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UK Renal Registry

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Chapter 1: Summary of Findings in the 2007 UK Renal Registry Report

In 2006, the overall annual acceptance rate for the whole UK was 113 pmp, an increase from 110 pmp in 2005. The rates in England (109 pmp) and Wales (135 pmp) continued to increase, whilst those in Scotland (114 pmp) and Northern Ireland (114 pmp) have fallen. From 2002 to 2006 there has been a 12% rise in the number accepted, the percentage rise being greater in England (14%) than in Scotland (5%) and Wales (4%).

The median age of patients starting RRT in the UK was 65.0 years. In non-Whites this was 59.1 years. By day 90, 8% had died and <1% stopped treatment. HD was the first modality of RRT in 77% of patients, a rise from 58% in 1998. 23% of all patients were referred late (<90 days before RRT start), a slight fall from previous years. Diabetes (either as primary renal disease or co-morbidity) and ischaemic heart disease were the most common co-morbid conditions, seen in 29% and 24% of patients respectively.

In univariate Cox regression analysis, the association for most co-morbid conditions with mortality at 1 year after 90 days from start of RRT, was more pronounced for patients <65 years compared to those aged ⩾65 years. In multivariate Cox analysis, malignancy and ischaemic/neuropathic ulcers were the strongest predictors of poor survival, followed by liver disease, increasing age, previous MI and diabetes.

At the end of 2006, 43,901 adult patients were receiving RRT in the UK, a population prevalence of 725 pmp, an increase from 694 pmp in 2005 (6.9% growth).The growth in England (7.6%) exceeded that in Wales (4.0%), Scotland (3.5%) and Northern Ireland (4.5%). For all ages, crude prevalence rates in males exceeded those in females, peaking in the 75–79 age band for males at 2,411 pmp and in females in the 60–64 age band at 1,221 pmp.

Of RRT patients in the UK, 45% had a transplant, 43% were on centre-based HD, 1% on home HD and 11% on PD which is falling.

The age adjusted survival of incident patients starting RRT continued to improve. There was an improvement for patients starting on HD and PD. The one year after 90 day survival was 87.3% (95% CI 86.7–88.1). There has been a survival improvement for both the under and over 65 year age groups. The last 8 years have shown an annual 3% relative improvement in survival in both the under and over 65 year age group.

The 'vintage effect' of increasing hazard of death with length of time on RRT, prominent in data from the US, was not seen in the UK within the 9 year incident cohort follow up period.

The 5 year survival rates (including deaths within the first 90 days) were 87%, 78%, 67%, 48%, 29% and 18% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and >75 years (last years published survival data had an error).

Overall, 80% of prevalent haemodialysis patients met the UK Renal Association standard for URR (>65%) in 2006 an increase from 56% in 1998.

At start of RRT, 40% of patients had a Hb <10 g/dl. The median Hb at commencement of dialysis was 10.4 g/dl. By 3 and 6 months after the start of RRT, 80% and 86% of incident patients had a Hb ⩾10 g/dl respectively. The median Hb on HD was 11.8 g/dl and 12.0 g/dl on PD.

The median ferritin in HD patients was 418 μg/L with 95% having a ferritin 100 μg/L. The median ferritin in PD patients was 250 μg/L with 85% having a ferritin 100 μg/L.

A higher proportion of HD patients required ESA therapy than PD patients (93% vs 79%).

The mean ESA dose was higher for HD than PD patients (9,223 vs 5,969 IU/week).

A serum phosphate of <1.8 mmol/L was achieved by 67% of dialysis patients (65% of HD patients, 73% of PD patients). An adjusted serum calcium concentration between ⩾2.2–⩽2.6 mmol/L was achieved by 75% of dialysis patients (74% of HD patients, 79% of PD patients). A serum calcium*phosphate product within the KDOQI guidelines was achieved by 71% of dialysis patients (70% of HD patients, 75% of PD patients). A serum PTH <32 pmol/L was achieved by 61% of dialysis patients (61% of HD patients, 60% of PD patients). Longitudinal analysis continued to show year-on-year improvement in achievement of Renal Association biochemical standards.

Serum bicarbonate of ⩾20–⩽26 mmol/L was achieved by 70% of HD patients. Serum bicarbonate of ⩾25–⩽29 mmol/L was achieved by 53% of PD patients.

A total serum cholesterol concentration of <5 mmol/L was achieved by 83% of dialysis patients (85% of HD patients and 71% of PD patients). A total serum cholesterol <5 mmol/L was achieved by 67% of transplant patients.

The percentage of patients achieving the combined BP standard pre-HD (<140/90 mmHg) averaged 44% and post-HD (<130/80) averaged 48%. 30% of PD patients and 25% of renal transplant recipients achieved the standard of <130/80. Over the last 9 years there has been no significant change in systolic or diastolic BP achievement. This suggests poorly achieving centres have failed to adopt a systematic approach to blood pressure control.

The total number of patients active on the renal transplant waiting list on 31/12/2006 was 6,220, an 8% increase from 2005. In 2006, heart beating deceased donor numbers decreased by 1% compared to 2005. In comparison, non-heart beating deceased donors and living kidney donors increased by 25% and 24% respectively. The proportion of renal transplants performed from deceased heart beating donors fell from 60% in 2005 to 55% in 2006. In 2006, 12.5% of incident transplants were performed in patients with diabetes, similar to 2005.

On 31/12/2006, 46% (20,262) of prevalent RRT patients, had a functioning transplant. During 2006, the death rate in prevalent transplant patients was 2.4/100 patient years. An additional 3.2% of all prevalent transplants failed with patients returning to dialysis.

There were wide and unexplained variations between centres in the percentage of prevalent dialysis patients on the renal transplant waiting list and also the time taken to listing incident patients.

Results from the joint RA/BTS survey highlighted centre differences in resource allocation and clinical practices governing access to renal transplantation in both transplant and non-transplanting centres.

The median eGFR in patients with a functioning kidney transplant was 46 ml/min/1.73 m^2, with 17% of prevalent transplant recipients having an eGFR <30. The median eGFR 12 months after transplantation for patients transplanted in 2001–2005 was 49 ml/min/1.73 m^2.

The median Hb in prevalent transplant recipients was 12.8 g/dl, with 4% of patients having a Hb <10 g/dl. The median Hb 12 months after transplantation for patients transplanted in 2001–2005, was 13.0 g/dl.

Transplant function analysed by CKD stage 1–2T, 3T, 4T and 5T, showed that these categories account for 24%, 59%, 15% and 2% of prevalent transplant patients respectively. Clinical and biochemical variables deteriorate with declining eGFR and patients with CKD stage 4T and 5T were less likely to achieve RA standards compared to prevalent patients on dialysis.

Chapter 2: Introduction to the 2007 UK Renal Registry Report

David Ansell, Simon Davies and Charlie Tomson

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 £16 per patient per annum (2007).

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 5 UK renal centres provided such electronic data extracts in 2006; these 5 provided summary data on incident and prevalent patients.

Geographical areas covered by the UK Renal Registry

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

All the reporting renal centres in England & Wales and also the Scottish Registry run the CCL Proton software, except:

Table 2.1: Centres in the 2007 Registry Report

	Hospital	Estimated population (millions)
England		**46.14**
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
Carlisle	Cumberland Infirmary	0.36
Carshalton	St Helier Hospital	1.80
*Chester	Countess of Chester Hospital	0.24
Chelmsford	Broomfield Hospital	0.50
Coventry	Walsgrave Hospital	0.85
Derby	Derby City Hospital	0.48
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

Table 2.1: (continued)

	Hospital	Estimated population (millions)
London	St Barts & The Royal London	1.79
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
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	1.75
Shrewsbury	Royal Shrewsbury Hospital	0.40
Southend	Southend Hospital	0.35
Stevenage	Lister Hospital	1.25
Sunderland	Sunderland Royal Hospital	0.34
Truro	Royal Cornwall Hospital	0.36
Wirral	Arrowe Park Hospital	0.31
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
Clwyd	Ysbyty Clwyd	0.15
Swansea	Morriston Hospital	0.70
Wrexham	Maelor General Hospital	0.32
Northern Ireland		**1.69**
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.

Table 2.2: Progress in centres not included in this report

	Hospital (indicates IT system used by hospital)	Estimated population (millions)
Stoke – submitted 2007	North Staffs (Cybernius system)	0.70
Manchester – submitted 2007	Royal Infirmary (CCL clinical vision)	2.51
Canterbury	Kent & Canterbury – Renalplus	0.91
London	St George's (CCL clinical vision)	
Colchester	Colchester General Hospital (new renal centre Fresenius, software not chosen)	

Ipswich and Bangor (Baxter system);
Aberdeen, Brighton and Newcastle (CCL clinical vision);
Kings, The London and Royal Free (Renalware);
Airdrie, Basildon, Chelmsford, Dorset, Dundee, Norwich and all six Northern Ireland centres (Mediqal eMed);
Shrewsbury & Stevenage (Renalplus);
Birmingham, Cambridge, QEH, Hammersmith and Hope Hospital (own systems).

Three renal centres were created in 2006 and two in 2007:

1. Liverpool Aintree (previously a satellite of University Hospital Liverpool renal centre)
2. Chester (previously a satellite of the Wirral renal centre)
3. Derry (previously a satellite of Tyrone renal centre)
4. Doncaster (until 2007 a satellite of Sheffield renal centre)
5. Colchester

In 2007, Derby changed their renal IT system from Proton to Vitaldata and Wrexham changed from Proton to Renalplus.

Future coverage by the Registry

From the analyses presented here, it can be seen that the report on the 2006 data covers over 90% of the UK with the remaining centres sending electronic data returns for 2007. With the recommendation in the Renal National Service Framework (NSF) that all renal centres should participate in audit through the Registry, all renal centres in England, Wales and Northern Ireland have invested in the IT technology and local support infrastructure to undertake returns to the UK Registry. To support the Renal Registry, continuing local investment is required in the additional local resources to maintain the clinical data within these systems.

The Health Care Commission (HCC) wishes to use the Registry as one vehicle for monitoring implementation of the NSF.

Centres not returning data electronically in 2006

All adult renal centres have moved to implementation of a Registry compatible renal IT system.

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 2.3). Ethnicity, date first seen by nephrologist and co-morbidity are not mandatory items in the Scottish Renal Registry returns so these centres have been listed separately.

Table 2.3: Completeness of data returns

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Co-morbidity	Average completeness	Country
Nottm	100.0	100.0	100.0	90.4	97.6	England
Swanse	98.2	91.2	100.0	94.7	96.0	Wales
Bradfd	93.9	89.8	100.0	100.0	95.9	England
Glouc	100.0	100.0	82.2	87.7	92.5	England
York	95.7	87.2	97.9	87.2	92.0	England
L West	100.0	91.5	89.7	67.3	87.1	England
Bristol	88.4	80.9	80.9	84.4	83.7	England
Wolve	97.8	80.6	100.0	45.2	80.9	England
Sheff	73.7	86.8	99.4	46.1	76.5	England
Ports	71.8	96.6	94.3	34.5	74.3	England
Newc	98.2	96.4	99.1	0.9	73.7	England
ManWst	100.0	100.0	87.4	6.3	73.4	England
L Kings	93.7	98.2	0.0	99.1	72.8	England
L Barts	96.6	99.4	22.3	72.6	72.7	England
Bangor	52.5	97.5	100.0	40.0	72.5	Wales
Leic	95.4	79.3	53.1	61.0	72.2	England
Shrew	81.5	98.1	100.0	0.0	69.9	England
Carlis	92.6	100.0	0.0	81.5	68.5	England
Truro	58.0	80.0	56.0	78.0	68.0	England
Middlbr	95.9	93.8	77.3	0.0	66.8	England
Sund	82.8	94.8	0.0	84.5	65.5	England
Wirral	87.5	96.4	73.2	1.8	64.7	England
Stevng	100.0	100.0	46.1	0.0	61.5	England
Leeds	47.3	55.9	83.9	51.6	59.7	England
Dudley	100.0	97.8	37.8	2.2	59.5	England
Derby	45.8	100.0	4.2	69.4	54.9	England
Liv RI	69.7	99.3	0.0	46.5	53.9	England
Sthend	20.5	97.7	0.0	95.5	53.4	England
Camb	72.8	100.0	35.9	0.0	52.2	England
Redng	100.0	100.0	0.0	0.0	50.0	England
Hull	5.1	96.9	1.0	94.9	49.5	England
B Heart	94.1	100.0	0.0	0.0	48.5	England
Covnt	80.8	98.1	0.0	0.0	44.7	England
Prstn	90.1	86.8	0.0	0.0	44.2	England
Exeter	22.8	62.3	50.9	24.6	40.2	England
Oxford	60.1	96.9	2.5	0.6	40.0	England
L Guys	57.9	99.2	0.0	0.0	39.3	England
Liv Ain	55.6	100.0	0.0	0.0	38.9	England
Chestr	50.0	100.0	0.0	0.0	37.5	England
Plymth	32.3	97.8	0.0	8.6	34.7	England
B QEH	97.3	38.5	0.0	0.0	34.0	England
Crdff	26.7	99.0	0.5	3.4	32.4	Wales
Clwyd	11.8	100.0	0.0	0.0	28.0	Wales
L Rfree	99.5	0.0	0.0	0.0	24.9	England
Wrexm	0.0	88.0	0.0	0.0	22.0	Wales
Brightn	21.4	49.6	0.8	0.8	18.2	England
Carsh	9.5	56.8	0.0	1.6	17.0	England
Centres whose co-morbidity data was excluded from this report due to incorrect data returns*						
Basldn	100.0	97.7	100.0			England
Chelms	40.0	100.0	86.0			England

Table 2.3: (continued)

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Co-morbidity	Average completeness	Country
Dorset	100.0	96.4	100.0			England
Ipswi	73.8	97.6	100.0			England
Norwch	44.5	100.0	18.2			England
Antrim	61.3	100.0	25.8			N Ireland
Belfast	77.0	93.8	52.2			N Ireland
Derry	100.0	100.0	100.0			N Ireland
Newry	7.1	100.0	71.4			N Ireland
Tyrone	90.0	100.0	96.7			N Ireland
Ulster	75.0	100.0	100.0			N Ireland
Scotland						
Abrdn	0.0	82.0				Scotland
Airdrie	94.5	94.5				Scotland
D&Gall	0.0	86.4				Scotland
Dundee	16.0	94.0				Scotland
Dunfn	2.9	97.1				Scotland
Edinb	1.9	100.0				Scotland
Glasgw	1.1	84.5				Scotland
Inverns	22.2	96.3				Scotland
Klmarnk	0.0	84.6				Scotland

*See chapter 5.

Software and links to the Registry

It is apparent that there are now 13 systems in use by renal centres, some of them commercial and some in-house. The Registry has worked with the relevant companies to provide appropriate software links to the Registry. As new data items (eg 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 an interface with the Registry for the new items. The NHS Information Centre has developed 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; the feasibility of collection of data items defined within the dataset is now being tested using existing renal centre IT systems and this project will also require software development to permit collection of data items not currently collected by the Registry.

Paediatric Renal Registry links

The BAPN were unable to return their data analyses in time to be included in this years report. In the UK in 2005 there were 768 patients under 18 years old at the 13 UK paediatric renal centres who were on renal replacement therapy. In order to integrate with the adult Registry and also benefit from funded resources for data management, the BAPN is intending to develop the means to collect the paediatric data electronically.

Relationship with the Renal Association

The UK Renal Registry is represented by the Chairman on the Renal Association Clinical Practice Guidelines Committee, which is in the process of producing a modular, 4th edition set of audit measures relating to all aspects of care of patients with kidney disease. Where possible, the Registry will adapt its data collection procedures so as to be able to report on performance against these audit measures. Many 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 Registry on the Clinical Affairs Board.

Links with other organisations

NHS Blood & Transplant and the British Transplantation Society

Close collaboration has developed with the NHS Blood and Transplant Authority (previously 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 2005 report included a full chapter of these analyses. New analyses for 2006 include the survival benefit of patients after having received a renal transplant when compared to a patient who remained on the transplant waiting list. The results were presented at the British Transplantation Society meeting and a paper is in preparation. The current report includes a centre specific analysis of access to the transplant waiting list and these analyses will be included in all future reports.

This years report (chapter 11) also includes a report from the BTS/RA national survey of clinical practices at transplanting and non-transplanting centres.

Departments of Health

Registry reports are sent to the Department of Health 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. The DoH for England is represented on the Registry Committee.

In 2007, the DoH for England invited bids for funding of new audit projects. The Registry submitted three bids and was awarded funding for each of these totalling just under £200K. The bids involved:

1. The development of software to enable the Registry to produce centre-specific audit packs, designed to encourage use of Registry analyses of individual centres' performance compared to other centres' performance in local audit activities. These centre-specific reports will include pdf documents and powerpoint slides in which each centre's results are highlighted.
2. Upgrading of the Registry database.
3. Collaboration with the East Midlands Public Health Observatory on use of graphical mapping software to present Registry analyses.

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

The Registry Chairman is a member of the National Renal Dataset project board. Following the definition of a proposed national renal dataset, the Registry has been awarded funding by the Information Centre to test the collection of several new data items defined within the dataset, including vascular access, peritoneal dialysis access and complications relating to these. Software is being developed for the Proton, Clinical Vision and Mediqal systems to enable collection of these data items.

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. A tender document focusing on transport for haemodialysis and vascular access for haemodialysis was subsequently developed by the Information Centre. The funding for this audit has now been awarded by the Healthcare Commission to the Information Centre. The Registry expects to be a key partner in the performance of the audit of vascular access.

Detailed negotiation continues with the Information Centre on how data will flow to the UKRR as the work of Connecting for Health 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. The Registry, together with the Renal Information Exchange Group, takes the view that specialty-specific systems, fully interoperable with the main electronic care record,

will continue to be necessary to support the care of patients with kidney disease. The alternative view is that full implementation of the solutions currently being developed by Local Service Providers will make such specialty-specific systems redundant. If that view were accepted, the data currently collected by the Registry would be available within the Secondary Uses Service, which replaces the Hospital Episode Statistics database as the repository of all data collected by the NHS in England. The role of the Registry in validating data, correcting errors and then in the design, performance and interpretation of clinically meaningful analyses, would remain to be defined.

The Registry is also keen however, to be able to use data from the Secondary Uses Service, for instance on hospitalisation, surgical procedures and discharge diagnoses. Under current arrangements, this would require approval from the Patient Information Advisory Group under Section 60 of the Health and Social Care Act, 2001.

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 and satellite centres, to ensure that all patients on RRT developing MRSA bacteraemia can be accurately identified. The Registry will provide denominator data for future analyses of MRSA rates and will be able to produce reports jointly with the HPA.

Agreement in principle has been reached with the HPA on work to describe the clinical epidemiology of all types of bacteraemia in patients with established renal failure, by linking the Registry dataset with the Lab-Base dataset held by the HPA. The latter contains reports of positive blood cultures submitted by nearly all microbiology laboratories in England.

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 recently been granted funding by the European Union; the first phase 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 cardio-vascular risk studies.

Commissioning of renal services and PCTs

An Executive summary of the 9th Annual Report was 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 Registry has reported some demographic analyses based on Local Authority and PCT areas. Only some of the boundaries of the PCTs and Local Authorities in England are similar. In 2007, the Office for National Statistics has been re-aligning the PCT boundaries with those of Local Authorities.

The Registry and clinical governance

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 (eg 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.

Anonymity and confidentiality

In the first few Registry Reports, all centres were anonymised. Anonymity was removed from all the adult data apart from survival in 2002 and in the 9th Annual Report anonymity for survival was also removed. It is now possible for any member of the healthcare community or general public to see centre-specific analyses on each audit measure, including survival. The response to this de-anonymisation has been uniformly positive, even from centres whose results are at the lower end of the distribution.

Data security and confidentiality

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 should 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 Health and Social Care Act 2001 and Trusts may independently verify this listing on their official register using the following link below (http://www.advisorybodies.doh.gov. uk/piag/register.htm).

When a data file has been created on the local hospital Trusts system, this is encrypted using an approved public/private key 256 bit encryption system prior to transmission to the Registry (www.pgp.com), then emailed as an attachment to the Registry. The Registry is able to provide a software licence for sites whose IT departments will not provide this package.

The data file is transferred to the Renal Registry server based in Southmead Hospital's secure computer room and is then decrypted. There is no external hospital access to the Renal Registry server and there is also no internet access to the server (even through the NHSnet). Access to the Registry server has been configured so that it is restricted to the hub that supplies the building housing the Renal Registry staff. All Registry staff have signed data confidentiality agreements.

Data extraction for statistical analysis excludes identifiable data and relies in the unique Renal Registry number allocated by the Registry.

The 'Health and Social Care Act 2001: section 60 exemption

The Registry has been granted temporary exemption by the Secretary of State to hold patient identifiable data under section 60 of the Health and Social Care Act. 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. The progress towards collection of anonymised data or obtaining permission of the individual patient is monitored by the Patient Information Advisory Group (PIAG). The third annual report on progress by the Registry towards anonymisation has been submitted to the PIAG and the fourth review is due in March 2008.

Quality Improvement

In the Introduction to the 9th Annual Report, details were given of a planned quality improvement collaborative, the aim of which was to identify and spread best practice in the management of serum phosphate concentration and the correction of renal anaemia. A half-day meeting was held at the British Renal Society meeting in May 2007 to start this work. In preparation for this, 'change packages' were developed by a faculty of clinicians from some of the renal centres with sustained high performance on these two performance indicators. This work was complicated by the changing definition of high performance relating to the management of anaemia: those centres with the highest proportion of patients with a Hb >10 g/dl were not the same as those with the highest proportion of patients with a Hb between 10.5 and 12.5 g/dl, which is the new audit measure introduced by the Renal Association – as many centres with a high proportion of patients with Hb >10 g/dl have, as a consequence of shifting the distribution to the right, a high proportion of patients with Hb >12.5 g/dl as well. Those centres that perform well on both measures have a narrower distribution of Hb values. Despite these difficulties, a number of clinical processes were identified both by the anaemia and phosphate faculties and were presented to participants after a brief intensive session on improvement methodology delivered by a senior clinician from the NHS Institute for Innovation and Improvement. The meeting generated a great deal of interest and enthusiasm. The intention had been to promote active collaboration between improvement teams in each participating renal centre, using a web-based social network. However, the intended website for this purpose proved unsuitable. The Renal Association provided a discussion forum within its website, but this has not proved conducive to improvement teams posting and sharing their experiences and to date there is little evidence of genuine collaboration between teams, although it is clear that some improvement teams have continued to work hard to improve their own results.

New data items

Pre-RRT care

In order to provide some description of the care prior to start of RRT, the Registry is developing software to extract data on laboratory variables at 1, 2, 3, 6 and 12 months prior to start of RRT.

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, along with software to enable these items to be extracted from renal IT systems.

Irrespective of this work and the possible Healthcare Commission-funded national renal audit, the Registry plans to collect data on vascular access from all UK renal centres as soon as possible. This will require that all centres develop and implement software enabling the collection of these data items. It is proposed to achieve this by asking all centres to record the type of vascular access actually used for each and every haemodialysis session, preferably by recording this at the point of care along with the pre- and post-dialysis blood pressure and weight. Those centres that also wish to record vascular access construction, complications and use using a 'timeline' approach should continue to do so, as this approach gives additional information that will be useful for local audit and may become suitable for national data collection at some point in the future; however, the former approach is considered simpler and more likely to be widely adopted.

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; co-morbidity, 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.

Peritoneal dialysis

The Registry Committee is acutely aware of the limitations of its analyses of the outcome 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 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 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 system, 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

In 2005 and 2006, the Registry 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 (eg UKCHIP), agenda for change and informatics related job profiles, ways

to enhance the role of IS managers within the MDT, 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 2008.

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 Poisson 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 65 centres and then centre Y with the other 64 centres. Thus, 129 comparisons have been made and at the commonly accepted 1 in 20 level at least 6 are likely to appear 'statistically significant' by chance. If 65 centres were compared with each other, 2,080 such individual comparisons would be made and one would expect to find 104 apparently 'statistically significant' differences at the $p = 0.05$ level and still 21 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). The Registry is investigating further methods of performing such comparisons.

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 Alex Hodsman and Dr Udaya Udayaraj started work at the Registry in February 2006 and Dr Daniel Ford started in August 2007.

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.

New data collection and analysis

The survey on vascular access

The two national surveys on vascular access have been invaluable in establishing a baseline

for monitoring implementation of the renal NSF and in identifying the obstructions to improvement in the provision of vascular access services. It highlighted the wide variations between renal centres, with some centres managing to start 95% of renal replacement therapy patients with definitive access and others less than 50%. As discussed above, the Registry is working on collecting patient based access data electronically.

Surveys of facilities

After consultation with the Clinical Affairs Board and the renal Clinical Directors forum the Registry has carried out a fourth national renal facilities survey. The Registry has collaborated with the British Renal Society to collect data on non-medical staffing.

Recent UK Renal Registry peer reviewed publications

1. 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. *Nephrol Dial Transplant* 2000;15:1022–1028.
2. 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.
3. 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.
4. Stel VS, van Dijk PC, van Manen JG, Dekker FW, Ansell D, Conte F, *et al*. Prevalence of co-morbidity in different European RRT populations and its effect on access to renal transplantation. *Nephrol Dial Transplant*. 2005;20:2803–11.
5. Tangri N, Ansell D, Naimark D. Lack of a centre effect in UK renal units: application of an artificial neural network model. *Nephrol Dial Transplant*. 2006; 21:743–8.
6. 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.
7. 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.
8. 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.
9. Van Dijk PC, Jager KJ, Stengel B, Gronhagen-Riska C, Feest TG, Briggs JD. Renal replacement therapy for diabetic end-stage renal disease: data from 10 registries in Europe (1991–2000). *Kidney Int* 2005;67: 1489–99.
10. 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.
11. Ahmad A, Roderick P, Ward M, Steenkamp R, Burden R, O'Donoghue D, *et al*. Current chronic kidney disease practice patterns in the UK: a national survey. *Quarterly Journal of Medicine* 2006; 23:23.
12. White P, James V, Ansell D, Lodhi V, Donovan KL. Equity of access to dialysis facilities in Wales. Qjm 2006;99(7):445–52.
13. Caskey FJ, Roderick PJ, Steenkamp R, Nitsch D, Thomas K, Ansell D, Feest TG. Social deprivation and survival on renal replacement therapy in England and Wales. *Kidney Int* 2006;70:2134–2140.
14. Ansell D, Udayaraj UP, Steenkamp R, Dudley CR. Chronic Renal Failure in Kidney Transplant Recipients. Do They Receive Optimum Care?: Data from the UK Renal Registry. *Am J Transplant*. 2007 May; 7(5):1167–76.
15. van Manen JG, van Dijk PC, Stel VS, Dekker FW, Cleries M, Conte F, *et al*. Confounding effect of comorbidity in survival studies in patients on renal replacement therapy. *Nephrol Dial Transplant* 2007; 22(1):187–95.

The following have been submitted for publication:

16. Byrne C, Roderick P, Steenkamp R, Ansell D, Roderick P, Feest TG. Ethnic factors in Renal Replacement Therapy.
17. Nitsch D, Burden R, Steenkamp R, Ansell D, Roderick P, Feest TG. Diabetes in patients with established renal failure: demographics, survival and biochemical parameters.
18. Rao AVR, Ansell D, van Schalkwyk D, Feest TGF, Peritoneal dialysis technique survival in the UK: A UK Renal Registry data analysis.
19. Rao AVR, Ansell D, Steenkamp R, Williams AJ, Dudley CRK. Effect of 1st Year Renal Graft Function on Post Transplant Hemoglobin, Blood Pressure and Bone Metabolism: Data from UK Renal Registry.

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.

Chapter 3: New Adult Patients Starting Renal Replacement Therapy in the UK in 2006

Ken Farrington, Udaya Udayaraj, Julie Gilg, Terry Feest and John Feehally

Summary

- In 2006 the overall annual acceptance rate for the whole UK, including children and young adults, was 113 per million population (pmp), an increase from 110 pmp in 2005. This was derived from complete data for the UK, as data were obtained separately from the five adult English centres not currently returning to the Registry.

- For adults only the acceptance rate for renal replacement therapy (RRT) in 2006 in the UK was 111 pmp, an increase from 108 pmp in 2005.

- The 2006 adult acceptance rates in England (109 pmp) and Wales (135 pmp) continued to increase, whilst those in Scotland (114 pmp) and Northern Ireland (114 pmp) have fallen. The only rate markedly different from the others is that in Wales.

- From 2002 to 2006, there has been a 12% rise in the number accepted, the percentage rise being greater in England (14%) than in Scotland (5%) and Wales (4%).

- In the UK, for adults in 2006, the crude annual acceptance rates in Local Authorities (with a population >150,000) varied widely from 55 in Bury (population 180,607) to 208 in Plymouth (pop. 240,722), 177 in Westminster (pop. 181,284) and 176 in Newham (pop. 243,889). The standardised acceptance rate ratios for acceptance varied from 0.51 (Bury) to 2.21 (Newham).

- Over the period 2001 to 2006, of those areas with data for a minimum of three years, 38 had significantly low acceptance ratios, all but two of them (Shetland and Stirling) in England. Forty-eight areas had significantly high acceptance ratios: 30 in England (including 20 in London and the East and West Midlands), 10 in Wales and 8 in Scotland. Twenty-four of these high areas had ethnic minority populations of more than 10%. Eight were in Scotland where data on ethnicity were not available. Of the remaining 16 with high acceptance ratios without large ethnic minorities, 10 were in Wales and 3 in the South-West.

- The median age of patients starting renal replacement therapy in the UK was 65.0 years. This has changed only minimally over the period 2000 to 2006. The median age of incident UK non-White patients was considerably lower than White patients at 59.1 years.

- In England and Scotland the acceptance rate is highest within the 75–79 age group (at 407 and 507 pmp respectively). In Wales and Northern Ireland the peak is within the 80–84 age group (at 567 and 759 pmp respectively).

- Diabetic renal disease remains the most common specific primary renal diagnosis in the UK. The proportion of new patients with this diagnosis has increased since 2005 in the UK from 20% to 22%.

- In the UK in 2006, haemodialysis (HD) was the first modality of RRT in 77% of patients, peritoneal dialysis (PD) in 20% and pre-emptive transplant in just over 3%. The proportion whose first modality was HD has progressively increased since 1998 from 58%.

- By 90 days, in the 2006 UK cohort, 8% of incident patients had died, less than 1% had stopped treatment, leaving 92% of the original cohort remaining on RRT, (73% were on HD, 22% on PD and 5% had received a transplant).

- Data on first referral to a nephrologist was available from 26 centres for at least part of the period 2001 to 2006 (for a total of 7,256 patients). In 2006, the mean percentage of

patients referred less than 90 days before dialysis initiation was 23%, representing a slight fall from previous years.

- Patients referred late were older. Patients with polycystic kidney disease and diabetic nephropathy tended to be referred early whilst those with uncertain aetiology and no recorded diagnosis were more likely to be late referrals.

- White patients referred late had lower estimated glomerular filtration rate (eGFR) at initiation of RRT compared to earlier referrals, but this was not the case in Black and South Asian patients.

- Patients referred late had lower haemoglobin concentrations at initiation of RRT compared to earlier referrals, were more likely to initiate RRT on HD and to remain on that treatment modality.

Introduction

The acceptance data presented are from the whole UK. In 2006, the UK Renal Registry (UKRR) received complete returns from all 5 centres in Wales, all 6 centres in Northern Ireland and 90% of the centres in England. Data from all 10 centres in Scotland were obtained from the Scottish Renal Registry. In this report, Glasgow Royal Infirmary and Glasgow Western Infirmary are grouped together as Glasgow. In addition summary data were obtained separately from the 5 remaining English centres not currently returning to the Registry, to enable accurate calculation of acceptance rates.

Extrapolation from Registry data to derive information relating to the whole UK was still necessary. These results must still be viewed with caution, although the reliability of estimates improves as coverage increases. The proportion of the population aged over 65 years was similar in the fully covered population (defined below, based on Local Authority areas whose population was thought to be fully covered by participating centres) compared with the general population of England and Wales. The proportion from ethnic minority groups was lower in the fully covered population at 8.1% compared with 9.0% in the total population, because some areas not reporting to the Registry have catchments with high ethnic minority populations.

For adults, the data from the Registry are fully valid for comparisons between centres and between local areas fully covered by the UKRR.

Adult patients accepted for renal replacement therapy in the UK, 2006

Overall take-on rate

In 2006, the number of adult patients starting renal replacement therapy (RRT) in the whole UK was 6,716, equating to an acceptance rate of 111 per million population (pmp) (Table 3.1), an increase from 108 pmp in 2005. The acceptance rates in England (109 pmp) and Wales (135 pmp) continued to increase, whilst those in Scotland (114 pmp) and Northern Ireland (114 pmp) have fallen (Figure 3.1). The only country with an acceptance rate markedly different from the others is Wales.

There continues to be marked gender differences in take-on rates, 139 (95% CI 135–143) pmp in males and 84 (95% CI 81–87) pmp in females.

Table 3.1: Number of new adult patients accepted in the UK in 2006

	England	Wales	Scotland	N Ireland	UK
Centres contributing to UKRR (67)	5,062	401	583	199	**6,245**
All UK centres (67 + 5 = 72)	5,533	401	583	199	**6,716**
*Total estimated population mid 2006 (millions)	50.8	3.0	5.1	1.7	**60.6**
Acceptance rate (pmp)	109	135	114	114	**111**
(95% CI)	(106–112)	(122–148)	(105–123)	(98–130)	**(108–113)**

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

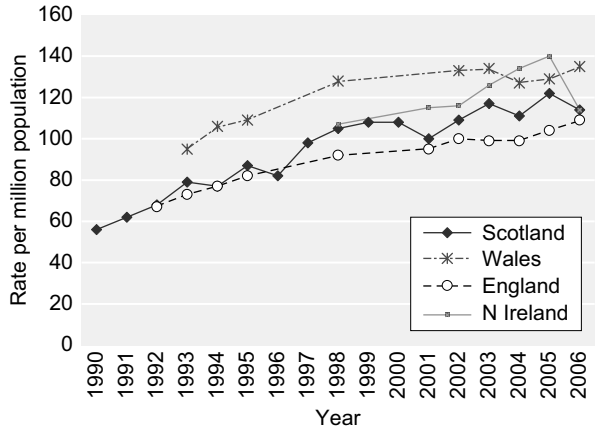

Figure 3.1: Adult incident rates in the countries of the UK; 1990–2006

Including the acceptances for children and young adults this gave a total annual acceptance rate for the UK of 113 pmp.

Acceptances by individual centres

Acceptance rates of individual centres have not been calculated as their catchment populations are not precisely defined.

The number of patients accepted by each centre in the years 2002 to 2006 is shown in Table 3.2. It shows the percentage change in those numbers over that time for each of the 49 centres with full reporting during that period

Table 3.2: Number of new patients accepted by individual centres reporting to the UK Renal Registry 2002–2006

		Year					
Country	**Centre**	**2002**	**2003**	**2004**	**2005**	**2006**	**% change since 2002**
England	B Heart	66	104	102	116	119	80
	B QEH			195	195	187	
	Basldn		53	46	29	44	
	Bradfd	62	74	62	66	49	−21
	Brightn			119	110	131	
	Bristol	124	163	164	176	173	40
	Camb	74	99	112	160	92	24
	Carlis	26	31	29	31	27	4
	Carsh	175	201	167	182	190	9
	Chelms			51	39	50	
	Chestr	3	4	5		4	33
	Colche					*0*	
	Covnt	96	75	76	84	104	8
	Derby		60	67	71	72	
	Dorset		66	60	45	55	
	Dudley	25	41	55	38	45	80
	Exeter	82	98	110	111	114	39
	Glouc	54	53	53	60	73	35
	Hull	105	80	109	126	98	−7
	Ipswi	41	39	44	55	42	2
	Kent				*104*	*124*	
	L Barts			187	183	179	
	L George				*90*	*100*	
	L Guys	141	93	104	133	133	−6
	L Kings	116	108	114	136	111	−4
	L Rfree				131	206	
	L West	234	230	272	267	272	16
	Leeds	152	185	174	164	186	22
	Leic	152	168	162	225	241	59
	Liv Ain			3	29	36	
	Liv RI	153	114	129	139	142	−7
	ManWst		143	113	111	127	
	ManRI				*181*	*160*	
	Middlbr	111	103	102	84	97	−13

Table 3.2: (continued)

Country	Centre	Year					% change since 2002
		2002	2003	2004	2005	2006	
	Newc	107	108	106	94	110	3
	Norwch			94	121	110	
	Nottm	87	115	107	146	136	56
	Oxford	170	187	172	163	163	−4
	Plymth	79	64	62	58	93	18
	Ports	146	141	118	151	174	19
	Prstn	110	98	79	118	121	10
	Redng	39	63	59	74	72	85
	Sheff	156	159	169	158	167	7
	Shrew			55	43	54	
	Stevng	101	119	88	91	115	14
	Sthend	33	42	40	34	44	33
	Stoke				*87*	*87*	
	Sund	57	56	51	59	58	2
	Truro	59	53	67	32	50	−15
	Wirral	40	49	63	58	56	40
	Wolve	99	88	105	93	93	−6
	York	63	57	48	43	47	−25
N Ireland	Antrim				42	31	
	Belfast				131	113	
	Derry					3	
	Newry				28	14	
	Tyrone				22	30	
	Ulster				9	8	
Scotland	Abrdn	60	52	69	64	50	−17
	Airdrie	60	52	51	39	55	−8
	D&Gall	22	22	16	21	22	0
	Dundee	68	63	62	76	50	−27
	Dunfn	29	27	29	44	35	21
	Edinb	81	90	98	99	105	30
	Glasgw	175	221	188	203	187	7
	Inverns	29	35	33	44	27	−7
	Klmarnk	32	40	29	43	52	63
Wales	Bangor	29	33	36	40	40	38
	Clwyd	20	12	14	27	17	−15
	Crdff	181	166	187	183	206	14
	Swanse	113	128	93	97	113	0
	Wrexm	42	32	29	41	25	−41
England		**3,338**	**3,784**	**4,469**	**5,294**	**5,533**	
N Ireland					**232**	**199**	
Scotland		**556**	**602**	**575**	**633**	**583**	
Wales		**385**	**371**	**359**	**388**	**401**	
UK		**4,279**	**4,757**	**5,403**	**6,547**	**6,716**	
Including only centres reporting continuously 2002–2006							
England		**3,335**	**3,458**	**3,474**	**3,725**	**3,807**	**14**
Scotland		**556**	**602**	**575**	**633**	**583**	**5**
Wales		**385**	**371**	**359**	**388**	**401**	**4**
Total		**4,276**	**4,431**	**4,408**	**4,746**	**4,791**	**12**

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

and also on a national level for the same centres. There have been wide variations in trends in acceptances between centres, ranging from increases of 80% or more (Birmingham Heartlands, Dudley and Reading) to reductions of 20% or more (Bradford, York, Dundee and Wrexham). The most dramatic changes appear to reflect changes in catchment populations and areas. The variation may also reflect chance fluctuation, completeness of reporting, changing incidence of established renal failure (ERF), changes in referral patterns and the introduction of conservative care programmes. Overall there has been a 12% rise in the numbers accepted, the percentage rise being greater in England (14%) than in Scotland (5%) and Wales (4%). Three centres with less than 10 patients (Chester (4), Derry (3) and Ulster (8)) starting RRT in 2006 are not shown in subsequent analyses.

Geographical variation in adult acceptance rates in England, Northern Ireland, Scotland and Wales

Introduction

Equity of access to RRT is an important goal of service provision. The need for RRT depends on many social and demographic factors including age, gender, social deprivation and ethnicity, so 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]. The population used for standardisation is the sum of all Local Authority (LA) areas for which the Registry had full coverage in 2006.

