equity of service provision. In the future, the UKRR database should also provide information on nephrology and pre-dialysis patients (CKD). This will allow a prediction of the need for RRT facilities, as well as indicating the opportunities for beneficial intervention.

8.6 UKRR data are used to track patient acceptance and prevalence rates over time, which allows the modelling of future demand and the validation of these predictions.

8.7 Information on the clinical diagnosis of new and existing RRT patients may help identify areas where possible preventive measures may have maximal effect.

8.8 The higher acceptance rates in the elderly, and the increasing demand from ethnic groups due to a high prevalence of renal, circulatory and diabetic disease, are measurable.

8.9 Comparative data are available in all categories for national and regional benchmarking.

8.10 The UKRR offers independent expertise in the analysis of renal services data and their interpretation, a resource that is widely required but difficult to otherwise obtain.

8.11 The 2007 cost of supporting the UKRR was £16 per registered patient per annum (2008 £17 and 2009 £18 per patient), which is less than 0.05% of the typical cost of a dialysis patient per annum. It is expected that this cost will need to be made explicit within the renal services contract.

8.12 The Registry Committee includes a representative from the health care commissioners. This allows an influence on the development of the UKRR and the topics of interest in data collection and analysis.

A:9 The role of the UK Renal Registry for national quality assurance agencies

9.1 The role of the UKRR in the national quality assurance programme of the Healthcare Quality Improvement Partnership, (previously the Healthcare Commission) will depend on the decisions on the role and responsibilities of that agency and their means to discharging them.

9.2 The demographic, diagnostic and outcomes data could support the investigation of clinical effectiveness.

9.3 The case mix information and comorbidity data that would allow better assessment of survival statistics remains incomplete. There is also some

clinical scepticism whether 'correction' of outcome data would reflect the realities of clinical practice.

9.4 With the publication of renal centre survival data, consideration of this issue in particular would be welcome in nephrological circles, with correspondence to the Registry Committee (email: renalreg@renalreg.com).

A:10 References

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Appendix B
Definitions and analysis criteria

B:1 Definition of the take-on (incident) population

The take-on population is defined as all patients over 18 who started RRT at UK Registry centres and did not have a recovery code within 90 days.

The treatment timeline is used to define take-on patients as follows:

If a patient has timeline entries from more than one centre then these are all combined and sorted by date. Then, the first treatment entry gives the first date of when they were receiving RRT. This is defined as a 'start date'. However, in the following situations there is evidence that the patient was already receiving RRT before this 'start date' and these people are not classed as take-on patients:

- Patients with an initial entry on the timeline of transferred in (codes 39 to 72)
- those with an initial entry of transferred out (code 38)
- those with an initial treatment of lost to follow up (code 95)
- those who had graft acute rejection (code 31) and did not have a transplant on the same day
- those with an initial entry of transfer to adult nephrology (code 37)
- those with an initial entry of graft functioning (code 72)
- those with an initial entry of nephrectomy transplant (code 76)

Where none of these applies, the entry is defined as a take-on (as long as there is no recovery code within 90 days).

If there is a recovery code **after** 90 days then the program looks at the modality codes after this date to see if the patient restarted RRT. If they did then this is classed as another take-on (however long the gap between the recovery code and the next treatment entry).

For example, a patient may start RRT in 2005, recover and then restart RRT in 2005. Providing that they do not have a recovery code within 90 days on either occasion, such patients will be counted twice.

Note: patients restarting dialysis after a failed transplant were not counted as take-ons.

B:2 Definition of the prevalent population for each year

The prevalent population for a year is defined as all RRT patients over 18, being treated at centres which were UK Registry centres for that year, who were alive on 31 December. It includes both incident patients for that year and patients who have been on treatment for longer. Note that any patients over 18 who are still being treated at paediatric centres are excluded.

Patients were only included under their primary treatment centre.

Patients who had transferred out, recovered function, stopped treatment without recovery of function or been lost to follow up before the end of the quarter were excluded.

Further exclusions when analysing quarterly biochemistry or BP data

For these analyses, further restrictions were made to the prevalent cohort for each quarter:

Patients who had 'transferred in' to the centre in that particular quarter were excluded.

Patients who had changed treatment modality in that particular quarter were excluded.

Patients who had been on RRT for less than 90 days were excluded.

Note: the length of time on RRT is calculated from the most recent take on date. So if a patient starts, then recovers, and then starts again this second start date is used. Also, for patients who are not defined as take on patients because their start date is unknown (for example, if their first timeline entry is a transfer in code) it is assumed that they have been on RRT for longer than 90 days and are included for every quarter.

B:3 Statistical definitions

Death rate calculation

A death rate per 100 patient years is calculated by counting the number of deaths and dividing by the person years exposed. This includes all patients, including those who died within the first 3 months of therapy. The person years at risk are calculated by adding up, for each patient, the number of days at risk (until they died or transferred out) and dividing by 365.

Odds ratio

This is the odds of an event in one group divided by the odds in a reference group. For example, if the event is death (within a certain time) and you are comparing phosphate groups then for phosphate group 1.8 to 2.1 mmol/L the odds of the event are:

$$\frac{\text{(probability of dying for someone with a phosphate of 1.8–2.1 mmol/L)}}{\text{(probability of surviving for someone with a phosphate of 1.8–2.1 mmol/L)}}$$

The odds ratio is then:

$$\frac{\text{(odds of dying if phosphate 1.8–2.1 mmol/L)}}{\text{(odds of dying for reference group)}}$$

Note that when the event being analysed is death, often the odds ratio would not be used but a 'survival analysis' used instead. This takes into account the time when the event occurs and also allows for censoring (for example if people are lost to follow up). Such an analysis gives hazard ratios (see below) rather than odds ratios.

Hazard function

The hazard function is the probability of dying in a short time interval, conditional on survival up to that point.

Hazard ratio

For the same example as above, the hazard ratio is the:

$$\frac{\text{(probability of dying in the next interval for a phosphate of 1.8–2.1 mmol/L)}}{\text{(probability of dying in the next interval for a phosphate in the reference range)}}$$

Relative hazard

Following the notation of Collett, D. (2003): Modelling survival data in medical research, Chapman & Hall, p. 57:

$$h_i(t) = \exp(\beta x_i) \times h_0(t)$$

The relative hazard is the $\exp(\beta x_i)$ component in the general proportional hazards model with age, the variable of interest and it's square as covariates. The plots were done for $\exp(\beta x_i)$ for different values of the variable of interest only, in other words, age was taken as a constant value of zero.

B:4 General and modality definitions

Definitions of analysis quarters

Quarter	Dates
1	1 January–31 March
2	1 April–30 June
3	1 July–30 September
4	1 October–31 December

The quarterly biochemistry data were extracted from renal centre systems as the last data item stored for that quarter. If the patient treatment modality was haemodialysis, the software will try to select a pre-dialysis value.

Home haemodialysis

Home haemodialysis patients cease to be classed as such if they need longer than two weeks of hospital dialysis when not an in-patient.

Satellite dialysis unit

A renal satellite unit is defined as a haemodialysis facility that is linked to a main renal centre, is not autonomous for medical decisions and provides chronic outpatient maintenance haemodialysis but with no acute or in-patient nephrology beds on site.

Start of established renal failure

Established renal failure (also known as end stage renal failure or end stage renal disease) was 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, the date of start of renal replacement should have been backdated to the start of acute dialysis. Many nephrologists do not do this and where this period of acute dialysis has been recorded in local systems, the UKRR will use this data to backdate the start of RRT.

If a patient was started on dialysis and dialysis was temporarily stopped for less than 90 days for any reason (including access failure and awaiting the formation of further access) except the recovery of renal function, the date of start of renal replacement therapy (RRT) in UKRR analyses remained the date of first dialysis.

Change of modality from PD to HD

Sites are requested to log in their timeline changes from PD to HD if the modality switch is for longer than 30 days.

B:5 Comorbidity definitions

Angina

History of chest pain on exercise with or without ECG changes, ETT, radionucleotide imaging or angiography.

Previous MI within last 3 months

Detection of rise and/or fall of a biomarker (CK, CK-MB or Troponin) with at least one value above the 99th percentile together with evidence of myocardial ischaemia with at least one of either:

a. ischaemic symptoms,
b. ECG changes indicative of new ischaemia (new ST-T changes or new left bundle branch block),
c. development of pathological Q waves,
d. imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.

This definition is from the European Society of Cardiology and American College of Cardiology.

Previous MI >3 months ago

Any previous MI at least 3 months prior to start of renal replacement therapy.

Previous CABG or coronary angioplasty

Previous episode of heart failure

Whether or not due to fluid overload.

Cerebrovascular disease

Any history of strokes (whatever cause) and including transient ischaemic attacks caused by carotid disease.

Diabetes (not causing ESRF)

This includes diet controlled diabetics.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is characterised by airflow obstruction. The airflow obstruction is usually progressive, not fully reversible and does not change markedly over several months.

- Airflow obstruction is defined as a reduced FEV1 (forced expiratory volume in 1 second) and a reduced FEV1/FVC ratio (where FVC is forced vital capacity), such that FEV1 is less than 80% predicted and FEV1/FVC is less than 0.7.
- The airflow obstruction is due to a combination of airway and parenchymal damage.
- The damage is the result of chronic inflammation that differs from that seen in asthma and which is usually the result of tobacco smoke.

There is no single diagnostic test for COPD. Making a diagnosis relies on clinical judgement based on a combination of history, (exertional breathlessness, chronic cough, regular sputum production, frequent winter 'bronchitis', wheeze) physical examination and confirmation of the presence of airflow obstruction using spirometry, (source: British Thoracic Society guidelines).

Liver Disease

Persistent enzyme evidence of hepatic dysfunction or biospy evidence or HbeAg or hepatitis C antigen (polymerase chain reaction) positive serology.

Malignancy

Defined as any history of malignancy (even if curative) e.g. removal of melanoma, excludes basal cell carcinoma.

Claudication

Current claudication based on a history, with or without Doppler or angiographic evidence.

Ischaemic/neuropathic ulcers
Current presence of these ulcers.

Angioplasty, stenting, vascular graft (all non coronary)
This category now includes vascular grafts (e.g. aortic bifurcation graft) and renal artery stents.

Amputation for peripheral vascular disease

Smoking
Current smoker or history of smoking within the last year.

Appendix C
Renal services described for non-physicians

(Reproduced from the third edition of the Renal Association Standards document, August 2002.)

This appendix provides information on the issues discussed in this Report, background information on renal failure and discusses the services available for its treatment.

Renal diseases

1.1 Diseases of the kidney are not as common as cardiovascular conditions or cancers but are much more common than some well known disorders such as multiple sclerosis or muscular dystrophy. Renal conditions account for about 7,000 deaths per annum according to the Registrar General's figures, but these are probably an underestimate since about one third of deaths of patients with renal failure are not recorded as such in mortality statistics. These figures exclude deaths from cancers of the kidney and associated organs of the urinary tract such as the bladder and prostate.

1.2 Over 100 different diseases affect the kidneys. These diseases may present early with features such as pain, the presence of blood or protein in the urine, or peripheral oedema (swelling of the legs), but much renal disease is self-limiting; it occurs and heals with few or no symptoms or sequelae. On the other hand, some kidney diseases start insidiously and progress but are undetected until renal failure develops.

Acute renal failure

1.3 Renal failure may be acute and reversible. It occurs in previously normal kidneys when their blood supply is compromised by a fall in blood pressure caused by crush injuries, major surgery, failure of the heart's pumping action, loss of blood, salt or water, or when they are damaged by poisons or overwhelming infection. Renal support is then needed for a few days or weeks before renal function returns. However, about half such patients die during these illnesses because of another condition, often the one which caused the renal failure.

Chronic renal failure (CRF) and established renal failure (ERF)

1.4 More common is irreversible chronic renal failure, in which the kidneys are slowly destroyed over months or years. To begin with there is little to see or find and this means that many patients present for medical help very late in their disease, or even in the terminal stages. Tiredness, anaemia, a feeling of being 'run down' are often the only symptoms. However, if high blood pressure develops, as often happens when the kidneys fail, or is the prime cause of the kidney disease, it may cause headache, breathlessness and perhaps angina. Ankle swelling may occur if there is a considerable loss of protein in the urine.

1.5 Progressive loss of kidney function is also called chronic renal failure. Early chronic renal failure is sometimes referred to as chronic renal impairment or insufficiency and established renal failure when it reaches its terminal stage. At this point, if nothing is done the patient will die. Two complementary forms of treatment – dialysis and renal transplantation – are available and both are needed if established renal failure is to be treated.

1.6 The incidence of chronic renal disease and established renal failure rises steeply with advancing age. Consequently, an increasing proportion of patients treated for established renal failure in this country are elderly and the proportion is even higher in some other developed countries. Evidence from the United States suggests that the relative risk of established renal failure in the Black population (predominantly of African origin) is two to four times higher than for Whites. Data collected during the review of renal specialist services in London suggest that there is in the Thames regions a similar greater risk of renal failure in certain ethnic populations (South Asian and African-Caribbean) than in Whites, this is supported by national mortality statistics. People from the Indian subcontinent have a higher prevalence of non-insulin dependent diabetes and those with diabetes are more likely than Whites to develop renal failure. This partly explains the higher acceptance rate of Asians onto renal replacement programmes.

Causes of renal failure

1.7 Most renal diseases that cause renal failure fall into six categories.

1. Systematic disease. Although many generalised diseases such as systematic lupus, vasculitis, amyloidosis and myelomatosis can cause kidney failure, by far the most important cause is diabetes mellitus (about 20% of all renal disease in many countries). Progressive kidney damage may begin after some years of diabetes, particularly if the blood sugar and high blood pressure have been poorly controlled. Careful lifelong supervision of diabetes has a major impact in preventing kidney damage.

2. Auto-immune disease. 'Glomerulonephritis' or 'nephritis' describes a group of diseases in which the glomeruli (the filters that start the process of urine formation) are damaged by the body's immunological response to tissue changes or infections elsewhere. Together, all forms of nephritis account for about 30% of renal failure in Britain. The most severe forms are therefore treated with medications that suppress response, but treatment makes only a small impact on the progress of this group of patients to established renal failure.

3. High blood pressure. Severe ('accelerated') hypertension damages the kidneys, but the damage can be halted – and to some extent reversed – by early detection and early treatment of high blood pressure. This is a common cause of renal failure in patients of African origin.

4. Obstruction. Anything that obstructs the free flow of urine can cause back-pressure on the kidneys. Much the commonest cause is enlargement of the prostate in elderly men.

5. Genetic disease. One common disease, polycystic kidneys and many rare inherited diseases which affect the kidneys, account for about 8% of all kidney failure in Britain. Although present at birth, polycystic kidney disease often causes no symptoms until middle age or later. Understanding of its genetic basis is rapidly advancing and may lead to the development of effective treatment.

Prevention

1.8 Although many diseases causing chronic renal failure cannot be prevented or arrested at present, better control of diabetes, high blood pressure and relief of obstruction have much to offer, provided they are employed early in the course of the disease before much renal damage has occurred. It has also been shown that a group of antihypertensives called angiotensin converting enzyme inhibitors (ACEI) delay the progression of renal failure. Screening for renal disease has not been widely practised because the relatively low incidence of

cases renders population screening inefficient and costly. Urine tests for protein or blood, or blood tests for the level of some substances normally excreted by the kidney such as creatinine and urea, are potentially useful methods for screening, if populations at risk of renal failure can be identified, e.g. diabetics and the elderly.

Complications and co-morbidity

1.9 Renal failure is often accompanied by other disease processes. Some are due to the primary disease, e.g. diabetes may cause blindness and diseases of the nerves and blood vessels. Others, such as anaemia, bone disease and heart failure, are consequences of the renal failure. Coincidental disease such as chronic bronchitis and arthritis are particularly common in older patients with renal failure. In addition, many patients with established renal failure have diseases affecting the heart and blood vessels (vascular) particularly ischaemic heart disease and peripheral vascular disease. All these conditions, collectively called co-morbidity, can influence the choice of treatment for renal failure and may reduce its benefits. Expert assessment of the patient before established renal failure can reduce co-morbidity and increase the benefit and cost effectiveness of treatment. Thus early detection and referral of patients at risk of renal failure is important.

Renal replacement therapy

1.10 The term renal replacement therapy (RRT) is used to describe treatments for established renal failure in which, in the absence of kidney function, the removal of waste products from the body is achieved by dialysis and other kidney functions are supplemented by drugs. The term also covers the complete replacement of all kidney functions by transplantation.

Therapeutic dialysis ('renal dialysis')

1.11 Dialysis involves the removal of waste products from the blood by allowing these products to diffuse across a thin membrane into dialysis fluid which is then discarded along with the toxic waste products. The fluid is chemically composed to draw or 'attract' excess salts and water from the blood to cross the membrane, without the blood itself being in contact with the fluid.

Haemodialysis

1.12 The method first used to achieve dialysis was the artificial kidney, or haemodialysis. This involves the attachment of the patient's circulation to a machine through which fluid is passed and exchange can take place. A disadvantage of this method is that some form of permanent access to the circulation must be produced to be used at every treatment. Each session lasts 4 to 5 hours and is needed three times a week.

Peritoneal dialysis

1.13 The alternative is peritoneal dialysis, often carried out in the form of continuous ambulatory peritoneal dialysis (CAPD). In this technique, fluid is introduced into the peritoneal cavity (which lies around the bowel) for approximately 6 hours before withdrawal. The washing fluid must be sterile in order to avoid peritonitis (infection and inflammation of the peritoneum), which is the main complication of the treatment. A silastic tube must be implanted into the peritoneum and this may give problems such as kinking and malposition. Each fluid exchange lasts 30 to 40 minutes and is repeated three or four times daily. Neither form of dialysis corrects the loss of the hormones secreted by the normal kidney so replacement with synthetic erythropoietin and vitamin D is often necessary.

Renal transplantation

1.14 Renal transplantation replaces all the kidneys' functions, so erythropoietin and vitamin D supplementation are unnecessary. A single kidney is placed,

usually in the pelvis close to the bladder to which the ureter is connected. The kidney is attached to a nearby artery and vein. The immediate problem is the body's acute rejection of the foreign graft, which can largely be overcome during the first months using drugs such as steroids and cyclosporin. These drugs and others that can be used for that purpose, have many undesirable side effects, including the acceleration of vascular disease. This often means that myocardial infarcts and strokes are commoner in transplant patients than in age-matched controls. During subsequent years there is a steady loss of transplanted kidneys owing to a process of chronic rejection; treatment of this is quite unsatisfactory at the moment, so many patients require a second or even a third graft over several decades, with further periods of dialysis in between.

1.15 The main problem with expanding the transplantation service is the shortage of suitable kidneys to transplant. Although the situation can be improved, it is now clear that whatever social and medical structures are present and whatever legislation is adopted, there will inevitably be a shortage of kidneys from humans. This remains the case even if kidneys from the newly dead (cadaver kidneys) are retrieved with the maximum efficiency and living donors (usually, but not always from close blood relatives of the recipient) are used wherever appropriate. Hope for the future rests with solving the problems of xenotransplantation (which involves using animal kidneys), probably from pigs, although baboons have also been suggested and are closer to humans. Many problems remain unsolved and it is thought highly unlikely that xenotransplantation will become a reliable treatment for established renal failure within the next 10 years.

Nature of renal services

1.16 The work of a nephrologist includes the early detection and diagnosis of renal disease and the long-term management of its complications such as high blood pressure, anaemia and bone disease. The nephrologist may share the management with the general practitioner or local hospital physician and relies on them to refer patients early for initial diagnosis and specific treatment. At any one time, perhaps only 5% of patients under care are inpatients in wards, the remainder being treated in their homes with 20% of these attending the renal centre regularly for haemodialysis. However, inpatient nephrology and the care of patients receiving centre-based dialysis are specialised, complex and require experienced medical advice to be available on a 24 hour basis. This implies sufficient staff to provide expert cover; cross-covering by inexperienced staff is inappropriate and to be condemned. The other 95% of renal work is sustained on an outpatient basis; this includes renal replacement therapy by dialysis and the care of transplant patients.

1.17 There are five major components to renal medicine:

1. Renal replacement therapy. The most significant element of work relates to the preparation of patients in established renal failure for RRT and their medical supervision for the remainder of their lives. The patient population will present increasing challenges for renal staffing as more elderly and diabetic patients are accepted for treatment.

2. Emergency work. The emergency work associated with the speciality consists of:

   i. Treatment of acute renal failure, often involving multiple organ failure and acute-on-chronic renal failure. Close co-operation with other medical specialties, including intensive care, is therefore a vital component of this aspect of the service.

   ii. Management of medical emergencies arising from an established renal failure programme. This workload is bound to expand rapidly as the number, age and co-morbidity of patients starting renal replacement therapy increases and this may interrupt the regular care of patients already on renal replacement therapy, so increased resources may be required.

3. Routine nephrology. A substantial workload is associated with the immunological and

metabolic nature of renal disease which requires investigative procedures in an inpatient setting. It is estimated that ten in-patient beds per million of the population are required for this work.

4. Investigation and management of fluid and electrolyte disorders. This makes up a variable proportion of the nephrologists work, depending on the other expertise available in the hospital.

5. Outpatient work. The outpatient work in renal medicine consists of the majority of general nephrology together with clinics attended by dialysis and renal transplant patients.

Further reading

Further details of renal services for renal failure, written for non-physicians, can be found in: Cameron JS. Kidney Failure – the Facts. London: Oxford University Press, 1996.

Appendix D
Methodology used for analyses of PCT incidence and prevalence rates and of standardised ratios

Described here are the methods for calculating the standardised acceptance ratios for the incident UK RRT cohort, the standardised prevalence ratios for the total UK RRT cohort and the ratios for prevalent transplant patients.

Patients

For the acceptance rate analyses, all new cases recorded by the Registry as accepted on to RRT in each year were included. For the prevalence rates analyses, prevalent patients at the end of the year were included. The analyses used the patient postcode rather than the GP postcode. Each postcode was matched to a 2001 Census output area and hence to the relevant area code.

Years used

Analyses have been done for each of the last 6 years. Combined analyses have also been done using the data from as many of the years as are available for each area. This combined analysis is especially useful for the acceptance rates and rate ratios analyses as there can be small numbers of incident patients particularly in the smaller areas.

Geography

The areas used were the 152 (English) Primary Care Trusts (PCTs), the 22 Welsh local health boards, the 32 Scottish council areas and the 26 Northern Ireland district council areas – these different types of area are collectively called PCTs here.

Prior to 2007, only some of the boundaries of PCTs and Local Authorities (LAs) in England were similar. There were roughly twice as many PCTs as LAs and the registry reports published analyses by LA in the main report and prevalence rates by PCT as an appendix. In October 2006, the Office for National Statistics reduced the number of PCTs and re-aligned many of the PCT boundaries in England with those of Local Authorities. As a result, in the 2008 Report these analyses will be presented by PCT (not LA). For data for years before the boundaries changed, patients are allocated to the new PCTs as they are now. In Northern Ireland, Scotland and Wales, the Health Authority boundaries align with the LAs and these areas have been included along with the English PCTs in the tables.

Areas included in the UK Registry 'covered' population

Up until now, not all renal centres have been sending data to the Registry. This means estimates could not be

obtained for all PCTs but only for those which were covered by the Registry in the relevant year. The UKRR identified all areas which were estimated to have complete coverage and analyses were restricted to those areas. Whether an area was covered or not was dependant on whether the renal centre in the area was sending data to the UKRR and whether there were any overlapping areas with renal centres not yet connected to the UKRR.

Due to various renal centres beginning to send data to the UKRR at different times, the covered PCTs are different for the analyses for each year. For example, for the 2007 data, 148 of the 152 English PCTs and all parts of Wales, Scotland and Northern Ireland were covered by the Registry. This is a total coverage of 228 areas out of 232.

Population data

Mid-2006 population estimates were obtained from the ONS website (www.statistics.gov.uk) by PCT, gender and age group. These 2006 estimates have been extrapolated by the ONS from the 2001 census data. The areas range in population size from 17,000 (Moyle in NI) to 1.27 million (Hampshire).

This 2006 population data is used for the analysis for each year. As the analyses only cover 6 years this was a reasonable approximation.