Methods

Standardised acceptance rate ratios were calculated as detailed in Appendix D found on the UKRR website at http://www.renalreg.org. Briefly, age and gender specific acceptance numbers were first calculated using the available Registry data on the number of incident patients for the covered areas of England, Wales, Scotland and Northern Ireland. The age and gender breakdown of the population of each Local Authority area was obtained from the 2001 Census data from the Office for National Statistics (ONS)[2] and used to calculate the expected age and gender specific acceptance numbers for each LA area. The age and gender standardised acceptance rate ratio is the observed acceptance numbers divided by the expected acceptance numbers. A ratio below 1 indicates that the observed rate is less than expected given the LA area's population structure. This is statistically significant at the 5% level if the upper confidence limit is less than 1.

Significance of results

Acceptance rates in Local Authorities with complete coverage by the Registry are shown in Table 3.3. Acceptance rates for RRT in relatively small populations such as those covered by individual Local Authorities have wide confidence intervals for any observed rate. To enable assessment of whether an observed acceptance rate differs significantly from the national average, Figure 3.2 has been included.

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. The example plot shown in Figure 3.2 assumes that the national average is 111 pmp. An observed acceptance rate outside these limits is significantly different from the national average. In order to be judged as significantly different from national norms the observed take-on rate for a population of 50,000 would have to be outside the limits of 19 to 203 per million population per year, whilst for a population of 1 million, the limits are from 90 to 132 per million population per year.

Results

Local Authority acceptance rates 2006

From Figure 3.2 it can be seen that quoting an acceptance rate for a population of less than 150,000 has such wide error margins as to be meaningless. However, no such small areas had single year acceptance rates significantly different from the mean.

Table 3.3: Crude adult annual acceptance rates (pmp) and standardised rate ratios 2001–2006

*For those areas not covered by the Registry for the entire period 2001–2006, the standardised acceptance rate ratio and the acceptance rates are averages for the years covered by the Registry.

O/E = standardised acceptance rate ratio.

Blank cells – no data returned to the Registry for that year.

Areas with data for minimum 3 years and with significantly high average acceptance ratios are bold in darker greyed areas, areas with significantly low acceptance ratios are italicised in darker grey areas.

% non-White = sum of % South Asian and Black from 2001 UK census.

UK Area	LA name	Tot Pop	2001	2002	2003	2004	2005	2006		2001–2006*				% non
			O/E	O/E	O/E	O/E	O/E	O/E	Pmp	O/E	LCL	UCL	Pmp	White
North East	*Darlington*	*97,838*	*0.74*	*0.91*	*0.96*	*0.77*	*0.45*	*0.70*	*82*	*0.75*	*0.56*	*1.00*	*80*	*2.1*
	Durham	*493,469*	*0.54*	*1.02*	*0.80*	*0.86*	*0.89*	*0.86*	*101*	*0.83*	*0.74*	*0.94*	*89*	*1.0*
	Hartlepool	88,610	1.08	0.57	1.31	0.99	0.82	1.28	147	1.01	0.78	1.31	105	1.2
	Middlesbrough	134,855	1.09	1.13	1.15	0.92	1.08	1.25	133	1.10	0.90	1.36	108	6.3
	Redcar and Cleveland	139,132	0.73	1.83	1.14	1.14	0.75	0.72	86	1.04	0.85	1.28	113	1.1
	Stockton-on-Tees	178,408	0.86	1.06	0.90	1.07	0.84	0.86	95	0.93	0.77	1.13	93	2.8
	Gateshead	191,151		1.22	1.06	0.92	0.63	0.83	99	0.92	0.76	1.13	103	1.6
	Newcastle upon Tyne	259,536		1.03	0.93	1.13	0.98	0.81	89	0.97	0.82	1.15	99	6.9
	North Tyneside	191,658		0.95	0.81	0.91	0.63	0.82	99	0.82	0.66	1.01	92	1.9
	Northumberland	*307,190*		*0.73*	*0.96*	*0.87*	*0.52*	*0.76*	*94*	*0.77*	*0.65*	*0.91*	*88*	*1.0*
	South Tyneside	152,785		0.82	0.66	0.97	0.90	1.03	124	0.88	0.70	1.10	98	2.7
	Sunderland	280,807	0.77	1.07	1.22	0.63	0.75	0.73	82	0.86	0.73	1.01	88	1.9
North West	Cheshire	673,787												1.6
	Halton	**118,209**	**1.65**	**0.84**	**1.24**	**1.34**	**1.41**	**1.36**	**144**	**1.31**	**1.06**	**1.61**	**125**	**1.2**
	Knowsley	150,459	0.76	0.94	1.31	0.97	0.71	0.75	80	0.90	0.73	1.13	88	1.6
	Liverpool	**439,471**	**1.95**	**0.99**	**0.75**	**1.01**	**1.22**	**1.23**	**132**	**1.18**	**1.06**	**1.32**	**116**	**5.7**
	Sefton	*282,958*	*0.98*	*1.00*	*0.67*	*0.54*	*0.86*	*0.83*	*102*	*0.81*	*0.69*	*0.95*	*91*	*1.6*
	St. Helens	176,843	1.26	0.98	0.60	0.50	1.23	1.09	124	0.95	0.78	1.15	98	1.2
	Warrington	*191,080*	*0.81*	*1.00*	*0.63*	*0.96*	*0.74*	*0.76*	*84*	*0.82*	*0.67*	*1.00*	*81*	*2.1*
	Wirral	312,293	0.52	0.84	1.00	1.21	1.19	0.77	93	0.93	0.81	1.07	101	1.7
	Blackburn with Darwen	**137,470**	**0.89**	**1.45**	**1.30**	**0.98**	**1.37**	**1.40**	**138**	**1.24**	**1.01**	**1.52**	**112**	**22.1**
	Blackpool	*142,283*	*0.81*	*1.02*	*0.37*	*0.43*	*0.63*	*0.55*	*70*	*0.63*	*0.49*	*0.80*	*73*	*1.6*
	Cumbria	*487,607*	*0.90*	*0.74*	*0.76*	*0.60*	*0.87*	*0.66*	*82*	*0.75*	*0.66*	*0.85*	*85*	*0.7*
	Lancashire	*1,134,975*	*0.94*	*0.64*	*0.60*	*0.57*	*0.61*	*0.66*	*77*	*0.67*	*0.61*	*0.73*	*70*	*5.3*
	Bolton	*261,037*			*0.97*	*0.74*	*0.69*	*0.84*	*92*	*0.81*	*0.66*	*1.00*	*83*	*11.0*
	Bury	*180,607*			*0.56*	*0.84*	*0.74*	*0.51*	*55*	*0.66*	*0.50*	*0.87*	*68*	*6.1*
	Manchester	392,821												19.0
	Oldham	*217,276*			*0.77*	*0.67*	*0.58*	*0.82*	*87*	*0.71*	*0.56*	*0.91*	*71*	*13.9*
	Rochdale	205,357			1.01	0.82	0.57	0.83	88	0.80	0.63	1.02	80	11.4
	Salford	*216,105*			*1.28*	*0.50*	*0.34*	*0.95*	*106*	*0.77*	*0.61*	*0.97*	*81*	*3.9*
	Stockport	284,527												4.3
	Tameside	213,043												5.4
	Trafford	210,145												8.4
	Wigan	301,415			0.86	0.83	0.93	0.72	80	0.83	0.69	1.01	87	1.3
Yorkshire and the Humber	*East Riding of Yorkshire*	*314,113*	*0.86*	*0.85*	*1.03*	*0.73*	*1.10*	*0.63*	*80*	*0.86*	*0.75*	*1.00*	*99*	*1.2*
	Kingston upon Hull	243,588	1.02	1.07	0.97	1.27	1.26	0.92	99	1.08	0.93	1.27	106	2.3
	North East Lincolnshire	157,981	0.27	1.16	0.67	1.10	1.14	1.10	127	0.92	0.75	1.13	96	1.4
	North Lincolnshire	152,848	0.80	0.95	0.61	1.34	0.96	1.04	124	0.95	0.78	1.17	104	2.5
	North Yorkshire	569,660	0.88	1.25	0.99	1.05	0.94	0.79	98	0.98	0.89	1.08	110	1.1
	York	181,096	0.87	1.49	1.47	0.95	0.88	1.14	133	1.13	0.95	1.34	120	2.2
	Barnsley	218,063	0.77	1.10	0.70	0.92	0.70	0.91	105	0.85	0.71	1.02	89	0.9
	Doncaster	*286,865*	*0.95*	*0.91*	*0.93*	*0.86*	*0.68*	*0.78*	*91*	*0.85*	*0.72*	*0.99*	*89*	*2.3*
	Rotherham	248,175	1.64	0.87	0.98	1.18	1.18	0.92	105	1.12	0.96	1.30	116	3.1
	Sheffield	513,234	1.01	0.96	0.95	1.16	1.03	1.07	121	1.03	0.93	1.15	106	8.8
	Bradford	**467,664**	**1.58**	**1.32**	**1.53**	**1.28**	**1.33**	**0.87**	**90**	**1.31**	**1.18**	**1.45**	**123**	**21.7**
	Calderdale	192,405	1.19	0.70	1.34	0.82	0.77	0.88	99	0.95	0.79	1.14	96	7.0

Table 3.3: (continued)

UK Area	LA name	Tot Pop	2001	2002	2003	2004	2005	2006		2001–2006*				% non
			O/E	O/E	O/E	O/E	O/E	O/E	Pmp	O/E	LCL	UCL	Pmp	White
Yorkshire and the Humber	**Kirklees**	**388,567**	**0.99**	**1.26**	**1.24**	**1.33**	**0.79**	**1.20**	**129**	**1.13**	**1.00**	**1.28**	**111**	**14.4**
	Leeds	715,403	1.05	0.87	1.04	0.94	1.16	0.93	101	1.00	0.91	1.10	99	8.2
	Wakefield	315,172	0.82	0.85	0.87	1.06	0.64	1.09	124	0.89	0.77	1.03	91	2.3
East Midlands	**Leicester**	**279,920**	**1.28**	**1.57**	**1.68**	**1.33**	**1.42**	**1.60**	**157**	**1.48**	**1.30**	**1.69**	**133**	**36.1**
	Leicestershire	*609,578*	*1.21*	*0.84*	*0.82*	*0.76*	*0.81*	*0.94*	*108*	*0.89*	*0.80*	*0.99*	*94*	*5.3*
	Northamptonshire	*629,676*	*0.98*	*0.95*	*0.76*	*0.73*	*0.88*	*0.95*	*103*	*0.88*	*0.79*	*0.98*	*86*	*4.9*
	Rutland	*34,563*	*0.59*	*0.28*	*1.07*	*0.27*	*0.75*	*0.24*	*29*	*0.53*	*0.30*	*0.94*	*58*	*1.9*
	Derby	221,709			0.89	1.07	1.21	1.21	135	1.10	0.91	1.33	116	12.6
	Derbyshire	*734,585*	*0.89*	*0.46*	*0.83*	*0.71*	*0.68*	*0.69*	*83*	*0.71*	*0.64*	*0.79*	*77*	*1.5*
	Lincolnshire	*646,644*	*0.71*	*0.65*	*0.60*	*0.76*	*1.08*	*0.91*	*116*	*0.79*	*0.71*	*0.88*	*92*	*1.3*
	Nottingham	**266,988**	**1.70**	**0.64**	**0.89**	**1.10**	**1.33**	**1.29**	**131**	**1.16**	**1.00**	**1.35**	**107**	**15.1**
	Nottinghamshire	748,508	0.94	0.83	1.05	0.97	1.21	1.07	127	1.02	0.93	1.11	109	2.6
West Midlands	**Birmingham**	**977,085**				**1.70**	**1.59**	**1.64**	**168**	**1.64**	**1.50**	**1.80**	**161**	**29.6**
	Dudley	*305,153*	*0.57*	*0.61*	*0.80*	*1.16*	*0.95*	*0.97*	*115*	*0.85*	*0.73*	*0.99*	*92*	*6.3*
	Sandwell	**282,904**				**1.83**	**1.39**	**1.32**	**148**	**1.50**	**1.27**	**1.78**	**163**	**20.3**
	Solihull	**199,515**	**1.28**	**0.78**	**1.54**	**1.26**	**1.09**	**1.26**	**150**	**1.21**	**1.03**	**1.41**	**130**	**5.4**
	Walsall	**253,498**	**1.13**	**1.32**	**1.22**	**1.53**	**1.11**	**1.41**	**162**	**1.29**	**1.12**	**1.48**	**134**	**13.6**
	Wolverhampton	**236,582**	**1.25**	**1.70**	**1.62**	**1.62**	**1.55**	**1.39**	**161**	**1.53**	**1.34**	**1.74**	**160**	**22.2**
	Coventry	**300,849**	**1.69**	**1.51**	**1.16**	**0.85**	**0.92**	**1.11**	**120**	**1.19**	**1.04**	**1.36**	**117**	**16.0**
	Herefordshire, County of	174,871				0.94	0.74	0.76	97	0.81	0.61	1.06	99	0.9
	Warwickshire	505,858	1.11	1.00	0.74	0.89	0.96	1.11	130	0.97	0.87	1.08	103	4.4
	Worcestershire	*542,105*				*0.93*	*0.81*	*0.70*	*83*	*0.81*	*0.69*	*0.95*	*92*	*2.5*
	Shropshire	283,173				1.16	0.91	1.02	127	1.03	0.85	1.25	122	1.2
	Staffordshire	806,743												2.4
	Stoke-on-Trent	240,635												5.2
	Telford and Wrekin	158,325				1.38	0.84	1.12	114	1.11	0.84	1.46	107	5.2
East of England	Bedfordshire	381,572	0.91	0.96	0.88	0.86	0.70	1.16	126	0.91	0.80	1.05	90	6.7
	Hertfordshire	*1,033,978*	*0.88*	*0.69*	*0.73*	*0.64*	*0.75*	*0.86*	*95*	*0.76*	*0.69*	*0.83*	*76*	*6.3*
	Luton	**184,373**	**1.49**	**0.92**	**1.79**	**0.93**	**1.57**	**1.12**	**108**	**1.30**	**1.10**	**1.55**	**115**	**28.1**
	Essex	*1,310,837*				*0.98*	*0.73*	*0.84*	*98*	*0.85*	*0.77*	*0.94*	*95*	*2.9*
	Southend-on-Sea	160,259	0.95	1.20	1.32	0.97	1.02	1.14	137	1.10	0.92	1.32	121	4.2
	Thurrock	143,128				1.60	1.21	1.03	105	1.27	0.97	1.66	123	4.7
	Cambridgeshire	552,659	0.94	0.69	0.87	1.00	1.44	0.67	74	0.94	0.84	1.05	94	4.1
	Norfolk	796,728				0.99	1.23	1.03	134	1.08	0.97	1.21	136	1.5
	Peterborough	156,061	0.96	1.20	1.14	0.94	1.19	1.21	128	1.11	0.91	1.35	107	10.3
	Suffolk	668,555				0.93	1.17	0.70	87	0.93	0.81	1.06	110	2.8
London	Barnet	314,561					0.73	1.56	162	1.15	0.92	1.45	118	26.0
	Camden	198,020					0.97	1.39	126	1.18	0.87	1.60	106	26.8
	Enfield	273,559					1.07	1.64	168	1.36	1.08	1.71	137	22.9
	Haringey	216,505					1.38	1.60	139	1.49	1.15	1.95	127	34.4
	Islington	175,797					1.71	1.59	142	1.65	1.25	2.17	145	24.6
	Barking & Dagenham	163,942				1.13	0.62	0.78	79	0.83	0.61	1.14	81	14.8
	City of London	7,183						1.20	139	1.20	0.17	8.54	139	15.4
	Hackney	**202,824**				**1.65**	**1.72**	**1.25**	**104**	**1.54**	**1.22**	**1.93**	**122**	**40.6**
	Havering	224,247						0.97	116	0.97	0.66	1.42	116	4.8
	Newham	**243,889**				**1.89**	**2.08**	**2.21**	**176**	**2.06**	**1.72**	**2.48**	**157**	**60.6**
	Redbridge	238,634				1.34	1.05	1.01	105	1.13	0.90	1.40	112	36.5
	Tower Hamlets	**196,105**				**1.25**	**1.42**	**1.39**	**112**	**1.35**	**1.06**	**1.74**	**105**	**48.6**
	Waltham Forest	218,341						1.28	119	1.28	0.87	1.88	119	35.5
	Brent	263,463						1.44	137	1.44	1.04	2.00	137	54.7
	Ealing	**300,948**		**1.90**	**1.84**	**2.12**	**1.62**	**1.53**	**146**	**1.79**	**1.58**	**2.04**	**159**	**41.3**
	Hammersmith & Fulham	**165,244**		**1.87**	**1.97**	**1.85**	**0.90**	**1.14**	**103**	**1.53**	**1.26**	**1.85**	**128**	**22.2**
	Harrow	206,817						1.27	135	1.27	0.88	1.84	135	41.2

Table 3.3: (continued)

UK Area	LA name	Tot Pop	2001	2002	2003	2004	2005	2006		2001–2006*				% non
			O/E	O/E	O/E	O/E	O/E	O/E	Pmp	O/E	LCL	UCL	Pmp	White
London	**Hillingdon**	**243,006**				**1.37**	**0.99**	**1.39**	**144**	**1.25**	**1.02**	**1.54**	**123**	**20.9**
	Hounslow	**212,342**				**2.26**	**1.49**	**1.64**	**155**	**1.78**	**1.47**	**2.16**	**162**	**35.1**
	Kensington and Chelsea	158,916						0.80	82	0.80	0.46	1.38	82	21.4
	Westminster	181,284						1.75	177	1.75	1.24	2.48	177	26.8
	Bexley	218,307	0.79	1.23	0.99	0.77	0.97	1.10	124	0.98	0.83	1.16	100	8.6
	Bromley	295,532	0.64	0.92	0.94	1.00	1.00	0.82	95	0.89	0.76	1.04	94	8.4
	Greenwich	**214,404**		**1.45**	**1.37**	**0.69**	**2.04**	**1.01**	**98**	**1.31**	**1.10**	**1.56**	**118**	**22.9**
	Lambeth	**266,169**	**0.81**	**1.61**	**1.31**	**1.43**	**1.84**	**1.34**	**113**	**1.40**	**1.21**	**1.63**	**108**	**37.6**
	Lewisham	**248,923**	**0.97**	**1.81**	**0.98**	**1.88**	**1.80**	**1.65**	**149**	**1.52**	**1.32**	**1.76**	**125**	**34.1**
	Southwark	**244,866**		**1.73**	**1.57**	**1.34**	**1.82**	**1.63**	**143**	**1.62**	**1.39**	**1.89**	**132**	**37.0**
	Croydon	**330,588**	**0.73**	**1.51**	**1.26**	**1.17**	**1.56**	**1.11**	**112**	**1.23**	**1.08**	**1.40**	**112**	**29.8**
	Kingston upon Thames	147,273												15.5
	Merton	187,908												25.0
	Richmond upon Thames	172,335												9.0
	Sutton	179,767				0.88	1.15	1.32	139	1.12	0.88	1.45	113	10.8
	Wandsworth	260,380												22.0
South East	*Hampshire*	*1,240,102*	*0.68*	*0.75*	*0.73*	*0.59*	*0.69*	*0.84*	*98*	*0.72*	*0.66*	*0.78*	*76*	*2.2*
	Isle of Wight	*132,731*	*0.67*	*0.70*	*0.61*	*0.67*	*0.40*	*0.55*	*75*	*0.59*	*0.46*	*0.76*	*74*	*1.3*
	Portsmouth	*186,700*	*1.16*	*0.70*	*0.89*	*0.61*	*0.67*	*0.70*	*75*	*0.78*	*0.63*	*0.97*	*76*	*5.3*
	Southampton	*217,444*	*0.70*	*0.78*	*0.78*	*0.69*	*0.68*	*0.75*	*78*	*0.73*	*0.59*	*0.90*	*69*	*7.6*
	Kent	1,329,716												3.1
	Medway	249,488												5.4
	Brighton and Hove	247,817				0.97	0.83	0.81	89	0.87	0.68	1.10	91	5.7
	East Sussex	492,326				1.13	0.67	0.99	134	0.92	0.80	1.07	120	2.3
	Surrey	*1,059,017*				*0.77*	*0.61*	*0.85*	*98*	*0.74*	*0.66*	*0.84*	*82*	*5.0*
	West Sussex	*753,612*				*0.59*	*0.79*	*0.88*	*111*	*0.76*	*0.66*	*0.87*	*92*	*3.4*
	Bracknell Forest	109,616				1.08	0.81	1.45	137	1.12	0.80	1.57	100	4.9
	Buckinghamshire	*479,026*	*1.03*	*0.70*	*0.67*	*0.80*	*0.67*	*0.72*	*79*	*0.76*	*0.66*	*0.87*	*76*	*7.9*
	Milton Keynes	207,057	0.83	0.98	1.38	1.10	0.87	0.89	82	1.01	0.83	1.22	85	9.3
	Oxfordshire	605,489	1.06	0.89	1.16	0.78	0.92	0.90	97	0.95	0.85	1.05	93	4.9
	Reading	143,096	0.96	0.76	1.11	0.64	0.97	1.08	105	0.92	0.73	1.17	82	13.2
	Slough	**119,064**	**1.40**	**1.14**	**1.57**	**1.98**	**1.94**	**1.69**	**160**	**1.63**	**1.34**	**1.99**	**140**	**36.3**
	West Berkshire	144,485	0.87	0.61	0.79	1.23	1.22	0.52	55	0.87	0.69	1.10	84	2.6
	Windsor & Maidenhead	133,625					1.10	0.73	82	0.91	0.62	1.33	101	7.6
	Wokingham	150,231	1.03	0.53	1.22	0.94	1.01	1.04	107	0.97	0.78	1.20	90	6.1
South West	Bath & NE Somerset	169,040	0.72	0.63	0.65	1.31	0.97	0.89	106	0.87	0.71	1.06	95	2.8
	Bristol, City of	**380,616**	**1.63**	**0.96**	**1.37**	**1.24**	**1.15**	**1.29**	**137**	**1.27**	**1.13**	**1.43**	**122**	**8.2**
	Gloucestershire	564,559	0.90	0.84	0.85	0.90	0.84	1.05	126	0.90	0.81	1.00	98	2.8
	North Somerset	188,564	1.12	0.92	1.34	1.24	1.16	0.91	117	1.11	0.94	1.31	129	1.4
	South Gloucestershire	245,641	1.03	1.25	1.02	1.02	1.22	1.00	110	1.09	0.93	1.27	109	2.4
	Swindon	180,051	0.64	1.10	0.98	1.28	0.60	0.73	78	0.89	0.72	1.09	85	4.8
	Wiltshire	*432,972*	*0.68*	*0.46*	*0.61*	*0.57*	*0.80*	*0.75*	*88*	*0.65*	*0.56*	*0.75*	*69*	*1.6*
	Bournemouth	*163,444*				*0.59*	*0.75*	*0.68*	*86*	*0.68*	*0.50*	*0.92*	*82*	*3.3*
	Dorset	*390,980*				*0.74*	*0.56*	*0.54*	*77*	*0.61*	*0.50*	*0.74*	*83*	*1.3*
	Poole	*138,288*				*0.81*	*0.46*	*0.62*	*80*	*0.63*	*0.44*	*0.89*	*77*	*1.8*
	Somerset	*498,095*	*0.79*	*0.94*	*0.82*	*0.91*	*0.65*	*0.82*	*104*	*0.82*	*0.73*	*0.92*	*95*	*1.2*
	Cornwall & Isles of Scilly	**501,267**	**1.05**	**1.49**	**1.23**	**1.39**	**0.70**	**1.07**	**142**	**1.15**	**1.04**	**1.26**	**138**	**1.0**
	Devon	704,491	0.89	0.83	0.88	1.04	1.04	1.00	133	0.95	0.87	1.04	115	1.1
	Plymouth	**240,722**	**1.54**	**1.47**	**1.39**	**1.03**	**1.04**	**1.85**	**208**	**1.39**	**1.21**	**1.59**	**141**	**1.6**
	Torbay	129,706	1.18	0.46	1.07	1.31	1.00	0.91	123	0.99	0.81	1.21	122	1.2
Wales	**Cardiff**	**305,353**	**0.96**	**1.73**	**1.60**	**1.36**	**1.34**	**1.33**	**138**	**1.39**	**1.22**	**1.58**	**131**	**8.4**
	Merthyr Tydfil	**55,979**	**0.76**	**1.82**	**1.73**	**2.43**	**1.78**	**2.66**	**304**	**1.89**	**1.49**	**2.41**	**197**	**1.0**
	Rhondda, Cynon, Taff	**231,947**	**1.19**	**1.53**	**1.08**	**1.63**	**1.37**	**1.32**	**151**	**1.35**	**1.18**	**1.56**	**141**	**1.2**

Table 3.3: (continued)

UK Area	LA name	Tot Pop	2001	2002	2003	2004	2005	2006		2001–2006*				% non
			O/E	O/E	O/E	O/E	O/E	O/E	Pmp	O/E	LCL	UCL	Pmp	White
Wales	The Vale of Glamorgan	119,292	0.87	1.16	0.95	1.27	0.74	1.42	168	1.07	0.86	1.33	115	2.2
	Carmarthenshire	172,842	1.10	1.10	1.40	1.10	1.07	1.04	133	1.13	0.96	1.34	132	0.9
	Ceredigion	74,941	1.42	1.36	0.59	0.82	0.77	0.42	53	0.88	0.65	1.17	100	1.4
	Pembrokeshire	114,131	1.25	0.87	1.21	0.76	1.20	0.96	123	1.04	0.84	1.29	121	0.9
	Powys	126,353	0.73	0.69	0.33	0.99	1.30	0.84	111	0.82	0.66	1.03	99	0.9
	Blaenau Gwent	70,064	1.33	1.27	0.13	1.08	1.14	0.98	114	0.98	0.73	1.32	105	0.8
	Caerphilly	**169,519**	**0.96**	**1.47**	**1.05**	**1.05**	**1.59**	**1.37**	**153**	**1.26**	**1.06**	**1.50**	**128**	**0.9**
	Monmouthshire	84,885	2.07	1.21	0.73	1.05	1.17	0.94	118	1.18	0.93	1.49	134	1.1
	Newport	137,012	1.26	1.05	1.43	0.93	0.94	1.17	131	1.13	0.92	1.38	116	4.8
	Torfaen	90,949	1.37	1.42	1.14	0.94	0.88	1.03	121	1.12	0.88	1.43	119	0.9
	Bridgend	**128,645**	**1.21**	**1.16**	**1.76**	**1.32**	**1.10**	**1.46**	**171**	**1.34**	**1.11**	**1.61**	**143**	**1.4**
	Neath Port Talbot	**134,468**	**1.33**	**1.40**	**1.54**	**1.34**	**0.88**	**1.33**	**164**	**1.30**	**1.08**	**1.56**	**145**	**1.1**
	Swansea	**223,300**	**2.10**	**1.41**	**1.75**	**1.22**	**0.99**	**1.36**	**166**	**1.46**	**1.27**	**1.66**	**161**	**2.2**
	Conwy	109,596		1.23	0.51	1.10	0.75	0.93	128	0.90	0.70	1.15	115	1.1
	Denbighshire	93,065	0.31	0.68	0.28	1.02	1.91	0.59	75	0.81	0.62	1.07	95	1.2
	Flintshire	**148,594**		**1.32**	**1.26**	**1.13**	**1.37**	**1.20**	**135**	**1.25**	**1.03**	**1.53**	**131**	**0.8**
	Gwynedd	**116,843**		**1.60**	**1.53**	**1.22**	**1.50**	**1.45**	**180**	**1.46**	**1.20**	**1.78**	**168**	**1.2**
	Isle of Anglesey	**66,829**		**0.96**	**1.44**	**1.17**	**1.71**	**1.29**	**165**	**1.32**	**1.01**	**1.73**	**156**	**0.7**
	Wrexham	128,476	1.24	1.03	1.28	0.83	1.20	1.02	117	1.10	0.89	1.35	114	1.1
Scotland	Aberdeen City	212,125	0.83	1.15	0.99	1.71	1.07	0.65	71	1.06	0.90	1.26	106	
	Aberdeenshire	226,871	1.02	1.11	0.71	0.93	1.03	0.79	88	0.93	0.78	1.10	93	
	Angus	**108,400**	**1.55**	**2.18**	**0.91**	**1.33**	**1.09**	**0.75**	**92**	**1.28**	**1.04**	**1.57**	**143**	
	Argyll & Bute	91,306	0.96	0.71	1.35	0.97	0.81	0.78	99	0.93	0.72	1.20	106	
	Scottish Borders	106,764	0.36	0.94	0.73	1.39	0.76	0.88	112	0.85	0.66	1.09	98	
	Clackmannanshire	48,077	0.92	1.10	1.46	1.05	1.18	0.76	83	1.07	0.76	1.53	107	
	West Dunbartonshire	93,378	1.75	0.56	0.64	1.39	0.40	1.34	150	1.00	0.77	1.30	102	
	Dumfries & Galloway	**147,765**	**1.46**	**1.34**	**1.39**	**1.04**	**1.25**	**1.15**	**149**	**1.27**	**1.07**	**1.50**	**149**	
	Dundee City	**145,663**	**1.42**	**1.42**	**1.86**	**1.29**	**2.17**	**1.34**	**158**	**1.59**	**1.35**	**1.87**	**170**	
	East Ayrshire	120,235	1.31	0.75	1.11	0.64	1.20	1.51	175	1.10	0.88	1.36	115	
	East Dunbartonshire	108,243	0.69	0.75	1.33	0.71	0.67	1.28	148	0.91	0.71	1.17	95	
	East Lothian	90,088	0.91	0.98	0.31	0.83	1.07	0.75	89	0.81	0.61	1.07	87	
	East Renfrewshire	89,311	0.61	0.46	0.99	0.88	1.24	1.09	123	0.89	0.68	1.18	91	
	Edinburgh, City of	448,624	0.85	0.81	1.04	1.05	1.00	1.01	109	0.96	0.85	1.09	95	
	Falkirk	145,191	1.03	0.57	0.67	0.68	1.14	0.91	103	0.84	0.67	1.05	86	
	Fife	349,429	1.18	1.13	0.93	1.02	1.39	0.99	114	1.11	0.98	1.26	116	
	Glasgow City	**577,869**	**1.19**	**1.27**	**1.73**	**1.42**	**1.26**	**1.09**	**118**	**1.32**	**1.21**	**1.45**	**130**	
	Highland	**208,914**	**1.36**	**1.26**	**1.46**	**1.29**	**1.83**	**1.00**	**120**	**1.36**	**1.18**	**1.58**	**148**	
	Inverclyde	**84,203**	**1.62**	**2.26**	**1.13**	**1.02**	**0.96**	**0.82**	**95**	**1.28**	**1.01**	**1.62**	**135**	
	Midlothian	**80,941**	**0.80**	**1.02**	**1.70**	**2.08**	**1.03**	**1.54**	**173**	**1.37**	**1.08**	**1.74**	**140**	
	Moray	86,940	0.72	0.92	1.32	0.99	1.34	1.39	161	1.13	0.88	1.45	119	
	North Ayrshire	135,817	0.47	1.34	1.20	1.21	1.26	1.53	177	1.18	0.97	1.44	124	
	North Lanarkshire	321,067	1.42	1.23	1.26	0.98	0.79	0.94	100	1.09	0.95	1.25	105	
	Orkney Islands	19,245	1.05	1.50	1.90	0.48	1.34	0.86	104	1.18	0.71	1.96	130	
	Perth & Kinross	134,949	0.79	1.24	1.31	1.31	0.86	0.65	82	1.02	0.83	1.25	116	
	Renfrewshire	**172,867**	**1.06**	**1.79**	**1.19**	**1.20**	**1.22**	**0.92**	**104**	**1.22**	**1.03**	**1.45**	**125**	
	Shetland Islands	*21,988*	*0.00*	*0.00*	*0.46*	*1.40*	*0.44*	*0.00*	*0*	*0.39*	*0.16*	*0.93*	*38*	
	South Ayrshire	112,097	0.85	0.65	1.16	0.70	1.02	0.63	80	0.84	0.66	1.07	97	
	South Lanarkshire	302,216	1.37	1.20	0.91	0.99	0.86	1.01	113	1.05	0.91	1.21	106	
	Stirling	*86,212*	*0.75*	*0.72*	*0.68*	*0.68*	*0.32*	*1.03*	*116*	*0.70*	*0.50*	*0.96*	*72*	
	West Lothian	158,714	0.54	0.96	0.56	0.64	1.19	1.15	113	0.85	0.68	1.07	77	
	Eilean Siar	26,502	0.36	0.68	0.97	1.29	0.00	0.88	113	0.70	0.40	1.20	82	
N Ireland	Antrim	48,366					2.31	1.34	124	1.82	1.11	2.97	165	
	Ards	73,244					1.05	0.63	68	0.84	0.49	1.44	89	

Table 3.3: (continued)

UK Area	LA name	Tot Pop	2001 O/E	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2006 Pmp	2001–2006* O/E	2001–2006* LCL	2001–2006* UCL	2001–2006* Pmp	% non White
N Ireland	Armagh	54,262					1.98	0.76	74	1.36	0.80	2.29	129	
	Ballymena	58,610					1.32	1.11	119	1.21	0.73	2.01	128	
	Ballymoney	26,895					1.87	0.72	74	1.29	0.61	2.70	130	
	Banbridge	41,389					1.01	1.46	145	1.24	0.67	2.31	121	
	Belfast	277,391					1.26	1.43	148	1.35	1.07	1.68	137	
	Carrickfergus	37,658					2.43	2.86	292	2.65	1.71	4.10	266	
	Castlereagh	66,488					2.33	1.33	150	1.82	1.25	2.65	203	
	Coleraine	56,314					2.62	1.01	107	1.80	1.17	2.76	186	
	Cookstown	32,581					2.73	0.99	92	1.84	1.02	3.32	169	
	Craigavon	80,671					1.70	0.50	50	1.09	0.68	1.75	105	
	Derry	105,066					1.17	1.68	143	1.43	0.97	2.12	119	
	Down	63,828					1.82	2.23	219	2.03	1.37	3.01	196	
	Dungannon	47,735					1.13	0.65	63	0.89	0.44	1.77	84	
	Fermanagh	57,527					1.05	1.34	139	1.20	0.71	2.02	122	
	Larne	30,833					0.92	0.59	65	0.75	0.31	1.80	81	
	Limavady	32,422					1.46	1.41	123	1.43	0.72	2.87	123	
	Lisburn	108,694					1.60	0.87	83	1.23	0.83	1.81	115	
	Magherafelt	39,778					1.41	1.09	101	1.25	0.65	2.39	113	
	Moyle	15,932					0.00	1.75	188	0.89	0.29	2.77	94	
	Newry and Mourne	87,058					0.90	0.74	69	0.82	0.47	1.41	75	
	Newtownabbey	79,996					0.98	1.06	113	1.02	0.64	1.64	106	
	North Down	76,323					1.19	0.80	92	0.99	0.62	1.59	111	
	Omagh	47,953					0.70	1.35	125	1.03	0.54	1.98	94	
	Strabane	38,246					0.58	0.83	78	0.71	0.29	1.70	65	

In the UK, for adults in 2006, the crude annual acceptance rates in Local Authorities (with a population >150,000) varied significantly from 55 in Bury (population 180,607) to 208 in Plymouth (pop. 240,722), 177 in Westminster (pop. 181,284) and 176 in Newham (pop. 243,889). The standardised rate ratios for acceptance varied from 0.51 (Bury) to 2.21 (Newham) (Table 3.3). The acceptance ratio for West Berkshire was 0.52 in 2006, a drop of 62% from that in 2005. This could be due to the fact that the London West centre whose catchment population includes West Berkshire, may not be sending a complete cohort of patients starting RRT.

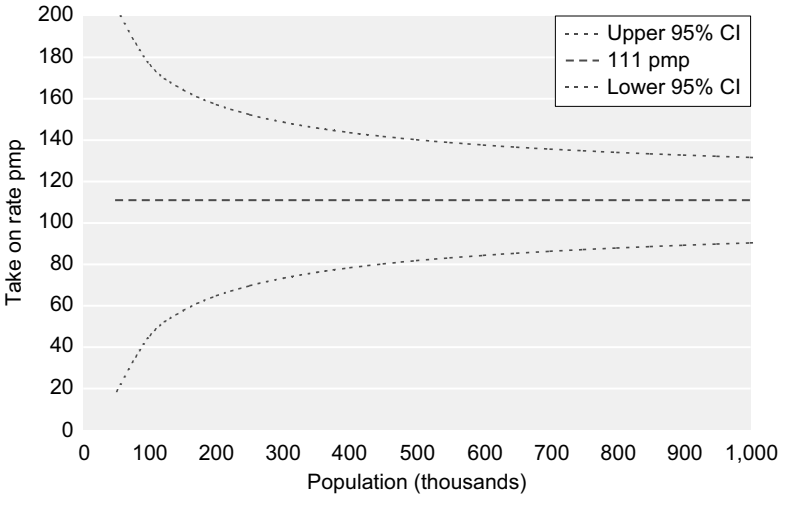

Figure 3.2: 95% confidence limits for take on rate of 111 pmp for population size 50,000–1 million

Local Authority acceptance rates 2001–2006

Over the 6 years from 2001 to 2006 there were wide variations in annual standardised acceptance ratios in areas with small populations, especially those with habitually low take-on rates.

By combining data from six years it was possible to identify significant differences between relatively small populations for which similar analysis would not be meaningful for a single year. This does however ignore trends within this period. As examples, Wiltshire still has a low acceptance ratio but it does appear to be rising and Bath has risen from a low ratio to become average.

Over the period 2001–2006, of those areas with data for a minimum of 3 years, 38 had significantly low acceptance ratios, all but two of them (Shetland and Stirling) were in England. Ten of these areas had ratios below 0.7: Shetland Islands (0.39), Rutland (0.53), Isle of Wight (0.59), Dorset (0.61), Poole (0.63), Blackpool (0.63), Wiltshire (0.65), Bury (0.66), Lancashire (0.67) and Bournemouth (0.68).

In those areas with significantly low ratios, 3.6% of the population were non-White; only Oldham (13.5%) and Bolton (11%) had >10% non-White. Over the same period 48 had significantly high ratios, 30 of whom were in England (including 19 in London and the West Midlands), 10 in Wales and 8 in Scotland. Four of the 48 had ratios greater than 1.7 (Hounslow (1.78), Ealing (1.79), Merthyr Tydfil (1.89) and Newham (2.06)). In those areas with significantly high ratios, the mean percentage of non-Whites in the population was 20.5, and 24 of these areas had ethnic minority populations of more than 10%. Of the remaining 24 high acceptance areas, 8 were in Scotland where data on ethnicity were not available. The remaining 16 areas had high acceptance ratios without large ethnic minorities: 10 in Wales and 3 in the South-West.

The relationship between ethnicity and take-on rate is explored further in Figure 3.3 in which standardised acceptance ratios derived from these combined data are plotted against the percentage of non-Whites in the general population (ONS 2001 census) corresponding to the same area. It can be seen that in general, areas with a high ethnic minority population (and/or a socially deprived population, as shown in previous reports) have high standardised acceptance rate ratios.

The age standardised rates (Table 3.3) are all relative to an overall acceptance rate which still has not been adjusted for social deprivation and ethnicity, adjustments which would allow the population RRT requirement to be more accurately calculated.

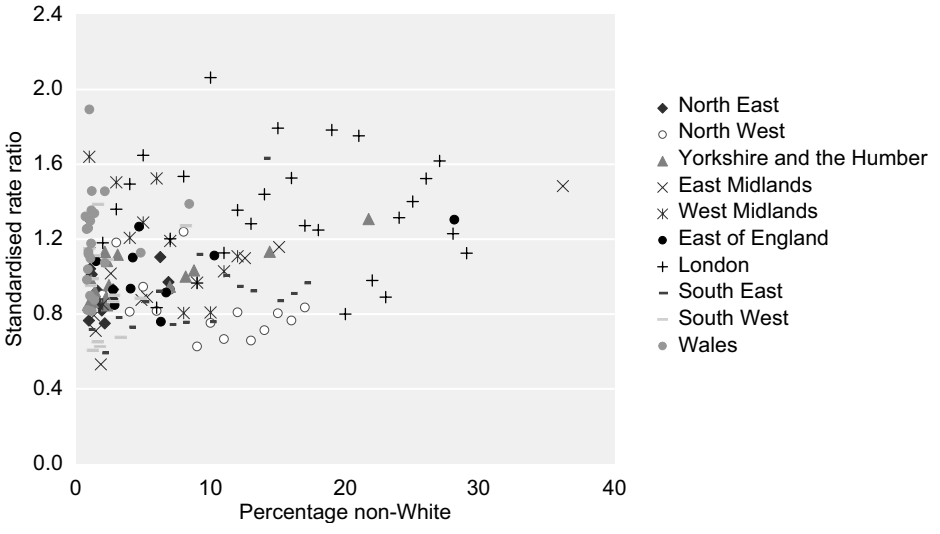

Figure 3.3: Relationship between ethnic mix and acceptance ratio (2001–2006)

Table 3.4: Percentage of patients in different ethnic groups by centre

			Percentage in each ethnic group				
Country	**Centre**	**Completion %**	**White**	**Black**	**South Asian**	**Chinese**	**Other**
England	Glouc	100.0	100.0				
	Dorset	100.0	98.2	1.8			
	Nottm	100.0	92.6	2.2	4.4		0.7
	Basldn	100.0	90.9	4.5	4.5		
	ManWst	100.0	86.6		12.6	0.8	
	Stevng	100.0	85.2	6.1	8.7		
	Redng	100.0	83.3	2.8	9.7		4.2
	Dudley	100.0	80.0	4.4	15.6		
	L West	100.0	45.6	13.2	24.6		16.5
	L Rfree	99.5	46.3	22.4	18.5	2.0	10.7
	Newc	98.2	95.4	0.9	1.9	0.9	0.9
	Wolve	97.8	84.6	5.5	9.9		
	B QEH	97.3	73.1	9.3	13.7	0.5	3.3
	L Barts	96.6	46.8	10.4	30.1	0.6	12.1
	Middlbr	95.9	95.7		3.2	1.1	
	York	95.7	97.8				2.2
	Leic	95.4	83.0	2.6	13.9		0.4
	B Heart	94.1	73.2	4.5	22.3		
	Bradfd	93.9	56.5	2.2	39.1		2.2
	L Kings	93.7	61.5	26.9	9.6	1.9	
	Carlis	92.6	100.0				
	Prstn	90.1	86.2	1.8	11.0		0.9
	Bristol	88.4	95.4	2.0	2.6		
	Wirral	87.5	100.0				
	Sund	82.8	97.9			2.1	
	Shrew	81.5	97.7		2.3		
	Covnt	80.8	81.0	4.8	13.1	1.2	
	Ipswi	73.8	93.5	6.5			
	Sheff	73.7	93.5	1.6	3.3	0.8	0.8
	Camb	72.8	94.0	1.5	4.5		
	Ports	71.8	96.8	1.6	1.6		
	Liv RI	69.7	97.0			2.0	1.0
	Oxford	60.1	82.7	4.1	10.2		3.1
	Truro	58.0	96.6	3.4			
	L Guys	57.9	51.9	44.2	2.6	1.3	
	Liv Ain	55.6	95.0		5.0		
N Ireland	Tyrone	90.0	100.0				
	Belfast	77.0	100.0				
	Antrim	61.3	100.0				
Scotland	Airdrie	94.5	100.0				
Wales	Swanse	98.2	98.2	1.8			
	Bangor	52.5	100.0				
England		**75.4**	**79.9**	**6.3**	**10.4**	**0.5**	**2.9**
N Ireland		**71.9**	**100.0**				
Scotland		**12.2**	**100.0**				
Wales		**47.1**	**97.4**	**1.6**	**1.1**		
UK		**67.6**	**81.7**	**5.8**	**9.5**	**0.4**	**2.6**

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

Ethnicity

Only 25 (39%) of the 64 centres submitting returns provided ethnicity data 90% or more complete. Whilst for 42 (66%) centres, the data was 50% or more complete (Table 3.4). This is similar to last year. This degree of incompleteness still makes the results of analysis of ethnicity data unreliable. In those centres with over 90% returns there was great variation in the percentage of new patients from ethnic minorities ranging from 0% in Tyrone, Gloucester, Carlisle and Airdrie to over 50% at the Royal Free, London Barts and London West. All the latter centres include areas with high standardised acceptance rates.

Age

The median ages of patients starting renal replacement therapy were 64.6 years in England, 68.2 years in Northern Ireland, 65.5 years in Scotland, 67.5 years in Wales and for the whole UK 65.0 years (Table 3.5). These values have changed only minimally over the period 2000–2006.

In England and Scotland the acceptance rate is highest in the 75–79 age group (at 407 and 507 pmp respectively). In Wales and Northern Ireland the peak is in the 80–84 age group (at 567 and 759 pmp respectively) (Table 3.6). In the whole UK, 50% of accepted patients were aged over 65 years, the proportions being greater in Northern Ireland (58%), Wales (56%) and Scotland (51%), than in England (49%).

The median age of 59.1 years for incident UK non-White patients in 2006 was considerably lower than for Whites, possibly reflecting the lower median age of the ethnic minority populations in general compared with the White population.

Table 3.6: Acceptance rate per million population (pmp) within age groups by country

	Pmp			
Age	England	Wales	Scotland	N Ireland
20–24	28	12	35	9
25–29	36	54	35	17
30–34	39	81	39	24
35–39	69	71	60	39
40–44	97	102	85	128
45–49	113	108	98	127
50–54	113	101	140	91
55–59	167	243	181	169
60–64	242	222	199	272
65–74	352	367	370	503
75–79	407	546	507	494
80–84	359	567	371	759
85–89	232	564	152	372
90+	39	155	0	0

Large variations persist in the median age of incident patients by centre (Figure 3.4). In three centres the median age was <60 years (Airdrie, Guys and Newcastle) and in five it was over 70 years (Dumfries & Galloway, Chelmsford, Swansea, Clwyd, and Antrim). These apparent differences between centres must be interpreted with extreme caution. Much of the difference maybe due to chance fluctuations because of low numbers taken on. Whether or not the centre is a transplant centre may also be a factor. Transplant patients are younger on average than dialysis patients, so importing of patients for pre-emptive transplantation will lower the median age. The median age of new patients in transplant centres was slightly but significantly lower than that in non-transplant centres (63.8 vs 66.5 years: p = <0.001). There may be differences in local population demographics including

Table 3.5: Median age of patients starting renal replacement therapy 2000–2006

	Year						
Country	2000	2001	2002	2003	2004	2005	2006
England	64.0	64.8	65.4	64.6	64.9	65.2	64.6
N Ireland						68.1	68.2
Scotland	64.8	66.6	65.3	66.5	65.5	65.9	65.5
Wales	66.7	65.4	67.0	66.5	68.7	67.4	67.5
UK	**64.5**	**65.2**	**65.5**	**65.0**	**65.2**	**65.5**	**65.0**

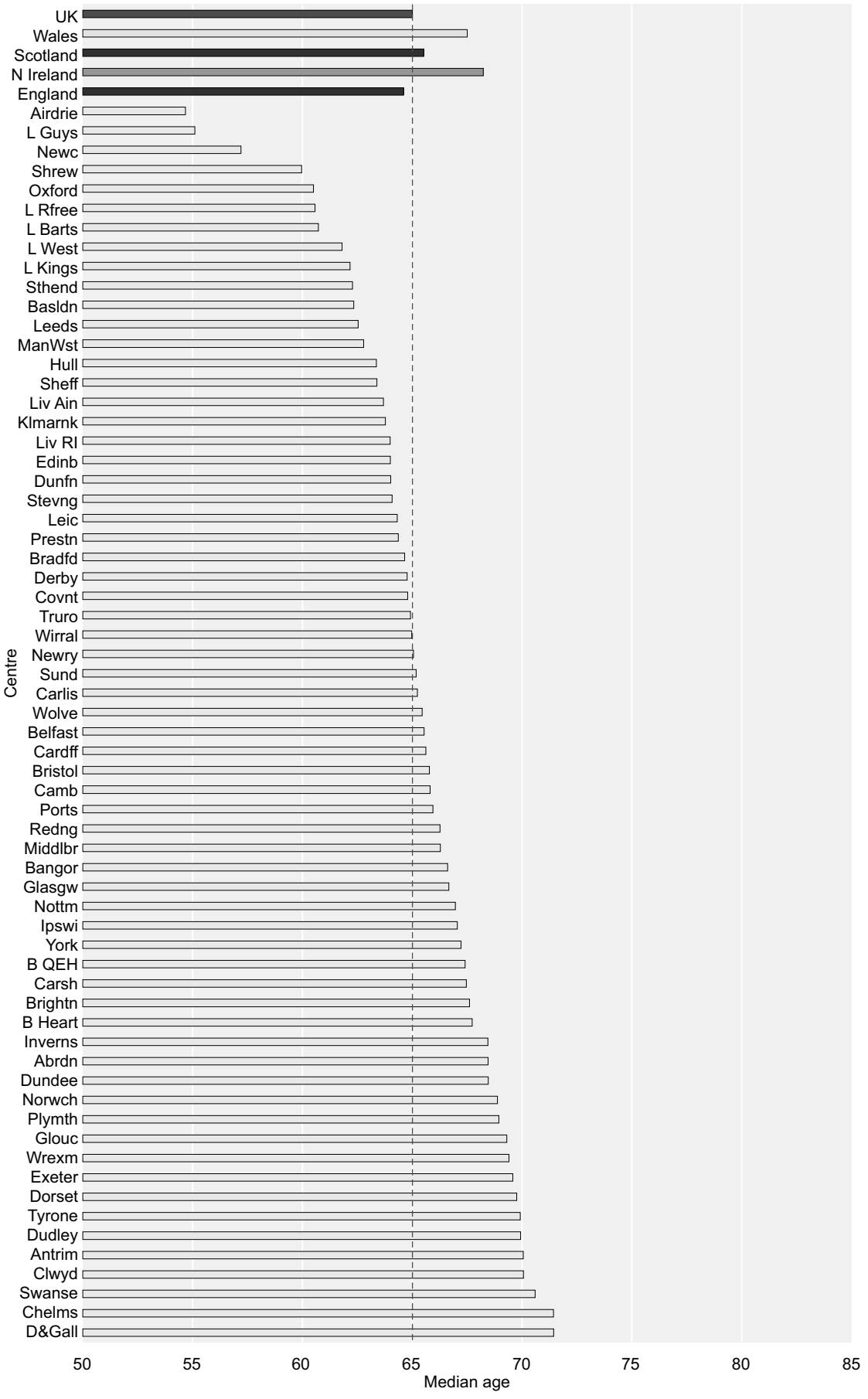

Figure 3.4: Median age of incident patients in each centre in 2006

the proportion of ethnic minorities in the catchment area. There may then be differences in the prevalence, nature and management of renal disease and in approaches to conservative management.

Gender

As in previous Registry reports there was an excess of males starting RRT in all age groups (Figure 3.5), with the relative proportion of males increasing in the very old (Figure 3.6).

In the whole UK, 62% of the 2006 incident cohort were male. All reporting centres except three had an excess of incident males, percentages varying from 37 to 76 (Figure 3.7). These extremes are likely to be an effect of small numbers as all three centres reporting less than 50% incident males in 2006 took on less than 50 patients in that year and Wrexham which had greater than 75% incident males took on only 25 patients.

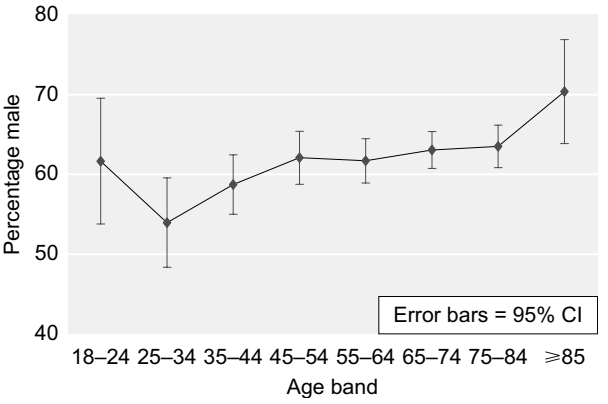

Figure 3.6: Percentage of males by age group among those starting RRT in 2006

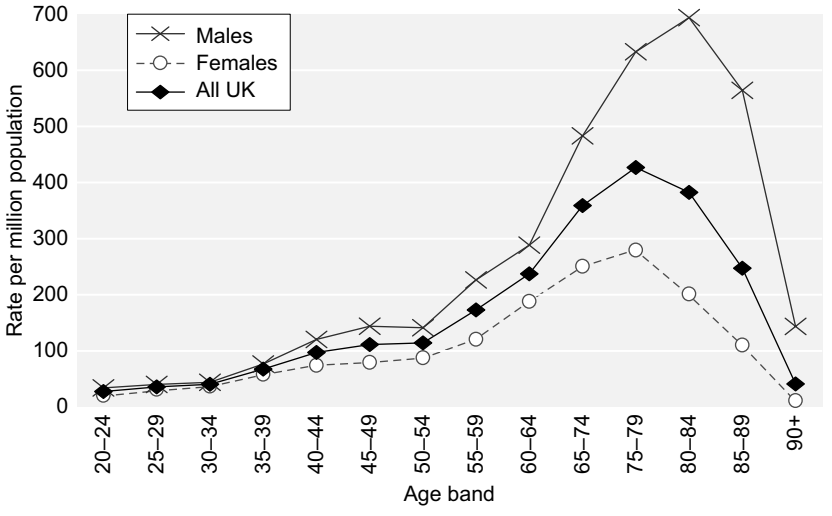

Figure 3.5: Incident rates by age and gender in 2006

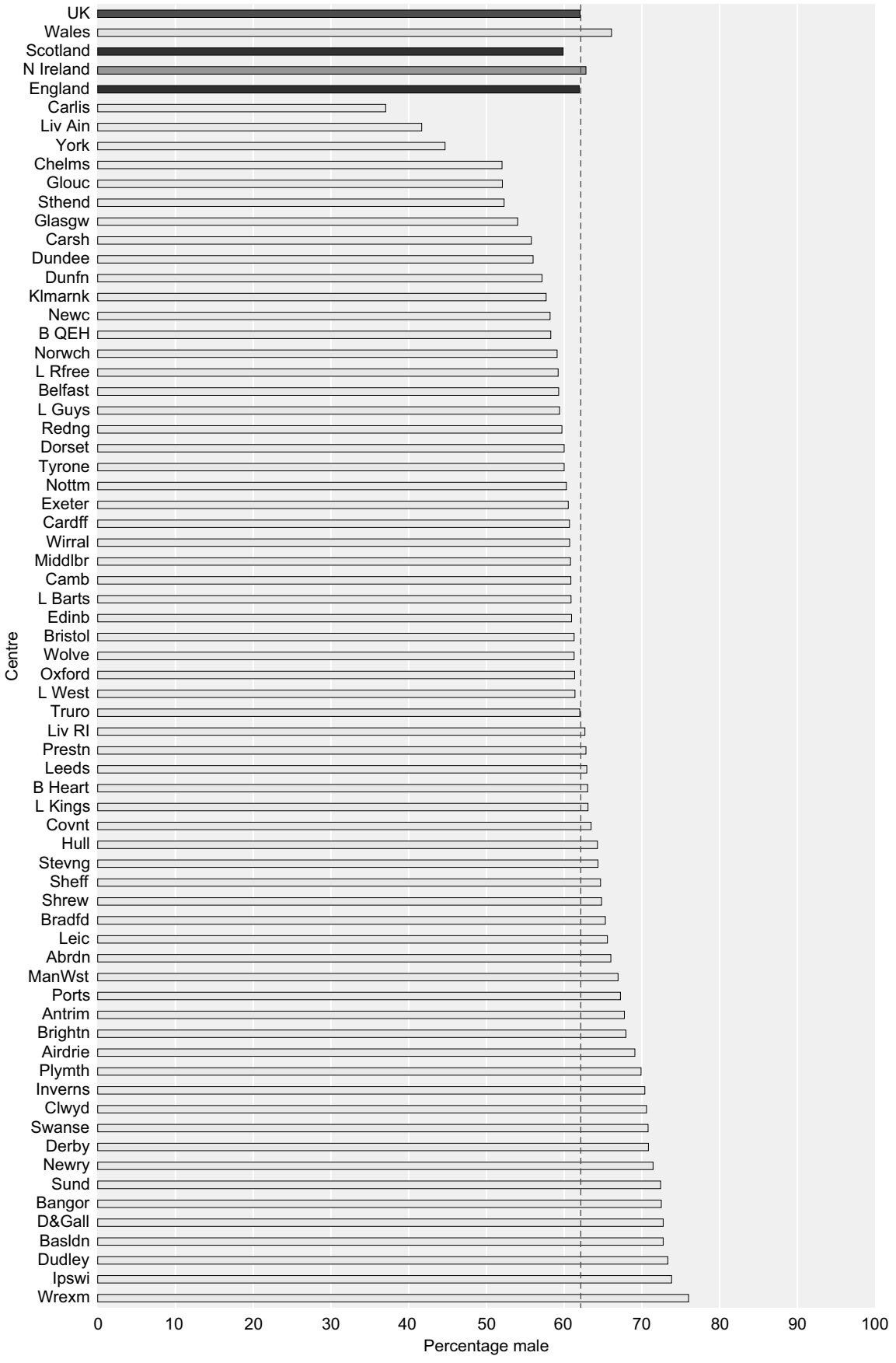

Figure 3.7: Percentage of incident patients who are male in each centre in 2006

Primary renal diagnosis

Proportion of patients with each primary renal diagnosis

The distribution of new patients by age, gender and cause of ERF is shown in Table 3.7. Patients with adult polycystic kidney disease (APKD) are relatively young when they develop ERF and this diagnosis was approximately 3 times more common in the younger incident cohort. Similarly the diagnoses of glomerulonephritis (twice as frequently diagnosed) and diabetes (40% more frequently diagnosed) were relatively more common in these younger patients. This contrasts with renal vascular disease which was over 5 times more common and hypertension which was 46% more common in the older cohort. Perhaps not surprisingly, uncertainty about the underlying diagnosis (aetiology uncertain/glomerulonephritis not biopsy proven), was also more common in the older cohort. For most primary renal diagnoses, the male to female ratio was >1.5:1. The gender imbalance may relate in part to the presence of hypertension, atheroma and renal vascular disease, which were more common in males and with increasing age. These factors may influence the rate of progression of renal failure. As would be expected from the mode of inheritance, APKD is a major exception, the ratio being much nearer to one for this condition.

The proportion of null returns for primary renal diagnosis again increased from a UK mean of 9.2% in 2004 to 12.0% in 2005 and 14.4% in 2006. This was mainly due to an increase in England, the proportions in Northern Ireland, Scotland and Wales have decreased. There was also very marked variation between centres (Table 3.8). There has been a slight reduction in the UK as a whole and in each individual home country with respect to the diagnosis aetiology uncertain/glomerulonephritis not biopsy proven, though there was still huge variation between centres. Some of this variation was likely to reflect the lack of clear definition of certain diagnostic categories eg hypertensive disease and renal vascular disease and some may have resulted from differences between centres in the degree of certainty required to record other diagnoses.

Diabetic nephropathy remained the most frequent specific primary renal diagnosis in the UK at about 22%. The proportion with this diagnosis has increased since 2005 from 20% in the UK as a whole and has risen in each of the home countries. The proportions of the other major diagnoses have changed little.

Incidence rates of primary renal diagnoses

Table 3.9 shows the primary renal disease diagnosis incidence rates per million population in

Table 3.7: Percentage distribution of primary renal diagnosis by age and gender ratio, in 2006 incident cohort

	UK <65		UK ⩾65		UK All		
Diagnosis	Incl. not sent	Excl. not sent	Incl. not sent	Excl. not sent	Incl. not sent	Excl. not sent	M:F
Aetiology uncertain/GN* not biopsy proven	18.3	21.0	26.5	31.5	22.4	26.2	1.6
GN* biopsy proven	11.8	13.6	5.9	7.0	8.9	10.4	2.3
Pyelonephritis	6.2	7.2	6.0	7.2	6.1	7.2	1.4
Diabetes	22.1	25.4	15.9	18.9	19.0	22.2	1.6
Renal vascular disease	1.9	2.2	9.7	11.6	5.8	6.8	2.0
Hypertension	3.7	4.3	5.4	6.5	4.6	5.4	2.2
Polycystic kidney	8.9	10.2	2.6	3.1	5.8	6.7	1.2
Other	14.1	16.2	12.0	14.3	13.1	15.3	1.4
Not sent	13.0	–	15.9	–	14.4	–	1.6
Number of patients	3,121	2,715	3,124	2,628	6,245	5,343	

*GN – glomerulonephritis.

Table 3.8: Percentage distribution of primary renal diagnosis by centre in 2006 incident cohort

Country	Centre	Not sent	Aetiology uncertain/ GN* not biopsy proven	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Reno-vascular disease
England	B Heart	0.0	26.9	24.4	10.9	3.4	13.5	4.2	11.8	5.0
	B QEH	61.5								
	Basldn	2.3	9.3	20.9	11.6	4.7	16.3	7.0	9.3	20.9
	Bradfd	10.2	22.7	31.8	13.6	2.3	13.6	4.6	2.3	9.1
	Brightn	50.4								
	Bristol	19.1	21.4	24.3	15.7	3.6	12.9	8.6	10.0	3.6
	Camb	0.0	89.1	1.1	3.3	0.0	4.4	1.1	1.1	0.0
	Carlis	0.0	0.0	22.2	0.0	11.1	25.9	11.1	3.7	25.9
	Carsh	43.2								
	Chelms	0.0	38.0	12.0	2.0	6.0	16.0	12.0	10.0	4.0
	Covnt	1.9	15.7	23.5	13.7	13.7	9.8	6.9	7.8	8.8
	Derby	0.0	19.4	31.9	16.7	0.0	9.7	4.2	13.9	4.2
	Dorset	3.6	22.6	17.0	17.0	5.7	13.2	17.0	5.7	1.9
	Dudley	2.2	25.0	29.6	13.6	9.1	6.8	2.3	9.1	4.6
	Exeter	37.7								
	Glouc	0.0	30.1	19.2	5.5	2.7	19.2	9.6	4.1	9.6
	Hull	3.1	14.7	25.3	9.5	7.4	19.0	7.4	11.6	5.3
	Ipswi	2.4	53.7	14.6	4.9	2.4	12.2	7.3	2.4	2.4
	L Barts	0.6	19.1	37.1	8.4	5.6	14.0	5.6	5.6	4.5
	L Guys	0.8	12.1	24.2	11.4	9.1	25.0	6.8	3.8	7.6
	L Kings	1.8	1.8	21.1	10.1	10.1	45.9	3.7	4.6	2.8
	L Rfree	100.0								
	L West	8.5	14.1	31.7	12.1	12.9	15.7	6.8	4.4	2.4
	Leeds	44.1								
	Leic	20.8	21.5	20.9	12.0	1.6	17.3	9.4	7.3	10.0
	Liv Ain	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Liv RI	0.7	53.2	13.5	5.7	6.4	7.1	4.3	7.1	2.8
	ManWst	0.0	96.1	0.8	0.0	0.0	0.8	0.0	0.8	1.6
	Middlbr	6.2	26.4	18.7	13.2	9.9	4.4	8.8	9.9	8.8
	Newc	3.6	18.9	17.0	15.1	1.9	23.6	7.6	9.4	6.6
	Norwch	0.0	42.7	21.8	10.9	3.6	9.1	5.5	3.6	2.7
	Nottm	0.0	21.3	23.5	12.5	3.7	16.2	6.6	8.1	8.1
	Oxford	3.1	22.2	27.2	12.0	1.3	20.9	10.1	3.2	3.2
	Plymth	2.2	19.8	16.5	12.1	3.3	20.9	5.5	7.7	14.3
	Ports	3.5	23.2	26.2	7.7	5.4	16.7	10.7	6.0	4.2
	Prstn	13.2	15.2	29.5	10.5	19.1	13.3	6.7	4.8	1.0
	Redng	0.0	20.8	16.7	5.6	2.8	25.0	6.9	13.9	8.3
	Sheff	13.2	37.2	16.6	9.7	2.8	12.4	6.2	11.0	4.1
	Shrew	1.9	22.6	24.5	7.6	7.6	15.1	7.6	9.4	5.7
	Stevng	0.0	31.3	27.8	8.7	3.5	19.1	4.4	3.5	1.7
	Sthend	2.3	23.3	20.9	16.3	7.0	16.3	4.7	4.7	7.0
	Sund	5.2	9.1	25.5	9.1	18.2	20.0	7.3	1.8	9.1
	Truro	20.0	7.5	27.5	20.0	5.0	12.5	5.0	15.0	7.5
	Wirral	3.6	98.2	0.0	1.9	0.0	0.0	0.0	0.0	0.0
	Wolve	19.4	13.3	21.3	16.0	2.7	18.7	6.7	9.3	12.0
	York	12.8	22.0	22.0	7.3	9.8	22.0	4.9	4.9	7.3

Table 3.8: (continued)

Country	Centre	Not sent	Aetiology uncertain./ GN* not biopsy proven	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Reno-vascular disease
N Ireland	Antrim	0.0	25.8	29.0	9.7	0.0	16.1	0.0	12.9	6.5
	Belfast	6.2	18.9	24.5	12.3	5.7	9.4	8.5	9.4	11.3
	Newry	0.0	0.0	14.3	7.1	0.0	28.6	14.3	7.1	28.6
	Tyrone	0.0	6.7	16.7	10.0	16.7	10.0	6.7	20.0	13.3
Scotland	Abrdn	18.0	19.5	39.0	14.6	0.0	9.8	4.9	9.8	2.4
	Airdrie	5.5	21.2	34.6	5.8	0.0	13.5	7.7	7.7	9.6
	D&Gall	13.6	26.3	21.1	5.3	10.5	5.3	10.5	15.8	5.3
	Dundee	6.0	8.5	14.9	14.9	17.0	12.8	4.3	12.8	14.9
	Dunfn	2.9	20.6	8.8	17.7	2.9	20.6	8.8	11.8	8.8
	Edinb	0.0	19.1	21.9	10.5	2.9	11.4	14.3	12.4	7.6
	Glasgw	15.5	15.8	22.2	13.9	0.0	19.6	10.8	9.5	8.2
	Inverns	3.7	15.4	15.4	15.4	11.5	23.1	3.9	11.5	3.9
	Klmarnk	15.4	15.9	20.5	4.6	6.8	9.1	6.8	15.9	20.5
Wales	Bangor	2.5	18.0	23.1	10.3	7.7	35.9	2.6	0.0	2.6
	Clwyd	0.0	47.1	41.2	0.0	0.0	11.8	0.0	0.0	0.0
	Crdff	1.0	38.2	27.0	7.8	5.4	4.4	7.4	8.8	1.0
	Swanse	8.9	16.5	29.1	6.8	2.9	9.7	1.9	6.8	26.2
	Wrexm	12.0	18.2	22.7	4.6	4.6	22.7	4.6	9.1	13.6
England		**16.2**	**27.4**	**21.6**	**10.5**	**5.6**	**15.9**	**6.5**	**6.5**	**6.1**
N Ireland		**3.5**	**16.2**	**24.0**	**10.4**	**6.3**	**12.0**	**7.3**	**11.5**	**12.5**
Scotland		**9.8**	**17.3**	**22.6**	**11.8**	**3.8**	**14.8**	**9.3**	**11.2**	**9.1**
Wales		**4.0**	**29.6**	**27.5**	**7.3**	**4.7**	**10.4**	**4.9**	**7.0**	**8.6**
UK		**14.4**	**26.2**	**22.2**	**10.4**	**5.4**	**15.3**	**6.7**	**7.2**	**6.8**

*GN – glomerulonephritis.
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 have not been calculated.

Table 3.9: Diagnosis incidence rates per million population (unadjusted) 2006

	Pmp*				
Diagnosis	**England**	**N Ireland**	**Scotland**	**Wales**	**UK**
Aetiology uncertain/GN** not biopsy proven	26.0	17.8	17.8	38.4	25.6
Glomerulonephritis	9.9	11.5	12.1	9.4	10.1
Pyelonephritis	6.2	12.6	11.5	9.1	7.0
Diabetes	20.5	26.4	23.2	35.7	21.7
Polycystic kidney	6.2	8.0	9.6	6.4	6.6
Hypertension	5.3	6.9	3.9	6.1	5.2
Reno-vascular disease	5.8	13.8	9.4	11.1	6.7
Other	15.1	13.2	15.2	13.5	14.9
Not sent	18.4	4.0	11.1	5.4	16.5
All	**113.2**	**114.4**	**113.9**	**135.0**	**114.5**

*The denominator population used includes only areas covered by the Registry.
**GN – glomerulonephritis.
These are minimal estimates for the incidence of each primary renal disease, as there will also be a contribution from the diagnosis not sent category.

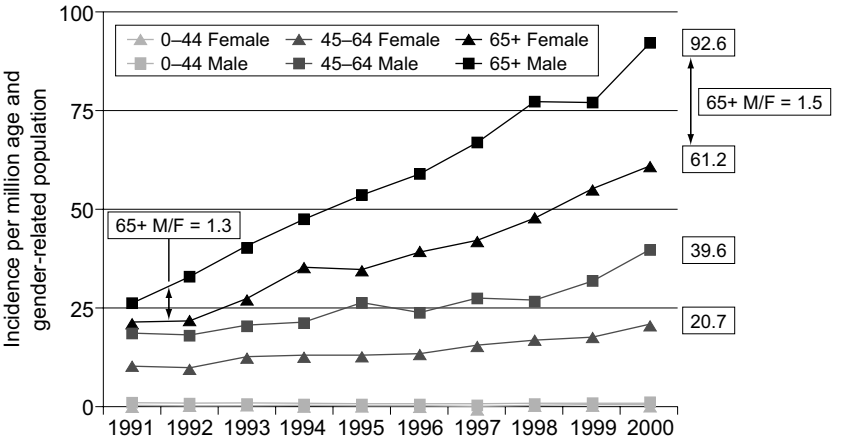

Figure 3.8: Trends in the incidence of RRT for treatment of type II diabetic nephropathy by gender and age category

The numbers on the right hand side indicate the incidence per million age and gender related population for each group for the year 2000. Reproduced from: Van Dijk *et al*. *Kidney Int*. 2005; 67 (4):1489–99

the 2006 cohort in the four home countries. In estimating these, the incidence rates for England and those for the whole UK were based only on data from centres making Registry returns. Hence the overall incident figures for England and the UK are slightly different from those quoted earlier in the chapter (Table 3.1). There were some major national differences in the frequency of primary renal disease diagnoses in this ERF cohort. Most notably it was apparent that the higher overall take-on rate in Wales was mainly accounted for by the higher reported diabetes incidence rates along with a higher incidence of those with uncertain aetiology. The reported incidences of renovascular disease and pyelonephritis were higher in Northern Ireland, Wales and Scotland than in England. The incidence of null returns was much higher in England.

It is important not to confuse incidence rates and the proportions of patients with a specific diagnosis. As an example, the proportion of patients with diabetes as a cause of ERF was higher in those under 65 than those over (25% and 19% respectively). However as ERF was more common in those over 65, the actual annual incidence of diabetic nephropathy as a cause of ERF was higher in those over 65 (57.2 pmp vs 15.0 pmp). The USRDS[3] and the European Renal Registry[4] have demonstrated that the major increase in diabetic nephropathy seen in recent years is largely from patients with Type II diabetes who developed ERF over the age of 60 (Figure 3.8).

First established treatment modality

In the UK in 2006, haemodialysis (HD) was the first modality of RRT in 76.6% of patients, peritoneal dialysis (PD) in 20% and pre-emptive transplant in just over 3.4% (defined as first treatment recorded irrespective of any later change). The frequency of HD as the first treatment modality continued to increase, in 1998 HD was the first treatment modality in 58% of incident patients.

Many patients, especially those referred late, undergo a brief period of HD, before a change 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 2006 UK cohort, 8% of incident patients had died, a further 0.6% had stopped treatment, leaving 92% of the original cohort remaining on RRT (Table 3.10). Expressed as a percentage of the whole 2006 UK cohort, 67% were on HD, 21% on PD and 4% had received a transplant (Table 3.10). Expressed as percentages of those still receiving RRT at 90 days, 73% were on HD, 22% on PD and 5% had received a transplant. Figure 3.9 shows the modality at 90 days of RRT patients in the 2006 incident cohort. Only around 0.1% of HD patients were receiving their treatment at home by 90 days, with the vast majority on centre-based treatment either in main hospital centres or satellite units. Around 30% of patients on PD were on automated treatments.

Table 3.10: RRT modality at 90 days in incident patients in 2006

		Percentage of patients on each modality				
Country	**Centre**	**HD**	**PD**	**Tx**	**Stopped treatment**	**Died**
England	B Heart	69.0	16.8	1.8	0.0	12.4
	B QEH	73.9	19.4	2.8	0.0	3.9
	Basldn	67.5	27.5	0.0	2.5	2.5
	Bradfd	72.5	13.7	0.0	0.0	13.7
	Brightn	65.6	25.8	0.0	0.0	8.6
	Bristol	68.1	19.8	3.3	0.0	8.8
	Camb	67.6	4.9	8.8	0.0	18.6
	Carlis	73.5	23.5	0.0	0.0	2.9
	Carsh	74.3	15.6	3.9	0.0	6.1
	Chelms	67.4	14.0	0.0	2.3	16.3
	Covnt	55.7	23.7	11.3	0.0	9.3
	Derby	64.5	28.9	0.0	0.0	6.6
	Dorset	49.1	36.8	5.3	7.0	1.8
	Dudley	66.7	18.8	0.0	0.0	14.6
	Exeter	65.0	24.3	3.9	0.0	6.8
	Glouc	73.8	13.8	3.1	0.0	9.2
	Hull	72.7	19.2	0.0	0.0	8.1
	Ipswi	52.5	40.0	0.0	0.0	7.5
	L Barts	51.9	39.2	5.3	0.0	3.7
	L Guys	77.5	15.2	5.8	0.0	1.4
	L Kings	66.7	22.7	5.7	0.0	5.0
	L Rfree	71.4	18.0	7.4	0.0	3.2
	L West	75.4	8.2	14.6	0.4	1.4
	Leeds	67.6	17.6	4.3	0.0	10.6
	Leic	62.7	19.3	7.3	0.0	10.7
	Liv Ain	84.8	0.0	0.0	4.3	10.9
	Liv RI	50.7	30.8	2.7	2.7	13.0
	ManWst	59.5	33.9	1.7	0.0	5.0
	Middlbr	67.7	19.4	2.2	0.0	10.8
	Newc	60.0	18.1	12.4	1.0	8.6
	Norwch	71.1	9.3	0.0	1.0	18.6
	Nottm	56.4	31.6	2.3	0.0	9.8
	Oxford	53.0	29.2	12.5	0.6	4.8
	Plymth	66.3	16.9	6.7	1.1	9.0
	Ports	62.4	23.1	6.9	0.0	7.5
	Prestn	71.2	22.0	1.7	0.0	5.1
	Redng	63.6	28.6	0.0	0.0	7.8
	Sheff	65.8	21.1	5.0	0.0	8.1
	Shrew	62.0	22.0	6.0	0.0	10.0
	Stevng	78.7	10.7	4.1	0.8	5.7
	Sthend	76.6	14.9	0.0	0.0	8.5
	Sund	78.4	13.5	0.0	0.0	8.1
	Truro	71.7	21.7	0.0	0.0	6.5
	Wirral	66.0	24.5	0.0	3.8	5.7
	Wolve	62.4	19.8	0.0	2.0	15.8
	York	63.0	26.1	0.0	0.0	10.9
N Ireland	Antrim	70.0	23.3	0.0	0.0	6.7
	Belfast	66.7	16.7	0.9	8.8	7.0

Table 3.10: (continued)

Country	Centre	Percentage of patients on each modality				
		HD	PD	Tx	Stopped treatment	Died
	Newry	71.4	21.4	0.0	0.0	7.1
	Tyrone	89.7	6.9	0.0	0.0	3.4
Scotland	Abrdn	82.5	12.3	0.0	0.0	5.3
	Airdrie	81.1	13.2	0.0	0.0	5.7
	D&Gall	75.0	5.0	0.0	5.0	15.0
	Dundee	69.0	17.2	1.7	0.0	12.1
	Dunfn	70.7	24.4	0.0	0.0	4.9
	Edinb	57.8	25.6	7.8	0.0	8.9
	Glasgw	65.4	21.2	3.4	0.0	10.1
	Inverns	52.8	44.4	0.0	0.0	2.8
	Klmarnk	74.5	19.6	0.0	0.0	5.9
Wales	Bangor	40.5	31.0	0.0	11.9	16.7
	Clwyd	80.0	4.0	0.0	0.0	16.0
	Cardff	66.1	19.3	6.4	0.0	8.3
	Swanse	76.0	18.2	0.8	0.0	5.0
	Wrexm	62.5	28.1	3.1	0.0	6.3
England		**66.4**	**20.7**	**4.7**	**0.4**	**7.8**
N Ireland		**70.7**	**16.7**	**0.5**	**5.1**	**7.1**
Scotland		**68.4**	**20.9**	**2.4**	**0.2**	**8.2**
Wales		**66.9**	**19.9**	**3.7**	**1.1**	**8.4**
UK		**66.8**	**20.6**	**4.2**	**0.6**	**7.8**

The percentage of the incident cohort who had died by day 90 appeared to vary considerably between individual centres (1% to 19%). Definition may be a major factor in apparent variation between centres; determining whether patients who died within 90 days were considered as acute or chronic renal failure. Another significant factor was small numbers, four of the seven centres with a death rate above 15% took on 50 or fewer patients. In addition, the median age of incident patients in all seven centres with the higher death rate was higher than the UK incident median.

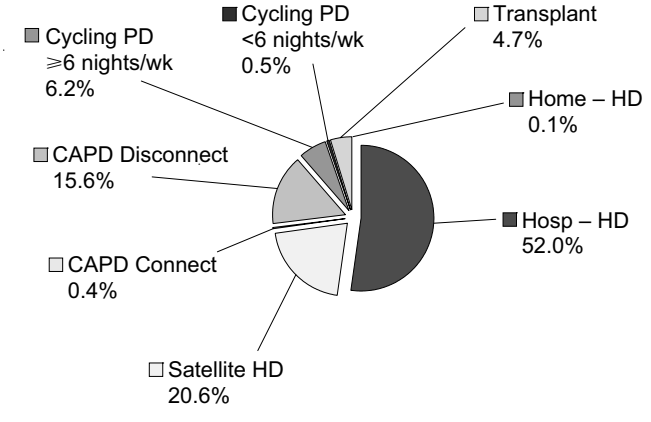

Figure 3.9: RRT modality at day 90 in incident patients in 2006

Other factors may also have contributed such as policies with respect to both conservative management and 'trials of dialysis' in patients in whom the benefits of initiating RRT may not have been clear. The percentage of patients with functioning transplants by 90 days, currently about 5%, appeared to be increasing, perhaps because of drives to encourage live donation and pre-emptive transplantation. There was wide variation between centres with respect to the percentage of patients with functioning transplants by 90 days (Table 3.10), which ranged from 0–15%. The mean percentage of patients with functioning transplants by 90 days was significantly higher in transplanting than in non-transplanting centres (6.7 vs 1.5: $p < 0.001$): this was partly if not totally due to importing of patients from other centres for pre-emptive transplantation.