Calculation of rates and rate ratios

Crude rates

The crude rates, per million population (pmp), were calculated for each PCT for each year:

$$1{,}000{,}000 \times (\text{observed number})/(\text{population size})$$

Confidence intervals have not been calculated for these rates but, if required, an assessment can be made of whether the rate for a given area is consistent with the rate in the whole covered population. This can be done by using the figures provided in the relevant report chapters showing the confidence intervals around the overall average rates for a range of PCT population sizes. These confidence intervals have been obtained using the Normal approximation to the Poisson distribution. For the incident analyses, confidence intervals have only been calculated around the overall average for populations of over 80,000. This is because below this level the number of cases you would expect per area is low and so the Poisson distribution is skewed and the Normal approximation is not appropriate. Due to the prevalence rates being higher, the plot for these can cover lower population sizes.

For the combined years analyses the observed cases are summed over the available years and the population is multiplied by the number of years that the area has been covered for. For example, if area × (population 100,000) became a covered area for the first time in 2006 and had 14 new patients in 2006 and 19 in 2007 then the combined years crude rate would be $1{,}000{,}000 \times (14 + 19)/(2 \times 100{,}000) = 165$ pmp. Again, this is a rate per million population per year. It is an average over the available years.

Note that when using the figures mentioned earlier in this section to assess how different an area's combined years crude rate is from the overall average then the population shown on the x-axis should be the area's population multiplied by the number of years of data that has been used (e.g. 2 for the example above). By doing this, the confidence intervals obtained become narrower as the analysis is now based on more than one year of data.

Standardised acceptance/prevalence ratios (SRR/SPR or just SR)

There are large differences in acceptance and prevalence rates for RRT between age and gender groups. As there are also differences in the age/gender breakdowns of the different areas it is useful to produce estimates standardised for age and gender. The method used is *indirect standardisation.*

Observed cases (O_i) were calculated by summing all cases in all age and gender bands for each PCT. Expected cases (E_i) for each PCT were calculated as follows:

> Overall crude rates (for each year) were calculated for the whole covered population (the *standard population*) by summing the observed numbers, over the PCTs, for each age/gender band and dividing this by the total covered population in that age/gender band. These crude rates (by age/gender band) were then multiplied by the population each PCT has in each band to give the number of cases expected in that band if that PCT had the same rates as the standard population.

These expected numbers were then summed over the age/gender bands to give an expected total number of cases in each PCT. The age/gender standardised ratio (SR) for PCT i is then O_i/E_i.

The expected number of cases is the number you would see if the rates seen in the standard population applied to that individual PCT's age/gender breakdown. 95% confidence intervals were calculated for each area using an error factor (EF) as follows:

$$\mathrm{LCL} = \mathrm{SR}/\mathrm{EF}$$

$$\mathrm{UCL} = \mathrm{SR} \times \mathrm{EF}$$

where $\mathrm{EF} = \exp(1.96\sqrt{(O_i)})$

A SR of 1 indicates that the area's rate was as expected if the age/gender rates found in the total covered population applied to the PCT area's population structure; a value above 1 indicates that the observed rate was greater than expected given the area's population structure, if the lower confidence limit was above 1 this was statistically significant at the 5% level. The converse applies to standardised ratios under one.

The combined years analyses are similar to the above except that the observed and expected numbers are summed over the years.

Remaining variability between rates

Even after standardisation there remains a large amount of variability between PCTs – as can be seen by the large numbers of significantly low or high rate ratios. This is partly because these ratios have only been adjusted for age and gender and have not been adjusted for ethnicity. Much higher rates are expected in populations with a high percentage of patients from South Asian and Black backgrounds.

Caution needed when comparing a PCT's standardised incidence or prevalence ratios over time

As the covered areas have changed over time, the 'total' population used for standardisation is different each year. For example, the rate ratios for 2005 and 2006 are not strictly comparable as they are standardised to different populations. However, for most years the change in numbers of covered areas is relatively small.

Appendix E
Additional data tables for 2007 new and existing patients

E:1 Patients starting renal replacement in 2007

Table E.1.1. Take on totals for new patients on dialysis at 90 days in 2007

	Aged <65		Aged ⩾65	
	No. on HD	No. on PD	No. on HD	No. on PD
England	1,635	711	1,880	419
N Ireland	59	12	101	6
Scotland	204	86	200	35
Wales	92	69	168	32
UK	**1,990**	**878**	**2,349**	**492**

Table E.1.2. Treatment modalities at 90 days

Centre	% HD	% PD	% transplant	% stopped treatment	% died
Abrdn	80	16			4
Airdrie	86	12			2
Antrim	90	2		7	
B Heart	81	10			8
B QEH	75	17	1		6
Bangor	46	17		9	29
Basldn	69	13		10	8
Belfast	77	11	5	2	5
Bradfd	73	15	3		9
Brightn	63	28	3		7
Bristol	63	21	4		12
Camb	64	11	16		9
Cardff	64	25	7		4
Carlis	70	22	4		4
Carsh	75	18	2		5
Chelms	67	24		2	7
Clwyd	70	30			
Covnt	61	26	3	1	9
D&Gall	70	30			
Derby	57	33		2	9
Donc	25	75			
Dorset	57	37	2	2	2
Dudley	53	47			
Dundee	77	18			5
Dunfn	67	30			3
Edinb	61	30	6		4
Exeter	72	23			5
Glasgw	69	16	4		11
Glouc	75	20			5
Hull	66	28	2	1	3
Inverns	48	45			7
Ipswi	56	38	6		
Klmarnk	79	21			
L Barts	55	40	4		2

Table E.1.2. Continued

Centre	% HD	% PD	% transplant	% stopped treatment	% died
L Guys	71	14	13		2
L Kings	63	29	4		4
L Rfree	67	16	13		4
L St.G	55	27	18		
L West	75	6	17		2
Leeds	69	20	7		4
Leic	64	24	8		5
Liv Ain	94				6
Liv RI	72	18	4		6
M Hope	68	27	1		4
M RI	54	20	23		3
Middlbr	72	15	3		10
Newc	60	20	9		10
Newry	63	31		6	
Norwch	59	22		3	16
Nottm	64	26	3		6
Oxford	56	29	10		5
Plymth	60	22	6	2	9
Ports	60	21	9		10
Prestn	77	19			3
Redng	62	37			1
Sheff	74	17	4	1	4
Shrew	69	21	2	2	6
Stevng	74	19			7
Sthend	79	15	3		3
Stoke	62	30			8
Sund	86	8			6
Swanse	68	23			9
Truro	71	25			4
Tyrone	94	–			6
Ulster	86	–		7	7
Wirral	75	17		2	6
Wolve	55	36		1	7
Wrexm	54	36	4		7
York	66	34			
England	**67**	**22**	**6**	**0**	**6**
N Ireland	**81**	**9**	**3**	**4**	**4**
Scotland	**70**	**21**	**2**		**6**
Wales	**63**	**25**	**4**	**1**	**8**
UK	**67**	**21**	**5**	**0**	**6**

Table E.1.3. Number of patients per treatment modality at 90 days

	HD	PD	Transplant	Stopped treatment	Died
England	3,516	1,130	299	18	291
N Ireland	160	18	5	8	7
Scotland	404	122	13		35
Wales	260	101	15	3	31
UK	**4,340**	**1,371**	**332**	**29**	**364**

Table E.1.4. First treatment modality

Centre	% HD	% PD	% transplant
Abrdn	79	21	
Airdrie	90	10	
Antrim	97	3	
B Heart	85	15	
B QEH	81	17	2
Bangor	81	19	
Basldn	85	15	
Belfast	82	12	5
Bradfd	82	18	
Brightn	75	25	
Bristol	70	23	7
Camb	72	13	16
Cardff	73	22	4
Carlis	84	16	
Carsh	81	19	
Chelms	69	31	
Clwyd	65	35	
Covnt	74	22	4
D&Gall	65	35	
Derby	60	40	
Donc	39	61	
Dorset	74	26	
Dudley	46	54	
Dundee	88	12	
Dunfn	70	30	
Edinb	66	27	7
Exeter	80	20	
Glasgw	83	14	3
Glouc	82	18	
Hull	75	25	
Inverns	48	52	
Ipswi	63	38	

Table E.1.4. Continued

Centre	% HD	% PD	% transplant
Klmarnk	63	38	
L Barts	65	33	2
L Guys	71	17	12
L Kings	71	23	5
L Rfree	74	16	9
L St.G	61	21	18
L West	79	5	16
Leeds	79	15	5
Leic	71	20	9
Liv Ain	100		
Liv RI	78	17	5
M Hope	60	40	
M RI	67	15	18
Middlbr	86	14	
Newc	77	14	10
Newry	73	27	
Norwch	87	13	
Nottm	69	29	2
Oxford	62	32	6
Plymth	71	26	3
Ports	69	22	8
Prestn	83	17	
Redng	63	37	
Sheff	80	16	5
Shrew	80	20	
Stevng	85	15	
Sthend	76	24	
Stoke	72	28	
Sund	87	13	
Swanse	77	23	
Truro	80	20	
Tyrone	100		
Ulster	100		
Wirral	83	17	
Wolve	68	32	
Wrexm	59	41	
York	69	31	
England	**74**	**21**	**5**
N Ireland	**88**	**9**	**3**
Scotland	**77**	**21**	**2**
Wales	**74**	**24**	**2**
UK	**75**	**21**	**5**

Table E.1.5. First treatment modality, patient numbers

	HD	PD	Transplant
England	3,927	1,091	263
N Ireland	163	17	5
Scotland	427	116	13
Wales	307	100	9
UK	**4,824**	**1,324**	**290**

Table E.1.6. Gender breakdown by treatment modality (at 90 days)

	Haemodialysis			Peritoneal dialysis		
Centre	% Male	% Female	M:F Ratio	% Male	% Female	M:F Ratio
Abrdn	73	27	2.7	38	63	0.6
Airdrie	50	50	1.0	83	17	5.0
Antrim	55	45	1.2	100	0	
B Heart	63	37	1.7	30	70	0.4
B QEH	60	41	1.5	54	46	1.2
Bangor	81	19	4.3	83	17	5.0
Basldn	78	22	3.5	80	20	4.0
Belfast	65	35	1.8	73	27	2.7
Bradfd	63	37	1.7	42	58	0.7
Brightn	64	36	1.8	88	13	7.0
Bristol	54	46	1.2	62	38	1.6
Camb	62	38	1.6	53	47	1.1
Cardff	68	32	2.2	67	33	2.1
Carlis	75	25	3.0	60	40	1.5
Carsh	64	36	1.8	44	56	0.8
Chelms	68	32	2.1	73	27	2.7
Clwyd	57	43	1.3	83	17	5.0

Table E.1.6. Continued

	Haemodialysis			Peritoneal dialysis		
Centre	% Male	% Female	M:F Ratio	% Male	% Female	M:F Ratio
Covnt	71	29	2.4	62	39	1.6
D&Gall	86	14	6.0	50	50	1.0
Derby	58	42	1.4	90	11	8.5
Donc	67	33	2.0	78	22	3.5
Dorset	61	39	1.6	70	30	2.3
Dudley	67	33	2.0	75	25	3.0
Dundee	65	35	1.9	64	36	1.7
Dunfn	41	59	0.7	70	30	2.3
Edinb	58	42	1.4	58	42	1.4
Exeter	69	31	2.2	56	44	1.3
Glasgw	59	41	1.5	53	47	1.1
Glouc	58	42	1.4	39	62	0.6
Hull	61	39	1.6	64	36	1.7
Inverns	86	14	6.0	67	33	2.0
Ipswi	78	22	3.5	92	8	11.0
Klmarnk	62	39	1.6	57	43	1.3
L Barts	66	35	1.9	63	37	1.7
L Guys	63	37	1.7	46	55	0.8
L Kings	67	33	2.0	42	58	0.7
L Rfree	55	46	1.2	47	53	0.9
L St.G	67	33	2.0	63	38	1.7
L West	61	39	1.6	50	50	1.0
Leeds	56	44	1.3	65	35	1.9
Leic	64	36	1.7	56	44	1.3
Liv Ain	57	43	1.3			
Liv RI	66	35	1.9	71	29	2.5
M Hope	58	42	1.4	79	21	3.7
M RI	61	39	1.5	54	46	1.2
Middlbr	60	40	1.5	64	36	1.8
Newc	44	56	0.8	58	42	1.4
Newry	70	30	2.3	100	0	
Norwch	58	42	1.4	77	23	3.3
Nottm	57	44	1.3	68	32	2.2
Oxford	67	33	2.0	58	42	1.4
Plymth	65	35	1.9	61	39	1.6
Ports	67	33	2.0	58	42	1.4
Prestn	68	32	2.1	67	33	2.0
Redng	57	43	1.3	79	21	3.9
Sheff	66	34	1.9	58	42	1.4
Shrew	53	47	1.1	73	27	2.7
Stevng	63	37	1.7	61	39	1.6
Sthend	62	39	1.6	80	20	4.0
Stoke	48	52	0.9	62	38	1.6
Sund	64	36	1.8	75	25	3.0
Swanse	66	34	1.9	82	19	4.4
Truro	59	41	1.4	58	42	1.4
Tyrone	59	41	1.4			
Ulster	67	33	2.0			
Wirral	60	40	1.5	67	33	2.0
Wolve	68	32	2.1	63	38	1.7
Wrexm	67	33	2.0	60	40	1.5
York	65	35	1.9	58	42	1.4
England	**62**	**38**	**1.6**	**62**	**38**	**1.6**
N Ireland	**63**	**37**	**1.7**	**83**	**17**	**5.0**
Scotland	**61**	**39**	**1.6**	**59**	**41**	**1.4**
Wales	**68**	**32**	**2.1**	**72**	**28**	**2.6**
UK	**62**	**38**	**1.6**	**63**	**37**	**1.7**