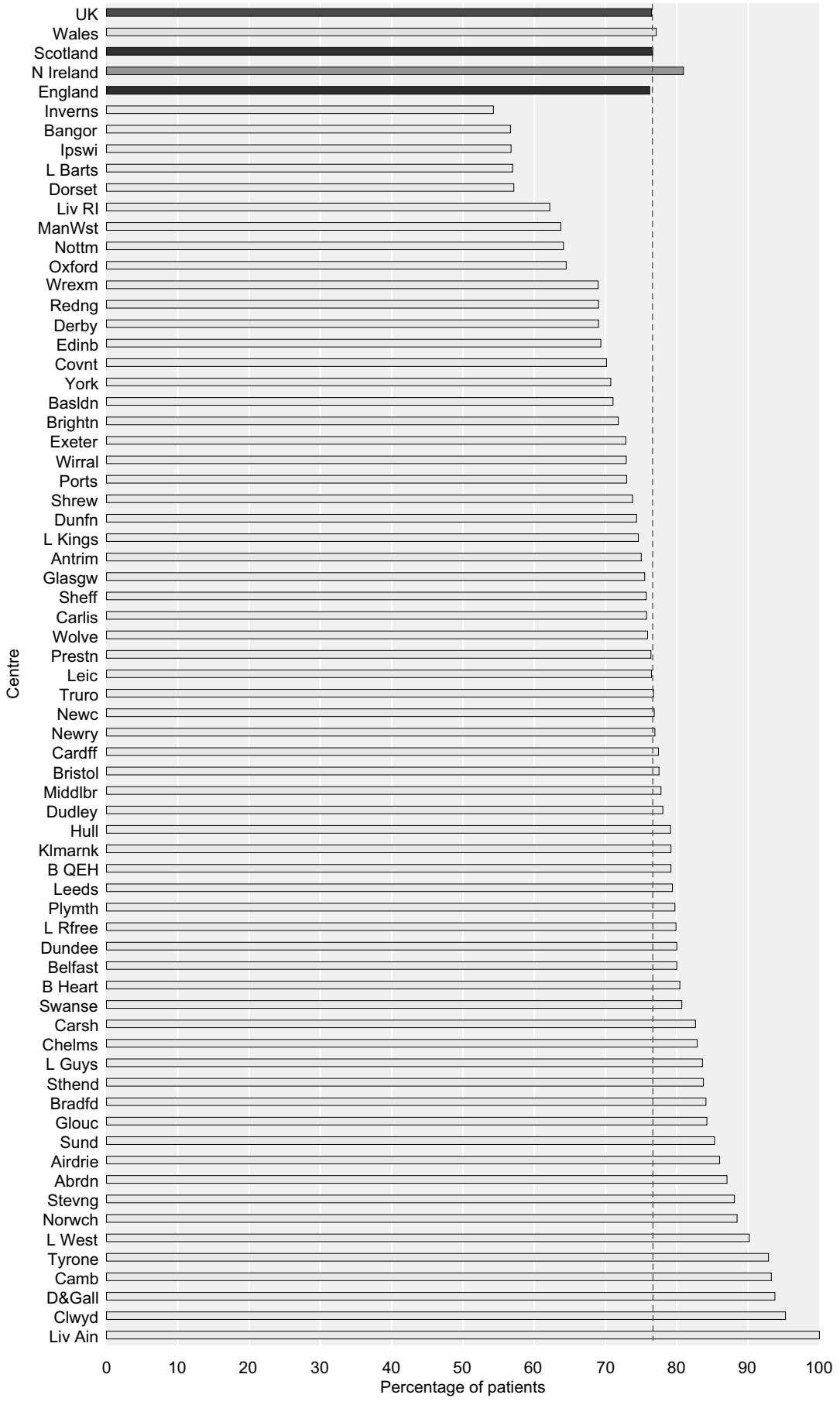

Figure 3.10: Percentage of incident dialysis patients in each centre on HD on day 90 in 2006

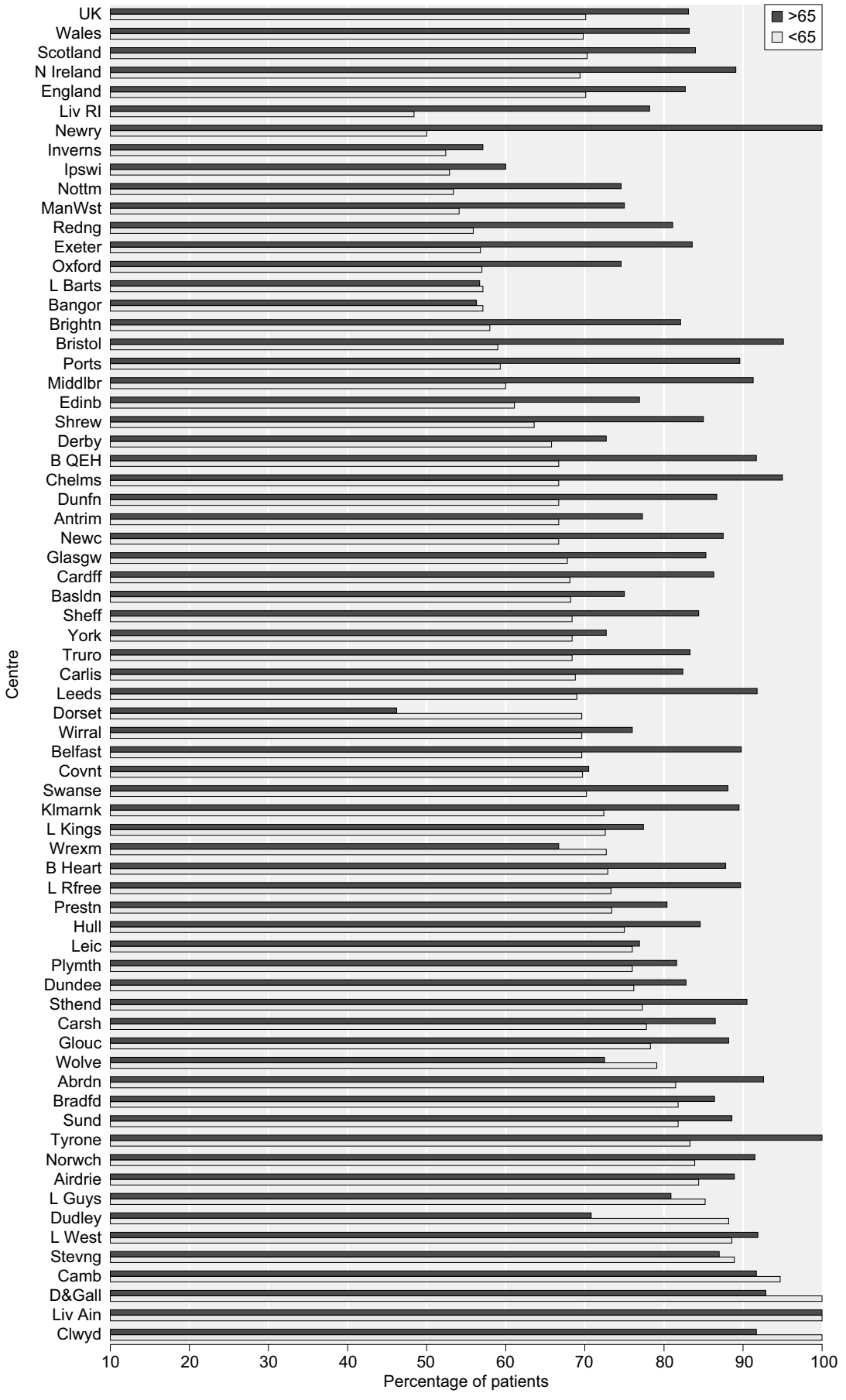

Figure 3.11: Percentage of incident dialysis patients in 2006 cohort on HD at 90 days, by age

Table 3.11: Percentage of patients on HD and PD at 90 days by age in 2006

	Aged <65 (%)		Aged >65 (%)	
Country	**HD**	**PD**	**HD**	**PD**
England	70	30	83	17
N Ireland	69	31	89	11
Scotland	70	30	84	16
Wales	70	30	83	17
UK	**70**	**30**	**83**	**17**

There were also differences between individual centres in the percentage of new dialysis patients established on HD at 90 days (Figure 3.10). Again small numbers played a major role in the centres at the extremes. In addition some centres such as Derry, Chester and Liverpool Aintree only offer HD on site, with nearby centres training their patients for PD. Excluding these 3 centres, 20 centres had 80% or more of their patients on HD at 90 days.

Older patients were more likely to be on HD rather than PD at 90 days (Figure 3.11). In the whole UK, 70% of incident patients aged less than 65 years were on HD at this stage compared with 83% of patients aged over 65. This difference was highly significant ($p < 0.0001$) (Table 3.11). Hence the percentage of patients on PD was almost twice as high in patients aged <65 years as in older patients (30% vs 17%). These overall UK differences were reflected in the majority of centres though the number in whom the proportions were equal or reversed has increased from 5 in 2005 to 11 in 2006 (Liverpool Aintree excluded as it offers only HD on site). The centres in which PD was as or more popular in the elderly as in younger patients were Dorset, Dudley, Clwyd, Dumfries & Galloway, Wolverhampton, Wrexham, London Guys, Cambridge, Stevenage, Bangor and London Barts. There was no difference in the male:female ratio between patients on HD and PD.

Renal function at the time of starting RRT

The eGFR of patients starting RRT was calculated using the abbreviated 4 variable MDRD calculation[5]. Data from patients with no available serum creatinine measurement within 14 days before the start of RRT were not used. Patients with an eGFR >20 ml/min/1.73 m^2 were excluded from analysis. Currently there are no defined standards for a threshold eGFR at which patients should start RRT for ERF. However, there are defined thresholds for pre-emptive listing for a kidney transplant. For example, the United Network for Organ Sharing (UNOS) permits patients to be waitlisted for a kidney transplant when their eGFR falls below 20 ml/min/1.73 m^2 (www.unos.org). 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 be considered for an early and pre-emptive transplantation when their eGFR decreases to <20 ml/min/1.73 m^2 [6]. The British Transplantation Society endorses the EBPG (http://www.bts.org.uk) and the 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[7]. It is therefore conceivable that patients could have started RRT for ERF at eGFR values as high as 20 ml/min/1.73 m^2. Patients with an eGFR >20 ml/min/1.73 m^2 were therefore excluded from the eGFR analyses due to concerns that the reported eGFR might not have been measured within two weeks prior to start of RRT. The log of the eGFR was taken to normalise the data and two sample t-tests and ANOVA were used as appropriate to compare the groups.

eGFR and age

In the 2006 cohort, older patient groups appear to have a higher geometric mean eGFR at start of RRT than younger groups (Figure 3.12).

Changes over time in eGFR at start of RRT

Analysis of serial data derived only from centres reporting continuously to the Registry since 1997 suggested that over this period there has been a tendency to initiate dialysis earlier at a higher geometric mean eGFR (Figure 3.13). There is no consistent difference in eGFR

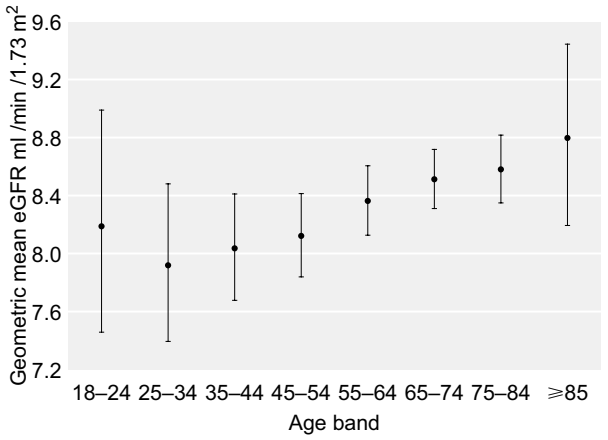

Figure 3.12: Geometric mean eGFR at start of RRT by age group in 2006
(p value from an ANOVA to test for differences between these age groups is 0.02)

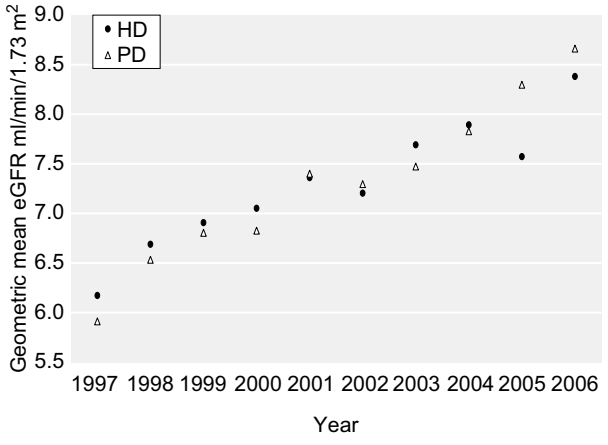

Figure 3.13: Change in eGFR on starting RRT 1997–2006; PD and HD

at start of RRT between dialysis modalities (Figure 3.13).

Late referral of incident patients

Methods

Data were included from all incident patients in the years 2001–2006 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 by a nephrologist was only available for a handful of people.
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 by a nephrologist were used to calculate the referral time. This is the number of days between first being seen and starting RRT. A small proportion of data (2%) was excluded because of actual or potential inconsistencies. Centres who had an unfeasibly high percentage (>10%) of people with referral time zero (i.e. first seen date being the same as date of starting RRT) for a given year were also excluded from the analysis for that year. Forty-nine people were calculated to have negative referral times (−1 to −14 days). These were attributed as zero. This accounted for only 0.7% of the cohort. Only data from those centres/years with 75% or more completeness were used. After these exclusions, data on 7,256 patients was available for analysis. Table 3.12 shows the percentage completeness of data for patients starting RRT in 2001–2006. Referral times of 90 days or more were defined as early referrals. Referral times of less than 90 days were defined as late referrals.

Late referral by centre and year

The percentage of patients referred to a nephrologist less than 90 days before RRT initiation in the included centres and years in the period 2001–2006 is shown in Table 3.13. The incidence of late referral ranged from 10–38% in 2006, giving a mean incidence of late referral of 23.2%.

Time referred before dialysis initiation in the 2006 incident cohort

In 2006, 60% 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, 6.4% within 3–6 months and 23.2% within 3 months. If the analysis is restricted to the 4 centres supplying continuous data for the last 5 years (Middlesbrough, Nottingham, Portsmouth and Sheffield, Table 3.14), it appears that there has been a sustained and significant reduction in late referral over that period ($p = 0.0052$ by Chi-squared test). Furthermore several other centres showed a marked reduction in the last two years, suggesting that

Table 3.12: Percentage completeness for time of referral data for patients starting RRT 2001–2006

	Year					
Centre	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Antrim						25.8
B Heart	0.0	0.0	0.0	0.0	0.0	0.0
B QEH				0.0	0.0	0.0
Bangor		65.5		97.2	87.5	
Basldn			96.2	97.8	89.7	100.0
Belfast					41.5	51.3
Bradfd				95.2	98.5	98.0
Brightn				0.0	0.0	0.0
Bristol	89.5	71.8	71.4	75.8	78.2	79.1
Camb	2.2	1.4		65.5	75.6	14.1
Cardff	0.6	0.0	3.0	1.6	1.1	0.5
Carlis				3.4	0.0	0.0
Carsh	0.0	0.0	0.5	0.0	0.6	0.0
Chelms				74.5	46.2	86.0
Chestr		33.3		60.0		0.0
Clwyd		0.0	0.0	0.0	0.0	0.0
Covnt	0.0	0.0	0.0	0.0	0.0	0.0
Derby	1.7		0.0	1.5	1.4	1.4
Derry						100.0
Dorset			98.5	100.0	100.0	100.0
Dudley	12.1	8.3	12.2			
Exeter	79.4	77.8	54.1	64.5	48.6	50.0
Glouc	0.0	1.9	0.0	13.2	93.3	81.9
Hull	4.1	0.0	1.3	0.0	2.4	0.0
Ipswi		92.7			94.4	92.9
L Barts				0.5	0.0	21.2
L Guys	0.9	0.0	0.0	0.0	0.0	0.0
L Kings		15.5	23.4	16.7	10.3	0.0
L Rfree					0.0	0.0
Leeds	66.9	64.7	76.5	87.0	88.3	83.9
Leic	90.7	87.4	94.0	92.5	60.3	50.8
Liv Ain				0.0	0.0	0.0
Liv RI	1.0	0.7	0.0	0.8	0.0	0.0
ManWst			52.8	58.4	75.7	87.4
Middlbr	85.2	91.0	92.2	87.3	90.5	76.3
Newc						97.3
Newry					32.1	71.4
Norwch				47.9	28.1	16.4
Nottm	99.2	93.8	99.1	98.1	98.6	97.8
Oxford	1.2	0.0	1.1	3.6	3.7	1.9
Plymth	0.0	0.0	0.0	0.0	0.0	0.0
Ports	97.8	95.0	95.0	93.1	91.3	94.2
Prestn	83.8	69.7	1.0	0.0	0.0	0.0
Redng	0.0	0.0	0.0	0.0	0.0	0.0
Sheff	95.3	97.4	98.7	98.2	97.4	95.2
Stevng			95.8	85.1	59.3	41.7
Sthend	5.6	0.0	0.0	0.0	0.0	0.0
Swanse	34.8	38.9	56.0	63.7	91.7	99.1
Truro	47.5	57.6	75.5	59.7	64.5	56.0

Table 3.12: (continued)

	Year					
Centre	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Tyrone					95.5	96.7
Ulster						100.0
Wirral		32.5	31.9	48.3	75.4	71.4
Wolve	50.0	67.3	79.1	98.1	98.9	95.7
Wrexm	0.0	2.4	0.0	0.0	0.0	0.0
York	67.6	87.3	84.2	93.5		93.6
Total	**41.1**	**39.1**	**44.8**	**41.9**	**39.7**	**39.6**

Table 3.13: Percentage of patients referred to a nephrologist less than 90 days before dialysis initiation

	Year					
Centre	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Bangor				34.3	40.0	
Basldn			39.2	35.6	19.2	25.0
Bradfd				16.9	32.3	16.7
Bristol	25.5			25.4	23.5	11.8
Camb					24.0	
Chelms						27.9
Dorset			25.0	18.6	35.6	16.4
Exeter	32.5	17.5				
Glouc					19.6	20.3
Ipswi		39.5			51.0	35.9
Leeds			35.7	28.6	32.6	30.8
Leic	21.2	28.8	19.2	22.3		
ManWst					20.2	13.5
Middlbr	17.4	32.7	26.3	31.5	22.4	17.6
Newc						22.4
Nottm	31.6	38.2	28.2	32.7	31.0	23.7
Ports	42.6	33.6	25.0	30.6	27.0	28.8
Prestn	20.2					
Sheff	24.5	20.9	26.9	19.8	20.9	22.0
Stevng			30.7	18.9		
Swanse					43.2	38.4
Truro			15.0			
Tyrone					23.8	10.3
Wirral					32.6	
Wolve			25.0	29.4	28.4	21.6
York		21.8	22.9	27.9		27.3
Total	**27.2**	**28.6**	**26.9**	**26.1**	**28.5**	**23.2**

the UK guidelines for the diagnosis, management and referral of CKD (http://www.renal.org) and the Quality and Outcomes Framework (QOF) initiative in the UK (http://www.dh.gov.uk) may be having some effect.

Age and late referral

In the whole cohort 2001–2006, patients who were referred late (<90 days before dialysis initiation) were significantly older than patients

Table 3.14: Referral times by year in 4 centres contributing continuous data for 2002–2006

Year	% <3 months	% 3–6 months	% 6–12 months	% >12 months
2002	30.1	9.8	11.1	49.0
2003	26.6	6.7	12.4	54.4
2004	27.4	8.6	9.7	54.2
2005	25.6	7.2	11.9	55.3
2006	23.9	6.6	11.0	58.4

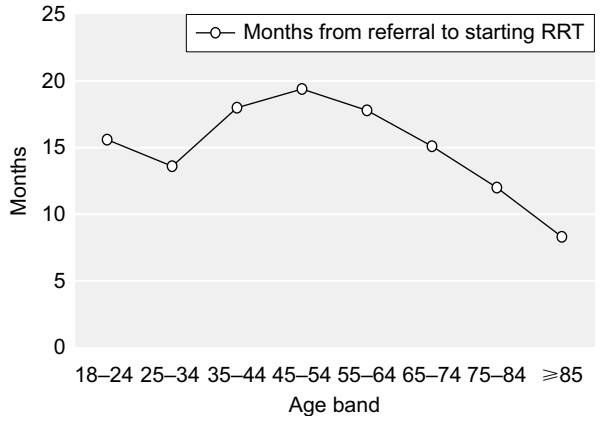

Figure 3.14: Duration of pre-dialysis care by age 2006

referred earlier (median age 67.7 vs 64.8 years: $p < 0.001$). Furthermore the median duration of pre-dialysis care diminished progressively with increasing age beyond the 45–54 age group (Figure 3.14).

Gender and late referral

In the whole cohort 2001–2006, the male:female ratio was slightly but not significantly higher in those referred late (<90 days) than in those referred earlier (1.79 vs 1.62).

Ethnicity, social deprivation and late referral

In this analysis of the 2001–2006 cohorts, ethnicity was restricted to South Asians and Blacks. Patients of other ethnic minority origin were excluded due to small numbers with referral data. The percentage of non-Whites (South Asian and Black) referred late (<90 days) was significantly lower than that of Whites (20% vs 26%: $p = 0.0025$), suggesting that late referral may be less common in non-Whites. This may be partly due to the high incidence of diabetes in non-Whites (as discussed below, patients with diabetes tend to be referred earlier) and may be related to the older median age of incident Whites. As discussed previously, advancing age was also associated with late referral. There was no relationship between social deprivation and referral pattern.

Primary renal disease and late referral

In the 2001–2006 cohort, late referral (<3 months) differed significantly between primary renal diagnoses (Table 3.15, X^2 test $p < 0.001$). Multiple comparison tests between the different diagnoses groups have not been made as there would be a high risk of producing a 'significant test' by chance. Patients classified as aetiology uncertain/glomerulonephritis unproven appeared to have higher rates of late referral, as do those classified as 'other diagnosis' or in whom diagnosis was unavailable. Those with diabetes and adult polycystic disease had lower rates of late referral (Table 3.15).

Modality and late referral

In the whole 2001–2006 cohort, referral pattern had a marked effect on initial modality choice. The percentage of patients whose initial modality was PD was significantly less in the late referral group in comparison to the group referred earlier (13% vs 29%: $p < 0.0001$). By 90 days after dialysis initiation the difference was partially redressed, though the percentage

Table 3.15: Late referral by primary renal diagnosis

	Late referral	
Diagnosis	No	%
Aetiology unc./GN. NP*	544	31
Diabetes	202	16
Glomerulonephritis	150	19
Other	472	45
Polycystic kidney	42	9
Pyelonephritis	117	21
Renal vascular disease	266	28
Not available	136	40

*Aetiology unc./GN. NP – aetiology uncertain/glomerulonephritis not biopsy proven.

Table 3.16: Percentage prevalence of specific co-morbidities amongst patients referred late (0–89 days) compared with those referred early (>89 days)

Co-morbidity	0–89 days	⩾90 days	p-value
Cerebrovascular disease	11	11	0.6594
COPD*	8	7	0.0749
Diabetes (not a cause of ERF)	8	9	0.2214
Ischaemic heart disease	23	25	0.1618
Liver disease	3	2	0.0725
Malignancy	19	10	<0.0001
Peripheral vascular disease	10	14	0.0007
Smoking	18	17	0.3161

*COPD – chronic obstructive pulmonary disease.

on PD was still significantly lower after late referral (19 vs 32%: $p < 0.0001$).

Co-morbidity and late referral

In the whole 2001–2006 cohort, significantly fewer patients who had been referred late (<90 days) were assessed as having no co-morbidity compared to the group referred earlier (40.2% vs 44.9%: $p = 0.004$). In terms of specific co-morbidities, peripheral vascular disease was significantly less common in the group referred late (Table 3.16).

Haemoglobin and late referral

In the whole 2001–2006 cohort, patients referred late had a significantly lower haemoglobin concentration at dialysis initiation than patients referred earlier (9.43 vs 10.38 g/dl: $p < 0.001$), presumably because of the lack of opportunity to actively manage anaemia.

eGFR and late referral

In the whole 2001–2006 cohort, eGFR at the onset of RRT was slightly lower in patients referred late compared to earlier referrals (7.49 vs 7.89 ml/min/1.73 m^2: $p = 0.0002$). The same relationship held true in males (7.74 vs 8.15 ml/min/1.73 m^2: $p = 0.002$) and females (7.05 vs 7.49 ml/min/1.73 m^2: $p = 0.011$).

In those over the age of 65 at the time of dialysis initiation the difference was more pronounced (7.57 vs 8.28 ml/min/1.73 m^2: $p < 0.0001$). The same relationship was found in 18–44 year olds (6.85 vs 7.61 ml/min/1.73 m^2: $p = 0.009$) but in the 45–64 year group there was no difference between eGFR in early and late referrals.

The difference between eGFR in late and earlier referrals remained significant in Whites (7.43 vs 7.92 ml/min/1.73 m^2: $p < 0.001$), but there were no significant differences in South Asians or in Blacks. There were no clear differences in eGFR between those referred late and those referred earlier when stratified by the Townsend social deprivation score. When stratified by primary renal disease, eGFR was significantly lower in late referrals with renal disease of uncertain aetiology (6.92 vs 7.73 ml/min/1.73 m^2: $p < 0.0001$) and 'other diagnoses' (7.32 vs 7.84 ml/min/1.73 m^2: $p = 0.032$). When stratifying by co-morbidity, eGFR was lower in patients referred late compared to earlier referrals in all co-morbidity groups. This difference was significant in smokers, in patients with malignancy, in those with liver disease and of borderline significance ($p = 0.05$) in those with cerebrovascular disease.

Survival of incident patients

This analysis is found in Chapter 6.

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Chapter 4: All Patients Receiving Renal Replacement Therapy in the United Kingdom in 2006

Ken Farrington, Alex Hodsman, Retha Steenkamp, Terry Feest and John Feehally

Summary

- Summary data are provided for the whole UK. There were 43,901 adult patients receiving RRT in the UK at the end of 2006, giving a UK population prevalence for adults of 725 per million population (pmp), an increase from 694 pmp in 2005.

- The more detailed analyses include data on 40,083 patients from 67 of the 72 centres which returned fuller data to the Registry: all centres in Northern Ireland, Scotland and Wales, and 47 of the 52 centres in England.

- The overall growth in the prevalent RRT population of the whole UK between 2005 and 2006 was 6.9%. The growth in England (7.6%) exceeded that in Wales (4.0%), Scotland (3.5%) and Northern Ireland (4.5%).

- The annual increase in prevalence in the 37 centres participating in the Registry since 2000 continued at 5.8%.

- There was significant substantial variation in the crude Local Authority area prevalence from 316 pmp to 1,304 pmp.

- In general, areas with large ethnic minority populations had high standardised prevalence ratios (SPR). Nevertheless, several Local Authority areas in South Wales and the South-West of England (Merthyr Tydfil, City of Bristol, Rhondda/Cynon/Taff, Swansea, Bridgend and Cardiff) had a higher SPR than would be predicted from the local ethnic mix. Another group (Bolton, Rochdale and Oldham) in the North West of England where the prevalence of RRT is generally lower had a lower SPR than expected from the local ethnic mix.

- Of RRT patients in the UK, 45% had a transplant, 43% were on centre-based haemodialysis (HD) and 11% on peritoneal dialysis (PD). The proportion on home HD has remained very small (1%) in spite of the recent NICE guidelines.

- The HD population has continued to expand and the PD population to contract. HD was increasingly prominent with increasing age and transplantation less common. The proportion treated by PD remained fairly stable across the age spectrum.

- The median age of prevalent patients on RRT was 57.1 years, that of patients on HD 65.0 years, PD 59.9 years and transplanted patients 49.9 years.

- The median vintage of the whole RRT population was 5.1 years: that of transplanted patients 10.2 years, HD patients 2.8 years and PD patients 2.0 years.

- For all ages, crude prevalence rates in males exceeded those in females, peaking in the 75–79 year age band for males at 2,411 pmp and in females in the 60–64 year age band at 1,221 pmp.

- In contrast with incident patients the most common identifiable diagnosis was glomerulonephritis (15%) and in those over 65 it was diabetes (14%). The differences from incident patients reflect the differing prognoses attached to different primary causes of ERF.

Introduction

This chapter presents data from all patients receiving renal replacement therapy (RRT) in the whole UK during 2006. In 2006, the UK Renal Registry (UKRR) received complete returns from all 5 centres in Wales, all 6 centres in Northern Ireland and 47 of the 52 of the centres in England. Data from all 9 centres in

Scotland (data from the Glasgow centres are combined in this year's report) were obtained from the Scottish Renal Registry. In addition summary data were obtained separately from the 5 remaining English centres not currently returning to the Registry, to enable accurate calculation of prevalence and modality used.

Methods

The cohort for this analysis was all patients on the Registry database in the fourth quarter of 2006. Exclusions were patients from centres not contributing data for the entire year, patients from paediatric centres (including adults from these centres) and patients less than 18 years old on 31/12/06. For most analyses, patients without an allocated treatment modality were also excluded. Population estimates were obtained from the Office for National Statistics (ONS) website.

Summary data and prevalence of RRT in 2006

The total numbers of prevalent RRT patients by country and for the whole UK were calculated using UKRR data supplemented by summary data from centres not currently submitting full data. These were analysed in conjunction with Office of National Statistics (ONS) data to obtain the prevalence of RRT per million population with 95% confidence intervals. The number of prevalent patients stratified by dialysis modality was calculated and compared to previous years, both for all centres (including percentage change from 2005 to 2006) and centres continuously reporting to the Registry since 2000 (including percentage change from 2000 to 2006).

Local Authority prevalence

The crude prevalence and standardised prevalence ratios of RRT by Local Authority (LA) were calculated as described in Appendix D (www.renalreg.org). In summary, age and gender specific prevalences were first calculated using the available Registry data on the number of prevalent patients for the covered area in England, Wales, Scotland and Northern Ireland. Data on the age and gender breakdown of the population of each Local Authority area were obtained from the 2001 census data from the ONS; these age and gender prevalences were then used to calculate the expected prevalence for each LA area. The age and gender standardised ratio was then calculated as (observed prevalence)/(expected prevalence). A ratio of 1 indicates that the LA area's prevalence was as would be expected if the age/gender rates found in the total covered population applied to the LA area's population structure; a level above 1 indicates that the observed prevalence was greater than expected given the LA area's population structure; if the lower confidence limit was above 1 this is statistically significant at the 5% level. The converse applies to standardised prevalence rate ratios less than 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. Figures 4.1 and 4.2 enable assessment of whether an observed prevalence rate differed significantly from the national average. For any size of population (x-axis), the upper and lower 1 in 20 confidence intervals around the national average prevalence can be read from the y-axis (dotted lines). Any observed prevalence for renal failure outside these limits was significantly different from the national average. Thus for a population of 50,000, an observed prevalence outside the limits of 489 to 961 pmp was significantly different, whilst for a population of 500,000 the limits are 650 to 799 pmp.

Case mix factors influencing prevalence of RRT

Several factors were analysed to explore differences in prevalence of patients on RRT. These included RRT vintage, age, gender, ethnicity, primary renal disease and diabetes. Chi-squared tests were used to test for significant differences in these analyses.

Modalities of treatment

The distribution of prevalent patients by treatment modality was calculated both by individual country and for the whole UK. These data were also analysed by age band.

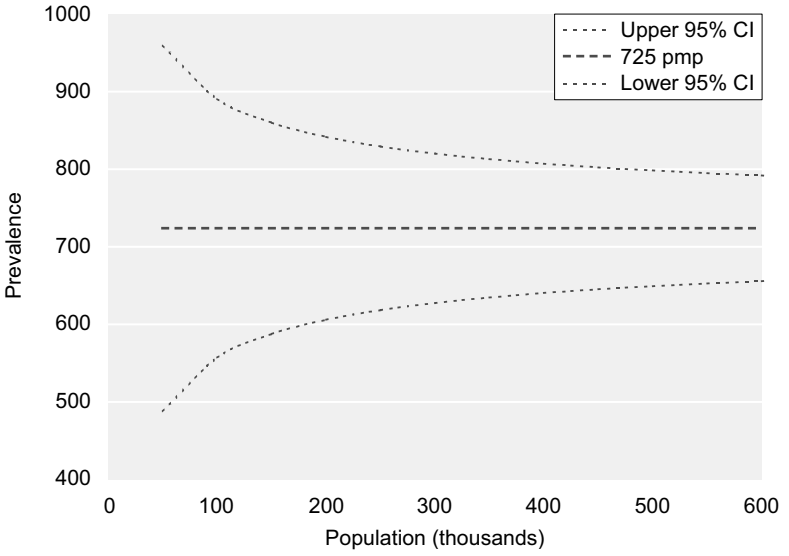

Figure 4.1: 95% confidence limits for prevalence of 725 pmp for population sizes 50,000–600,000

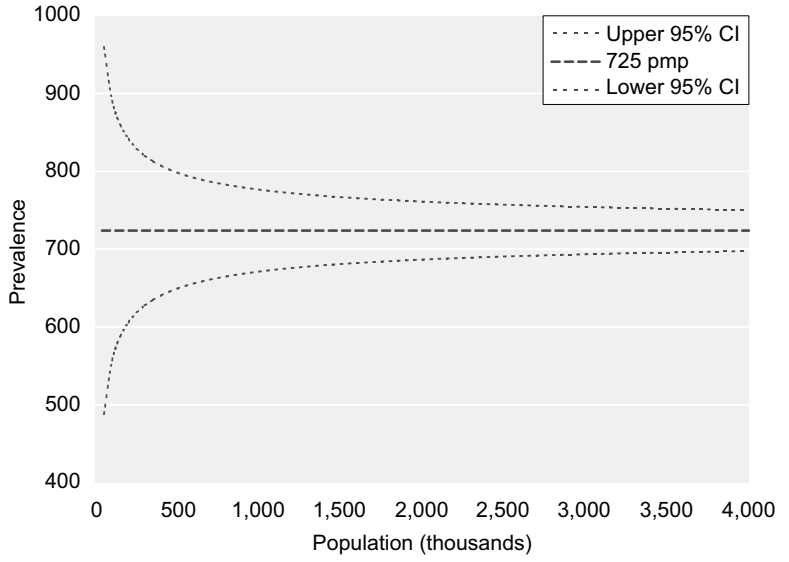

Figure 4.2: 95% confidence limits for prevalence of 725 pmp for population sizes 50,000–4 million

Results

All adult patients receiving RRT on 31/12/06

There were 43,901 adult patients receiving RRT in the UK at the end of 2006, giving a UK population prevalence for adults of 725 pmp (Table 4.1), an increase from 694 pmp in 2005. The prevalence has increased in each of the four home countries but remained lower in England (718 pmp) than in Wales (725 pmp), Scotland (769 pmp) and Northern Ireland (777 pmp). This analysis includes summary statistics from five centres not contributing individual patient data to the UKRR. It excludes patients without a treatment modality code. The figures are not adjusted for age or ethnic mix. The prevalences in Scotland and Northern Ireland are just significantly larger than in England.

Prevalent patients by centre

The number of prevalent patients in each centre and the distribution of their treatment modalities are shown in Table 4.2. There was wide variation in the number of prevalent patients in each centre and in the distribution of these patients between the different treatment modalities. Many factors contributed to this including

Table 4.1: Prevalence of RRT in the UK on 31/12/06

	England	Wales	Scotland	N Ireland	UK
Centres contributing to UKRR (67)	32,644	2,151	3,934	1,354	40,083
All UK centres (67 + 5 = 72)	36,462	2,151	3,934	1,354	43,901
Total population, mid-2006 estimates from ONS web site (millions)	50.8	3.0	5.1	1.7	60.6
Prevalence pmp HD	306	318	336	381	311
Prevalence pmp PD	76	107	81	65	78
Prevalence pmp dialysis	382	425	417	446	389
Prevalence pmp transplant	336	300	352	331	336
Prevalence pmp total	718	725	769	777	725
Confidence intervals total	711–726	695–756	745–793	736–819	718–731

Table 4.2: Number of prevalent patients per treatment modality by centre on 31/12/06

Country	Centre	HD	PD	Dialysis	Transplant	RRT
England	B Heart	370	41	411	167	578
	B QEH*	740	136	876	681	1,557
	Basldn	130	28	158	28	186
	Bradfd	158	45	203	162	365
	Brightn	319	97	416	243	659
	Bristol*	458	80	538	665	1,203
	Camb*	329	64	393	513	906
	Carlis	87	12	99	89	188
	Carsh	508	125	633	469	1,102
	Chelms	103	32	135	20	155
	Chestr	43	0	43		43
	Colchester	84	0	84	0	84
	Covnt*	292	69	361	314	675
	Derby	206	79	285	16	301
	Dorset	146	56	202	194	396
	Dudley	129	52	181	82	263
	Exeter	282	84	366	264	630
	Glouc	169	37	206	113	319
	Hull	307	64	371	239	610
	Ipswi	101	57	158	125	283
	Kent & Cntbury	259	101	360	186	546
	L Barts*	531	234	765	651	1,416
	L Guys*	455	71	526	789	1,315
	L Kings	318	77	395	274	669
	L RFree*	574	132	706	677	1,383
	*L St George's**	199	44	243	352	595
	L West*	1,071	83	1,154	*1,002*	2,156
	Leeds*	505	110	615	765	1,380
	Leic*	621	200	821	679	1,500
	Liv Ain	99	0	99		99
	Liv RI*	411	97	508	830	1,338
	*Man RI**	358	146	504	1,000	1,504
	ManWst	303	135	438	280	718
	Middlbr	265	35	300	340	640

Table 4.2: (continued)

Country	Centre	HD	PD	Dialysis	Transplant	RRT
	Newc*	245	65	310	595	905
	Norwch	241	54	295	142	437
	Nottm*	343	143	486	437	923
	Oxford*	370	125	495	755	1,250
	Plymth*	146	42	188	224	412
	Ports*	375	106	481	662	1,143
	Prestn	360	91	451	381	832
	Redng	216	84	300	230	530
	Sheff*	585	143	728	504	1,232
	Shrew	136	50	186	73	259
	Stevng	346	47	393	213	606
	Sthend	124	16	140	44	184
	Stoke	249	101	350	238	588
	Sund	153	16	169	102	271
	Truro	158	37	195	96	291
	Wirral	128	35	163		163
	Wolve	294	63	357	94	451
	York	112	26	138	85	223
Wales	Bangor	68	35	103		103
	Cardff*	447	151	598	735	1,333
	Clwyd	65	8	73	7	80
	Swanse	270	87	357	146	503
	Wrexm	92	37	129	3	132
Scotland	Abrdn	203	31	234	200	434
	Airdrie	153	26	179	54	233
	D&Gall	56	12	68	9	77
	Dundee	148	48	196	169	365
	Dunfn	99	27	126	30	156
	Edinb*	259	81	340	361	701
	Glasgw*	586	105	691	862	1,553
	Inverns	78	42	120	80	200
	Klmarnk	136	45	181	34	215
N Ireland	Antrim	129	25	154	46	200
	Belfast*	273	62	335	416	751
	Derry	31	0	31	3	34
	Newry	83	17	100	48	160
	Ulster	56	2	58	3	61
	England	**15,511**	**3,867**	**19,378**	**17,084**	**36,462**
	N Ireland	**664**	**113**	**777**	**577**	**1,354**
	Scotland	**1,718**	**417**	**2,135**	**1,799**	**3,934**
	Wales	**942**	**318**	**1,260**	**891**	**2,151**
	UK	**18,835**	**4,715**	**23,550**	**20,351**	**43,901**

Centres in *italics* contributed summary data only.
* by centre name indicates a transplanting centre.

geography, local population density, age distribution, ethnic composition and social deprivation index of that population. Local organisation, facilities, preferences and centre transplanting status also played a role in determining the modality distribution. As examples, Chester and Liverpool Aintree do not run PD programmes, the service being provided by adjacent centres. The 23 transplant centres had higher mean prevalent numbers in all modalities

than non-transplanting centres ($p < 0.001$ for all modalities) and also had a higher ratio of prevalent patients with a functioning transplant to patients on dialysis (1.17 vs 0.55: $p < 0:001$). The wide variability in this ratio both in transplanting (0.69–1.98) and non-transplanting (0–1.13) centres suggests considerable variation in transplant follow-up policies; some transplant centres transfer patients back to the referring dialysis centre on initial discharge, others undertake long-term follow up of patients referred from other centres.

Changes in prevalence 2005–2006

The overall growth in the prevalent RRT population of the whole UK between 2005 and 2006 was 6.9% (Table 4.3). The growth in England (7.6%) exceeded that in Wales (4.0%), Scotland (3.5%), and Northern Ireland (4.5%). There

Table 4.3: Number of patients on RRT by centre 2003–2006

Treatment centre	31/12/2003	31/12/2004	31/12/2005	31/12/2006	% change 2005–2006
Abrdn	349	388	416	434	4.3
Airdrie	172	181	171	233	36.3
Antrim			189	200	5.8
B Heart	497	503	540	578	7.0
B QEH		1,420	1,516	1,557	2.7
Bangor	96	93	102	103	1.0
Basldn	165	161	169	186	10.1
Belfast			740	751	1.5
Bradfd	309	323	367	365	−0.5
Brightn		592	622	659	5.9
Bristol	1,050	1,089	1,162	1,203	3.5
Camb	722	765	818	906	10.8
Cardff	1,155	1,217	1,269	1,333	5.0
Carlis	170	179	185	188	1.6
Carsh	885	956	1,001	1,102	10.1
Chelms		138	134	155	15.7
Chestr	36	36	35	43	22.9
Clwyd	65	70	83	80	−3.6
Covnt	575	602	637	675	6.0
D&Gall	79	61	69	77	11.6
Derby	259	274	279	301	7.9
Derry				34	
Dorset	354	369	382	396	3.7
Dudley	242	255	258	263	1.9
Dundee	299	320	358	365	2.0
Dunfn	127	136	150	156	4.0
Edinb	619	649	669	701	4.8
Exeter	520	570	583	630	8.1
Glasgw	1,488	1,518	1,589	1,553	−2.3
Glouc	243	257	281	319	13.5
Hull	514	549	588	610	3.7
Inverns	160	179	199	200	0.5
Ipswi	243	281	290	283	−2.4
Klmarnk	168	159	181	215	18.8
L Barts		1,296	1,337	1,416	5.9
L Guys	1,183	1,215	1,221	1,315	7.7
L Kings	575	593	634	669	5.5

Table 4.3: (continued)

Treatment centre	31/12/2003	31/12/2004	31/12/2005	31/12/2006	% change 2005–2006
L Rfree			1,342	1,383	3.1
L West	1,087	1,144	1,147	1,655	44.3
Leeds	1,229	1,282	1,318	1,380	4.7
Leic	1,121	1,270	1,430	1,500	4.9
Liv Ain	39	34	81	99	22.2
Liv RI	1,209	1,250	1,275	1,338	4.9
ManWst	533	574	630	718	14.0
Middlbr	550	577	589	640	8.7
Newc	804	803	866	905	4.5
Newry			155	148	−4.5
Norwch		360	409	437	6.8
Nottm	808	829	893	923	3.4
Oxford	1,397	1,197	1,195	1,250	4.6
Plymth	345	349	368	412	12.0
Ports	1,028	1,051	1,084	1,143	5.4
Prestn	733	766	773	832	7.6
Redng	227	376	409	530	29.6
Sheff	1,084	1,148	1,165	1,232	5.8
Shrew		225	236	259	9.7
Stevng	566	544	563	606	7.6
Sthend	167	181	181	184	1.7
Sund	237	268	278	271	−2.5
Swanse	418	448	473	503	6.3
Truro	230	277	269	291	8.2
Tyrone			167	160	−4.2
Ulster			44	61	38.6
Wirral	121	149	157	163	3.8
Wolve	399	423	440	451	2.5
Wrexm	200	183	141	132	−6.4
York	186	183	204	223	9.3
England	**22,642**	**27,683**	**30,341**	**32,644**	**7.6**
N Ireland			**1,296**	**1,354**	**4.5**
Scotland	**3,461**	**3,591**	**3,802**	**3,934**	**3.5**
Wales	**1,934**	**2,011**	**2,068**	**2,151**	**4.0**
UK	**28,037**	**33,285**	**37,507**	**40,083**	**6.9**

were wide variations between centres with respect to changes in prevalent patient numbers between 2005 and 2006, ranging from a 44.3% increase (London West) to a 6.4% decrease (Wrexham). Both these extremes relate to adjustments in catchment area. The prevalent numbers in two other centres increased considerably, Airdrie (36.3%), following a fall in prevalence in 2005 and Ulster (38.6%), a small but growing new centre.

Long-term changes in prevalence 2003–2006

The long-term (1982–2006) 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 continues.

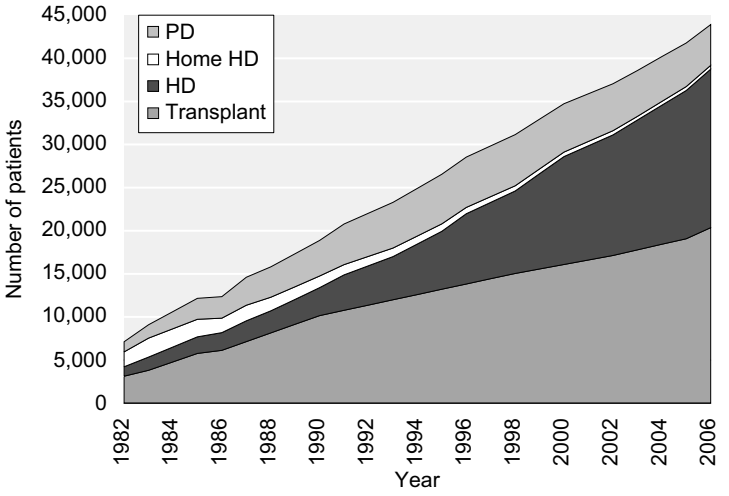

Figure 4.3: Growth in prevalent patients by treatment modality at the end of each year 1982–2006

Between 2000 and 2006, prevalent numbers in the UK increased by 35% in those 37 centres with continuous reporting over that period (Table 4.4), note that figures for the Glasgow centres are combined in this year's report). There were rises in all individual centres not affected by boundary changes. The rate of increase was similar in England (36.0%), Scotland (32.8%) and Wales (33.5%) and fairly uniform over the time span, varying between 4.2 and 6.5% per year for the UK. Many of the more extreme increases in individual centre RRT prevalence over this time were associated with boundary changes (eg Reading) but other increases of over

Table 4.4: Number of prevalent patients in renal centres reporting continuously from 2000–2006

Centre	31/12/2000	31/12/2001	31/12/2002	31/12/2003	31/12/2004	31/12/2005	31/12/2006	% change 2000–2006
Abrdn	304	319	356	349	388	416	434	42.8
Airdrie	99	144	171	172	181	171	233	135.4
B Heart	422	452	444	497	503	540	578	37.0
Bristol	907	948	992	1,050	1,089	1,162	1,203	32.6
Cardff	1,028	1,055	1,091	1,155	1,217	1,269	1,333	29.7
Carlis	156	159	161	170	179	185	188	20.5
Carsh	671	697	784	885	956	1,001	1,102	64.2
Covnt	514	546	563	575	602	637	675	31.3
D&Gall	54	72	73	79	61	69	77	42.6
Derby	123	161		259	274	279	301	144.7
Dudley	246	237	232	242	255	258	263	6.9
Dundee	236	244	288	299	320	358	365	54.7
Dunfn	90	112	119	127	136	150	156	73.3
Edinb	563	579	597	619	649	669	701	24.5
Exeter	411	437	509	520	570	583	630	53.3
Glasgw	1,386	1,410	1,430	1,488	1,518	1,589	1,553	12.0
Glouc	235	195	210	243	257	281	319	35.7
Hull	420	443	506	514	549	588	610	45.2
Inverns	94	122	147	160	179	199	200	112.8
Klmarnk	136	143	157	168	159	181	215	58.1
L Guys	1,124	1,144	1,185	1,183	1,215	1,221	1,315	17.0
Leeds	1,177	1,173	1,196	1,229	1,282	1,318	1,380	17.2

Table 4.4: (continued)

Centre	31/12/2000	31/12/2001	31/12/2002	31/12/2003	31/12/2004	31/12/2005	31/12/2006	% change 2000–2006
Leic	974	1,029	1,080	1,121	1,270	1,430	1,500	54.0
Middlbr	416	424	520	550	577	589	640	53.8
Nottm	761	818	788	808	829	893	923	21.3
Oxford	1,241	1,316	1,359	1,397	1,197	1,195	1,250	0.7
Plymth	408	394	387	345	349	368	412	1.0
Prestn	474	521	588	733	766	773	832	75.5
Redng	178	205	199	227	376	409	530	197.8
Sheff	866	943	1,022	1,084	1,148	1,165	1,232	42.3
Stevng	451	452	528	566	544	563	606	34.4
Sthend	141	143	150	167	181	181	184	30.5
Sund	228	218	236	237	268	278	271	18.9
Swanse	226	383	384	418	448	473	503	122.6
Wolve	317	336	366	399	423	440	451	42.3
Wrexm	220	201	202	200	183	141	132	−40.0
York	95	128	160	186	183	204	223	134.7
England	**12,956**	**13,519**	**14,165**	**15,187**	**15,842**	**16,541**	**17,618**	**36.0**
Scotland	**2,962**	**3,145**	**3,338**	**3,461**	**3,591**	**3,802**	**3,934**	**32.8**
Wales	**1,474**	**1,639**	**1,677**	**1,773**	**1,848**	**1,883**	**1,968**	**33.5**
UK	**17,392**	**18,303**	**19,180**	**20,421**	**21,281**	**22,226**	**23,520**	**35.2**

100% were seen in Derby (145%), Airdrie (135%), York (135%) and Inverness (113%). In these centres the large increases were due to low baseline prevalence numbers (Derby [123] Airdrie [99], York [95] and Inverness [94]). Larger centres often had larger numerical increases which amounted to smaller percentage change.

Local authority prevalence

In 2006, there were significant and substantial variations in the crude Local Authority area prevalence from 316 pmp in Bury to 1,304 pmp in Methyr Tydfil with the standardised prevalence ratio (SPR), shown in Table 4.5 as O/E (observed/expected) varying from 0.44 in Bury to 1.93 in Carrickfergus. Geographical considerations and ethnicity are the major factors underlying the variation in SPR. In 2006 there were 33 Local Authority areas with a significantly low SPR, 132 with a normal SPR and 45 with a significantly high SPR. The geographical distribution of these is summarised in Table 4.6. The North West ($p < 0{:}0001$) had a significantly higher proportion of areas with a low SPR, whilst in London, Wales, Scotland and Northern Ireland, the proportion was significantly lower ($p < 0.05$ in all cases). Conversely, London ($p < 0{:}0001$) had a significantly higher proportion of areas with a high SPR, whilst in the North West of England ($p = 0.03$), the proportion was significantly lower.

Table 4.5: Prevalence of RRT and standardised prevalence ratios in local authorities with complete coverage

O/E = observed prevalence/expected prevalence. This is the age and gender standardised prevalence ratio referred to as 'SPR' in the accompanying text.
UCL = upper confidence limit.
LCL = lower confidence limit.
Blank cells – no data returned to the Registry for that year.
Areas with a prevalence significantly above the mean are bold in darker greyed areas, areas with a prevalence significantly below the mean are italicised in darker grey areas.
% non-White = sum of % South Asian and Black from 2001 UK census.

Region	Local Authority	Total Pop	2001	2002	2003	2004	2005	2006				All	% non-
			O/E	O/E	O/E	O/E	O/E	O/E	LCL	UCL	pmp	O/E	White
NE England	Darlington	97,838	0.59	0.72	0.77	0.81	0.85	0.79	0.61	1.02	583	0.76	2.1
	Durham	493,469	0.46	0.81	0.79	0.84	0.92	0.94	0.85	1.05	707	0.79	1.0
	Hartlepool	88,610	0.67	0.75	0.81	0.90	0.89	1.01	0.79	1.29	734	0.84	1.2
	Middlesbrough	134,855	0.78	0.95	1.01	0.94	0.94	1.03	0.84	1.26	704	0.94	6.3
	Redcar/Cleveland	139,132	0.64	0.84	0.85	0.91	0.92	0.98	0.80	1.19	733	0.86	1.1
	Stockton-on-Tees	178,408	0.49	0.65	0.70	0.78	0.83	0.94	0.79	1.13	673	0.73	2.8
	Gateshead	191,151		0.87	0.86	0.87	0.90	0.91	0.77	1.08	685	0.88	1.6
	Newcastle on Tyne	259,536		0.82	0.80	0.80	0.89	0.93	0.80	1.08	643	0.85	6.9
	North Tyneside	191,658		0.83	0.84	0.87	0.94	0.99	0.84	1.17	751	0.89	1.9
	Northumberland	*307,190*		*0.74*	*0.76*	*0.80*	*0.82*	*0.82*	*0.71*	*0.94*	*641*	*0.79*	*1.0*
	South Tyneside	152,785		0.67	0.72	0.77	0.84	0.92	0.76	1.11	687	0.78	2.7
	Sunderland	280,807	0.60	0.82	0.88	0.90	0.91	0.91	0.79	1.05	655	0.84	1.9
NW England	Cheshire												1.6
	Halton	118,209	0.63	0.69	0.83	0.89	0.93	1.05	0.85	1.29	728	0.84	1.2
	Knowsley	150,459	0.91	0.96	1.04	1.08	1.06	1.07	0.88	1.29	731	1.02	1.6
	Liverpool	439,471	0.92	0.94	0.96	1.01	1.02	1.10	0.99	1.22	753	0.99	5.7
	Sefton	*282,958*	*0.52*	*0.71*	*0.73*	*0.72*	*0.79*	*0.83*	*0.72*	*0.96*	*633*	*0.72*	*1.6*
	St. Helens	176,843	0.57	0.70	0.70	0.70	0.78	0.88	0.73	1.06	645	0.72	1.2
	Warrington	*191,080*	*0.53*	*0.64*	*0.75*	*0.79*	*0.77*	*0.80*	*0.66*	*0.96*	*570*	*0.71*	*2.1*
	Wirral	312,293	0.49	0.85	0.89	0.91	0.94	0.97	0.85	1.10	724	0.84	1.7
	Blackburn/Darwen	137,470	0.54	0.69	0.87	0.97	1.06	1.17	0.97	1.42	757	0.88	22.1
	Blackpool	*142,283*	*0.49*	*0.52*	*0.64*	*0.65*	*0.66*	*0.62*	*0.49*	*0.79*	*485*	*0.60*	*1.6*
	Cumbria	*487,607*	*0.56*	*0.62*	*0.68*	*0.69*	*0.72*	*0.76*	*0.68*	*0.86*	*597*	*0.67*	*0.7*
	Lancashire	*1,134,975*	*0.48*	*0.54*	*0.69*	*0.74*	*0.74*	*0.79*	*0.73*	*0.85*	*576*	*0.66*	*5.3*
	Bolton	*261,037*			*0.61*	*0.62*	*0.74*	*0.80*	*0.68*	*0.94*	*559*	*0.69*	*11.0*
	Bury	*180,607*			*0.29*	*0.36*	*0.43*	*0.44*	*0.34*	*0.58*	*316*	*0.38*	*6.1*
	Manchester												19.0
	Oldham	*217,276*			*0.40*	*0.46*	*0.46*	*0.58*	*0.47*	*0.71*	*396*	*0.48*	*13.9*
	Rochdale	*205,357*			*0.40*	*0.45*	*0.45*	*0.60*	*0.49*	*0.74*	*414*	*0.48*	*11.4*
	Salford	*216,105*			*0.56*	*0.54*	*0.58*	*0.65*	*0.53*	*0.79*	*458*	*0.58*	*3.9*
	Stockport												4.3
	Tameside												5.4
	Trafford												8.4
	Wigan	*301,415*			*0.51*	*0.56*	*0.62*	*0.69*	*0.59*	*0.82*	*501*	*0.60*	*1.3*
Yorkshire & Humber	*E Riding of Yorkshire*	*314,113*	*0.60*	*0.68*	*0.72*	*0.73*	*0.79*	*0.81*	*0.70*	*0.92*	*637*	*0.72*	*1.2*
	Kingston on Hull	243,588	0.79	0.84	0.84	0.92	0.99	1.00	0.86	1.17	686	0.90	2.3
	NE Lincolnshire	157,981	0.60	0.74	0.79	0.89	0.96	0.99	0.82	1.19	715	0.83	1.4
	N Lincolnshire	152,848	0.76	0.81	0.81	0.85	0.84	0.93	0.77	1.12	700	0.83	2.5
	N Yorkshire	*569,660*	*0.55*	*0.65*	*0.68*	*0.74*	*0.78*	*0.82*	*0.74*	*0.90*	*634*	*0.70*	*1.1*
	York	181,096	0.71	0.76	0.82	0.81	0.84	0.91	0.77	1.09	668	0.81	2.2
	Barnsley	218,063	0.85	0.95	1.00	1.07	1.04	1.08	0.93	1.25	793	1.00	0.9
	Doncaster	286,865	0.72	0.81	0.91	0.93	0.92	0.99	0.86	1.13	729	0.88	2.3
	Rotherham	248,175	0.90	0.95	0.99	1.07	1.08	1.07	0.93	1.23	778	1.01	3.1
	Sheffield	513,234	0.76	0.84	0.86	0.94	0.97	1.06	0.96	1.18	758	0.91	8.8
	Bradford	**467,664**	**0.89**	**1.00**	**1.10**	**1.14**	**1.23**	**1.19**	**1.07**	**1.32**	**791**	**1.09**	**21.7**
	Calderdale	192,405	0.78	0.85	0.95	0.99	1.03	1.08	0.92	1.26	774	0.95	7.0

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2006 LCL	2006 UCL	2006 pmp	All O/E	% non-White
Yorkshire & Humber	**Kirklees**	**388,567**	**0.86**	**0.94**	**1.03**	**1.07**	**1.10**	**1.20**	**1.08**	**1.34**	**834**	**1.03**	**14.4**
	Leeds	715,403	0.82	0.85	0.86	0.88	0.96	1.02	0.93	1.11	704	0.90	8.2
	Wakefield	315,172	0.71	0.72	0.74	0.77	0.82	0.91	0.80	1.05	663	0.78	2.3
East Midlands	**Leicester**	**279,920**	**1.35**	**1.47**	**1.52**	**1.59**	**1.66**	**1.72**	**1.53**	**1.92**	**1,090**	**1.55**	**36.1**
	Leicestershire	609,578	0.74	0.76	0.80	0.86	0.88	0.94	0.85	1.03	694	0.83	5.3
	Northamptonshire	629,676	0.76	0.78	0.79	0.66	0.88	0.92	0.84	1.01	653	0.80	4.9
	Rutland	34,563	0.53	0.65	0.68	0.72	0.80	0.80	0.52	1.22	608	0.70	1.9
	Derby	221,709			1.03	1.08	1.10	1.16	1.00	1.34	812	1.09	12.6
	Derbyshire	*734,585*	*0.60*	*0.52*	*0.72*	*0.73*	*0.76*	*0.82*	*0.74*	*0.89*	*619*	*0.69*	*1.5*
	Lincolnshire	*646,644*	*0.65*	*0.67*	*0.67*	*0.73*	*0.78*	*0.81*	*0.74*	*0.89*	*637*	*0.72*	*1.3*
	Nottingham	**266,988**	**1.18**	**1.08**	**1.07**	**1.10**	**1.14**	**1.18**	**1.03**	**1.35**	**760**	**1.13**	**15.1**
	Nottinghamshire	748,508	0.80	0.81	0.83	0.88	0.94	0.96	0.89	1.05	724	0.87	2.6
West Midlands	**Birmingham**	**977,085**				**1.45**	**1.56**	**1.64**	**1.54**	**1.74**	**1,066**	**1.55**	**29.6**
	Dudley	305,153	0.63	0.61	0.64	0.85	0.88	0.89	0.78	1.02	669	0.75	6.3
	Sandwell	**282,904**				**1.25**	**1.32**	**1.40**	**1.24**	**1.57**	**990**	**1.32**	**20.3**
	Solihull	199,515	0.62	0.61	0.73	0.91	0.92	1.02	0.87	1.20	767	0.80	5.4
	Walsall	**253,498**	**0.58**	**0.67**	**0.68**	**1.11**	**1.18**	**1.22**	**1.07**	**1.39**	**884**	**0.91**	**13.6**
	Wolverhampton	**236,582**	**0.91**	**0.95**	**1.03**	**1.15**	**1.22**	**1.26**	**1.10**	**1.44**	**905**	**1.09**	**22.2**
	Coventry	**300,849**	**1.06**	**1.07**	**1.13**	**1.14**	**1.14**	**1.17**	**1.04**	**1.33**	**801**	**1.12**	**16.0**
	Herefordshire, County	*174,871*				*0.76*	*0.80*	*0.83*	*0.69*	*0.99*	*658*	*0.80*	*0.9*
	Warwickshire	505,858	0.81	0.86	0.86	0.97	1.01	1.04	0.95	1.15	785	0.93	4.4
	Worcestershire	*542,105*				*0.74*	*0.80*	*0.82*	*0.74*	*0.91*	*622*	*0.78*	*2.5*
	Shropshire	283,173				0.76	0.84	0.88	0.76	1.01	682	0.83	1.2
	Staffordshire												2.4
	Stoke-on-Trent												5.2
	Telford/Wrekin	158,325				0.80	0.80	0.87	0.71	1.06	587	0.82	5.2
East of England	Bedfordshire	381,572	0.66	0.72	0.74	0.79	0.83	0.91	0.81	1.03	647	0.77	6.7
	Hertfordshire	*1,033,978*	*0.40*	*0.48*	*0.51*	*0.52*	*0.70*	*0.82*	*0.75*	*0.89*	*584*	*0.57*	*6.3*
	Luton	**184,373**	**0.85**	**0.91**	**1.02**	**1.03**	**1.23**	**1.33**	**1.14**	**1.55**	**852**	**1.06**	**28.1**
	Essex	*1,310,837*				*0.72*	*0.77*	*0.78*	*0.72*	*0.83*	*579*	*0.75*	*2.9*
	Southend-on-Sea	160,259	0.61	0.72	0.81	0.90	0.97	1.02	0.85	1.22	755	0.84	4.2
	Thurrock	143,128				0.79	0.93	0.99	0.81	1.20	664	0.90	4.7
	Cambridgeshire	552,659	0.62	0.70	0.72	0.78	0.87	0.93	0.84	1.03	666	0.77	4.1
	Norfolk	*796,728*				*0.75*	*0.80*	*0.88*	*0.81*	*0.95*	*699*	*0.81*	*1.5*
	Peterborough	156,061	0.58	0.70	0.82	0.89	0.96	1.07	0.89	1.28	730	0.84	10.3
	Suffolk	*668,555*				*0.66*	*0.71*	*0.76*	*0.69*	*0.84*	*582*	*0.71*	*2.8*
London	**Barnet**	**314,561**					**1.06**	**1.27**	**1.12**	**1.43**	**852**	**1.16**	**26.0**
	Camden	198,020					1.01	1.17	1.00	1.38	732	1.09	26.8
	Enfield	**273,559**					**1.40**	**1.51**	**1.34**	**1.70**	**1,013**	**1.46**	**22.9**
	Haringey	**216,505**					**1.54**	**1.67**	**1.46**	**1.91**	**1,002**	**1.61**	**34.4**
	Islington	**175,797**					**1.31**	**1.46**	**1.25**	**1.70**	**899**	**1.38**	**24.6**
	Barking/Dagenham	163,942				0.89	1.00	1.05	0.87	1.27	683	0.98	14.8
	City of London	7,183						0.18	0.02	1.26	139	0.18	15.4
	Hackney	**202,824**				**1.09**	**1.44**	**1.50**	**1.29**	**1.74**	**863**	**1.34**	**40.6**
	Havering												4.8
	Newham	**243,889**				**1.27**	**1.50**	**1.69**	**1.48**	**1.92**	**931**	**1.48**	**60.6**
	Redbridge	**238,634**				**1.02**	**1.20**	**1.25**	**1.09**	**1.44**	**846**	**1.16**	**36.5**
	Tower Hamlets	**196,105**				**1.08**	**1.19**	**1.31**	**1.11**	**1.55**	**724**	**1.19**	**48.6**
	Waltham Forest	**218,341**						**1.31**	**1.13**	**1.51**	**815**	**1.31**	**35.5**
	Brent	**263,463**						**1.39**	**1.22**	**1.58**	**888**	**1.39**	**54.7**
	Ealing	**300,948**		**1.23**	**1.24**	**1.35**	**1.42**	**1.62**	**1.45**	**1.81**	**1,043**	**1.37**	**41.3**
	H/smith/Fulham	**165,244**		**1.19**	**1.27**	**1.37**	**1.32**	**1.34**	**1.14**	**1.59**	**835**	**1.30**	**22.2**
	Harrow												41.2

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2006 LCL	2006 UCL	2006 pmp	All O/E	% non-White
London	Hillingdon	243,006				0.77	0.92	1.04	0.90	1.21	704	0.91	20.9
	Hounslow	**212,342**				**1.53**	**1.56**	**1.53**	**1.34**	**1.75**	**980**	**1.54**	**35.1**
	Kensington/Chelsea												21.4
	Westminster												26.8
	Bexley	218,307	0.57	0.93	0.98	0.96	1.01	1.12	0.97	1.30	806	0.93	8.6
	Bromley	295,532	0.54	0.76	0.79	0.83	0.90	0.94	0.82	1.08	690	0.79	8.4
	Greenwich	214,404		0.85	0.86	0.82	1.06	1.14	0.97	1.33	728	0.95	22.9
	Lambeth	**266,169**	**0.68**	**1.13**	**1.17**	**1.24**	**1.31**	**1.39**	**1.22**	**1.59**	**819**	**1.16**	**37.6**
	Lewisham	**248,923**	**0.99**	**1.35**	**1.35**	**1.49**	**1.61**	**1.72**	**1.53**	**1.94**	**1,061**	**1.42**	**34.1**
	Southwark	**244,866**		**1.38**	**1.47**	**1.51**	**1.63**	**1.72**	**1.52**	**1.95**	**1,041**	**1.54**	**37.0**
	Croydon	**330,588**	**0.65**	**0.81**	**0.92**	**1.00**	**1.12**	**1.17**	**1.04**	**1.32**	**780**	**0.95**	**29.8**
	Kingston on Thames												15.5
	Merton												25.0
	Richmond on Thames												9.0
	Sutton												10.8
	Wandsworth												22.0
SE England	*Hampshire*	*1,240,102*	*0.58*	*0.61*	*0.65*	*0.68*	*0.71*	*0.77*	*0.72*	*0.83*	*571*	*0.66*	*2.2*
	Isle of Wight	*132,731*	*0.51*	*0.56*	*0.60*	*0.62*	*0.58*	*0.60*	*0.47*	*0.77*	*497*	*0.58*	*1.3*
	Portsmouth	186,700	0.92	0.94	0.96	0.98	1.00	1.00	0.84	1.19	680	0.97	5.3
	Southampton	217,444	0.69	0.73	0.77	0.83	0.86	0.90	0.75	1.07	593	0.80	7.6
	Kent												3.1
	Medway												5.4
	Brighton/Hove	247,817				0.75	0.79	0.86	0.73	1.00	601	0.80	5.7
	East Sussex	*492,326*				*0.74*	*0.75*	*0.78*	*0.70*	*0.87*	*628*	*0.75*	*2.3*
	Surrey	*1,059,017*				*0.67*	*0.72*	*0.79*	*0.73*	*0.85*	*582*	*0.73*	*5.0*
	West Sussex	*753,612*				*0.67*	*0.71*	*0.77*	*0.70*	*0.84*	*593*	*0.71*	*3.4*
	Bracknell Forest	109,616				0.80	0.79	0.91	0.72	1.17	593	0.83	4.9
	Buckinghamshire	479,026	0.75	0.82	0.83	0.87	0.92	0.97	0.87	1.08	701	0.86	7.9
	Milton Keynes	207,057	0.77	0.78	0.89	0.92	0.97	0.98	0.82	1.16	628	0.88	9.3
	Oxfordshire	605,489	0.86	0.88	0.95	0.98	1.00	1.06	0.97	1.17	748	0.96	4.9
	Reading	143,096	0.91	0.98	1.03	1.05	1.00	1.12	0.92	1.36	720	1.02	13.2
	Slough	**119,064**	**0.86**	**1.32**	**1.40**	**1.46**	**1.57**	**1.79**	**1.52**	**2.12**	**1,134**	**1.40**	**36.3**
	West Berkshire	144,485	0.71	0.70	0.76	0.89	0.89	0.90	0.73	1.10	637	0.81	2.6
	Windsor/Maidenhead												7.6
	Wokingham	150,231	0.66	0.67	0.76	0.80	0.86	0.97	0.80	1.18	679	0.79	6.1
SW England	Bath/NE Somerset	169,040	0.57	0.56	0.59	0.73	0.82	0.85	0.71	1.03	639	0.69	2.8
	Bristol, City of	**380,616**	**1.03**	**1.09**	**1.16**	**1.21**	**1.24**	**1.31**	**1.17**	**1.45**	**883**	**1.17**	**8.2**
	Gloucestershire	564,559	0.66	0.70	0.74	0.80	0.86	0.93	0.85	1.03	703	0.78	2.8
	North Somerset	188,564	0.79	0.81	0.92	1.00	0.99	1.00	0.85	1.18	790	0.92	1.4
	South Gloucestershire	245,641	0.84	0.93	0.93	0.97	1.01	1.06	0.92	1.22	761	0.95	2.4
	Swindon	180,051	0.72	0.74	0.77	0.88	0.86	0.93	0.77	1.11	644	0.82	4.8
	Wiltshire	*432,972*	*0.55*	*0.57*	*0.58*	*0.58*	*0.65*	*0.71*	*0.62*	*0.81*	*527*	*0.61*	*1.6*
	Bournemouth	*163,444*				*0.69*	*0.66*	*0.74*	*0.60*	*0.91*	*557*	*0.70*	*3.3*
	Dorset	*390,980*				*0.72*	*0.76*	*0.76*	*0.67*	*0.86*	*637*	*0.75*	*1.3*
	Poole	138,288				0.75	0.82	0.86	0.70	1.05	673	0.81	1.8
	Somerset	*498,095*	*0.64*	*0.73*	*0.76*	*0.79*	*0.83*	*0.88*	*0.79*	*0.98*	*685*	*0.77*	*1.2*
	Cornwall/Isles of Scilly	501,267	0.73	0.81	0.86	0.98	0.97	1.04	0.95	1.15	840	0.90	1.0
	Devon	*704,491*	*0.62*	*0.68*	*0.72*	*0.77*	*0.80*	*0.87*	*0.80*	*0.95*	*700*	*0.74*	*1.1*
	Plymouth	240,722	0.96	0.96	0.96	0.93	0.94	1.13	0.98	1.30	806	0.98	1.6
	Torbay	129,706	0.69	0.71	0.74	0.88	0.89	0.94	0.77	1.15	763	0.81	1.2
Wales	**Cardiff**	**305,353**	**0.98**	**1.03**	**1.10**	**1.16**	**1.18**	**1.24**	**1.10**	**1.41**	**822**	**1.12**	**8.4**
	Merthyr Tydfil	**55,979**	**0.99**	**1.01**	**1.18**	**1.41**	**1.46**	**1.80**	**1.43**	**2.27**	**1,304**	**1.31**	**1.0**
	Rhondda/Cynon/Taff	**231,947**	**1.03**	**1.07**	**1.02**	**1.18**	**1.22**	**1.29**	**1.13**	**1.48**	**936**	**1.14**	**1.2**
	Vale of Glamorgan	119,292	0.76	0.80	0.86	0.99	0.92	1.03	0.84	1.27	763	0.89	2.2

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2006 LCL	2006 UCL	2006 pmp	All O/E	% non-White
Wales	Carmarthenshire	172,842	0.89	0.85	0.93	0.99	1.05	1.10	0.93	1.29	862	0.97	0.9
	Ceredigion	74,941	0.62	0.73	0.73	0.81	0.80	0.78	0.58	1.04	600	0.74	1.4
	Pembrokeshire	114,131	0.67	0.61	0.75	0.77	0.91	0.92	0.75	1.15	727	0.77	0.9
	Powys	126,353	0.36	0.38	0.38	0.78	0.88	0.91	0.74	1.12	736	0.62	0.9
	Blaenau Gwent	70,064	0.99	1.09	1.03	1.03	1.11	1.11	0.85	1.44	814	1.06	0.8
	Caerphilly	169,519	0.88	0.99	0.95	0.99	1.06	1.15	0.97	1.35	820	1.00	0.9
	Monmouthshire	84,885	0.95	1.02	1.01	1.04	1.14	1.08	0.86	1.36	848	1.04	1.1
	Newport	137,012	0.89	0.97	1.10	1.11	1.13	1.19	0.99	1.43	847	1.06	4.8
	Torfaen	90,949	0.96	0.97	1.03	1.06	1.08	1.10	0.88	1.39	814	1.03	0.9
	Bridgend	**128,645**	**0.81**	**0.85**	**0.96**	**1.04**	**1.11**	**1.25**	**1.04**	**1.49**	**925**	**1.00**	**1.4**
	Neath/Port Talbot	134,468	0.91	0.85	0.98	1.03	1.09	1.18	0.99	1.41	900	1.01	1.1
	Swansea	**223,300**	**1.04**	**1.01**	**1.11**	**1.15**	**1.23**	**1.27**	**1.11**	**1.45**	**954**	**1.14**	**2.2**
	Conwy	109,596		0.72	0.80	0.84	0.82	0.87	0.70	1.09	712	0.81	1.1
	Denbighshire	93,065	0.33	0.72	0.79	0.83	0.98	0.91	0.72	1.16	709	0.76	1.2
	Flintshire	148,594		0.87	0.95	0.97	1.02	1.08	0.90	1.30	787	0.98	0.8
	Gwynedd	116,843		0.93	1.02	0.92	0.98	0.98	0.79	1.20	745	0.97	1.2
	Isle of Anglesey	66,829		0.68	0.80	0.82	0.97	1.01	0.77	1.32	793	0.86	0.7
	Wrexham	128,476	1.16	1.11	1.16	1.13	1.12	1.15	0.95	1.39	841	1.14	1.1
Scotland	Aberdeen City	212,125	0.81	0.89	0.90	1.07	1.11	1.11	0.95	1.29	787	0.98	
	Aberdeenshire	226,871	0.78	0.83	0.81	0.84	0.93	0.97	0.83	1.13	710	0.86	
	Angus	108,400	0.83	1.06	0.99	1.12	1.17	1.12	0.92	1.37	867	1.05	
	Argyll & Bute	91,306	0.79	0.78	0.79	0.83	0.81	0.89	0.70	1.14	701	0.82	
	Scottish Borders	106,764	0.56	0.65	0.63	0.71	0.78	0.82	0.64	1.03	646	0.69	
	Clackmannanshire	48,077	0.38	0.52	0.72	0.75	0.87	0.84	0.58	1.20	603	0.68	
	W Dunbartonshire	93,378	0.82	0.79	0.73	0.78	0.78	0.85	0.66	1.10	610	0.79	
	Dumfries/Galloway	147,765	0.90	0.90	0.96	0.89	0.96	0.98	0.82	1.18	785	0.93	
	Dundee City	**145,663**	**0.89**	**1.01**	**1.12**	**1.17**	**1.32**	**1.39**	**1.18**	**1.63**	**1,016**	**1.15**	
	E Ayrshire	120,235	0.81	0.81	0.81	0.82	0.92	1.05	0.85	1.28	773	0.87	
	E Dunbartonshire	108,243	0.91	0.93	1.06	1.02	0.99	1.06	0.85	1.31	785	0.99	
	E Lothian	90,088	0.87	0.92	0.89	0.93	0.92	0.95	0.74	1.21	710	0.91	
	E Renfrewshire	89,311	0.81	0.80	0.88	0.91	1.03	1.09	0.86	1.38	795	0.92	
	Edinburgh	448,624	0.80	0.80	0.83	0.88	0.90	0.94	0.84	1.06	660	0.86	
	Falkirk	145,191	0.88	0.85	0.88	0.87	0.95	0.97	0.80	1.18	709	0.90	
	Fife	349,429	0.74	0.81	0.81	0.85	0.94	0.97	0.86	1.10	713	0.85	
	Glasgow City	**577,869**	**1.09**	**1.12**	**1.17**	**1.17**	**1.22**	**1.26**	**1.15**	**1.37**	**870**	**1.17**	
	Highland	208,914	0.70	0.82	0.90	1.01	1.16	1.14	0.99	1.32	876	0.95	
	Inverclyde	84,203	1.08	1.11	1.11	1.12	1.20	1.19	0.95	1.49	879	1.13	
	Midlothian	80,941	0.83	0.85	0.95	1.08	1.08	1.24	0.98	1.56	902	1.01	
	Moray	86,940	0.75	0.84	0.82	0.87	1.04	1.17	0.93	1.46	863	0.91	
	N Ayrshire	**135,817**	**0.91**	**1.00**	**1.05**	**1.12**	**1.16**	**1.35**	**1.14**	**1.59**	**994**	**1.09**	
	N Lanarkshire	321,067	0.93	1.02	1.05	1.05	1.05	1.07	0.94	1.21	748	1.03	
	Orkney Islands	19,245	0.54	0.81	0.94	1.01	1.14	1.14	0.71	1.84	883	0.93	
	Perth/Kinross	134,949	0.71	0.80	0.90	0.93	0.94	0.96	0.79	1.16	748	0.87	
	Renfrewshire	172,867	0.85	0.96	1.00	1.02	1.10	1.10	0.93	1.30	804	1.00	
	Shetland Islands	21,988	0.57	0.57	0.57	0.70	0.57	0.51	0.25	1.02	364	0.58	
	S Ayrshire	112,097	0.77	0.80	0.90	0.85	0.96	1.00	0.82	1.24	794	0.88	
	S Lanarkshire	302,216	0.96	1.00	1.02	1.04	1.02	1.03	0.91	1.18	751	1.01	
	Stirling	86,212	0.72	0.72	0.75	0.75	0.77	0.78	0.59	1.03	568	0.75	
	W Lothian	158,714	0.89	0.91	0.93	0.91	1.00	1.00	0.83	1.21	674	0.94	
	Eilean Siar	*26,502*	*0.47*	*0.52*	*0.52*	*0.71*	*0.47*	*0.52*	*0.29*	*0.94*	*415*	*0.53*	
N Ireland	**Antrim**	**48,366**					**1.31**	**1.47**	**1.10**	**1.97**	**930**	**1.39**	
	Ards	73,244					1.24	1.22	0.95	1.56	860	1.23	
	Armagh	**54,262**					**1.38**	**1.36**	**1.02**	**1.80**	**866**	**1.37**	

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2006 LCL	2006 UCL	2006 pmp	All O/E	% non-White
N Ireland	Ballymena	58,610					1.10	1.18	0.89	1.56	819	1.14	
	Ballymoney	26,895					0.84	0.95	0.59	1.53	632	0.89	
	Banbridge	41,389					1.03	1.25	0.90	1.76	821	1.14	
	Belfast	**277,391**					**1.12**	**1.19**	**1.04**	**1.36**	**779**	**1.16**	
	Carrickfergus	**37,658**					**1.81**	**1.93**	**1.46**	**2.55**	**1,301**	**1.87**	
	Castlereagh	**66,488**					**1.43**	**1.53**	**1.22**	**1.92**	**1,098**	**1.48**	
	Coleraine	56,314					0.97	0.99	0.72	1.36	675	0.98	
	Cookstown	32,581					0.79	0.84	0.52	1.36	522	0.82	
	Craigavon	80,671					1.20	1.15	0.89	1.48	744	1.18	
	Derry	**105,066**					**1.23**	**1.38**	**1.12**	**1.71**	**799**	**1.31**	
	Down	63,828					1.09	1.24	0.94	1.63	799	1.17	
	Dungannon	47,735					0.80	0.80	0.53	1.19	503	0.80	
	Fermanagh	57,527					0.86	1.04	0.76	1.42	695	0.95	
	Larne	**30,833**					**1.64**	**1.50**	**1.07**	**2.12**	**1,070**	**1.57**	
	Limavady	32,422					1.03	1.08	0.70	1.65	648	1.05	
	Lisburn	108,694					1.15	1.17	0.94	1.45	745	1.16	
	Magherafelt	**39,778**					**1.48**	**1.64**	**1.21**	**2.24**	**1,006**	**1.56**	
	Moyle	15,932					0.82	1.00	0.56	1.81	690	0.91	
	Newry/Mourne	87,058					1.36	1.25	0.98	1.59	770	1.31	
	Newtownabbey	79,996					1.05	1.14	0.89	1.47	788	1.10	
	North Down	76,323					0.99	0.97	0.74	1.27	708	0.98	
	Omagh	47,953					1.32	1.32	0.96	1.81	813	1.32	
	Strabane	38,246					1.13	1.26	0.88	1.80	784	1.20	
	England	**42,885,358**	**0.44**	**0.53**	**0.59**	**0.82**	**0.91**	**0.98**			**705**	**0.85**	
	Scotland	**5,062,011**	**0.85**	**0.90**	**0.93**	**0.97**	**1.02**	**1.05**			**770**	**0.95**	
	Wales	**2,903,083**	**0.73**	**0.89**	**0.95**	**1.02**	**1.07**	**1.12**			**834**	**0.99**	
	N Ireland	**1,685,260**					**1.16**	**1.22**			**798**	**0.21**	
	Total	**52,535,712**	**0.49**	**0.57**	**0.62**	**0.82**	**0.93**	**1.00**			**721**	**0.89**	

Table 4.6: Regional distribution of Local Authority areas with significantly low, normal or significantly high standardised prevalence ratios

	Number of Local Authority areas				
	Prevalence group				
Region	Low	Normal	High	Total	Mean % non-White
NE England	1	11	0	12	3
NW England	11	6	0	17	5
Yorkshire & Humber	2	11	2	15	5
East Midlands	2	5	2	9	9
West Midlands	2	5	5	12	11
East of England	4	5	1	10	7
London	0	7	17	24	31
SE England	5	10	1	16	7
SW England	5	9	1	15	2
Wales	0	17	5	22	2
Scotland	1	28	3	32	n/a
N Ireland	0	18	8	26	n/a
All Regions	**33**	**132**	**45**	**210**	

Association with ethnicity

Areas with a high SPR had significantly higher ethnic minority populations than areas with significantly low or normal SPRs ($p < 0:0001$) (Figure 4.4). Mean SPR was significantly higher in the 40 Local Authority areas with an ethnic minority population greater than 10% (1.28 vs 0.95: $p < 0.001$). The relationship between the ethnicity of the population in a Local Authority area and SPR is further demonstrated in Figure 4.5, which shows the relationship between ethnicity and SPR for all Local Authorities with available data.