Table E.1.7. Treatment modality numbers (at 90 days) by gender

	Haemodialysis		Peritoneal dialysis	
	Male	Female	Male	Female
England	2,176	1,339	699	431
N Ireland	101	59	15	3
Scotland	247	157	71	50
Wales	176	84	73	28
UK	**2,700**	**1,639**	**858**	**512**

E:2 Current patients 2007

Table E.2.1. Treatment modalities for patients aged under and over 65

	Patients aged <65				Patients aged ⩾65			
Centre	% HD	% PD	% transplant	HD:PD	% HD	% PD	% transplant	HD:PD
Abrdn	33	10	57	3.5	77	4	20	21.6
Airdrie	54	12	35	4.6	87	7	7	13.0
Antrim	45	7	47	6.3	83	9	9	9.4
B Heart	56	6	39	10.1	81	6	12	12.9
B QEH	35	8	57	4.3	72	8	20	8.8
Bangor	64	36		1.8	69	31		2.2
Basldn	57	13	30	4.3	74	18	8	4.2
Belfast	25	9	66	2.8	59	7	34	8.5
Bradfd	33	12	55	2.7	70	8	22	8.3
Brightn	34	12	55	2.8	68	14	18	4.9
Bristol	23	6	70	3.7	64	7	29	9.4
Camb	26	5	69	5.3	69	7	25	10.6
Cardff	22	10	68	2.2	62	14	24	4.4
Carlis	30	6	63	4.8	63	7	30	9.6
Carsh	34	10	57	3.5	72	13	15	5.4
Chelms	45	22	33	2.1	69	23	8	3.0
Clwyd	34	12	53	2.8	70	12	18	5.8
Covnt	33	9	59	3.7	64	15	22	4.3
D&Gall	49	24	27	2.0	80	18	3	4.6
Derby	64	28	8	2.3	72	24	4	3.1
Derry	73	9	18	8.0	97	3		28.0
Donc	48	35	17	1.4	62	36	2	1.7
Dorset	28	8	64	3.3	49	21	29	2.3
Dudley	41	23	36	1.8	51	26	23	2.0
Dundee	31	9	60	3.3	67	5	28	12.5
Dunfn	61	17	22	3.6	81	13	6	6.1
Edinb	31	10	59	3.1	56	13	32	4.5
Exeter	28	10	62	3.0	70	16	13	4.3
Glasgw	26	6	67	4.2	65	7	28	9.5
Glouc	32	10	57	3.1	78	10	11	7.5
Hull	33	14	53	2.3	74	11	15	6.6
Inverns	32	15	53	2.2	59	29	13	2.1
Ipswi	29	14	57	2.1	51	26	23	2.0
Klmarnk	49	26	25	1.9	79	16	5	5.0
L Barts	35	14	51	2.5	53	22	25	2.4
L Guys	25	4	71	6.1	63	6	31	10.4
L Kings	39	12	49	3.3	67	13	20	5.3
L Rfree	31	9	60	3.6	69	9	23	7.8
L St.G	24	7	69	3.3	60	14	27	4.4
L West	38	2	60	15.9	73	5	22	15.6

Table E.2.1. Continued

	Patients aged <65				Patients aged ⩾65			
Centre	% HD	% PD	% transplant	HD:PD	% HD	% PD	% transplant	HD:PD
Leeds	25	8	67	3.3	65	7	27	8.7
Leic	34	11	56	3.2	61	17	22	3.5
Liv Ain	100	0			100	0		
Liv RI	26	7	67	3.7	53	10	37	5.3
M Hope	34	17	49	2.0	65	20	15	3.3
M RI	21	7	72	2.8	46	16	38	2.9
Middlbr	30	5	65	6.7	69	4	27	17.4
Newc	20	6	74	3.4	49	6	45	8.3
Newry	45	13	42	3.5	77	5	18	16.0
Norwch	38	12	51	3.2	73	15	13	4.9
Nottm	27	14	59	2.0	62	19	19	3.3
Oxford	18	10	73	1.8	47	15	38	3.2
Plymth	16	8	76	2.0	57	15	28	3.8
Ports	22	8	70	2.9	61	11	28	5.6
Prestn	39	9	52	4.5	69	12	19	6.0
Redng	28	17	55	1.6	65	19	16	3.4
Sheff	37	7	56	5.0	70	9	20	7.8
Shrew	45	17	38	2.7	75	11	14	6.9
Stevng	48	7	45	6.7	80	9	11	8.8
Sthend	50	11	39	4.5	79	9	12	8.5
Stoke	37	14	49	2.5	56	20	25	2.8
Sund	51	4	45	12.0	74	8	18	9.9
Swanse	41	16	43	2.6	73	14	13	5.1
Truro	34	10	56	3.6	76	9	15	8.2
Tyrone	43	5	52	8.4	80	0	20	
Ulster	79	7	14	11.5	98	2		56.0
Wirral	82	18		4.6	86	14		6.3
Wolve	50	13	37	3.8	79	15	5	5.2
Wrexm	48	21	31	2.3	64	25	10	2.5
York	33	10	57	3.1	74	13	14	5.9
England	**32**	**9**	**59**	**3.5**	**66**	**12**	**22**	**5.4**
N Ireland	**35**	**9**	**56**	**4.0**	**74**	**6**	**20**	**13.3**
Scotland	**33**	**10**	**57**	**3.3**	**68**	**10**	**22**	**7.1**
Wales	**29**	**12**	**58**	**2.3**	**66**	**16**	**18**	**4.2**
UK	**32**	**9**	**59**	**3.4**	**66**	**12**	**22**	**5.6**

Note: Patients without a treatment modality on 31/12/2007 are excluded

Table E.2.2. Number of patients under and over 65 per treatment modality

	Patients aged <65			Patients aged ⩾65		
	HD	PD	Transplant	HD	PD	Transplant
England	7,885	2,274	14,688	7,904	1,461	2,625
N Ireland	306	76	493	385	29	103
Scotland	911	274	1,591	867	122	278
Wales	441	189	884	569	137	157
UK	**9,543**	**2,813**	**17,656**	**9,725**	**1,749**	**3,163**

Note: Patients without a treatment modality on 31/12/2007 are excluded

Table E.2.3. Treatment modality median age by centre

Centre	Median age on HD	Median age on PD	Median age on transplant	Median age for all
Abrdn	65.6	52.9	51.6	56.7
Airdrie	59.9	48.3	44.8	54.3
Antrim	70.9	67.4	47.9	65.5
B Heart	66.2	64.5	50.6	62.6
B QEH	65.3	56.5	49.7	56.2
Bangor	67.7	64.0		67.5
Basldn	65.4	67.7	47.3	62.7
Belfast	63.7	53.7	48.4	53.4
Bradfd	66.0	50.5	48.8	55.7
Brightn	69.0	62.5	51.7	61.7
Bristol	69.0	60.8	51.6	58.5
Camb	65.3	60.0	49.4	55.0
Cardff	67.3	62.7	50.1	57.0
Carlis	66.8	59.8	51.4	58.6
Carsh	68.0	61.9	49.0	59.9
Chelms	70.0	65.3	57.0	65.6
Clwyd	64.2	56.0	52.4	58.6
Covnt	64.6	63.9	48.2	55.7
D&Gall	69.1	63.8	46.2	65.3
Derby	63.9	62.9	54.2	62.8
Derry	67.2	60.7	50.0	63.2
Donc	64.9	61.0	55.8	61.5
Dorset	66.1	70.3	56.3	60.3
Dudley	62.0	63.1	57.4	59.6
Dundee	68.8	59.4	55.1	60.0
Dunfn	64.5	57.9	54.3	61.4
Edinb	60.5	53.9	52.2	54.8
Exeter	71.2	67.6	49.8	60.9
Glasgw	64.1	57.2	49.5	54.6
Glouc	72.5	63.2	51.9	63.3
Hull	66.0	55.0	49.1	58.1
Inverns	64.6	65.0	47.4	56.6
Ipswi	60.7	61.5	51.8	56.8
Klmarnk	65.1	60.6	48.7	61.4
L Barts	57.0	58.1	49.9	53.8
L Guys	62.3	57.2	49.0	52.2
L Kings	61.1	59.2	50.1	55.8
L Rfree	64.1	57.4	48.4	55.0
L St.G	67.2	63.3	52.4	57.7
L West	64.0	63.0	51.9	56.9
Leeds	65.9	59.2	50.2	54.9
Leic	63.4	62.9	50.0	57.4
Liv Ain	61.4			61.4
Liv RI	60.0	54.9	49.7	52.8
M Hope	60.9	57.7	47.1	54.7
M RI	58.9	57.2	49.4	51.5
Middlbr	67.0	56.1	49.4	57.7
Newc	63.1	56.2	51.6	55.5
Newry	65.5	54.3	55.2	62.7
Norwch	67.8	63.2	50.3	61.9
Nottm	65.2	59.9	48.1	55.7
Oxford	64.7	59.7	50.1	54.9
Plymth	71.0	68.2	51.0	59.3
Ports	66.6	60.0	50.1	56.1
Prestn	62.9	58.1	50.6	57.2
Redng	69.9	59.4	53.7	60.2

Table E.2.3. Continued

Centre	Median age on HD	Median age on PD	Median age on transplant	Median age for all
Sheff	64.6	59.9	50.0	57.3
Shrew	65.3	57.8	50.7	59.9
Stevng	65.4	62.1	50.9	59.7
Sthend	67.1	60.8	56.8	63.0
Stoke	62.3	60.0	48.7	56.0
Sund	63.3	60.2	51.0	56.9
Swanse	69.6	63.7	54.7	63.1
Truro	71.6	63.6	53.8	64.3
Tyrone	64.3	62.4	45.9	59.5
Ulster	71.7	49.4	43.4	70.8
Wirral	65.9	61.1		65.3
Wolve	65.6	58.1	45.0	60.5
Wrexm	67.4	65.6	47.3	64.3
York	69.1	64.0	45.8	60.8
England	**65.0**	**60.4**	**50.2**	**56.9**
N Ireland	**67.1**	**57.4**	**48.6**	**58.6**
Scotland	**64.5**	**57.7**	**50.0**	**56.2**
Wales	**67.9**	**63.0**	**50.6**	**59.2**
UK	**65.2**	**60.3**	**50.1**	**57.0**