Only 3 of the 40 Local Authority areas with ethnic minority populations greater than 10% had low SPRs, the remainder had normal (9 centres) or high values (28 centres). These 3 were clustered in the North West of England, Bolton, Rochdale and Oldham where the overall prevalence was low. Conversely, only 6 of the 112 Local Authority areas with ethnic minority populations less than 10% had high SPRs. These were all clustered in Wales and the South West of England, (Merthyr Tydfil, City of Bristol, Rhondda/Cynon/Taff, Swansea, Bridgend and Cardiff). It is unlikely that social deprivation alone can account for these disparities. Further investigation of the causes underlying these regional differences would be of great interest.

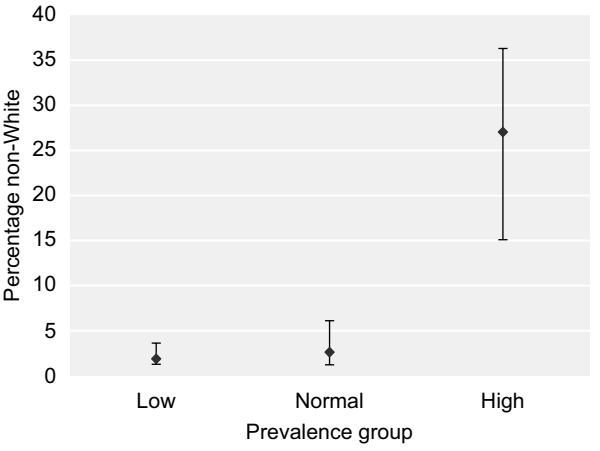

Figure 4.4: Percentage of non-Whites in areas with significantly low, normal and significantly high standardised prevalence ratios (mean and 95% confidence intervals)

Vintage

Table 4.7 shows the median vintage (years since starting RRT) of prevalent RRT patients in 2006. Median vintage of the whole RRT population was 5.1 years. Patients with functioning transplants had survived a median 10.2 years on RRT whilst the median vintage of HD and PD patients was much less (2.8 and 2.0 years respectively). The dialysis population was older (Table 4.8) and would be expected to have shorter survival than the transplant population. There was little change from 2005.

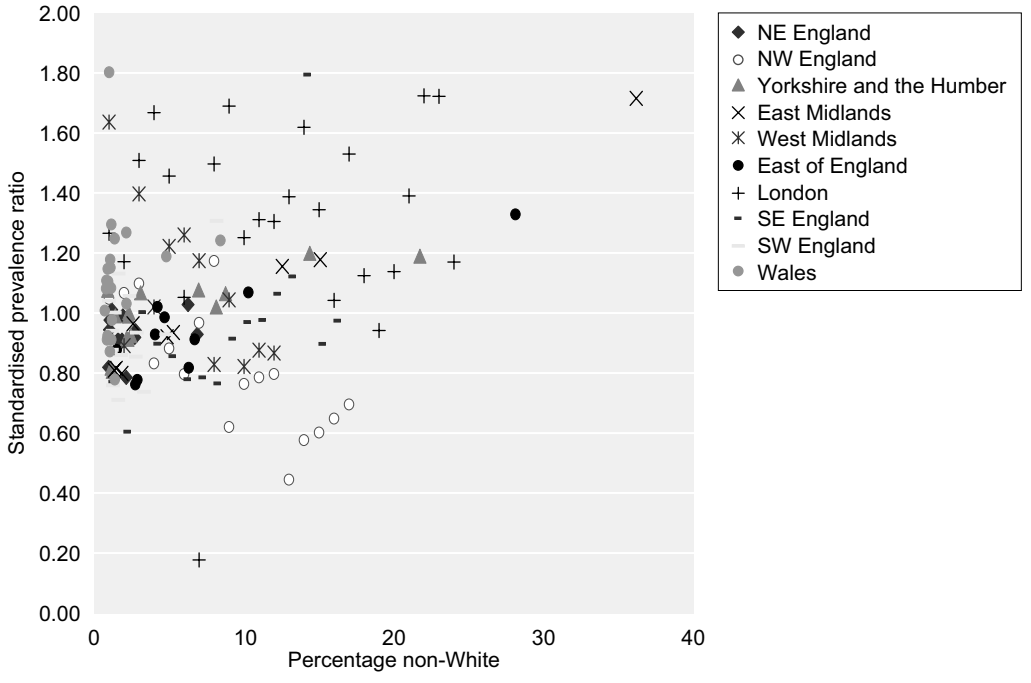

Figure 4.5: Ethnicity and standardised prevalence ratio for all Local Authorities with available data

Table 4.7: Median vintage of prevalent RRT patients on 31/12/06

Modality	No	Median time treated (years)
Haemodialysis	17,238	2.8
Peritoneal dialysis	4,257	2.0
Transplant	16,748	10.2
All RRT	38,243*	5.1

*Patients with no start date excluded from this analysis.

Age

The median age of prevalent UK patients on RRT in 2006 was 57.1 years (Table 4.8). The age profile was markedly different in patients on dialysis than that in transplanted patients. The median age of patients on HD (65.0 years) was higher than that of patients on PD (59.9 years) and substantially higher than that of transplanted patients (49.9 years). Differences from 2005 were minimal, as were differences

Table 4.8: Median age of prevalent RRT patients by treatment modality by centre on 31/12/06

Centre	Median age – HD	Median age – PD	Median age – transplant	Median age – all
Exeter	71.9	63.3	50.5	60.5
Glouc	71.7	62.6	51.4	63.6
Truro	71.5	64.1	55.4	65.5
Antrim	70.7	65.6	48.2	65.0
Chelms	70.2	64.9	56.3	65.4
York	69.9	63.1	44.8	60.1
Plymth	69.5	65.7	50.5	59.5
Ulster	69.5	62.4	42.5	68.8
Derry	69.4		59.0	67.5
D&Gall	69.0	63.2	46.2	65.5
Norwch	69.0	63.2	50.3	62.4
Dundee	68.9	59.0	54.7	59.9
Bristol	68.9	58.2	51.5	58.5
Swanse	68.5	63.7	53.7	62.4
Chestr	68.5			68.5
Brightn	68.1	62.2	51.7	60.8
Carlis	67.8	48.1	52.4	58.9
Bangor	67.0	66.7		66.7
Carsh	67.0	58.2	48.3	59.1
Bradfd	66.9	51.5	48.1	55.1
Redng	66.9	57.4	54.6	61.3
B Heart	66.8	63.2	49.9	62.4
Klmarnk	66.8	59.4	48.6	61.9
Wirral	66.7	65.5		66.5
Leeds	66.4	59.5	49.8	54.9
Cardff	66.3	60.3	49.9	56.4
Ipswi	66.2	56.9	52.1	56.8
Ports	66.1	59.5	50.5	55.9
Tyrone	66.1	62.7	44.9	59.4
Sthend	66.1	62.2	53.1	62.5
Newry	65.9	57.3	54.3	62.2
Wolve	65.8	63.3	44.6	60.9
Middlbr	65.6	53.3	50.2	56.9
Nottm	65.5	58.8	48.6	55.7
Dorset	65.3	70.4	56.7	60.8
Derby	65.3	63.0	48.4	64.1
Hull	65.2	53.0	49.6	57.7
Stevng	65.2	61.6	49.9	59.4

Table 4.8: (continued)

Centre	Median age – HD	Median age – PD	Median age – transplant	Median age – all
Glasgw	65.1	56.1	49.1	54.4
L West	65.0	56.6	53.4	61.1
Inverns	65.0	58.1	46.4	55.3
Abrdn	65.0	49.0	50.8	56.6
B QEH	64.8	55.7	48.9	55.9
Oxford	64.6	60.8	50.5	55.2
Shrew	64.6	55.2	49.3	58.2
Clwyd	64.6	71.5	51.4	63.1
Camb	64.4	62.8	49.0	54.4
Dunfn	64.3	56.9	48.9	60.2
Belfast	64.0	55.3	47.7	53.8
Prestn	64.0	57.6	50.0	56.4
Sund	63.4	55.6	50.6	57.9
Sheff	63.4	60.3	49.3	56.9
Covnt	63.2	64.5	47.0	55.3
L Rfree	63.1	59.9	48.3	54.3
Wrexm	62.6	64.1	59.6	62.6
Basldn	62.5	62.2	49.6	61.7
Leic	62.2	63.1	50.4	56.7
Dudley	61.9	63.3	56.4	60.2
Newc	61.3	55.6	51.7	54.9
L Kings	60.9	61.9	49.9	55.7
ManWst	60.6	54.8	46.4	53.9
Edinb	60.4	57.1	50.9	55.0
Liv RI	60.3	57.0	49.7	52.7
Airdrie	60.3	45.9	43.2	53.8
L Guys	60.2	60.7	49.3	51.7
Liv Ain	59.6			59.6
L Barts	56.9	58.4	49.3	53.2
England	**64.9**	**60.1**	**50.0**	**57.1**
N Ireland	**66.9**	**60.4**	**47.9**	**58.0**
Scotland	**64.8**	**56.9**	**49.5**	**56.0**
Wales	**66.9**	**62.9**	**50.5**	**58.7**
UK	**65.0**	**59.9**	**49.9**	**57.1**

between the four home countries. There were however wide inter-centre variations in the median age of their RRT population (51.7 to 68.8 years). As would be expected there was a significant correlation between the median age of the prevalent RRT population in a centre and the ratio of the number of transplant and dialysis patients in that centre ($R^2 = 0.59$, $p < 0{:}0001$). The median age of the RRT population of transplanting centres was significantly less than that of non-transplanting centres (55.5 vs 59.7 years: $p < 0.001$). The differing age distributions of transplant and dialysis patients are illustrated in Figure 4.6, the maximum prevalence of dialysis patients being around two decades later than that of transplant patients.

Age had a major influence on modality distribution. In the whole UK in 2006, 57% of prevalent RRT patients under the age of 65 years had a functioning transplant with 43% on dialysis. The proportions were dramatically different in older patients, with 21% having been transplanted and 79% on dialysis.

Ethnicity also had an effect on the median age of the RRT population. Centres with an ethnic minority population greater than 10% having a lower median age than those with lower proportions (57.3 vs 60.2: $p = 0.01$), at least partly a reflection of the lower median age of the ethnic minorities in the population as a whole.

Figure 4.6: Age profile of prevalent dialysis and transplant patients on 31/12/06

Gender

In the UK in 2006, there were more patients in the age range 55–64 years than in any other decade in both males and females (Figure 4.7). Correcting for the age and gender distribution of the UK population (calculated from Local Authority populations covered by the Registry using 2001 Census data) allows estimation of crude prevalence rates by age and gender (Figure 4.8). The overall UK peak crude prevalence rate occurred in the age band 65–74 at 1,668 pmp. For all ages, crude prevalence rates in males exceeded those in females, peaking in the 75–79 year age band for males at 2,411 pmp and in females in the 60–64 year age band at 1,221 pmp. Furthermore the male:female ratio of crude prevalence rate whilst remaining stable at around 1.5 until the 60–65 age band, increased markedly thereafter with age to 1.8 in the 65–74 age band, 2.3 at 75–79 years, 2.9 at 80–84 years, 4.6 at 85–90 years, and 7.9 in the over-nineties.

Ethnicity

Thirty-seven of the 67 centres submitting data to the Registry in 2006 provided ethnicity data that were at least 90% complete; which represented no improvement in data completeness

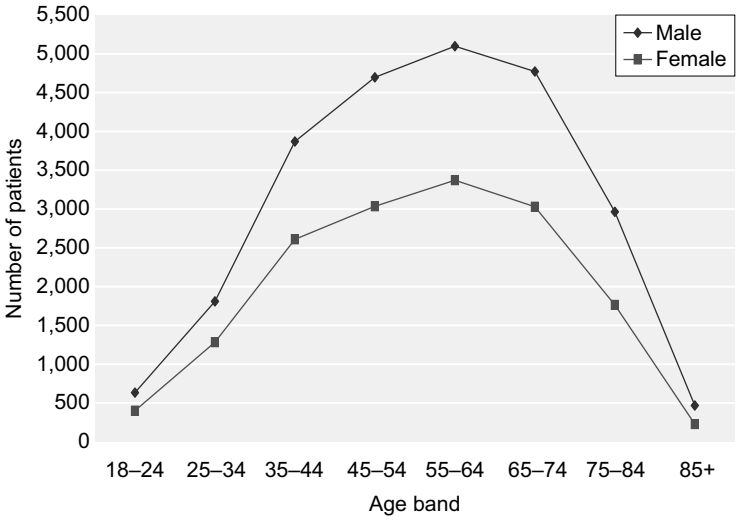

Figure 4.7: Age profile of adult patients by gender on 31/12/06

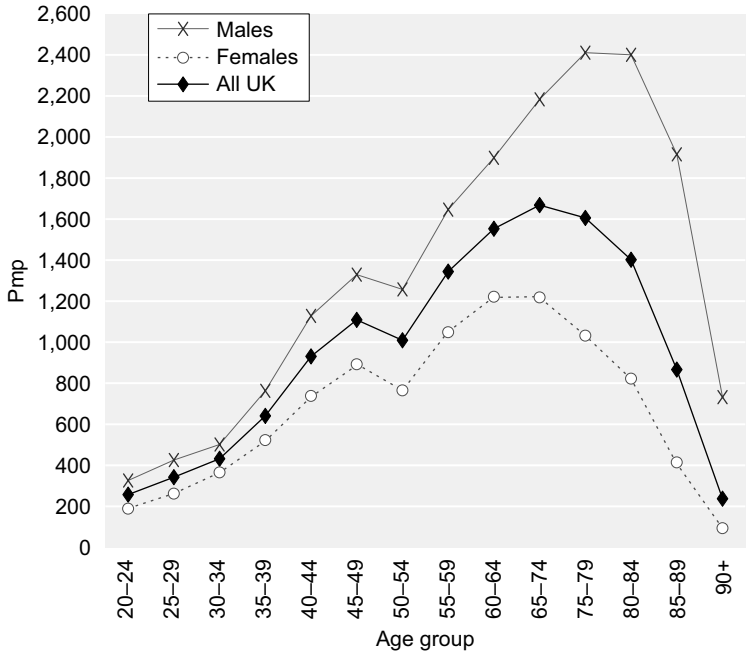

Figure 4.8: Crude prevalence rate of RRT patients per million population by age and gender on 31/12/06

from 2005. Data from the 58 centres with greater than 50% returns for ethnicity are shown in Table 4.9. Centres in Scotland are shown separately in Table 4.9 as they were not required to report ethnicity to the Scottish Registry. Of the prevalent RRT population 17.8% were from an ethnic minority which compares to approximately 11% in the general population. There was wide variation between centres in the proportion of patients from ethnic minorities, ranging from zero in 6 centres (Derry, Tyrone, Antrim, Newry, Chester and Inverness) to 56.7% in London West. Centres with an ethnic minority population greater than 10% had higher average numbers of patients on RRT 925 v 448 ($p < 0.001$), on HD 416 vs 195 ($p < 0.001$), on PD 103 vs 47 ($p < 0.001$) and with functioning transplants 406 vs 206 ($p = 0.001$). Of transplanting centres, 48% had an ethnic minority population greater than 10% compared with 24% of non-transplanting centres ($p = 0.052$).

Primary renal disease

The most common primary renal diagnosis identified in the 2006 prevalent cohort remains glomerulonephritis, which affected 15% of patients. Diabetes accounted for 13% of prevalent diagnoses (Table 4.10). This is in contrast to the pattern in the 2006 incident cohort in whom diabetes predominated (Table 3.8). This reflects different survival and different ages of the patients with these diagnoses. The same pattern was also found if analysis was restricted to younger patients (age <65 years). However, the reverse was found in older patients in whom diabetes predominated over glomerulonephritis (14% vs 10%).

There were other age-related differences. The prevalence of patients identified as 'aetiology uncertain/glomerulonephritis – not biopsy proven' was much greater in those aged over 65 years (26% vs 19%), as was the prevalence of renovascular disease (9% vs 1%).

The male:female ratio was significantly greater than unity for most primary renal diseases, but not for polycystic kidney disease and pyelonephritis. The ratio for polycystic kidney disease was similar to that in incident patients and the possible underlying reasons were discussed in Chapter 3. The ratio for pyelonephritis was slightly lower in prevalent (1.1) and incident patients (1.4). This was the only obvious difference between primary renal disease distribution in the prevalent and incident cohorts. It was a consistent finding and perhaps indicates poorer survival on RRT of males with this diagnosis.

Primary renal diagnosis also influenced the distribution of patients between the modalities (Table 4.11) and in particular the likelihood of

Table 4.9: Ethnicity of prevalent RRT patients by centre on 31/12/06

	% Complete	% White	% Black	% South Asian	% Chinese	% Other
Antrim	94	100.0				
B Heart	99	68.1	5.7	24.4	0.3	1.4
B QEH	100	68.7	10.0	19.3	0.9	1.0
Bangor	94	99.0	1.0			
Basldn	99	90.8	2.7	4.9	1.1	0.5
Belfast	98	99.7		0.1	0.1	
Bradfd	78	58.1	2.8	38.0		1.1
Brightn	36					
Bristol	97	93.4	3.2	2.6	0.3	0.6
Camb	87	92.6	1.9	4.1	0.6	0.8
Cardff	33					
Carlis	97	99.5		0.5		
Carsh	66	74.4	9.4	10.1	0.8	5.4
Chelms	56	94.3	1.1	4.6		
Chestr	84	100.0				
Clwyd	29					
Covnt	89	80.0	4.3	14.9	0.7	0.2
Derby	84	88.5	2.4	6.7	0.8	1.6
Derry	100	100.0				
Dorset	100	97.2	0.8	0.5	0.8	0.8
Dudley	100	87.8	2.7	9.1	0.4	
Exeter	62	98.5	0.8	0.3	0.3	0.3
Glouc	100	99.4	0.6			
Hull	55	98.2		0.3	0.6	0.9
Ipswi	97	94.9	2.6	2.2	.	0.4
L Barts	96	48.7	12.0	22.3	1.8	15.3
L Guys	82	70.9	24.4	3.2	1.4	0.1
L Kings	95	58.8	27.0	12.3	1.9	
L Rfree	96	53.7	18.6	17.5	2.2	8.0
L West	96	43.3	11.8	24.7	0.9	19.3
Leeds	71	82.2	3.9	13.0		0.9
Leic	93	80.0	2.6	16.3	0.1	0.9
Liv Ain	79	96.2		1.3	1.3	1.3
Liv RI	91	96.6	1.0	0.7	1.1	0.6
ManWst	93	84.6	1.0	12.8	0.4	1.0
Middlbr	94	96.5		3.0	0.5	
Newc	99	96.1	0.4	2.3	0.6	0.6
Newry	90	100.0				
Norwch	66	98.3	1.0	0.3		0.3
Nottm	98	89.1	4.7	5.4		0.8
Oxford	50	89.3	3.1	6.1	0.6	0.9
Plymth	74	95.8	2.3	0.3	1.0	0.7
Ports	96	96.2	0.6	2.2	0.5	0.5
Prestn	95	85.4	1.1	12.9		0.6
Redng	100	73.4	6.5	16.1	0.9	3.1
Sheff	93	92.7	1.7	4.0	0.7	0.9
Shrew	97	94.8	2.0	3.2		
Stevng	100	79.7	6.4	12.7	0.3	0.8
Sthend	70	93.8	1.6	1.6	2.3	0.8
Sund	90	97.1	0.8	0.4	0.8	0.8

Table 4.9: (continued)

	% Complete	% White	% Black	% South Asian	% Chinese	% Other
Swanse	100	98.8	0.4	0.6		0.2
Truro	59	97.1	2.9			
Tyrone	98	100.0				
Ulster	98	98.3			1.7	
Wirral	93	96.7	0.7	0.7		2.0
Wolve	99	77.2	6.9	15.0	0.7	0.2
Wrexm	32					
York	91	98.0		1.0		1.0
England	**87**	**80.1**	**6.1**	**10.1**	**0.7**	**2.9**
N Ireland	**96**	**99.8**		**0.1**	**0.2**	
Wales	**51**	**97.8**	**0.7**	**1.3**	**0.1**	**0.1**
Abrdn	70	99.0			0.7	0.3
Airdrie	77	99.4		0.6		
D&Gall	14					
Dundee	84	99.0		0.3	0.3	0.3
Dunfn	32					
Edinb	10					
Glasgw	9					
Inverns	64	100.0				
Klmarnk	4					
Scotland	**30**					
UK	**80**	**82.2**	**5.5**	**9.1**	**0.7**	**2.6**

Centres with <50% ethnicity data do not have the breakdown of ethnic groups shown.

having a functioning renal transplant. In patients aged 65 and less, the ratios of prevalent patients with functioning transplants to those on dialysis were much higher in the groups diagnosed with pyelonephritis (2.0), polycystic kidney disease (1.6) and glomerulonephritis (1.8) than in the groups with diabetes (0.6) and renovascular disease (0.6), suggesting a much higher transplant rate in the former groups. In older patients the ratios were all much lower and those for diabetes (0.1) and renovascular disease (0.1) particularly so.

Table 4.10: Primary renal disease in prevalent RRT patients by age and gender on 31/12/06

Primary diagnosis	% all patients	% inter-centre range	% Age <65	% Age ⩾65	M:F ratio
Aetiology uncertain/GN* (not biopsy proven)	22	0.94–86.05	19	26	2
GN (biopsy proven)	15	0.94–21.88	18	10	2
Pyelonephritis	12	0.58–20.5	14	9	1
Diabetes	13	0.29–24.25	12	14	2
Polycystic kidney disease	9	1.59–16.22	10	8	1
Hypertension	5	0.22–17.71	4	7	2
Renovascular disease	4	1.01–18.24	1	9	2
Other	14	1.23–35.28	16	11	1
Not sent	7	0.14–94.22	6	7	2

*Glomerulonephritis.

Table 4.11: Ratio of patients with a functioning transplant compared to those on dialysis by age and primary renal disease in prevalent RRT patients on 31/12/06

	Transplant : dialysis ratio	
Primary diagnosis	**<65 years**	**⩾65 years**
Aetiology uncertain/GN* (not biopsy proven)	1.3	0.2
GN (biopsy proven)	1.8	0.5
Pyelonephritis	2.0	0.3
Diabetes	0.6	0.1
Polycystic kidney	1.6	1.0
Hypertension	1.1	0.3
Renal vascular disease	0.6	0.1
Other	1.4	0.3
Not sent	0.9	0.2

*Glomerulonephritis.

Diabetes

In this year's report there was no differentiation between Type I and Type II diabetes, since the distinction was not made in data submitted by centres in Scotland and some in Northern Ireland. Furthermore, the distinction is not always made reliably and does not allow for other specific types of diabetes, for example maturity onset diabetes in young people (MODY). The number of patients with diabetes in the 2006 prevalent cohort with data for primary renal diagnosis was 5,038, 13.5% of all patients (Table 4.12). Though the median age at dialysis initiation was much higher in diabetics than in non-diabetics (55.0 vs 47.0 years), the median age of the prevalent diabetic population was similar to that in non-diabetics (59.4 vs 56.6), indicating reduced survival in diabetics. In keeping with this, the RRT vintage of prevalent diabetics (2.8 years) was significantly less than that of prevalent non-diabetics (5.9 years). The percentage of patients with a functioning transplant was much lower in diabetics than in non-diabetics (27% vs 48.5%). The proportions were even lower in patients over the age of 65 (Table 4.13).

Table 4.12: Median age, gender ratio and treatment modality in prevalent RRT patients with and without diabetes on 31/12/06

	All diabetics	Non-diabetics
Number	5,038	32,391
M : F ratio	1.62	1.53
Median age on 31/12/06	59.4	56.6
Median age at start of RRT	55.0	47.0
Median years on RRT	2.8	5.9
% HD	59	41
% PD	14	10
% transplant	27	49

Modalities of treatment

The most common treatment modality in the 2006 UK prevalent cohort was transplantation (45%), closely followed by centre-based HD (43%) as depicted in Figure 4.9. The proportion of patients on home HD remained very small (1%) and has not increased in spite of the

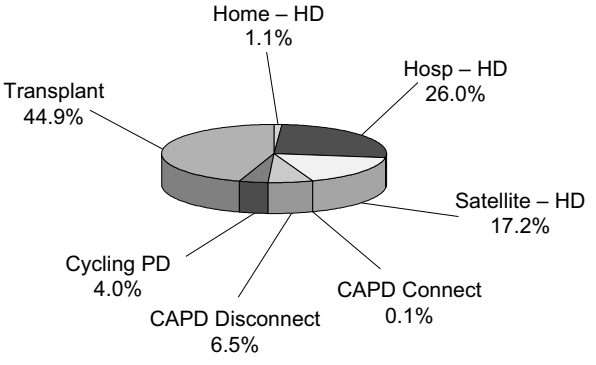

Figure 4.9: Treatment modalities in prevalent RRT patients on 31/12/06

Table 4.13: Age relationship in prevalent RRT patients with and without diabetes on 31/12/06

	<65 years		⩾65 years	
	Diabetics	**Non-diabetics**	**Diabetics**	**Non-diabetics**
Total no.	3,216	21,967	1,822	10,424
% HD	48	30	79	64
% PD	14	9	14	12
% transplant	38	60	7	24

Table 4.14: Treatment modalities by age in UK countries for prevalent RRT patients on 31/12/06

	<65 years			≥65 years		
UK countries	**% HD**	**% PD**	**% Transplant**	**% HD**	**% PD**	**% Transplant**
England	33.0	9.9	57.1	66.8	12.4	20.8
N Ireland	35.6	8.4	56.0	72.3	8.3	19.4
Scotland	32.2	10.9	56.9	68.5	10.0	21.5
Wales	31.8	13.4	54.8	65.1	17.3	17.7
UK	**33.0**	**10.1**	**56.9**	**67.0**	**12.3**	**20.6**

recent NICE guidance. Transplantation (57%) was the principal treatment modality in patients less than 65 years old, though in older patients haemodialysis (67%) predominated (Table 4.14). The distribution was similar in all the home countries.

Haemodialysis was increasingly prominent with increasing age at the expense of transplantation (Figure 4.10). The proportion of each age group treated by PD remained fairly stable across the whole age spectrum (Figure 4.10).

The proportion of prevalent dialysis patients on HD in the UK (Table 4.15) continued to increase and in the 2006 cohort was 80% and higher still in those aged over 65 years compared to younger patients (86% vs 77%). There was some variation among the four home countries with Wales having a slightly lower and Northern Ireland a slightly higher percentage of patients on HD.

Table 4.15: Percentage of prevalent dialysis patients on haemodialysis by age on 31/12/06

	% on Haemodialysis		
	<65 years	**≥65 years**	**All**
England	77	84	80
N Ireland	81	90	86
Scotland	75	87	81
Wales	70	79	75
UK	**77**	**85**	**80**

There was considerable variation among individual centres in the percentage of prevalent dialysis patients on HD, ranging from 64% in

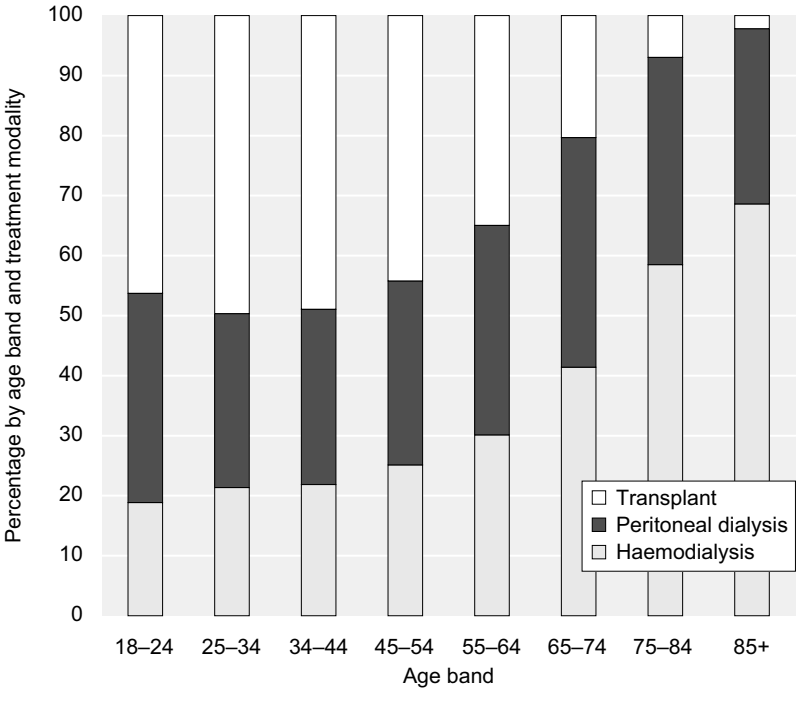

Figure 4.10: Treatment modality distribution by age in prevalent RRT patients on 31/12/06

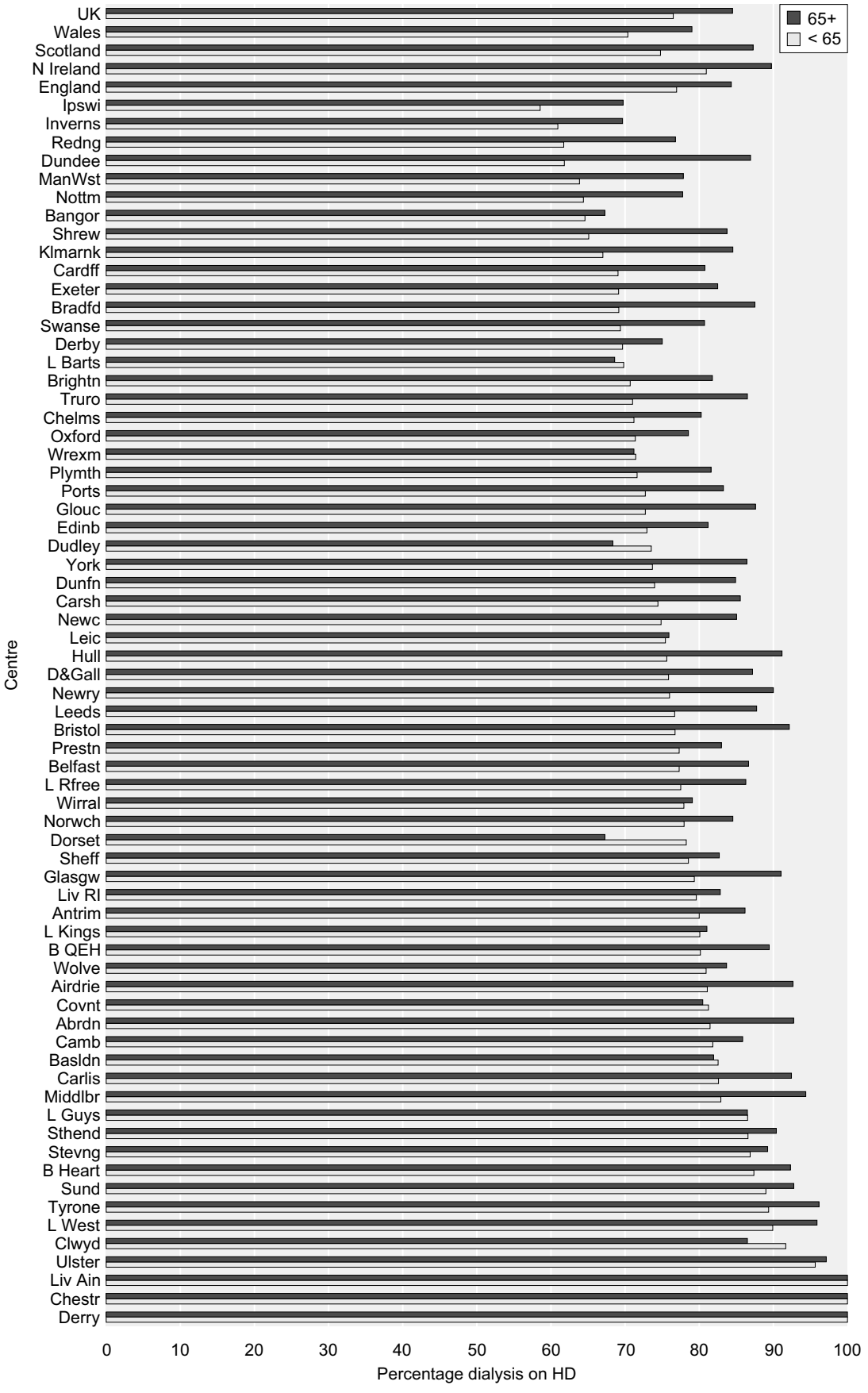

Figure 4.11: Percentage of prevalent dialysis patients on HD by age on 31/12/06

Ipswich to 100% in Liverpool Aintree, Chester and Derry. These three centres with 100% on HD have PD available for their patients through adjacent centres in their networks. The national pattern of a higher percentage of older dialysis patients receiving HD was replicated in most centres (Figure 4.11), although in 6 centres (Basildon, Coventry, London Barts, Clwyd, Dudley and Dorset), the pattern was reversed. The percentage of dialysis patients receiving home HD varied from zero in 19 centres, to greater than 5% of dialysis activity in 5 centres – Brighton (7%), Sheffield (6%), London Guys (5%), Bristol (5%) and Ipswich (5%) (Table 4.16). Twenty-six centres had no satellite haemodialysis whilst in 8 centres more than 50% of their dialysis activity took place in satellites. There was much diversity between centres in the proportion of PD patients on cycling treatments, ranging from 0 to 100% (Table 4.16).

Table 4.16: Percentage by dialysis modality by centre on 31/12/2006

	Haemodialysis			Peritoneal dialysis			
Centre	Home	Hospital	Satellite	Standard	Disconnect	Cycled >6 nights	Cycled <6 nights
L West	1	19	73	1	2	4	0
Bristol	5	16	64	0	12	3	0
L Guys	5	24	58	0	6	0	8
B QEH	2	22	60	0	9	7	0
Leic	3	19	54	0	14	11	0
Wolve	0	26	56	0	18	0	0
L Kings	0	26	54	0	7	12	0
Prestn	4	28	48	0	11	9	0
Stevng	0	36	52	0	12	0	0
Middlbr	1	39	49	0	9	2	0
L Rfree	2	34	46	0	7	12	0
Sheff	6	33	42	0	20	0	0
Carsh	0	38	43	0	11	9	0
Exeter	0	35	42	0	16	7	0
Cardff	0	35	40	0	25	0	0
Truro	2	42	37	0	18	1	0
Ports	0	40	38	0	22	0	0
Hull	2	45	36	0	8	9	0
Leeds	2	47	34	0	8	10	0
Liv RI	1	46	35	0	9	10	0
Brightn	7	41	29	0	10	13	0
Camb	2	49	33	0	0	0	0
Nottm	2	36	33	0	13	16	0
York	2	47	33	0	19	0	0
ManWst	1	35	33	0	19	11	0
Liv Ain	0	70	30	0	0	0	0
L Barts	1	40	28	0	16	15	0
Redng	0	41	29	0	31	0	0
Dorset	1	45	27	0	19	8	1
Swanse	4	50	22	0	24	0	0
Norwch	3	58	21	0	15	2	1
Dudley	2	48	22	0	29	0	0
Bradfd	0	59	19	0	10	12	0
Sund	1	73	17	0	3	7	0
Wirral	1	64	14	9	4	9	0
Shrew	1	59	14	0	27	0	0

Table 4.16: (continued)

	Haemodialysis			Peritoneal dialysis			
Centre	**Home**	**Hospital**	**Satellite**	**Standard**	**Disconnect**	**Cycled >6 nights**	**Cycled <6 nights**
Carlis	1	76	11	0	2	9	1
B Heart	3	80	7	0	8	2	0
Oxford	4	70	1	0	13	12	0
Ipswi	5	59	0	0	20	15	1
Glasgw	4	81	0	0	8	7	1
Antrim	3	81	1	0	10	6	1
Newc	3	76	0	0	5	16	0
Derby	3	69	0	0	22	6	0
Bangor	3	63	0	1	13	20	0
Belfast	2	79	0	1	4	13	0
Abrdn	3	84	0	0	13	0	0
Covnt	3	78	0	0	19	0	0
Wrexm	2	69	0	0	2	25	1
Ulster	2	95	0	0	0	4	0
Edinb	2	75	0	0	12	12	0
Clwyd	1	88	0	7	0	3	0
Klmarnk	1	74	0	0	10	13	2
Tyrone	1	92	0	1	1	4	0
Newry	1	82	0	0	0	16	0
Inverns	1	64	0	0	13	22	0
Plymth	1	77	0	0	21	1	0
Chestr	0	100	0	0	0	0	0
Derry	0	100	0	0	0	0	0
Sthend	0	89	0	0	11	0	0
Basldn	0	82	0	0	8	10	0
Glouc	0	82	0	0	9	9	0
Chelms	0	76	0	2	4	17	0
Dunfn	0	79	0	0	2	19	0
Airdrie	0	86	0	0	6	9	0
Dundee	0	76	0	0	9	11	5
D&Gall	0	82	0	0	6	10	2
England	**2**	**42**	**37**	**0**	**12**	**7**	**0**
N Ireland	**2**	**83**	**0**	**0**	**4**	**10**	**0**
Scotland	**2**	**79**	**0**	**0**	**9**	**10**	**1**
Wales	**2**	**48**	**25**	**1**	**20**	**4**	**0**
UK	**2**	**47**	**31**	**0**	**12**	**7**	**0**

Chapter 5: Co-morbidities in UK Patients at the Start of Renal Replacement Therapy

Udaya Udayaraj, Julie Gilg, Charlie Tomson and David Ansell

Summary

- This chapter contains an analysis of the available data on co-morbidity and smoking status at the start of Renal Replacement Therapy (RRT) in England and Wales between 2001 and 2006. Co-morbidity data completeness remained low and has improved little since 2001.

- Of all the patients starting RRT between 2001 and 2006 in centres reporting to the UK Renal Registry (after exclusion of data from centres from which data returns are considered unreliable) and for whom data on the presence or absence of co-morbid conditions was reported, 55% were reported to have one or more co-morbidities. Diabetes (either as primary renal disease or co-morbidity) and ischaemic heart disease were the most common conditions, seen in 29% and 24% of patients respectively.

- The prevalence of co-morbidity increased with increasing age up to the 65–74 age group. The prevalence of ischemic heart disease, cerebrovascular disease and peripheral vascular disease increased with increasing age, whereas the proportion of patients reported as being smokers declined with increasing age.

- The prevalence of most co-morbid conditions was much lower amongst patients of Black or South Asian origin compared to Whites, except for diabetes, which was more commonly observed in the ethnic minority populations.

- Patients who had a pre-emptive transplant had fewer co-morbidities compared to those whose first RRT modality was either haemodialysis (HD) or peritoneal dialysis (PD). Patients starting on PD were on average eight years younger and had fewer co-morbidities present compared to those on HD.

- The geometric mean eGFR was lower in those patients starting RRT without any co-morbidity compared to those starting RRT with at least one co-morbid condition (7.1 vs 7.9 ml/min/1.73 m^2, $p < 0.0001$).

- The presence of most co-morbidities were associated with a lower probability of being waitlisted for a deceased donor kidney transplant within the first year of RRT. The patient's smoking history did not affect waitlisting.

- In univariate Cox regression analysis, the association for most co-morbid conditions (except for chronic obstructive pulmonary disease and smoking) with mortality at 1 year after 90 days from start of RRT, was more pronounced for patients <65 years compared to those aged $\geqslant 65$ years.

- In multivariate Cox stepwise regression analysis, malignancy and ischaemic/neuropathic ulcers were the strongest predictors of poor survival at 1 year after 90 days from start of RRT, followed by liver disease, increasing age, previous MI and diabetes.

Introduction

Recording and reporting of the extent of co-morbidity 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 RRT: co-morbidity is associated with both early and long term mortality[1–4] and may also influence attainment of various clinical performance measures amongst patients on RRT. 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 co-morbidity may require more inpatient[2] and outpatient care[5] and their treatment is therefore likely to cost more; information on co-morbidity may therefore help policy-makers, commissioners and providers to plan services.
3. Management of individual patients: the National Kidney Foundation and others have expanded clinical practice guidelines to include management of diabetes[6], dyslipidaemia[7] and cardiovascular disease[8] in patients with chronic kidney disease (CKD). It is therefore important as a first step, to document the presence of cardiovascular risk factors and other co-morbid illness to facilitate attainment of these goals.
4. Risk adjustment in clinical research: adjustment for differences in case mix is required in order to determine the true association of the treatment or other covariates with the outcome. For example, factors that may determine selection of peritoneal dialysis over haemodialysis such as young age and minimal co-morbidity are associated with better survival. Without adequate case mix adjustments, survival comparisons on PD versus HD will be biased in favour of PD.
5. International comparisons: there are marked national and international variations in the take-on rate for RRT with differences in underlying primary diagnoses. Comparisons of outcomes between countries require adjustment for the differences in co-morbidities. Many patients die before reaching ERF in Northern European countries with high rates of IHD in the general population.

The prevalence of various co-morbid conditions at the time of starting RRT and the association of these co-morbidities with patient demographics and early mortality are described in this chapter.

Methods

Study population

All adult ($\geqslant$18 years) patients who started RRT between 2001 and 2006 in centres reporting to the UK Renal Registry (UKRR) in these years and with data on co-morbidity were included. The total number of incident RRT patients in the centres included in a given year is described in Chapter 3. Scottish centres do not provide co-morbidity data to the UKRR and were not included in the analyses.

Data on completeness of co-morbidity returns from each centre and overall may differ from those in previous reports because of the exclusion of centres previously included (see below) and due to some centres backfilling previously missing co-morbidity data.

Centre exclusions

In the previous report[9] it was stated that centres using the Mediqal IT system had the highest co-morbidity data completeness. On more detailed investigation many of these centres seemed to have lower rates of co-morbidities present than expected for RRT patients. These high data completeness rates from the centres using Mediqal software were due to the IT system having a default setting to report missing co-morbidity data (data not entered) as an absence of co-morbidity. Therefore all six centres in Northern Ireland and four centres in England (Basildon, Chelmsford, Dorset and Norwich) have been excluded from these analyses.

Ipswich (Baxter software) was found to have an unusually low proportion (<15%) of patients with no co-morbidity present. They also had a low data completeness (<35%). One possible explanation was selective under-reporting of patients with no co-morbidity. This centre has been excluded from these analyses pending further investigation of reasons for this discrepancy.

Definition of co-morbidity and method of data collection

Clinical staff in each centre are responsible for recording (in yes/no format), on their renal IT system, the presence or absence of 13 co-morbid conditions and information on current tobacco smoking (Table 5.1) for each patient at the time of starting RRT. Definitions of each of these conditions are given elsewhere[10]. Complete data on co-morbidity 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 14 co-morbid conditions. For some analyses co-morbidities have been collapsed into broader categories.

Table 5.1: Co-morbid conditions listed in the Registry dataset

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

- 'Ischaemic heart disease' was defined as the presence of one or more of the following conditions: angina, myocardial infarction (MI) in the 3 months prior to starting RRT, MI more than 3 months prior to starting RRT, or coronary artery bypass grafting (CABG)/angioplasty.

- 'Peripheral vascular disease' was defined as the presence of one or more of the following conditions: claudication, ischaemic or neuropathic ulcers, non-coronary angioplasty, vascular graft, aneurysm, or amputation for peripheral vascular disease.

- '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[11].

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 J at www.renalreg.org.

Renal function and haemoglobin at the start of RRT

The association of various co-morbidities with haemoglobin and with estimated glomerular filtration rate (eGFR) at start of RRT was studied amongst patients with data on these two variables within 14 days before the start of RRT.

Two-sample t-tests were used to compare the mean haemoglobin at start of RRT amongst patients with a specific co-morbidity with the mean for those with none of the co-morbidities. The eGFR was calculated using the abbreviated 4v MDRD study equation[12]. 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 co-morbidity against those with none of the co-morbidities present. As many 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 this is weighted in conjunction with

other clinical parameters. 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 be considered for an early and pre-emptive transplantation when their eGFR decreases to $<20\,ml/min/1.73\,m^2$ [13]. In the UK, the British Transplantation Society endorses the EBPG (www.bts.org.uk) 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[14]. 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 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 for the year 2006 and patients starting RRT in this centre in 2006 have been included.

The analyses excluded 3,104 patients who had no data on eGFR within 14 days prior to start of RRT, 365 who had eGFR values $>20\,ml/min/1.73\,m^2$ and 446 patients from London West leaving 6,896 patients in this analysis.

Activation on deceased donor transplant waiting list

There are no standards for the proportion of patients in a centre that should be waitlisted for a deceased donor transplant. It was previously reported that the proportion of patients on the active deceased donor transplant waiting list (TWL) varied widely across centres[15]. Both centre specific and patient specific factors including co-morbidity could have accounted for these variations. Therefore an analysis was undertaken to investigate if there were differences in co-morbidity amongst patients activated early on the TWL compared to those activated later or never.

Date of first activation on the deceased donor TWL for all patients starting RRT between 2001 and 2004 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. All patients were followed until 31st December 2005 to determine the date of activation on the TWL. The prevalence of various co-morbidities amongst patients activated on the deceased donor TWL within the first year of RRT was compared with those not activated on the TWL within the first year. Patients who died within the first year and were not on the active TWL at the time of death were included under the 'non-waitlisted' group.

Co-morbidity and 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 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 of results from other national Registries, the association of co-morbid 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 co-morbidity with survival was studied using univariate and also multivariate Cox regression models. For analyses of survival within the first 90 days, the cohort included patients starting RRT between 1st January 2001 and 30th September 2006 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 2001 and 30th September 2005.

For each variable, the models estimated the hazard ratio of death comparing those with a particular co-morbidity with those who do not have the co-morbidity. 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.

In the univariate models, patients were first stratified by age group (<65 years and ⩾65 years) to account for the increasing incidence of certain co-morbidities with age, which may otherwise obscure the analysis. The variables included in the multivariate model were: age per 10 years, 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 co-morbidity), chronic obstructive pulmonary disease (COPD), liver disease, malignancy, claudication, ischaemic/neuropathic ulcers, angioplasty/vascular graft, amputation and smoking.

The effect within each centre of adjusting overall survival for co-morbidity is reported in Chapter 6.

Results

Completeness of co-morbidity returns from each participating centre

Table 5.2 shows that completeness of data returns still varies markedly between centres with one centre providing data on 100% of patients but 22 providing data for less than 5% of their new patients. There was no relationship between the size of the centre and the completeness of data returns. Amongst all incident patients, data on co-morbidity has declined from 42.3% of patients starting in 2001 to only 35.1% in 2006 (Table 5.3). After excluding centres that returned no data at all, the average completeness of data returns from centres ranged from 1–100% (mean 52%) for 2006, a moderate improvement on a mean of 47.8% in 2001. As stated above, a return was considered to be 'complete' if there was at least one answer to the 14 questions on the co-morbidity screen. However, most records that contained at least one answer contained answers to most or all of the other questions; only 0.4% had 10 or fewer questions answered, 1.2% contained 11 answers, 1.2% contained 12 answers, 7.7% contained 13 answers and 89.6% contained answers to all 14 questions.

Prevalence of multiple co-morbidity

Of patients for whom co-morbidity data were available, 54.6% had at least one co-morbidity present and 28.4% had more than one co-morbid condition (Table 5.4).

Frequency of each co-morbidity condition

Table 5.5 gives the frequency of each co-morbidity and the percentage this was of the total number of incident patients (for whom data was available for that item) for patients aged <65 and ⩾65 years in addition to the overall percentage who had each co-morbidity in the incident population.

Prevalence of co-morbidity by age band

Figures 5.1 and 5.2 illustrate the rising prevalence of co-morbidity with increasing age up to the 65–74 age group in incident patients; the levelling off or slight reductions in reported co-morbidity amongst patients aged over 75 years may reflect a 'healthy survivor effect' or decisions made by nephrologists and/or patients aged >75 years with cardiovascular co-morbidity not to embark on RRT. The prevalence of smoking reported amongst patients starting RRT decreased as age increases above age 55. Ischaemic heart disease, cerebrovascular disease and peripheral vascular disease all become more common as age group increases.

Table 5.2: Completeness of co-morbidity data returns on incident patients from individual centres (2001–2006)

	2001		2002		2003		2004		2005		2006	
	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return
B Heart	85	0	66	2	104	0	102	0	116	1	119	0
B QEH							195	0	195	1	187	0
Bangor			29	59	33	42	36	56	40	53	40	40
Bradfd	61	93	62	100	74	85	62	92	66	95	49	100
Brightn							119	0	110	0	131	1
Bristol	153	92	124	82	163	83	164	79	176	88	173	84
Camb	92	5	74	4	99	1	112	0	160	0	92	0
Cardff	154	1	181	0	166	3	187	6	183	20	206	3
Carlis	29	3	26	23	31	19	29	66	31	90	27	81
Carsh	123	18	175	6	201	8	167	7	182	4	190	2
Chestr	2	0	3	0	4	0	5	0			4	0
Clwyd			20	0	12	0	14	0	27	0	17	0
Covnt	106	0	96	1	75	0	76	0	84	0	104	0
Derby	59	44			60	73	67	78	71	90	72	69
Dudley	34	0	25	8	41	0	55	0	38	0	45	2
Exeter	97	35	82	50	98	51	110	45	111	28	114	25
Glouc	49	96	54	67	53	87	53	89	60	97	73	88
Hull	74	0	105	5	80	89	109	86	126	95	98	95
L Barts							187	74	183	84	179	73
L Guys	111	2	141	2	93	2	104	3	133	3	133	0
L Kings			116	88	108	100	114	99	136	99	111	99
L Rfree									131	2	206	0
L West			234	77	230	67	272	72	267	55	272	67
Leeds	165	88	152	86	185	86	174	82	164	66	186	52
Leic	184	90	152	88	168	96	162	94	225	63	241	61
Liv Ain							3	0	29	3	36	0
Liv RI	217	50	153	49	114	62	129	60	139	59	142	46
ManWst					143	32	113	41	111	34	127	6
Middlbr	81	90	111	100	103	0	102	1	84	0	97	0
Newc			107	1	108	3	106	0	94	3	110	1
Nottm	120	68	87	99	115	98	107	95	146	99	136	90
Oxford	170	2	170	1	187	44	172	53	163	17	163	1
Plymth	65	6	79	11	64	5	62	18	58	14	93	9
Ports	144	58	146	47	141	57	118	58	151	46	174	34
Prestn	135	1	110	0	98	1	79	0	118	0	121	0
Redng	62	0	39	3	63	0	59	0	74	0	72	0
Sheff	153	88	156	62	159	61	169	46	158	33	167	46
Shrew							55	0	43	0	54	0
Stevng	127	4	101	3	119	3	88	3	91	3	115	0
Sthend	36	33	33	61	42	64	40	70	34	68	44	95
Sund	39	5	57	47	56	64	51	88	59	92	58	84
Swanse	113	73	113	82	128	97	93	92	97	97	113	95
Truro	40	55	59	66	53	83	67	81	32	84	50	78
Wirral			40	18	49	12	63	14	58	7	56	2
Wolve	75	99	99	100	88	100	105	96	93	84	93	45
Wrexm	35	0	42	0	32	3	29	0	41	0	25	0
York	37	92	63	81	57	84	48	92	43	91	47	87
Totals	**3,227**		**3,682**		**3,997**		**4,533**		**4,931**		**5,162**	

Blank cells – no data returned to the Registry for that year.

Table 5.3: Summary of completeness of incident patient co-morbidity returns (2001–2006)

	Years						Combined years
	2001	2002	2003	2004	2005	2006	
Number of centres included	34	39	41	46	46	47	
Total number of new patients	3,227	3,682	3,997	4,533	4,931	5,162	25,532
Number of patients with co-morbid data entries	1,365	1,622	1,912	2,078	2,023	1,811	10,811
Percentage of patients from all centres	42	44	48	46	41	35	42
Median percentage amongst only centres returning co-morbidity	50	50	62	71	57	56	59

Table 5.4: Number of reported co-morbidities in patients starting RRT, as a proportion of those for whom co-morbidity data was available (2001–2006)

Number of co-morbidities	0	1	2	3	4	5+
%	45.4	26.2	13.8	7.6	4.0	2.9

Table 5.5: Frequency with which each condition was reported in incident RRT patients 2001–2006

	Age <65 years		Age ⩾65 years		
Co-morbidity	No. patients	%	No. patients	%	Overall incidence (%)
Ischaemic heart disease	799	14.8	1,756	33.6	24.0
Angina	551	10.1	1,310	25.0	17.4
MI in past 3 months	94	1.7	211	4.0	2.8
MI >3 months ago	333	6.1	853	16.2	11.0
CABG/angioplasty	266	4.9	412	7.9	6.4
Cerebrovascular disease	340	6.2	776	14.7	10.4
Diabetes (not cause of ERF)	271	5.1	565	10.9	7.9
Diabetes as primary disease	1,340	24.3	932	17.6	21.0
Diabetes of either category	1,611	29.3	1,497	28.2	28.8
COPD	217	4.0	536	10.2	7.1
Liver disease	154	2.8	96	1.8	2.3
Malignancy	351	6.4	913	17.3	11.7
Peripheral vascular disease	490	9.0	851	16.2	12.5
Claudication	292	5.3	646	12.2	8.7
Ischaemic/neuropathic ulcers	207	3.8	183	3.5	3.6
Angioplasty/vascular graft	101	1.8	249	4.7	3.3
Amputation	136	2.5	77	1.5	2.0
Smoking	964	19.0	688	13.8	16.4
No co-morbidity present	3,121	56.7	1,792	33.8	45.4

Prevalence of co-morbidity amongst patients with diabetes

Diabetes was recorded as the primary renal disease in 21% of all patients starting RRT between 2001 and 2006. Only 10,556 patients who had data on co-morbidity and had a non-missing code for primary renal disease were included in this analysis. Table 5.6 compares co-morbidity amongst patients with diabetes and without diabetes (either as primary renal disease or co-morbidity) who had at least one other co-morbidity present, showing higher rates of ischaemic heart disease, cerebrovascular disease and peripheral vascular disease amongst diabetic patients.

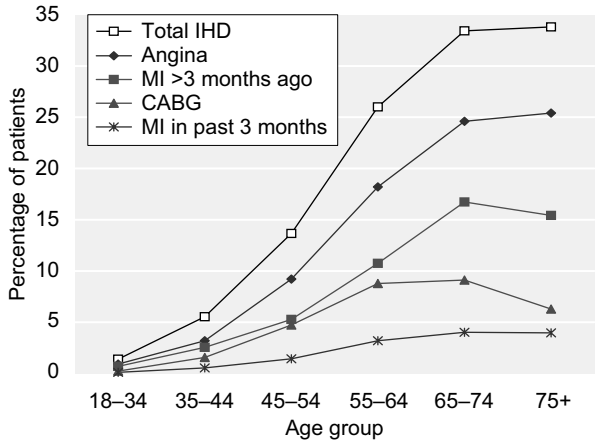

Figure 5.1: Prevalence of ischaemic heart disease amongst incident patients 2001–2006 by age at start of RRT

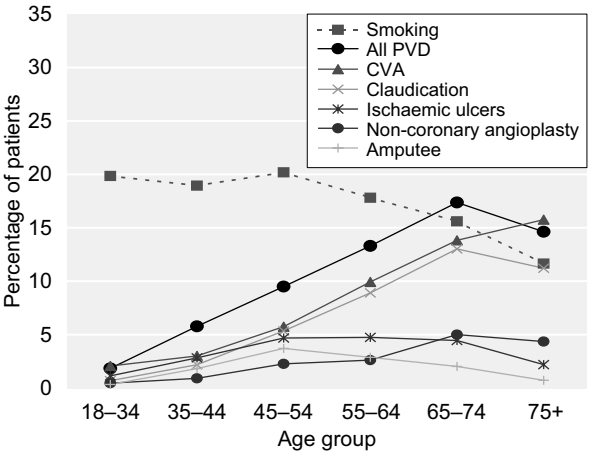

Figure 5.2: Prevalence of vascular disease amongst incident patients 2001–2006 by age at start of RRT

Age and co-morbidity in patients by treatment modality at start of RRT

Amongst all patients with data on co-morbidity, 1.7% started RRT with a pre-emptive transplant. This compared with a UK average of 4% of patients being pre-emptively transplanted. This must reflect a tendency to not report co-morbidity on some patients who have no co-morbid conditions present.

The proportion of patients aged less than 65 years who had at least one co-morbidity was 44.2% amongst those who started with either HD or PD compared to 16.3% 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 co-morbidities.

The median age of patients on PD at the start of RRT was 66.6 years compared with 59.0 years for those starting HD (Kruskal Wallis test, $p < 0.0001$). Table 5.7 compares the prevalence of individual co-morbidities in patients on HD and PD at the start of RRT, showing significantly higher prevalence amongst HD patients of all co-morbid conditions other than MI more than 3 months ago and previous CABG. The percentages shown are out of the total population of patients on that modality at the start of RRT with data for that co-morbidity. 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 co-morbid 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 APD (by a carer) which may alter this patient distribution in future.

Table 5.6: Percentage of patients with and without diabetes (either as primary diagnosis or co-morbidity) who have other co-morbid conditions

Co-morbidity	Non-diabetics	Diabetics	p value*
Ischaemic heart disease	19.8	33.6	<0.0001
Cerebrovascular disease	8.7	14.4	<0.0001
Peripheral vascular disease	8.2	23.1	<0.0001
Smoking	16.6	16.4	0.82
COPD	7.0	7.2	0.71
Malignancy	13.5	7.6	<0.0001
Liver disease	2.2	2.6	0.30

*p values from Chi-squared test for differences in the % with the co-morbidities, between diabetics and non-diabetics.

Table 5.7: Percentage of patients with co-morbid conditions present in incident patients starting PD and HD 2001–2006

	HD		PD		
Co-morbidity	**%**	**Median age**	**%**	**Median age**	**p value***
Angina	19.0	71.5	13.5	67.7	<0.0001
MI >3 months ago	11.4	71.5	10.4	68.5	0.15
MI in past 3 months	3.3	70.3	1.6	70.7	<0.0001
CABG/angioplasty	6.3	68.7	6.7	66.6	0.47
Cerebrovascular disease	11.5	71.6	7.5	66.0	<0.0001
Diabetes (not cause of ERF)	9.1	71.0	4.9	66.9	<0.0001
COPD	8.2	71.2	4.1	68.3	<0.0001
Smoking	17.1	62.5	14.8	55.3	0.008
Liver disease	2.7	60.1	1.1	59.3	<0.0001
Malignancy	13.5	72.0	6.9	70.0	<0.0001
Claudication	9.5	70.5	6.8	66.8	<0.0001
Ischaemic/neuropathic ulcers	4.2	64.8	2.0	58.6	<0.0001
Angioplasty/vascular graft	3.6	71.8	2.4	66.8	0.005
Amputation	2.2	62.1	1.5	55.0	0.019

*p values from Chi-squared tests for differences between modalities in the % with the co-morbidities.

Prevalence of co-morbidity by ethnic origin

Of the incident patients starting RRT between 2001 and 2006, there were 9,277 patients with data returns on both ethnicity and co-morbidity who were included in this analysis.

Figure 5.3 illustrates the presence or absence of co-morbidity by ethnic origin, showing a lower prevalence of co-morbidity amongst patients of ethnic minority compared with those of White origin. Figures 5.4, 5.5 and 5.6 show that the lower prevalence of co-morbidity amongst patients of Black or Asian origin is not entirely attributable to younger age amongst these groups, as the prevalence of co-morbidity was lower than in the White population even in the 18–34 year age group. Table 5.8 shows the prevalence of major co-morbidities in each group; compared to Whites, Blacks and South Asians had lower prevalence of most co-morbid conditions (with the exception of liver disease and diabetes).

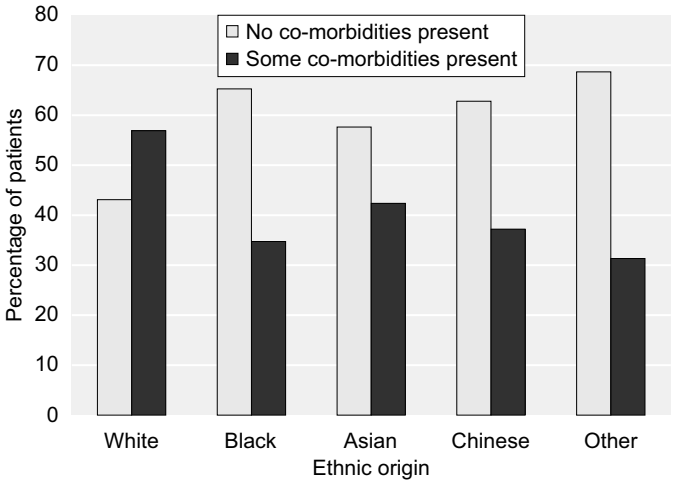

Figure 5.3: Presence or absence of co-morbid conditions at the start of RRT amongst patients starting RRT 2001–2006

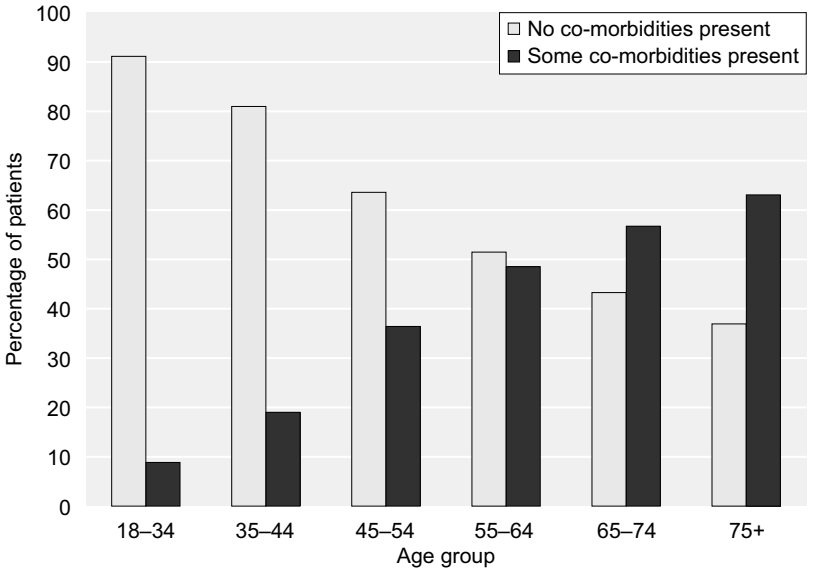

Figure 5.4: Presence or absence of co-morbid conditions at the start of RRT amongst patients of South Asian origin starting RRT 2001–2006

Renal function at the time of starting RRT and co-morbidity

The (geometric) mean eGFR prior to starting RRT in patients who are recorded as starting without any co-morbidity present was 7.1 ml/min/1.73 m^2 (Table 5.9). Patients starting with each of the co-morbidities were compared against the no co-morbidity present group. Due to multiple testing, caution needs to be exercised while interpreting the significance of the associations and a p value of <0.01 would be considered statistically significant. This however may not indicate any clinical significance as there may only be a small variation in values between the two groups.

In each case, average eGFR was slightly higher amongst patients with co-morbidity compared to patients without any co-morbidity, suggesting that patients with more co-morbidity tend to be advised to start dialysis earlier than those without co-morbidity. If trying to compare patient survival between these groups, then

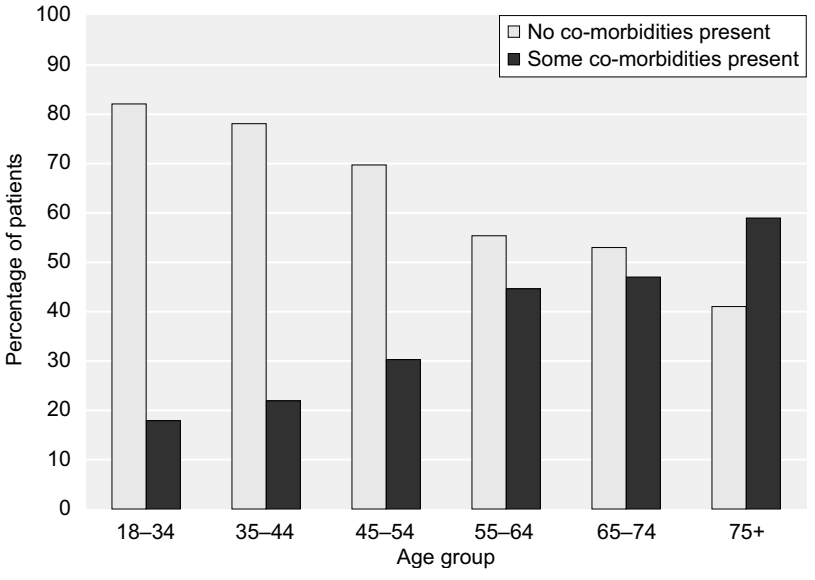

Figure 5.5: Presence or absence of co-morbid conditions at the start of RRT amongst patients of Black origin starting RRT 2001–2006

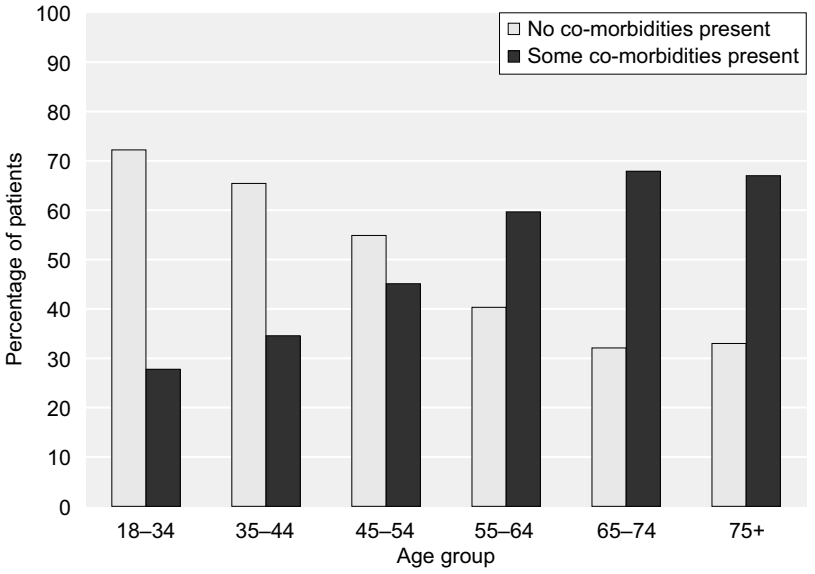

Figure 5.6: Presence or absence of co-morbid conditions at the start of RRT amongst patients of White origin starting RRT 2001–2006

the potential of an 'earlier start' may need to be adjusted for in the analyses.

Haemoglobin concentration at the time of starting RRT and co-morbidity

The mean haemoglobin prior to starting RRT in patients who are recorded as starting without any co-morbidity present is 10.1 g/dl, with 53% of these patients achieving a haemoglobin >10 g/dl. Patients starting with each of the co-morbidities were compared against this group (Table 5.10). Again due to multiple testing, a p value of <0.01 would be considered statistically significant. This however may not indicate clinical significance as they may be only small variations. Haemoglobin concentrations at the start of RRT were slightly higher amongst patients with previous CABG and MI more than 3 months prior to starting RRT than in those without any co-morbidities and lower amongst those with ischaemic/neuropathic ulcers. In addition to the

Table 5.8: Prevalence of co-morbidities amongst incident patients starting RRT 2001–2006 by ethnic group, as percentages of the total number of patients in that ethnic group for whom co-morbidity data were available

	% with co-morbidity					
	South Asian	Black	White	Chinese	Other	p value*
Number of patients with data	859	452	7,674	43	249	
Smoking	6.6	8.2	18.0	5.4	5.2	<0.0001
Cerebrovascular disease	8.7	9.8	10.3	9.3	6.8	0.26
Peripheral vascular disease	9.7	5.1	13.0	14.0	7.7	<0.0001
Ischaemic heart disease	24.2	11.6	24.7	9.5	13.2	<0.0001
Liver disease	3.5	3.1	2.2	7.0	0.8	0.010
COPD	3.5	2.4	7.9	0.0	3.3	<0.0001
Malignancy	2.9	5.1	13.0	4.7	4.8	<0.0001
Diabetes of either category	49.0	35.0	25.7	30.2	41.0	<0.0001
Diabetes (not cause of ERF)	9.0	4.5	7.8	7.1	7.8	0.071
Diabetes as primary disease	40.4	30.5	18.0	23.3	33.3	<0.0001

*p values from Chi-squared tests for differences between ethnic groups in the % with the co-morbidities.

Table 5.9: eGFR within 2 weeks prior to the start of RRT (2001–2006) by co-morbidity

	eGFR geometric mean (ml/min/1.73 m^2)	eGFR 95% CI	p value*
Without co-morbidity	7.1	7.0–7.2	Ref
Some co-morbidity present	7.9	7.8–8.0	<0.0001
Angina	8.4	8.2–8.5	<0.0001
MI in past 3 months	8.3	7.9–8.8	<0.0001
MI >3 months ago	8.4	8.2–8.6	<0.0001
CABG/angioplasty	8.6	8.4–8.9	<0.0001
Cerebrovascular disease	8.0	7.8–8.3	<0.0001
Diabetes (not cause of ERF)	8.2	7.9–8.4	<0.0001
Diabetes as primary disease	8.3	8.1–8.5	<0.0001
Diabetes of either category	8.3	8.1–8.4	<0.0001
COPD	8.2	7.9–8.5	<0.0001
Liver disease	7.8	7.3–8.3	0.009
Malignancy	7.5	7.3–7.7	0.003
Claudication	8.4	8.2–8.7	<0.0001
Ischaemic/neuropathic ulcers	8.3	8.0–8.7	<0.0001
Angioplasty/vascular graft	8.5	8.1–8.9	<0.0001
Amputation	8.7	8.1–9.2	<0.0001
Smoking	7.9	7.7–8.1	<0.0001

*Two-sample t-test compares log (eGFR) for each co-morbidity against those without co-morbidity.

Table 5.10: Haemoglobin concentration at the start of RRT (2001–2006) by co-morbidity

	Hb mean (g/dl)	Hb 95% CI	p value*	% Hb >10 g/dl
Without co-morbidity	10.1	10.0–10.2	Ref	53.0
Some co-morbidity present	10.1	10.0–10.1	0.410	51.5
Angina	10.2	10.1–10.3	0.231	54.0
MI in past 3 months	10.0	9.8–10.3	0.575	53.6
MI >3 months ago	10.4	10.2–10.5	0.001	57.8
CABG/angioplasty	10.4	10.2–10.5	0.006	56.6
Cerebrovascular disease	10.2	10.0–10.3	0.493	53.3
Diabetes (not cause of ERF)	10.0	9.9–10.1	0.231	50.4
Diabetes as primary disease	10.0	9.9–10.1	0.602	51.4
COPD	10.0	9.9–10.2	0.295	51.8
Liver disease	9.8	9.5–10.0	0.025	43.4
Malignancy	10.0	9.8–10.1	0.026	48.5
Claudication	10.0	9.9–10.1	0.170	50.7
Ischaemic/neuropathic ulcers	9.8	9.6–10.0	0.005	43.0
Angioplasty/vascular graft	10.3	10.0–10.5	0.231	56.7
Amputation	9.9	9.6–10.1	0.121	46.2
Smoking	10.1	10.0–10.2	0.547	50.6

*Two-sample t-test compares mean Hb for each co-morbidity against those without co-morbidity.

direct influence of co-morbidity, EPO prescribing patterns and the late referral of patients will also affect haemoglobin levels.

Co-morbidity and subsequent activation on deceased donor transplant waiting list

Table 5.11 shows that patients starting dialysis as their first RRT modality and who were activated on the TWL within the first year, were younger and had significantly less co-morbidity (except smoking) at the start of RRT than those who were not activated within the first year. 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 co-morbidity should be made for meaningful comparisons of the performance of each centre in listing patients for a transplant.

Co-morbidity and survival within 90 days of starting RRT

On univariate analysis stratified for age, most co-morbidities were associated with an increased risk of death in the first 90 days, both amongst patients aged <65 years and those aged ⩾65 years, the associations being more profound for those aged <65 years. There was no increased risk of death within the first 90 days associated with diabetes mellitus as a co-morbidity in the absence of diabetes as a cause of primary renal disease; and smoking was also not associated with an increased 90 day risk (Table 5.12). Both these factors are associated with longer term increased risk.

Some co-morbidities may appear not to be associated with an increased risk of death because of the low number of patients in these groups – for instance, liver disease in those aged 65 or over. Table 5.13 shows the hazard of death within 90 days of RRT associated with various co-morbid conditions grouped into broader categories.

On multivariate analysis using the stepwise Cox proportional hazards model, age and eight of the co-morbid conditions were identified as significant independent predictors of the risk of death (Table 5.14). Diabetes did not emerge as an independent predictor, probably due to the close association between diabetes and ischaemic heart disease, cerebrovascular disease and peripheral vascular disease.

Co-morbidity and survival 1 year after 90 days of commencing RRT

On univariate analysis (Table 5.15) stratified for age, most co-morbidities were associated with

Table 5.11: Co-morbidity amongst incident patients 2001–2004 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 on waiting list			On waiting list			
Co-morbidity	**%**	**N**	**Median age**	**%**	**N**	**Median age**	**p value***
Angina	21.6	1187	70.7	3.8	51	56.3	<0.0001
MI >3 months ago	13.5	743	70.6	1.9	25	55.6	<0.0001
MI in past 3 months	3.6	200	69.9	0.4	6	52.5	<0.0001
CABG/angioplasty	6.8	371	68.0	2.4	31	56.3	<0.0001
Cerebrovascular disease	12.4	685	71.5	2.7	36	55.6	<0.0001
Diabetes (not cause of ERF)	8.5	463	71.6	2.5	33	49.7	<0.0001
COPD	8.8	480	71.5	2.1	28	54.4	<0.0001
Smoking	17.8	925	65.4	16.8	212	44.0	0.381
Liver disease	2.7	149	62.1	0.9	12	49.2	<0.0001
Malignancy	14.4	796	71.8	1.6	21	57.3	<0.0001
Claudication	11.8	648	70.1	1.8	24	48.2	<0.0001
Ischaemic/neuropathic ulcers	4.5	249	64.4	1.0	13	50.0	<0.0001
Angioplasty/vascular graft	4.1	224	71.0	0.3	4	55.3	<0.0001
Amputation	2.4	134	59.6	0.4	5	51.7	<0.0001

*p values from Chi-squared tests for differences between transplant waiting list groups in the % with the co-morbidities.