Table E.2.4. Dialysis modalities for patients aged under 65

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Abrdn	4	73	0	0	13	9	0	0
Airdrie	0	82	0	0	8	10	0	0
Antrim	6	80	0	0	2	12	0	0
B Heart	6	78	8	0	8	1	0	0
B QEH	3	20	58	0	11	7	0	0
Bangor	11	53	0	0	13	23	0	0
Basldn	0	81	0	0	4	15	0	0
Belfast	2	72	0	0	4	21	0	2
Bradfd	0	61	13	0	8	18	0	0
Brightn	10	42	23	0	11	15	0	0
Bristol	10	17	52	0	16	5	0	0
Camb	1	51	32	0	0	0	0	16
Cardff	0	38	32	0	31	0	0	0
Carlis	0	59	24	0	4	13	0	0
Carsh	0	31	47	0	10	12	0	0
Chelms	0	67	0	2	15	16	0	0
Clwyd	2	71	0	12	0	14	0	0
Covnt	4	75	0	0	21	0	0	0
D&Gall	0	67	0	0	11	11	11	0
Derby	3	67	0	0	26	4	0	0
Derry	0	85	4	4	4	4	0	0
Donc	0	58	0	0	30	12	0	0
Dorset	1	33	43	0	15	8	0	0
Dudley	2	42	20	0	36	0	0	0
Dundee	0	77	0	0	2	19	2	0

Table E.2.4. Continued

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Dunfn	0	78	0	0	3	19	0	0
Edinb	3	73	0	0	12	12	0	0
Exeter	1	39	34	0	11	15	0	0
Glasgw	6	74	0	0	10	8	2	0
Glouc	0	76	0	0	9	15	0	0
Hull	4	41	24	0	11	19	0	0
Inverns	3	66	0	0	13	19	0	0
Ipswi	5	63	0	0	16	16	0	0
Klmarnk	1	65	0	0	10	19	5	0
L Barts	2	40	30	0	9	20	0	0
L Guys	8	15	63	0	5	0	9	0
L Kings	0	32	45	0	6	17	0	0
L Rfree	3	34	42	0	7	15	0	0
L St.G	6	71	0	17	1	5	0	0
L West	2	21	71	0	2	4	0	0
Leeds	5	45	26	0	9	14	0	0
Leic	4	19	53	0	12	12	0	0
Liv Ain	3	55	42	0	0	0	0	0
Liv RI	2	42	35	0	8	13	0	0
M Hope	2	27	37	0	20	13	0	1
M RI	12	28	34	0	4	22	0	0
Middlbr	1	37	49	0	11	2	0	0
Newc	5	72	0	0	5	18	0	0
Newry	0	78	0	0	0	22	0	0
Norwch	5	51	20	0	22	0	1	0
Nottm	2	52	13	0	12	22	0	0
Oxford	5	59	1	0	13	23	0	0
Plymth	2	66	0	0	22	11	0	0
Ports	0	42	33	0	26	0	0	0
Prestn	6	27	49	0	7	11	0	0
Redng	1	33	28	0	39	0	0	0
Sheff	9	37	38	0	16	0	0	0
Shrew	1	46	26	1	26	0	0	0
Stevng	0	29	58	0	13	0	0	0
Sthend	0	82	0	0	18	0	0	0
Stoke	3	58	11	5	0	24	0	0
Sund	2	73	17	0	3	5	0	0
Swanse	8	45	20	0	28	0	0	0
Truro	6	42	30	0	14	8	0	0
Tyrone	2	87	0	0	2	6	0	2
Ulster	4	88	0	0	0	8	0	0
Wirral	1	48	34	7	4	7	0	0
Wolve	0	26	53	0	21	0	0	0
Wrexm	0	69	0	0	25	2	2	2
York	2	52	22	0	24	0	0	0
England	**3**	**40**	**34**	**0**	**11**	**10**	**0**	**0**
N Ireland	**2**	**78**	**0**	**0**	**3**	**16**	**0**	**1**
Scotland	**3**	**74**	**0**	**0**	**10**	**12**	**2**	**0**
Wales	**3**	**46**	**21**	**1**	**26**	**3**	**0**	**0**
UK	**3**	**45**	**29**	**0**	**12**	**10**	**0**	**0**

Table E.2.5. Dialysis modalities for patients aged over 65

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Abrdn	1	95	0	0	2	3	0	0
Airdrie	0	93	0	0	3	4	0	0
Antrim	0	90	0	0	3	6	0	0
B Heart	2	85	6	0	7	0	0	0
B QEH	0	20	70	0	6	4	0	0
Bangor	0	69	0	0	8	24	0	0
Basldn	0	81	0	0	11	7	1	0
Belfast	3	87	0	0	5	6	0	0
Bradfd	0	69	21	0	4	7	0	0
Brightn	2	46	35	0	10	7	0	0
Bristol	2	10	78	0	7	2	0	0
Camb	1	49	42	0	0	0	0	9
Cardff	0	33	48	0	18	0	0	0
Carlis	0	62	28	0	2	8	0	0
Carsh	0	24	60	0	8	8	0	0
Chelms	0	75	0	0	16	9	0	0
Clwyd	0	85	0	12	0	2	0	0
Covnt	0	81	0	0	19	0	0	0
D&Gall	0	82	0	0	0	15	3	0
Derby	4	71	0	0	22	3	0	0
Derry	0	97	0	0	0	3	0	0
Donc	0	61	2	2	20	15	0	0
Dorset	1	30	39	0	20	10	0	0
Dudley	0	53	14	0	33	0	0	0
Dundee	0	93	0	0	2	4	2	0
Dunfn	0	86	0	0	0	14	0	0
Edinb	0	82	0	0	8	11	0	0
Exeter	0	35	45	0	16	3	0	0
Glasgw	1	90	0	0	6	3	1	0
Glouc	0	88	0	0	6	6	0	0
Hull	1	45	41	0	8	5	0	0
Inverns	0	67	0	0	16	16	0	0
Ipswi	0	66	0	0	23	8	2	2
Klmarnk	0	83	0	0	10	5	1	0
L Barts	0	39	31	0	15	14	0	0
L Guys	1	31	59	0	4	0	5	0
L Kings	0	24	60	0	5	11	0	0
L Rfree	1	36	52	0	4	7	0	0
L St.G	0	80	1	13	2	4	0	0
L West	0	19	75	0	4	2	0	0
Leeds	0	48	42	0	5	5	0	0
Leic	1	21	56	0	13	9	0	0
Liv Ain	0	73	27	0	0	0	0	0
Liv RI	0	53	31	0	7	5	2	0
M Hope	0	33	44	0	20	3	0	1
M RI	2	28	45	1	8	17	0	0
Middlbr	1	33	61	0	5	0	0	0
Newc	0	89	0	0	1	10	0	0
Newry	0	94	0	0	0	6	0	0
Norwch	0	57	27	0	14	2	1	0
Nottm	1	52	24	0	14	9	0	0
Oxford	3	72	2	0	19	4	0	0
Plymth	0	79	0	0	18	3	0	0
Ports	0	34	51	0	15	0	0	0

Table E.2.5. Continued

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Prestn	1	20	65	0	7	8	0	0
Redng	0	56	22	0	23	0	0	0
Sheff	1	48	40	0	11	0	0	0
Shrew	0	61	26	0	13	0	0	0
Stevng	0	27	63	0	10	0	0	0
Sthend	0	89	0	0	11	0	0	0
Stoke	0	59	15	13	0	13	0	0
Sund	0	72	18	0	7	3	0	0
Swanse	0	60	23	0	16	0	0	0
Truro	1	45	43	0	8	3	0	0
Tyrone	0	100	0	0	0	0	0	0
Ulster	0	98	0	0	0	2	0	0
Wirral	0	46	40	6	1	6	0	0
Wolve	0	27	57	0	16	0	0	0
Wrexm	0	72	0	0	27	0	2	0
York	0	54	31	0	14	0	0	0
England	**1**	**44**	**40**	**1**	**10**	**5**	**0**	**0**
N Ireland	**1**	**92**	**0**	**0**	**2**	**5**	**0**	**0**
Scotland	**0**	**87**	**0**	**0**	**5**	**6**	**1**	**0**
Wales	**0**	**50**	**30**	**1**	**17**	**2**	**0**	**0**
UK	**1**	**50**	**35**	**0**	**10**	**5**	**0**	**0**

Table E.2.6. Patient age ranges by centre (%)

Centre	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Abrdn	2	10	14	20	22	17	13	1
Airdrie	2	9	20	21	15	21	11	0
Antrim	0	6	11	14	18	27	21	4
B Heart	2	6	12	15	21	26	16	2
B QEH	3	8	17	20	20	19	13	2
Bangor	2	5	9	8	23	23	23	5
Basldn	2	9	9	15	21	22	19	2
Belfast	2	10	17	24	18	18	9	1
Bradfd	6	9	14	20	18	21	11	1
Brightn	3	6	13	15	21	23	17	3
Bristol	3	7	14	19	23	19	12	3
Camb	3	9	17	20	22	16	10	1
Cardff	3	8	16	21	22	18	11	2
Carlis	2	3	18	19	20	26	11	1
Carsh	2	6	16	17	21	21	14	3
Chelms	3	5	7	16	18	30	18	4
Clwyd	3	3	14	23	25	20	10	2
Covnt	1	7	20	20	18	20	11	2
D&Gall	1	1	13	13	19	30	19	3
Derby	1	7	11	16	20	25	19	3
Derry	2	6	11	11	23	18	24	5
Donc	0	2	9	18	27	21	21	2
Dorset	2	6	13	17	24	21	14	2

Table E.2.6. Continued

Centre	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Dudley	2	3	11	19	28	23	13	0
Dundee	2	6	15	16	21	22	14	4
Dunfn	0	7	10	21	19	23	16	2
Edinb	2	8	17	23	23	19	7	1
Exeter	2	5	14	19	20	19	18	4
Glasgw	2	8	18	22	21	18	9	1
Glouc	2	6	10	17	19	23	20	5
Hull	3	7	16	19	24	18	12	2
Inverns	2	9	18	20	17	22	11	0
Ipswi	2	5	15	24	25	18	10	1
Klmarnk	2	4	15	16	24	19	17	2
L Barts	2	9	18	24	22	18	7	0
L Guys	2	9	21	24	19	16	8	1
L Kings	1	7	19	20	20	19	12	1
L Rfree	3	11	16	20	20	18	10	2
L St.G	1	7	14	21	23	22	11	1
L West	1	6	16	22	23	19	11	2
Leeds	4	9	16	20	21	17	10	1
Leic	3	7	17	19	23	19	11	2
Liv Ain	0	5	8	17	26	26	17	2
Liv RI	2	8	19	26	20	16	8	1
M Hope	2	9	20	20	23	18	8	0
M RI	4	9	21	25	21	14	6	0
Middlbr	2	6	18	20	20	21	11	1
Newc	4	7	15	23	25	16	9	1
Newry	1	8	12	16	20	24	16	2
Norwch	2	6	14	14	21	23	16	4
Nottm	4	7	16	20	20	18	11	2
Oxford	2	7	18	22	23	16	9	2
Plymth	2	7	16	18	19	20	15	2
Ports	3	8	15	21	22	17	12	2
Prestn	1	8	17	19	22	19	12	1
Redng	2	6	13	17	23	21	15	3
Sheff	3	7	15	21	21	21	12	1
Shrew	4	6	13	15	23	25	12	2
Stevng	2	5	15	18	21	23	14	2
Sthend	1	5	9	16	25	25	14	5
Stoke	5	7	16	21	16	21	13	1
Sund	1	6	16	21	23	17	15	1
Swanse	1	4	10	15	25	22	20	3
Truro	0	6	9	14	22	24	21	5
Tyrone	3	11	15	12	26	18	13	3
Ulster	0	5	8	13	8	35	26	6
Wirral	3	4	8	18	17	27	21	2
Wolve	1	6	15	19	18	23	17	2
Wrexm	4	5	13	15	16	24	22	1
York	6	10	13	14	16	18	19	4
England	**3**	**7**	**16**	**20**	**21**	**19**	**12**	**2**
N Ireland	**2**	**9**	**14**	**19**	**19**	**21**	**14**	**2**
Scotland	**2**	**8**	**17**	**21**	**21**	**19**	**11**	**1**
Wales	**2**	**6**	**14**	**19**	**23**	**20**	**14**	**2**
UK	**2**	**7**	**16**	**20**	**21**	**19**	**12**	**2**

Table E.2.7. Dialysis modalities for non-diabetic patients (all ages)

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Abrdn	5	83	0	0	6	6	0	0
Airdrie	0	85	0	0	6	9	0	0
Antrim	2	88	0	0	2	8	0	0
B Heart	5	80	6	0	8	1	0	0
B QEH	3	19	62	0	10	5	0	0
Bangor	6	59	0	0	12	23	0	0
Basldn	0	82	0	0	8	9	1	0
Belfast	2	76	0	0	4	17	0	1
Bradfd	0	58	21	0	7	14	0	0
Brightn	6	42	31	0	11	10	0	0
Bristol	6	12	67	0	11	4	0	0
Camb	1	50	36	0	0	0	0	12
Cardff	0	36	37	0	27	0	0	0
Carlis	0	61	25	0	2	11	0	0
Carsh	0	27	54	0	10	9	0	0
Chelms	0	71	0	0	17	12	0	0
Clwyd	2	80	0	12	0	6	0	0
Covnt	3	76	0	0	21	0	0	0
D&Gall	0	73	0	0	4	16	7	0
Derby	4	69	0	0	23	3	0	0
Derry	0	93	0	2	2	2	0	0
Donc	0	65	1	1	20	13	0	0
Dorset	1	30	42	0	18	9	0	0
Dudley	1	49	20	0	30	0	0	0
Dundee	0	85	0	0	3	11	2	0
Dunfn	0	81	0	0	1	19	0	0
Edinb	2	75	0	0	10	13	0	0
Exeter	1	34	44	0	14	6	0	0
Glasgw	4	80	0	0	8	6	2	0
Glouc	0	84	0	0	7	9	0	0
Hull	3	42	32	0	11	13	0	0
Inverns	2	63	0	0	13	21	0	0
Ipswi	3	65	0	0	19	12	0	1
Klmarnk	1	72	0	0	11	13	3	0
L Barts	2	37	31	0	12	18	0	0
L Guys	7	18	63	0	4	0	8	0
L Kings	0	27	52	0	7	14	0	0
L Rfree	2	36	46	0	5	10	0	0
L St.G	4	77	1	13	2	4	0	0
L West	1	24	67	0	3	4	0	0
Leeds	3	40	41	0	6	9	0	0
Leic	3	21	52	0	12	12	0	0
Liv Ain	2	62	36	0	0	0	0	0
Liv RI	1	46	35	0	7	10	1	0
M Hope	1	31	35	0	21	10	0	1
M RI	17	25	29	1	7	20	0	0
Middlbr	1	34	55	0	9	1	0	0
Newc	3	79	0	0	3	15	0	0
Newry	0	85	0	0	0	15	0	0
Norwch	2	52	24	0	18	1	1	0
Nottm	2	50	19	0	13	16	0	0
Oxford	5	65	1	0	14	14	0	0
Plymth	1	75	0	0	19	6	0	0
Ports	0	35	44	0	21	0	0	0

Table E.2.7. Continued

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Prestn	4	21	57	0	7	10	0	0
Redng	0	49	21	0	29	0	0	0
Sheff	6	42	39	0	13	0	0	0
Shrew	1	54	24	1	20	0	0	0
Stevng	0	28	60	0	12	0	0	0
Sthend	0	83	0	0	17	0	0	0
Stoke	2	59	14	9	0	17	0	0
Sund	1	69	19	0	6	4	0	0
Swanse	4	52	22	0	21	0	0	0
Truro	3	45	40	0	9	3	0	0
Tyrone	1	92	0	0	1	4	0	1
Ulster	2	95	0	0	0	3	0	0
Wirral	0	47	37	7	2	7	0	0
Wolve	0	25	57	0	17	0	0	0
Wrexm	0	70	0	0	26	0	2	1
York	1	56	27	0	16	0	0	0
England	**2**	**42**	**36**	**0**	**11**	**7**	**0**	**0**
N Ireland	**2**	**84**	**0**	**0**	**2**	**11**	**0**	**1**
Scotland	**2**	**78**	**0**	**0**	**7**	**11**	**1**	**0**
Wales	**2**	**48**	**24**	**1**	**22**	**2**	**0**	**0**
UK	**2**	**47**	**31**	**0**	**11**	**7**	**0**	**0**

Note: Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table E.2.8. Number of non-diabetic patients by treatment modality

	HD	PD	Transplant
England	12,043	2,888	14,734
N Ireland	545	89	550
Scotland	1,388	331	1,705
Wales	787	272	947
UK	**14,763**	**3,580**	**17,936**

Note: Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table E.2.9. Dialysis modalities for non-diabetic patients aged under 65

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Abrdn	8	74	0	0	10	8	0	0
Airdrie	0	79	0	0	8	13	0	0
Antrim	6	81	0	0	0	13	0	0
B Heart	7	76	5	0	10	1	0	0
B QEH	4	19	57	0	12	7	0	0
Bangor	13	50	0	0	15	23	0	0
Basldn	0	81	0	0	5	15	0	0
Belfast	2	69	0	0	4	23	0	2
Bradfd	0	57	13	0	10	20	0	0
Brightn	11	41	21	0	11	16	0	0
Bristol	10	14	52	0	16	7	1	0
Camb	2	51	32	0	0	0	0	16
Cardff	0	38	29	0	33	0	0	0
Carlis	0	59	26	0	3	13	0	0
Carsh	0	31	46	0	11	12	0	0
Chelms	0	65	0	0	17	17	0	0
Clwyd	3	76	0	13	0	8	0	0
Covnt	5	76	0	0	20	0	0	0
D&Gall	0	65	0	0	9	13	13	0
Derby	4	65	0	0	27	5	0	0
Derry	0	86	0	5	5	5	0	0
Donc	0	65	0	0	22	14	0	0
Dorset	1	34	43	0	16	6	0	0
Dudley	3	43	24	0	31	0	0	0
Dundee	0	76	0	0	3	19	3	0
Dunfn	0	77	0	0	2	22	0	0
Edinb	3	71	0	0	12	14	0	0
Exeter	2	38	30	0	14	15	0	0
Glasgw	7	72	0	0	10	8	2	0
Glouc	0	78	0	0	9	13	0	0
Hull	5	40	24	0	13	19	0	0
Inverns	4	63	0	0	12	22	0	0
Ipswi	6	65	0	0	14	14	0	0
Klmarnk	1	62	0	0	11	22	4	0
L Barts	2	38	30	0	9	20	0	0
L Guys	10	13	62	0	4	0	10	0
L Kings	0	33	45	0	7	16	0	0
L Rfree	4	34	43	0	5	14	0	0
L St.G	8	73	0	14	1	5	0	0
L West	3	24	67	0	2	4	0	0
Leeds	7	42	31	0	8	13	0	0
Leic	5	20	51	0	11	13	0	0
Liv Ain	3	55	42	0	0	0	0	0
Liv RI	2	41	37	0	7	14	0	0
M Hope	2	29	33	0	21	14	0	1
M RI	21	26	27	1	4	20	0	0
Middlbr	1	38	47	0	12	2	0	0
Newc	6	72	0	0	5	18	0	0
Newry	0	78	0	0	0	23	0	0
Norwch	6	50	20	0	22	0	2	0
Nottm	2	52	12	0	10	22	0	0
Oxford	6	59	1	0	12	22	0	0
Plymth	2	64	0	0	22	13	0	0
Ports	0	39	34	0	27	0	0	0

Table E.2.9. Continued

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Prestn	6	22	51	0	8	12	0	0
Redng	1	38	24	0	37	0	0	0
Sheff	10	37	37	0	15	0	0	0
Shrew	1	46	27	1	25	0	0	0
Stevng	0	30	55	0	15	0	0	0
Sthend	0	76	0	0	24	0	0	0
Stoke	3	62	12	4	0	20	0	0
Sund	2	73	17	0	4	5	0	0
Swanse	9	48	19	0	24	0	0	0
Truro	9	49	26	0	11	6	0	0
Tyrone	3	85	0	0	3	8	0	3
Ulster	6	89	0	0	0	6	0	0
Wirral	1	49	32	7	4	8	0	0
Wolve	0	25	53	0	21	0	0	0
Wrexm	0	69	0	0	25	0	3	3
York	2	54	22	0	22	0	0	0
England	**4**	**40**	**33**	**0**	**12**	**10**	**0**	**0**
N Ireland	**2**	**76**	**0**	**0**	**3**	**17**	**0**	**1**
Scotland	**4**	**72**	**0**	**0**	**9**	**13**	**2**	**0**
Wales	**4**	**47**	**20**	**1**	**26**	**2**	**0**	**0**
UK	**4**	**45**	**28**	**0**	**12**	**10**	**0**	**0**

Note: Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table E.2.10. Number of non-diabetic patients aged under 65 by treatment modality

	HD	PD	Transplant
England	6,049	1,745	12,393
N Ireland	242	67	450
Scotland	699	225	1,442
Wales	354	152	797
UK	**7,344**	**2,189**	**15,082**

Note: Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table E.2.11. Dialysis modalities for non-diabetic patients aged over 65

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Abrdn	1	91	0	0	3	4	0	0
Airdrie	0	92	0	0	3	5	0	0
Antrim	0	91	0	0	3	6	0	0
B Heart	2	83	7	0	7	1	0	0
B QEH	1	20	68	0	8	4	0	0
Bangor	0	67	0	0	9	23	0	0
Basldn	0	83	0	0	10	5	1	0
Belfast	3	86	0	0	4	7	0	0
Bradfd	0	59	30	0	5	6	0	0
Brightn	2	43	38	0	11	6	0	0
Bristol	3	10	78	0	8	2	0	0
Camb	1	50	41	0	0	0	0	9
Cardff	0	34	45	0	21	0	0	0
Carlis	0	64	25	0	2	9	0	0
Carsh	0	23	60	0	9	8	0	0
Chelms	0	75	0	0	17	8	0	0
Clwyd	0	85	0	11	0	4	0	0
Covnt	0	77	0	0	23	0	0	0
D&Gall	0	79	0	0	0	18	3	0
Derby	5	74	0	0	18	2	0	0
Derry	0	100	0	0	0	0	0	0
Donc	0	64	2	2	19	12	0	0
Dorset	1	26	41	0	20	12	0	0
Dudley	0	58	14	0	28	0	0	0
Dundee	0	92	0	0	2	4	1	0
Dunfn	0	84	0	0	0	16	0	0
Edinb	0	83	0	0	7	10	0	0
Exeter	0	31	54	0	15	0	0	0
Glasgw	1	88	0	0	6	4	1	0
Glouc	0	87	0	0	7	7	0	0
Hull	1	44	41	0	9	5	0	0
Inverns	0	64	0	0	15	21	0	0
Ipswi	0	64	0	0	25	9	0	2
Klmarnk	0	85	0	0	11	3	2	0
L Barts	1	35	34	0	17	13	0	0
L Guys	2	25	63	0	4	0	6	0
L Kings	0	17	64	0	7	12	0	0
L Rfree	1	38	50	0	4	7	0	0
L St.G	0	81	1	13	2	2	0	0
L West	0	24	67	0	5	4	0	0
Leeds	0	38	53	0	4	5	0	0
Leic	1	22	54	0	14	10	0	0
Liv Ain	0	72	28	0	0	0	0	0
Liv RI	0	53	31	0	7	5	3	1
M Hope	0	35	39	0	22	3	0	1
M RI	3	21	36	0	18	21	0	0
Middlbr	1	31	62	0	6	0	0	0
Newc	0	88	0	0	1	11	0	0
Newry	0	93	0	0	0	7	0	0
Norwch	0	54	28	0	15	2	1	0
Nottm	2	48	26	0	15	9	0	0
Oxford	3	73	2	0	17	6	0	0
Plymth	0	80	0	0	18	2	0	0
Ports	0	31	53	0	16	0	0	0

Table E.2.11. Continued

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Prestn	1	20	64	0	7	8	0	0
Redng	0	59	20	0	22	0	0	0
Sheff	1	47	40	0	12	0	0	0
Shrew	0	65	20	0	14	0	0	0
Stevng	0	26	64	0	10	0	0	0
Sthend	0	89	0	0	11	0	0	0
Stoke	0	55	17	15	0	13	0	0
Sund	0	65	23	0	8	3	0	0
Swanse	1	55	26	0	19	0	0	0
Truro	1	44	45	0	8	2	0	0
Tyrone	0	100	0	0	0	0	0	0
Ulster	0	98	0	0	0	2	0	0
Wirral	0	45	41	7	1	6	0	0
Wolve	0	25	61	0	14	0	0	0
Wrexm	0	71	0	0	27	0	2	0
York	0	56	31	0	13	0	0	0
England	**1**	**44**	**40**	**1**	**10**	**5**	**0**	**0**
N Ireland	**1**	**92**	**0**	**0**	**2**	**5**	**0**	**0**
Scotland	**1**	**86**	**0**	**0**	**5**	**7**	**1**	**0**
Wales	**0**	**50**	**29**	**1**	**19**	**2**	**0**	**0**
UK	**1**	**50**	**34**	**0**	**10**	**5**	**0**	**0**

Note: Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table E.2.12. Number of non-diabetic patients aged over 65 by treatment modality

	HD	PD	Transplant
England	5,994	1,143	2,341
N Ireland	303	22	100
Scotland	689	106	263
Wales	433	120	150
UK	**7,419**	**1,391**	**2,854**

Note: Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table E.2.13. Dialysis modalities for diabetic patients

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Abrdn	0	93	0	0	8	0	0	0
Airdrie	0	94	0	0	3	3	0	0
Antrim	2	84	0	0	4	9	0	0
B Heart	1	86	8	0	5	0	0	0
B QEH	0	20	68	0	4	7	0	0
Basldn	0	75	0	0	4	21	0	0
Belfast	2	88	0	0	7	3	0	0
Bradfd	0	82	3	0	3	11	0	0
Brightn	5	54	25	0	6	11	0	0
Bristol	5	16	67	0	11	1	0	0
Camb	0	44	44	0	0	0	0	12
Cardff	0	32	53	0	14	0	0	0
Carlis	0	56	31	0	6	6	0	0
Carsh	0	29	56	0	6	9	0	0
Chelms	0	75	0	3	9	13	0	0
Clwyd	0	75	0	8	0	17	0	0
Covnt	0	84	0	0	16	0	0	0
Derby	1	66	0	0	29	4	0	0
Dorset	0	43	30	0	20	7	0	0
Dudley	0	39	8	0	53	0	0	0
Dundee	0	85	0	0	0	12	3	0
Dunfn	0	94	0	0	0	6	0	0
Edinb	0	81	0	0	13	6	0	0
Exeter	0	45	29	0	12	12	2	0
Glasgw	1	90	0	0	5	3	1	0
Glouc	0	86	0	0	4	11	0	0
Hull	1	47	32	0	6	14	0	0
Inverns	0	83	0	0	17	0	0	0
Ipswi	0	58	0	0	23	15	4	0
Klmarnk	0	74	0	0	5	16	5	0
L Barts	0	44	27	0	10	18	0	0
L Guys	1	33	57	0	6	0	4	0
L Kings	0	35	49	0	3	13	0	0
L Rfree	0	39	47	0	4	10	0	0
L St.G	0	80	1	11	1	6	0	0
L West	0	25	68	0	3	4	0	0
Leeds	2	51	31	0	5	10	0	0
Leic	0	23	56	0	9	12	0	0
Liv RI	0	50	27	0	14	9	0	0
M Hope	0	14	79	0	7	0	0	0
M RI	0	33	27	0	7	33	0	0
Middlbr	0	36	60	0	4	0	0	0
Newc	0	83	0	0	2	14	0	0
Newry	0	89	0	0	0	11	0	0
Norwch	0	68	20	0	12	0	0	0
Nottm	1	58	14	0	13	14	0	0
Oxford	1	61	1	0	24	13	0	0
Plymth	0	71	0	0	24	6	0	0
Ports	0	54	31	0	15	0	0	0
Prestn	1	35	54	0	4	6	0	0
Redng	0	32	35	0	33	0	0	0

Table E.2.13. Continued

Centre	% home HD	% hospital HD	% satellite HD	% connect PD	% disconnect PD	% cycling PD ⩾6 nights	% cycling PD <6 nights	% unknown type of PD
Sheff	1	44	38	0	17	0	0	0
Shrew	0	50	36	0	14	0	0	0
Stevng	0	28	65	0	7	0	0	0
Sthend	0	97	0	0	3	0	0	0
Stoke	0	60	7	7	0	26	0	0
Sund	0	86	11	0	0	3	0	0
Swanse	1	57	20	0	22	0	0	0
Truro	0	37	46	0	11	6	0	0
Wolve	0	31	48	0	21	0	0	0
Wrexm	0	71	0	0	24	5	0	0
York	0	35	35	0	29	0	0	0
England	**0**	**46**	**36**	**0**	**10**	**8**	**0**	**0**
N Ireland	**1**	**88**	**1**	**0**	**4**	**6**	**0**	**0**
Scotland	**0**	**88**	**0**	**0**	**7**	**5**	**1**	**0**
Wales	**0**	**48**	**32**	**1**	**15**	**3**	**0**	**0**
UK	**0**	**51**	**31**	**0**	**10**	**7**	**0**	**0**

Note: Diabetic patients are patients with a primary renal disease code of diabetes

Table E.2.14. Number of diabetic patients by treatment modality

	HD	PD	Transplant
England	2,835	629	1,365
N Ireland	146	16	46
Scotland	302	42	160
Wales	221	53	91
UK	**3,504**	**740**	**1,662**

Note:
Diabetic patients are patients with a primary renal disease code of diabetes
Diabetes type 1 is patients with an EDTA code of 1080
Diabetes type 2 is patients with an EDTA code of 1081
Excludes diabetic patients without a treatment modality

Table E.2.15. Diabetics

Centre	M:F ratio	Median age on 31/12/2007	Median age at start of treatment	Median time on RRT in days	Median time on RRT in years
Abrdn	1.1	61	55	1,295	3.5
Airdrie	2.2	50	46	689	1.9
Antrim	1.6	65	60	1,137	3.1
B Heart	1.9	65	62	917	2.5
B QEH	1.5	65	60	1,164	3.2
Basldn	3.0	62	59	809	2.2
Belfast	1.5	57	54	1,102	3.0
Bradfd	1.7	64	59	694	1.9
Brightn	1.8	63	59	938	2.6
Bristol	1.5	59	55	1,062	2.9
Camb	1.7	48	41	1,517	4.2
Cardff	1.8	61	57	871	2.4
Carlis	2.4	62	59	1,175	3.2
Carsh	1.5	63	60	924	2.5

Table E.2.15. Continued

Centre	M:F ratio	Median age on 31/12/2007	Median age at start of treatment	Median time on RRT in days	Median time on RRT in years
Chelms	2.1	65	62	634	1.7
Clwyd	1.6	60	50	752	2.1
Covnt	1.6	63	58	965	2.6
Derby	1.7	62	60	799	2.2
Dorset	2.1	55	50	1,206	3.3
Dudley	4.0	61	58	826	2.3
Dundee	1.4	56	52	1,113	3.0
Edinb	1.4	59	55	714	2.0
Exeter	1.5	56	51	1,322	3.6
Glasgw	1.2	56	50	1,084	3.0
Glouc	1.0	60	56	823	2.3
Hull	1.9	61	56	948	2.6
Inverns	2.3	51	48	818	2.2
Ipswi	1.6	57	56	756	2.1
Klmarnk	3.8	55	51	1,197	3.3
L Barts	1.8	61	58	775	2.1
L Guys	1.3	54	51	1,134	3.1
L Kings	1.2	65	60	1,290	3.5
L Rfree	1.4	65	62	712	1.9
L St.G	1.5	69	65	957	2.6
L West	1.6	61	56	1,376	3.8
Leeds	1.2	59	53	1,519	4.2
Leic	1.6	61	56	878	2.4
Liv RI	1.8	53	46	1,972	5.4
M Hope	1.4	60	54	1,995	5.5
M RI	1.2	52	46	1,600	4.4
Middlbr	1.3	51	46	1,104	3.0
Newc	1.8	52	46	1,165	3.2
Newry	1.4	65	61	1,016	2.8
Norwch	1.1	63	60	689	1.9
Nottm	1.2	56	52	845	2.3
Oxford	1.8	53	48	1,260	3.4
Plymth	2.7	55	46	1,400	3.8
Ports	1.8	55	52	758	2.1
Prestn	1.7	62	59	829	2.3
Redng	1.9	62	60	936	2.6
Sheff	1.7	58	52	1,254	3.4
Shrew	1.4	65	62	674	1.8
Stevng	2.1	61	56	693	1.9
Sthend	2.3	63	57	1,027	2.8
Stoke	1.1	60	56	1,018	2.8
Sund	1.8	56	55	595	1.6
Swanse	1.7	65	62	670	1.8
Truro	1.8	63	62	608	1.7
Wolve	2.0	57	55	962	2.6
Wrexm	3.6	54	49	1,204	3.3
York	1.1	58	56	636	1.7
England	**1.6**	**60**	**56**	**1,057**	**2.9**
N Ireland	**1.4**	**63**	**59**	**1,082**	**3.0**
Scotland	**1.4**	**56**	**52**	**1,025**	**2.8**
Wales	**1.9**	**61**	**57**	**776**	**2.1**
UK	**1.6**	**60**	**55**	**1,035**	**2.8**

Notes:
Diabetic patients are patients with a primary renal disease code of diabetes
Patients with an initial treatment modality of transferred in or transferred out were excluded from the calculation of median age at start of treatment and median time on RRT, since their treatment start date is not accurately known

Table E.2.16. Transplant gender ratios

	% males	% females	No. males	No. females	M:F ratio
England	60.6	39.4	10,493	6,820	1.5
N Ireland	62.8	37.2	374	222	1.7
Scotland	60.0	40.0	1,121	748	1.5
Wales	63.1	36.9	657	384	1.7
UK	**60.7**	**39.3**	**12,645**	**8,174**	**1.5**

Note: Excludes patients without a treatment modality

Appendix F
UK Renal Registry dataset specification

This appendix is available on the UK Renal Registry website only and the current version of this document can be found at www.renalreg.org.

Appendix G
Coding: Ethnicity; EDTA primary renal diagnoses and EDTA causes of death

G1: Ethnicity coding

Ethnicity data is recorded in the clinical information systems in the individual renal centres in the format of 9S... read codes.

Ethnic category	Read code	Old PAS	Renal Assoc	New PAS
White	9S1..	0	W	A1
Black Caribbean	9S2..	1		M1
Black African	9S3..	2		N1
Black other/non-mixed origin	9S4..	3		P1
Indian	9S6..	4		H1
Pakistani	9S7..	5		J1
Bangladeshi	9S8..	6		K1
Chinese	9S9..	7	C	R1
Black British	9S41.			PD
Black Caribbean	9S42.			
Black North African	9S43.			
Black other African country	9S44.			
Black East African Asian	9S45.			
Black Indian sub-continent	9S46.			
Black other Asian	9S47.			
Black Black other	9S48.		B	PE
Black other/mixed	9S5..			
Other Black Black/White origin	9S51.			GC
Other Black Black/Asian origin	9S52.			GA
Other ethnic non-mixed (NMO)	9SA..			
Brit. ethnic minor. spec. (NMO)	9SA1.			
Brit. ethnic minor. unsp (NMO)	9SA2.			
Caribbean Island (NMO)	9SA3.			
North African Arab (NMO)	9SA4.			
Other African countries (NMO)	9SA5.			
East African Asian (NMO)	9SA6.			
Indian sub-continent (NMO)	9SA7.			
Other Asian (NMO)	9SA8.		A	L1
Irish (NMO)	9SA9.			B1
Greek Cypriot (NMO)	9SAA.			CG
Turkish Cypriot (NMO)	9SAB.			CJ
Other European (NMO)	9SAC.			C1

Ethnic category	Read code	Old PAS	Renal Assoc	New PAS
Other ethnic NEC (NMO)	9SAD.			S1
Other ethnic mixed origin	9SB..	8		
Other ethnic Black/White origin	9SB1.			E1
Other ethnic Asian/White origin	9SB2.			F1
Other ethnic mixed white origin	9SB3.			
Other ethnic other mixed origin	9SB4.			G1

G2: EDTA primary renal diagnoses

Code	Title	Group
0	Chronic renal failure; aetiology uncertain unknown/unavailable	Uncertain
10	Glomerulonephritis; histologically NOT examined	Uncertain
11	Focal segmental glomeruloscerosis with nephrotic syndrome in children	Glomerulonephritis
12	IgA nephropathy (proven by immunofluorescence, not code 76 and not 85)	Glomerulonephritis
13	Dense deposit disease; membrano-proliferative GN; type II (proven by immunofluorescence and/or electron microscopy)	Glomerulonephritis
14	Membranous nephropathy	Glomerulonephritis
15	Membrano-proliferative GN; type I (proven by immunofluorescence and/or electron microscopy – not code 84 or 89)	Glomerulonephritis
16	Crescentic (extracapillary) glomerulonephritis (type I, II, III)	Glomerulonephritis
17	Focal segmental glomeruloscerosis with nephrotic syndrome in adults	Glomerulonephritis
19	Glomerulonephritis; histologically examined, not given above	Glomerulonephritis
20	Pyelonephritis – cause not specified	Pyelonephritis
21	Pyelonephritis associated with neurogenic bladder	Pyelonephritis
22	Pyelonephritis due to congenital obstructive uropathy with/without vesico-ureteric reflux	Pyelonephritis
23	Pyelonephritis due to acquired obstructive uropathy	Pyelonephritis
24	Pyelonephritis due to vesico-ureteric reflux without obstruction	Pyelonephritis
25	Pyelonephritis due to urolithiasis	Pyelonephritis
29	Pyelonephritis due to other cause	Pyelonephritis
30	Interstitial nephritis (not pyelonephritis) due to other cause, or unspecified (not mentioned above)	Interstitial
31	Nephropathy (interstitial) due to analgesic drugs	Interstitial
32	Nephropathy (interstitial) due to cis-platinum	Interstitial
33	Nephropathy (interstitial) due to cyclosporin A	Interstitial
34	Lead induced nephropathy (interstitial)	Interstitial
39	Drug induced nephropathy (interstitial) not mentioned above	Interstitial
40	Cystic kidney disease – type unspecified	Cystic/poly
41	Polycystic kidneys; adult type (dominant)	Cystic/poly
42	Polycystic kidneys; infantile (recessive)	Cystic/poly
43	Medullary cystic disease; including nephronophtisis	Other
49	Cystic kidney disease – other specified type	Other
50	Hereditary/Familial nephropathy – type unspecified	Other
51	Hereditary nephritis with nerve deafness (Alport's Syndrome)	Other
52	Cystinosis	Other
53	Primary oxalosis	Other
54	Fabry's disease	Other
59	Hereditary nephropathy – other specified type	Other
60	Renal hypoplasia (congenital) – type unspecified	Other
61	Oligomeganephronic hypoplasia	Other
63	Congenital renal dysplasia with or without urinary tract malformation	Other
66	Syndrome of agenesis of abdominal muscles (Prune Belly)	Other
70	Renal vascular disease – type unspecified	Renal vascular disease
71	Renal vascular disease due to malignant hypertension	Renal vascular disease

Code	Title	Group
72	Renal vascular disease due to hypertension	Renal vascular disease
73	Renal vascular disease due to polyarteritis	Renal vascular disease
74	Wegener's granulomatosis	Other
75	Ischaemic renal disease/cholesterol embolism	Renal vascular disease
76	Glomerulonephritis related to liver cirrhosis	Other
78	Cryoglobulinemic glomerulonephritis	Other
79	Renal vascular disease – due to other cause (not given above and not code 84–88)	Renal vascular disease
80	Type 1 diabetes with diabetic nephropathy	Diabetes
81	Type 2 diabetes with diabetic nephropathy	Diabetes
82	Myelomatosis/light chain deposit disease	Other
83	Amyloid	Other
84	Lupus erythematosus	Other
85	Henoch-Schoenlein purpura	Other
86	Goodpasture's Syndrome	Other
87	Systemic sclerosis (scleroderma)	Other
88	Haemolytic Ureaemic Syndrome (including Moschcowitz Syndrome)	Other
89	Multi-system disease – other (not mentioned above)	Other
90	Tubular necrosis (irreversible) or cortical necrosis (different from 88)	Other
91	Tuberculosis	Other
92	Gout nephropathy (urate)	Other
93	Nephrocalcinosis and hypercalcaemic nephropathy	Other
94	Balkan nephropathy	Other
95	Kidney tumour	Other
96	Traumatic or surgical loss of kidney	Other
98	Not known	Missing
99	Other identified renal disorders	Other
199	Code not sent	Missing

G3: EDTA cause of death

EDTA code	Cause
0	Cause of death uncertain/not determined
11	Myocardial ischaemia and infarction
12	Hyperkalaemia
13	Haemorrhagic pericarditis
14	Other causes of cardiac failure
15	Cardiac arrest/sudden death; other cause or unknown
16	Hypertensive cardiac failure
17	Hypokalaemia
18	Fluid overload/pulmonary oedema
21	Pulmonary embolus
22	Cerebro-vascular accident, other cause or unspecified
23	Gastro-intestinal haemorrhage (digestive)
24	Haemorrhage from graft site
25	Hameorrhage from vascular access or dialysis circuit
26	Haemorrhage from ruptured vascular aneurysm (not code 22 or 23)
27	Haemorrhage from surgery (not codes 23, 24, 26)
28	Other haemorrhage, (not codes 23–27)
29	Mesenteric infarction
31	Pulmonary infection bacterial (not code 73)
32	Pulmonary infection (viral)
33	Pulmonary infection (fungal or protozoal; parasitic)
34	Infections elsewhere except viral hepatitis

EDTA code	Cause
35	Septicaemia
36	Tuberculosis (lung)
37	Tuberculosis (elsewhere)
38	Generalized viral infection
39	Peritonitis (all causes except for Peritoneal Dialysis)
41	Liver disease due to hepatitis B virus
42	Liver disease due to other viral hepatitis
43	Liver disease due to drug toxicity
44	Cirrhosis – not viral (alcoholic or other cause)
45	Cystic liver disease
46	Liver failure – cause unknown
51	Patient refused further treatment for ESRF
52	Suicide
53	ESRF treatment ceased for any other reason
54	ESRF treatment withdrawn for medical reasons
61	Uraemia caused by graft failure
62	Pancreatitis
63	Bone marrow depression (Aplasia)
64	Cachexia
66	Malignant disease in patient treated by immunosuppressive therapy
67	Malignant disease: solid tumors except those of 66
68	Malignant disease: lymphoproliferative disorders (Except 66)
69	Dementia
70	Peritonitis (sclerosing, with peritoneal dialysis)
71	Perforation of peptic ulcer
72	Perforation of colon
73	Chronic obstructive pulmonary disease
81	Accident related to ESRF treatment (not 25)
82	Accident unrelated to ESRF treatment
99	Other identified cause of death
100	Peritonitis (bacterial, with peritoneal dialysis)
101	Peritonitis (fungal, with peritoneal dialysis)
102	Peritonitis (due to other cause, with peritoneal dialysis)

Appendix H
Acronyms and abbreviations used in the Report

ACE (inhibitor)	Angiotensin converting enzyme (inhibitor)
APD	Automated peritoneal dialysis
ARF	Acute renal failure
ASSIST	The Association of ICT Professionals in Health and Social Care
AVF	Arteriovenous fistula
BAPN	British Association of Paediatric Nephrology
BCG	Bromocresol green
BCP	Bromocresol purple
BMI	Body mass index
BOO	Bladder output obstruction
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
CI	Confidence interval
CIC	Clean intermittent catheterisation
CKD	Chronic kidney disease
CMMS (CMS)	US Centre for Medicare and Medicaid Services
COPD	Chronic obstructive pulmonary disease
CRF	Chronic renal failure
CRP	C-reactive protein
CXR	Chest x-ray
DBP	Diastolic blood pressure
DCCT	Diabetes Control and Complications Trial
DFS	Date first seen
DM	Diabetes mellitus
DoH	Department of Health
DOPPS	Dialysis Outcomes and Practice Patterns Study
DOQI	Disease Outcomes Quality Initiative
E&W	England and Wales
EBPG	European Best Practice Guidelines
eGFR	Estimated GFR
ER	Early referral
ERA	European Renal Association
ERA-EDTA	European Renal Association – European Dialysis and Transplant Association
EPO	Erythropoietin
EPR	Electronic patient record
ERF	Established renal failure

ESA	Erythropoietin stimulating agent
ESRD	End stage renal disease
ESRF	End stage renal failure
EWNI	England, Wales and Northern Ireland
FSGS	Focal segmental glomerulosclerosis
GFR	Glomerular filtration rate
GN	Glomerulonephritis
HA	Health Authority
HbA1c	Glycated Haemoglobin
HCAI-DCS	Healthcare Associated Infection Data Capture System
HCFA	USA Health Care Finance Administration – now replaced by CMMS
HD	Haemodialysis
HDL	High-density lipoprotein
Hb	Haemoglobin
HLA	Human leucocyte antigen
HQIP	Healthcare Quality Improvement Partnership
HR	Hazard ratio
ICNARC	National intensive care audit
ICRS	Integrated care records system
IHD	Ischaemic heart disease
IDOPPS	International Dialysis Outcomes and Practice Patterns Study
IFCC	International Federation of Clinical Chemistry & Laboratory Medicine
IM&T	Information Management & Technology
IPD	Intermittent peritoneal dialysis
iPTH	Intact parathyroid hormone
ITU	Intensive therapy unit
ISB	Information Standards Board
KDOQI	Kidney Disease Outcomes Quality Initiative
KM	Kaplan Meier
LA	Local Authority
LDL	Low-density lipoprotein
LR	Late referral
LSPs	Local service providers
LV	Left ventricular
LVH	Left ventricular hypertrophy
MAP	Mean arterial blood pressure
MDRD study	Modified Diet in Renal Disease study
MDT	Multi-disciplinary team
MESS	Mandatory Enhanced Surveillance System
MI	Myocardial infarction
MINAP	Myocardial infarction audit
MRSA	Methicillin resistant Staphylococcal aureus
NASP	National Application Service Providers
NCRS	National Care Records Service
NeLH	National electronic library for health
NEQAS	UK National External Quality Assessment Scheme
NFKPA	National Federation of Kidney Patients' Associations
NHS	National Health Service
NHID	National Health Informatics Development
NHS BT	National Health Service Blood and Transplant
NHSIA	NHS Information Agency
NICE	National Institute of Clinical Excellence
NPfIT	National Programme for Information Technology
NSF	National service framework
OA	Output area (census)
OBSC	Output based specification contract
ONS	Office of National Statistics
PCT	Primary Care Trust
PD	Peritoneal dialysis
PIAG	Patient Information Advisory Group

PKD	Polycystic kidney disease
PMCP	Per million child population
PMP	Per million population
PP	Pulse pressure
PTH	Parathyroid hormone
PUV	Posterior urethral valves
PVD	Peripheral vascular disease
RA	Renal Association
RNSF	Renal National Service Framework (or NSF)
ROCR	Review of central information requirements
RR	Relative risk
RRDSS	Renal Registry data set specification
RRT	Renal replacement therapy
SARR	Standardised acceptance rate ratio
SAS	Statistical Analysis System (statistical software used by the Registry
SBP	Systolic blood pressure
SD	Standard deviation
SDS	Standard deviation score
SDII	Renal Standards document – second edition
SDIII	Renal Standards document – third edition
SES	Socio-economic status
SHARP	Study of Heart and Renal Protection
SI	System International (units)
SIRS	Study of Implementation of Renal Standards
SMR	Standardised mortality ratios
StHAs	Strategic health authorities
SUS	Secondary uses service
TOR	Take-on rate
TSAT	Transferrin saturation
UA	Unitary authorities
UKCHIP	UK Council for Health Informatics Professions
UKRR	UK Renal Registry
UKT	UK Transplant
USRDS	United States Renal Data System
URR	Urea reduction ratio

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
Abbreviations used for the renal centre names in the figures and data tables

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	Bristol Royal Hospital for Children	Bris RHC	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	Derby City General Hospital	Derby	England
Doncaster	Doncaster Royal Infirmary	Donc	England
Dorset	Dorchester Hospital	Dorset	England
Dudley	Russells Hall Hospital (previously reported as Wordsley, Stourbridge)	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 Hospital and Leeds General Infirmary	Leeds	England
Leicester	Leicester General Hospital	Leic	England
Liverpool	Alder Hey Children's Hospital	AlderHy	England
Liverpool	Liverpool 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' Hospitals	L West	England
London	King's College Hospital	L Kings	England
London	Royal Free, Middlesex, 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

City	Hospital	Abbreviation	Country
Newcastle	Freeman Hospital	Newc	England
Norwich	Norfolk and Norwich University Hospital	Norwch	England
Nottingham	Nottingham City Hospital	Nottm	England
Oxford	John 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	North Staffordshire Hospital	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 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 District General 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 & 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