Table 5.12: Univariate analysis of the risk of death within the first 90 days of RRT associated with co-morbid conditions at the start of RRT during 01/01/01–30/9/06

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Angina	2.9	<0.0001	1.4	0.001
MI >3 months ago	2.2	0.004	1.5	0.001
MI in past 3 months	3.8	0.001	2.5	<0.0001
CABG/angioplasty	1.2	0.626	1.0	0.970
Cerebrovascular disease	2.7	0.001	1.4	0.009
Diabetes (not cause of ERF)	1.2	0.609	1.2	0.130
COPD	2.2	0.016	1.5	0.003
Smoking	1.1	0.675	1.2	0.197
Liver disease	5.7	<0.0001	1.1	0.772
Malignancy	5.3	<0.0001	1.6	<0.0001
Claudication	2.1	0.009	1.2	0.096
Ischaemic/neuropathic ulcers	2.6	0.002	2.0	0.001
Angioplasty/vascular graft	0.9	0.853	0.8	0.350
Amputation	2.9	0.004	0.9	0.819

Table 5.13: Univariate analysis of the risk of death within the first 90 days of RRT associated with co-morbid conditions at the start of RRT (during 01/01/01–30/09/06) grouped into broader categories

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Diabetes as primary disease	1.4	0.109	0.8	0.043
Diabetes of either category	1.4	0.081	0.9	0.502
Ischaemic heart disease	2.6	<0.0001	1.4	0.001
Peripheral vascular disease	3.3	<0.0001	1.2	0.064
Vascular disease	3.1	<0.0001	1.3	0.004
Cardio-vascular disease	2.9	<0.0001	1.4	0.000

Table 5.14: Multivariate Cox proportional hazards model for predictors of death within the first 90 days of starting RRT during 01/01/01–30/9/06

Variable	**Hazard ratio**	**95% CI**	**p value**
Ischaemic/neuropathic ulcers	2.1	1.5–2.9	<0.0001
Liver disease	2.0	1.3–3.1	0.002
Malignancy	1.9	1.6–2.3	<0.0001
MI in past 3 months	1.9	1.4–2.7	0.001
Age (per 10 yrs)	1.6	1.5–1.8	<0.0001
COPD	1.4	1.1–1.8	0.019
MI >3 months ago	1.4	1.1–1.7	0.012
Angina	1.3	1.0–1.6	0.027
Angioplasty/vascular graft	0.6	0.3–0.9	0.021

an increased risk of death in the 1st year after 90 days, both in patients starting RRT aged <65 years and in those ⩾65 years, the associations being more profound for patients aged <65 years. COPD and smoking were not significantly associated with increased risk of death in patients under 65 years of age. Table 5.16 shows the hazard of death in the year after the first 90

Table 5.15: Univariate analysis of the risk of death one year after completion of the first 90 days of RRT associated with co-morbid conditions at the start of RRT during 01/01/01–30/9/05

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Angina	1.9	<0.0001	1.4	<0.0001
MI >3 months ago	2.5	<0.0001	1.4	0.000
MI in past 3 months	2.5	0.002	1.5	0.022
CABG/angioplasty	2.0	0.000	0.9	0.337
Cerebrovascular disease	1.8	0.001	1.4	<0.0001
Diabetes (not cause of ERF)	2.4	<0.0001	1.3	0.015
COPD	1.4	0.185	1.4	0.002
Smoking	1.2	0.169	1.3	0.003
Liver disease	2.6	<0.0001	1.6	0.040
Malignancy	4.8	<0.0001	1.4	<0.0001
Claudication	1.9	0.001	1.2	0.085
Ischaemic/neuropathic ulcers	3.0	<0.0001	1.8	0.001
Angioplasty/vascular graft	1.9	0.035	1.3	0.078
Amputation	3.1	<0.0001	1.8	0.017

Table 5.16: Univariate analysis of the risk of death in the one year after the first 90 days of RRT associated with co-morbid conditions at the start of RRT (during 01/01/01–30/09/06) grouped into broader categories

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Diabetes as primary disease	2.0	<0.0001	1.0	0.647
Diabetes of either category	2.4	<0.0001	1.1	0.224
Ischaemic heart disease	1.9	<0.0001	1.4	<0.0001
Peripheral vascular disease	2.1	<0.0001	1.3	0.011
Vascular disease	2.0	<0.0001	1.4	<0.0001
Cardio-vascular disease	2.0	<0.0001	1.5	<0.0001

days of RRT associated with various co-morbid conditions grouped into broader categories.

On multivariate analysis using the stepwise Cox proportional hazards model, age and eight other variables were identified as independent predictors of death (Table 5.17). Recent MI was no longer significantly associated with an increased risk of death, possibly because the prognostic importance of this marker is

Table 5.17: Cox proportional hazards model for predictors of death in the first year after completion of 90 days of starting RRT during 01/01/01–30/9/05

Variable	**Hazard ratio**	**95% CI**	**p value**
Malignancy	1.9	1.6–2.2	<0.0001
Ischaemic/neuropathic ulcers	1.8	1.4–2.4	<0.0001
Liver disease	1.8	1.3–2.6	0.001
Age (per 10 yrs)	1.5	1.4–1.6	<0.0001
MI >3 months ago	1.4	1.2–1.6	0.000
Diabetes of either category	1.3	1.2–1.5	<0.0001
Cerebrovascular disease	1.3	1.1–1.6	0.003
COPD	1.2	1.0–1.5	0.050
Smoking	1.2	1.0–1.4	0.021

time-dependent and so would not be any more powerful a predictor than other markers of atherosclerotic vascular disease a year later. Diabetes was a powerful predictor of increased risk of death after the first 90 days.

Discussion

These analyses demonstrate that co-morbidities are common amongst UK patients starting RRT, with over 54% of patients with co-morbidity data having some recorded co-morbidity. Furthermore, these analyses demonstrate that co-morbidity is 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 co-morbidity scores[3,4,16–39]. 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 co-morbidity on the renal IT system by clinical staff requires appreciation of the advantages of such data reporting, plus considerable manpower and resources. It is anticipated however, 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 co-morbidity.

The publication, from 2006 onwards, of de-anonymised survival statistics for each centre and demonstrating the centre effect on survival of adjusting for these co-morbidities may provide some stimulus to clinical directors to improve collection of co-morbidity data.

The prevalence and severity of co-morbidity increases with time on RRT and this change in co-morbidity over time has been reported to be associated with mortality[4]. The Registry, in addition to collecting baseline co-morbidity data, is therefore hoping to stimulate collection of annual co-morbidity data on RRT patients. The Registry 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 providing some of these data from inpatient diagnosis discharge codes, along the lines of the approach used by the United States Renal Data System.

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Chapter 6: Survival of Incident and Prevalent Patients

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Summary

- The age adjusted survival of incident patients starting RRT continued to improve. There was an improvement for patients starting on HD and PD. The one year after 90 day survival was 87.3% (95% CI 86.7–88.1).

- There has been a survival improvement for both the under and over 65 year age groups. The last 8 years have shown an annual 3% relative improvement in survival in both the under and over 65 year age group.

- The 'vintage effect' of increasing hazard of death with length of time on RRT, prominent in data from the US, was not seen in the UK within the 9 year incident cohort follow up period.

- From the date of first RRT, the 1 year survival of all patients (unadjusted for age) was 81%. From the 90th day of RRT (to allow comparison with other countries' 1 year survival), the 1 year survival was 86%. The age adjusted (60 years) survival for the 1 year after 90 day period was 85%. There was a high death rate in the first 90 days on RRT (6% of all patients starting RRT), a period not included in reports by many registries and other studies.

- The 5 year survival rates (including deaths within the first 90 days) were 87%, 78%, 67%, 48%, 29% and 18% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and >75 years (last years published data was incorrect).

- It was possible to compare co-morbidity adjusted survival (in addition to age and primary renal diagnosis) for nine centres.

- Eight centres had a figure for the 1 year after 90 day survival which was outside 2 standard deviations from the mean for the UK. In 5 centres this was better survival and in 3 centres poorer survival than expected. Poor reporting by renal centres of patient co-morbidity makes interpretation of these apparent differences in patient survival between centres difficult and a relationship to clinical performance cannot yet be inferred.

- Analysis of prevalent dialysis patient survival showed 6 centres outside 2 standard deviations, (4 below and 2 above).

Introduction

The analyses presented in this chapter examine survival from the start of renal replacement therapy (RRT). They encompass the outcomes from the total incident UK dialysis population reported to the Registry, including the 21% who started on peritoneal dialysis and the 5% who received a pre-emptive transplant and were not censored for transplantation. The results therefore show a true reflection of the whole UK RRT population. The incident survival figures reported here are better than those reported for the UK by the iDOPPS study (which only included a haemodialysis cohort). Additionally, 1st year UK survival data included patients that had died within the first 90 days of starting RRT, a period excluded from most other countries' registry data.

For the first time, the dataset this year included patients from all the UK countries (Northern Ireland data were not available in previous Reports). Patients returning to dialysis after a failed transplant were not included in the incident cohort as their survival was calculated from the date of their first RRT.

The incident survival figures quoted in this chapter are from the first day of renal replacement therapy. In many instances survival from day 90 onwards is also presented, as this allows comparison with many other registries, including

the US, which mainly record data from day 90 onwards. This distinction is important, as there is a high death rate in the first 90 days which would distort international comparisons. In many other countries, patients are not reported to their national registry or considered to have established renal failure until they have completed 90 days on RRT, whereas in the UK all patients starting RRT are included from the date of the first RRT treatment unless they recover renal function within 90 days. 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 irreversible established renal failure.

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 2005 was approximately 65 years, but the Registry has maintained age adjustment to 60 years for comparability with previous years' analyses.

Survival rates in different centres contributing to the UK Renal Registry are reported here. In the 2006 Report, with the agreement of all UK clinical directors, centre anonymity was removed for the first time. Similarly to last year, it is stressed that these are raw data that require very cautious interpretation. The Registry can adjust for the effects of the different age distributions of patients in different centres, but lacks sufficient data from many participating centres to enable adjustment for co-morbidity and ethnic origin, which have been demonstrated to have a major impact on outcome. With this lack of information on case mix, it was difficult to interpret any apparent difference in survival between centres. Using data only from those centres with greater than 85% complete data returns on co-morbidity, 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 co-morbidity. It is hoped this will encourage all centres to allocate the resources to return the co-morbidity data.

Despite the uncertainty about any apparent differences in outcome for centres which appear to be outliers, the Registry will follow the clinical governance procedures as set out in Chapter 2[1].

The survival of prevalent patients, in previous Reports included within the prevalent chapter, has now been incorporated within this chapter.

Methods

Methodology for incident patient survival

The take-on population in a year included patients who recover from ERF after 90 days from the start of RRT, but excluded those that recover within 90 days. Patients newly transferred into a centre who were already on RRT were excluded from the take-on population for that centre. Patients re-starting dialysis after a failed transplant were also excluded (unless they started RRT in that current year).

Patients who started treatment at a centre and then transferred out after starting RRT treatment were counted at the original centre.

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 re-started 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.

Patients who transferred out of their initial treatment centre to one of the five UK centres not returning individual patient data to the Registry, were censored on the day they transferred out.

The one year incident survival for patients in 2005 were for those who had all been followed for 1 full year through 2006. The 2006 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 2005, were not included in the cohort, as 2007 data on these patients were not yet available. The analyses prior to the 2006 Registry Report have used the previous year's patient cohort to calculate the 1 year after 90 day survival (eg this year the alternative would have been to use the 2004 rather than 2005 cohort) starting in October. A comparison of these two methods has shown no difference between them for any but the smallest centres (who will have wide 95% confidence intervals), so for simplicity of understanding the cohort and using a common cohort across analyses, the Registry will now use the previous year's data (2005 cohort).

Adjustment of 1 year after 90 day survival for the effect of co-morbidity, was undertaken using a combined incident cohort from 2001 to 2005. Nine centres had returned >85% of co-morbidity data for patients. Adjustment was first performed to a mean age of 60 years, then to the average primary diagnosis mix for all the nine centres. The individual centre data were then further adjusted for average co-morbidity mix present at these centres.

Methodology for prevalent patient survival

All patients who had been established on RRT for at least 90 days on 1 January 2006 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. The results are shown in Table 6.13. Overall there is a 0.5% increase in survival using the censored data. With such small differences only the censored results have been quoted throughout the prevalent analyses.

Another potential source of error in comparing survival of dialysis patients in different renal centres, especially younger patients, is the differing transplant rates between centres. Those with a high transplant rate have removed more of the fitter patients from dialysis and are left with a higher risk population on dialysis.

Centre exclusion from survival analysis

The survival analysis for the London West centre (2005 Hammersmith & Charing Cross data) revealed that this centre was an outlier with an apparent survival of better than 3 s.ds above average. Due to this finding, these data were investigated further. Investigation showed that there were no deaths reported (to the UKRR) from this centre for the first 5 months of the year.

This finding is statistically unlikely and suggests either that the centre were not reporting the deaths from this period or were not reporting patients that had started RRT earlier and then died within this timeframe. As the Registry does not solely rely on the centre to report the date of death but also uses the NHS tracing service to verify death (linked to the Office for National Statistics Deaths Register), under-reporting of deaths by the centre, in patients already registered with the UKRR, could not be the cause. There must therefore be an incomplete cohort of patients being sent by this centre to the UKRR. This centre has therefore been excluded from the incident and prevalent survival analysis.

Incident (new RRT) patient survival results

The 2005 cohort included 6,085 patients who were starting RRT (Table 6.1).

Comparison with audit standards

The 2002 UK Renal Standards document[2] (www.renal.org) 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 (1998) recommended at least 90% one year survival for patients aged 18–55 years with standard primary renal disease. This may have been too low as the rate in participating centres in the Registry was 97%, though numbers were small.***

The Renal Standards document defines standard primary renal disease using the EDTA-ERA diagnosis codes (including only codes 0–49), this excludes patients with renal disease due to diabetes and other systemic diseases. It is more widespread practice to simply exclude patients with diabetes, so these analyses were also included in this report to allow comparison with reports from other registries. The results are shown in Table 6.2 and are similar to the previous year.

Between country

The Northern Ireland figures have not been included in this table as data are only available from 2005 onwards. Two years incident data have been combined to increase the size of the patient cohort, so that any differences between the three other UK countries are more likely to be identified (Table 6.3). These data have not been adjusted for differences in primary renal diagnosis, ethnicity or co-morbidity.

Table 6.1: Summary of the exclusions from the 2005 incident cohort

Reasons for exclusion	No of Patients
Recovered and started again in 2005 (2nd start only included)	−1
Recovered in 2004 with 2nd start in 2005 and had a recovery period <90 days (so remain in the 2004 cohort)	−5
Recovered in 2005 with 2nd start in 2006 and had a recovery period ⩾90 days (these will be included in the 2006 analysis)	−7
Patients with date of death before RRT start date	−3
Patients without a treatment modality at start	−18
Total incident survival cohort	6,051
Number of deaths in the first year	1,139

Table 6.2: One-year patient survival, patients aged 18–54, 2005 cohort

First treatment	Standard primary renal disease	All primary renal diseases except diabetes
All %	96.1	93.8
95% CI	*94.7–97.2*	*92.4–94.9*
HD %	94.9	91.5
95% CI	*92.8–96.3*	*89.5–93.1*
PD %	98.7	98.8
95% CI	*96.6–99.5*	*97.2–99.5*

Modality

The age-adjusted one year survival estimates on HD and PD were 85.8% and 93.1% respectively with the improvement in HD survival from 2002 (83.9%) being maintained. There appears to be better survival on PD compared with HD (Table 6.4) after age adjustment, similar to data from the USRDS and Australasian (ANZDATA) registries. However, a straightforward comparison of the modalities in this way is not valid, as there are significant factors in

Table 6.3: Incident patient percentage survival across the UK, combined 2 year cohort (2004–2005), adjusted to age 60

	England	Wales	Scotland	UK
% 90 day	94.4	93.5	94.3	94.3
95% CI	*93.9–94.9*	*92.1–95.0*	*93.1–95.4*	*93.8–94.8*
% 1 year after 90 days	87.9	86.1	83.9	87.3
95% CI	*87.1–88.6*	*83.9–88.6*	*81.9–86.0*	*86.65–88.08*

Table 6.4: One-year after day 90 survival by first established treatment modality (adjusted to age 60)

Year		HD	PD
2005	Adjusted 1 year after 90 days %	85.8	93.1
	95% CI	*84.6–87.1*	*91.6–94.5*
2004	Adjusted 1 year after 90 days %	85.5	90.3
	95% CI	*84.3–86.8*	*88.7–92.0*
2003	Adjusted 1 year after 90 days %	85.7	92.5
	95% CI	*84.3–87.2*	*90.9–94.1*
2002	Adjusted 1 year after 90 days %	83.9	90.2
	95% CI	*82.4–85.5*	*88.46–92.1*

Table 6.5: Unadjusted 90 day survival of new patients, 2005 cohort, by age

Age	KM* survival (%)	KM 95% CI	N
18–64	96.2	95.5–96.9	2,957
⩾65	88.2	87.0–89.3	3,112
All ages	92.1	91.4–92.8	6,069

*KM = Kaplan–Meier.

selection for the modalities and the patients in the two groups are not comparable.

Age

Tables 6.5 to 6.10 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 dialysis 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 6.1 and 6.2).

If the survival data in Tables 6.8 to 6.10 are calculated from day 90 (1 year after day 90

Table 6.6: Unadjusted 1 year after day 90 survival of new patients, 2005 cohort, by age

Age	KM survival (%)	KM 95% CI	N
18–64	91.5	90.4–92.5	2,837
⩾65	78.0	76.4–79.5	2,737
All ages	84.9	83.9–85.8	5,574

Table 6.7: Increase in proportional hazard of death for each 10 year increase in age, at 90 days and for 1 year thereafter

Interval	Hazard of death for 10 year age increase	95% CI
First 90 days	1.69	1.56–1.83
1 year after first 90 days	1.55	1.47–1.64

Table 6.8: Unadjusted KM survival of new patients 1997–2005 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	95% CI for latest yr	N
2005	89.5									88.4–90.6	2,957
2004	89.8	83.8								82.3–85.1	2,650
2003	89.4	82.5	77.1							75.3–78.7	2,364
2002	88.4	81.5	75.9	70.7						68.6–72.6	2,075
2001	87.4	79.9	74.3	68.8	64.1					61.8–66.3	1,844
2000	89.5	81.9	75.2	70.4	65.2	60.2				57.7–62.6	1,585
1999	87.7	81.5	74.1	68.1	63.2	59.2	55.1			52.4–57.8	1,366
1998	86.9	79.6	72.9	67.7	61.6	56.8	52.8	50.4		47.5–53.1	1,278
1997	86.0	78.5	71.3	65.8	60.7	56.1	52.5	50.3	48.5	44.9–52.0	789

Table 6.9: Unadjusted KM survival of new patients 1997–2005 cohort for patients aged ⩾65

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	95% CI for latest yr	N
2005	72.7									71.1–74.2	3,112
2004	68.8	54.8								52.9–56.7	2,733
2003	69.2	53.9	42.6							40.6–44.6	2,378
2002	66.0	51.5	41.1	33.0						31.0–35.0	2,180
2001	67.2	52.1	39.5	30.6	23.2					21.3–25.2	1,861
2000	66.8	53.3	40.2	29.3	22.9	18.2				16.3–20.2	1,508
1999	66.3	50.6	38.4	28.9	21.5	15.4	11.1			9.4–12.9	1,266
1998	63.8	46.7	36.4	27.5	20.6	14.8	10.8	7.4		5.9–9.0	1,140
1997	64.0	46.0	33.2	23.9	16.5	11.6	7.9	6.3	4.6	3.1–6.5	582

Table 6.10: Unadjusted survival of new patients 1997–2005 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	95% CI for latest yr	N
2005	80.9									79.9–81.9	6,069
2004	79.1	69.0								67.8–70.3	5,383
2003	79.2	68.1	59.8							58.3–61.2	4,742
2002	76.9	66.1	58.0	51.3						49.8–52.8	4,255
2001	77.3	66.0	56.8	49.6	43.5					41.9–45.1	3,705
2000	78.4	68.0	58.2	50.4	44.6	39.8				38.1–41.5	3,093
1999	77.4	66.6	56.9	49.2	43.1	38.1	33.9			32.1–35.8	2,632
1998	76.0	64.1	55.7	48.8	42.3	37.1	33.0	30.1		28.3–32.0	2,418
1997	76.7	64.8	55.2	48.1	42.1	37.3	33.7	31.7	29.9	27.5–32.4	1,371

survival, 2 year after day 90 survival, etc) the survival in all cases increased by an additional 3–4% across both age bands. These are the results most comparable to the figures quoted by the USRDS from the USA and most other national registries[3,4] (see Chapter 12 on international comparisons).

There was a nonlinear increase in death rate per 1,000 patient years with age, shown in

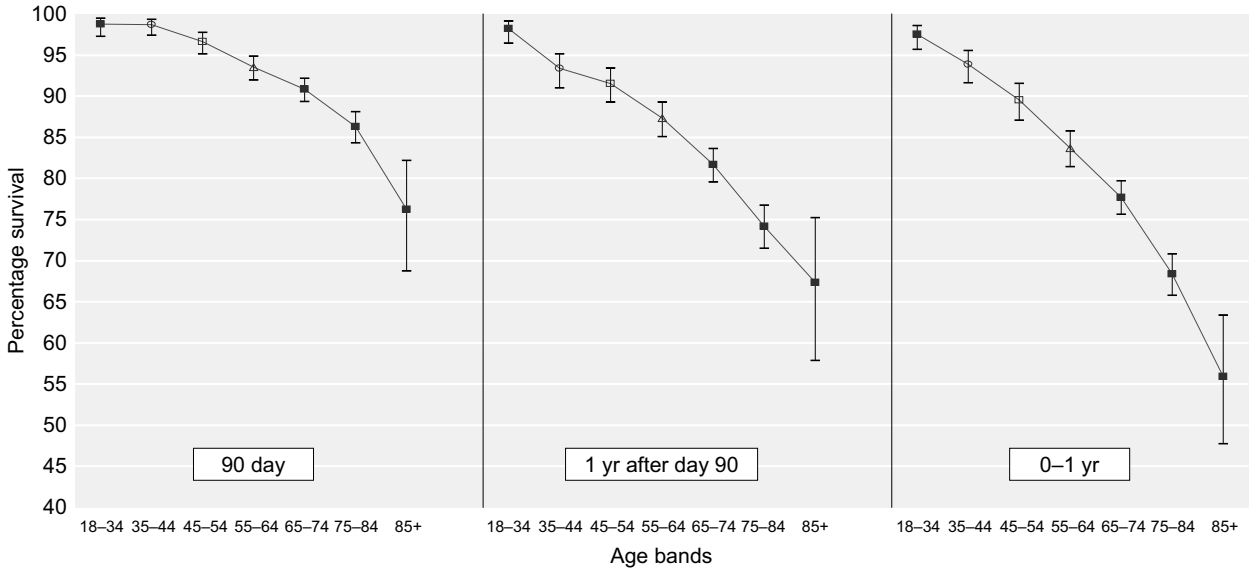

Figure 6.1: Unadjusted survival of all incident patients 2005 by age band

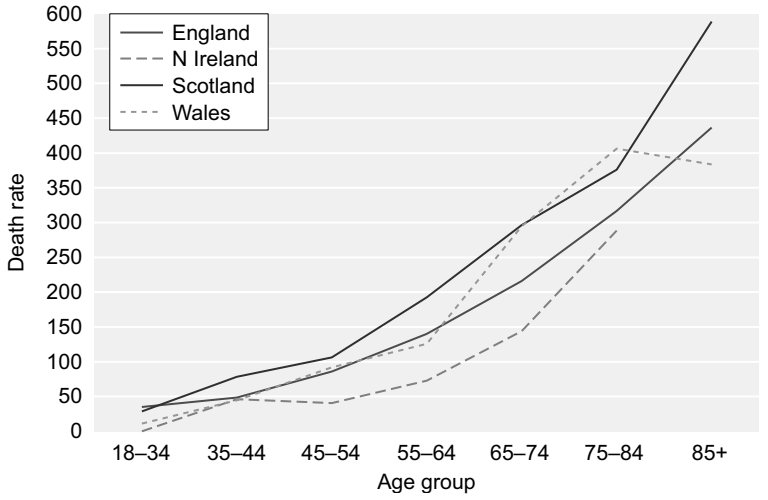

Figure 6.2: One year after 90 days death rate per 1,000 patients years by nation and age group for incident patients, 2002–2005 cohort

Figure 6.2 for the period one year after 90 days. There were no differences between UK countries.

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

The KM long term survival curves published in all previous years reports, were censored at the time of transplantation. This was not made clear in the analysis and although not incorrect, will make the longer term outcomes of younger patients (who are more likely to have undergone transplantation) appear worse. This is because those younger patients remaining on dialysis (who may have more co-morbidity) will have only been included in the survival analysis. To demonstrate this difference in outcome between these two methods, Figure 6.3a is shown below without censoring for transplantation and Figure 6.3b with censoring. In future reports it is planned to only reproduce the single figure of the longer term age related survival which is uncensored at the time of transplantation.

In addition, it should be noted that in the printed version and CD copy of the 2006 Report, Figure 12.2 showing the 8 year KM survival of

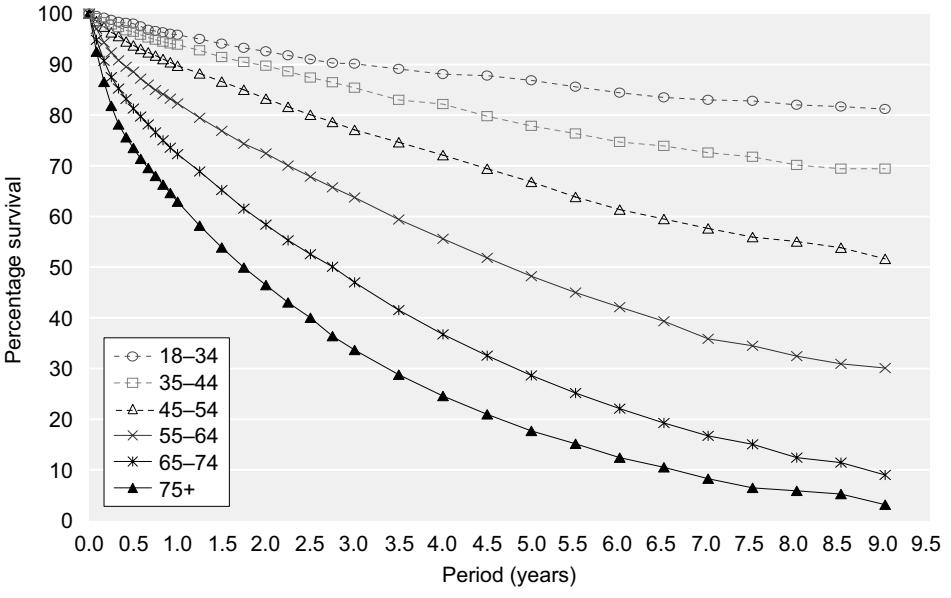

Figure 6.3a: Kaplan–Meier 9-year survival of incident patients 1997–2005 cohort (from day 0), without censoring at transplantation

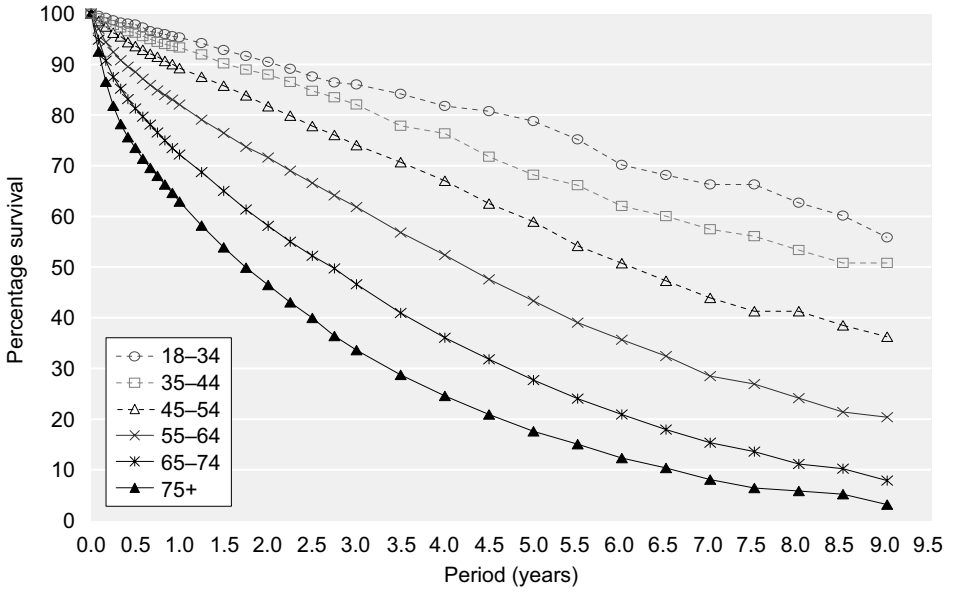

Figure 6.3b: Kaplan–Meier 9-year survival of incident patients 1997–2005 cohort (from day 0), with censoring at transplantation

incident patients was incorrect, with the incorrect figure showing very much ***poorer*** *survival than is the case. An error has been found in the SAS code previously used to calculate these data and this has now been corrected.*

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

As discussed earlier in this chapter, the UKRR collects data from the 1st day of starting RRT. Figure 6.4 shows that the monthly hazard of death for patients aged over 55 is 60% lower in those patients that have survived beyond 4 months. This reduction in hazard of death was not seen in the younger aged patients and will therefore affect proportionality in any Cox model analysis that uses data starting from day zero and combines these different aged cohorts.

The USRDS in contrast reports a rising mortality throughout the first recorded 3 month period[3] and this was most likely to reflect lack of reporting to the USRDS of patients that start on RRT who do not survive the first 90 days. A similar pattern of rising death rates has

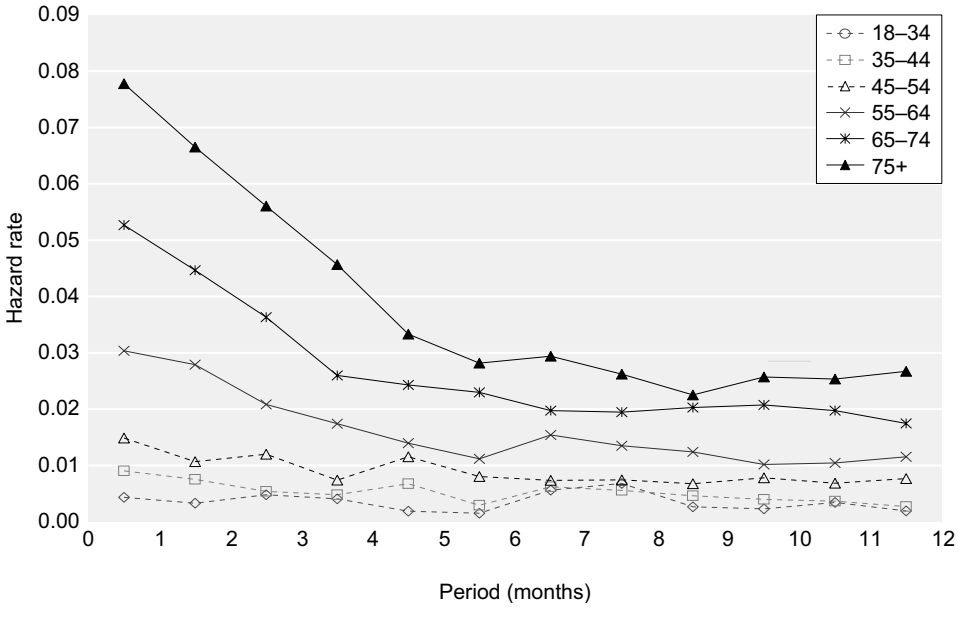

Figure 6.4: 1st-year monthly hazard of death, by age band 1997–2005 cohort

been shown in analysis of data from the German Renal Registry, with under-reporting of patients with early deaths highlighted as the cause (Caskey F, verbal communication).

Changes in survival from 1997–2005

The KM survival tables have been included as in previous years. The one year death rate per 1,000 patient years has also been included this year (Figure 6.5). 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 unadjusted KM survival data (Tables 6.8 and 6.9, Figures 6.6 and 6.7) 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. The patients aged under 65 years have seen the 1st year survival improve from 86% to 89.5%. As survival rates were already high in these patients, the overall survival improvement was only 4%. The reduction in risk of death (= relative survival improvement) in Figure 6.5 shows that this equates to a 26% relative improvement over this 8 year period (= 3% annual improvement in the reduction in risk of death). Similar reduction in risk of death was seen in the 2 year and 3 year cohorts.

Similarly for patients aged over 65 years there has been a 14% improvement in 1st year

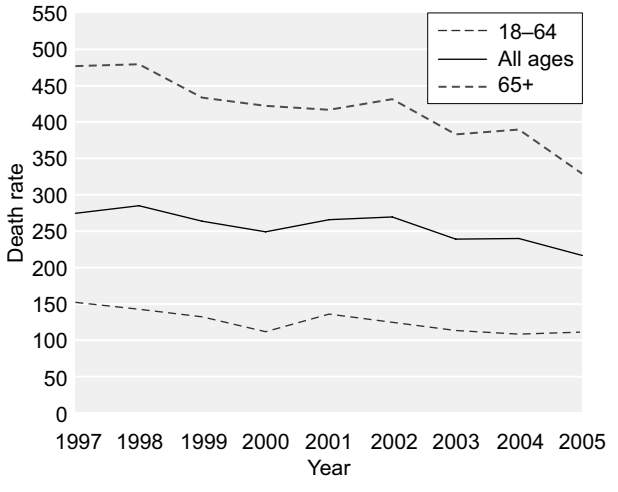

Figure 6.5: One-year incident death rate per 1,000 patient years for all age groups

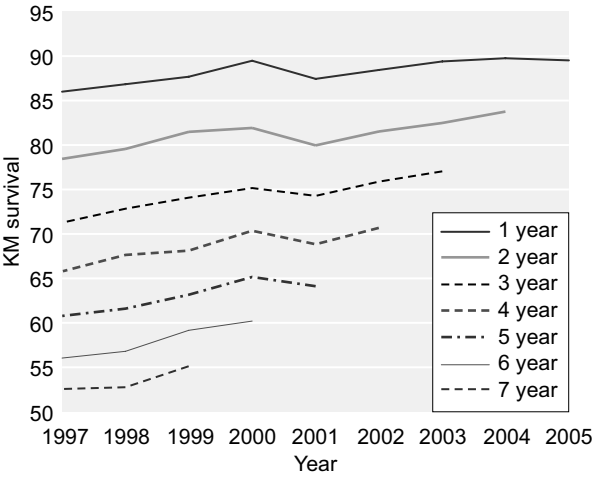

Figure 6.6: Change in KM long term survival by year of starting RRT; for incident patients aged 18–64 years

survival, which translates into a similar 25% relative reduction in risk of death over this 8 year period.

A confounding factor may be the fact that additional renal centres have joined the Registry over these intervening years. To attribute this year on year improvement to this fact, then every renal centre joining in each subsequent year must have better patient survival than all renal centres in each of the previous years. This would be statistically very improbable. Additionally, a separate analysis of survival in the earlier vs latter centres has shown this not to be the reason.

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

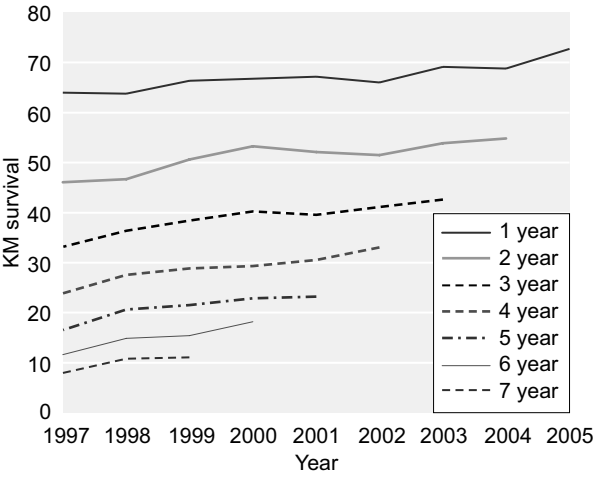

Figure 6.7: Change in KM long term survival by year starting RRT; for incident patients aged ⩾65 years

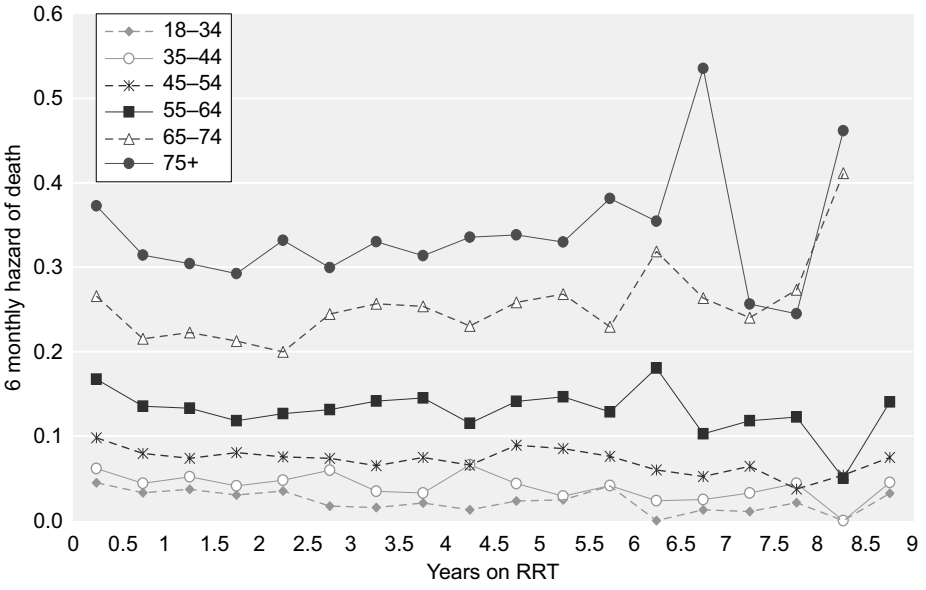

Figure 6.8: Six monthly hazard of death, by vintage and age band, 1997–2005 incident cohort after day 90

mean haemoglobin in HD patients has shown annual improvement rising from 10.2 g/dl in 1998 to 11.6 g/dl in 2006. Other improvements in phosphate and calcium control have been restricted to the last 3 years. This recent improvement contrasts with dialysis dose where the main improvements were in the first 4 years.

Change in survival on renal replacement therapy by vintage

RRT patients in the UK continued to show no evidence of a worsening prognosis with time on RRT (vintage), even with the follow up period now increased to 9 years. Figure 6.8 demonstrates this clearly for patients aged under 65 years. For those patients aged over 65 years, no vintage effect was seen within the first 7 years, though with the decreasing numbers remaining alive beyond 7 years the numbers become too small to draw any further conclusions. Figures 6.9 and 6.10 show these data for the non-diabetic and diabetic patients respectively.

As highlighted in last years report, these data contrast with the USRDS data[3] which shows worsening prognosis with increasing length of time on RRT.

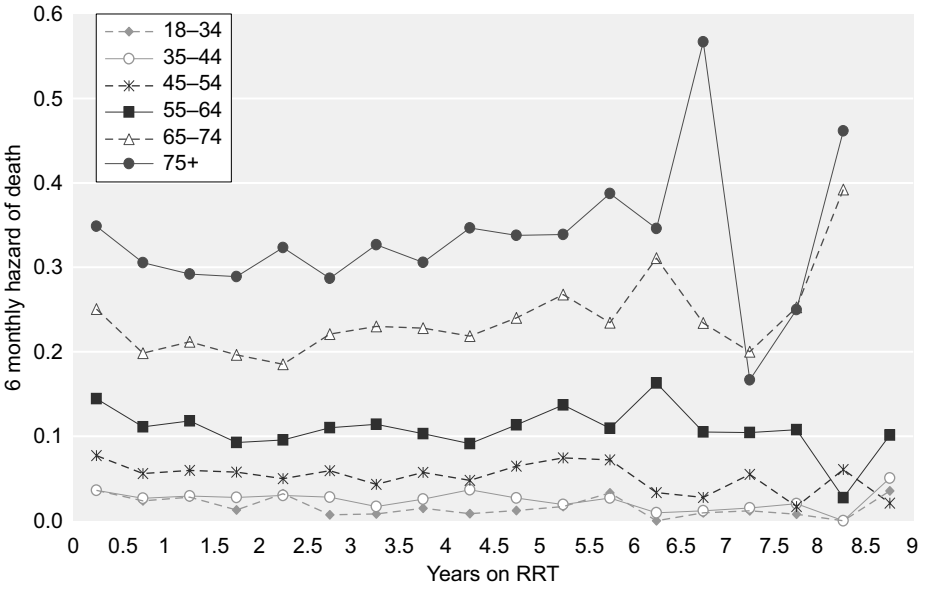

Figure 6.9: Six monthly hazard of death, by vintage and age band, 1997–2005 non-diabetic incident cohort after day 90

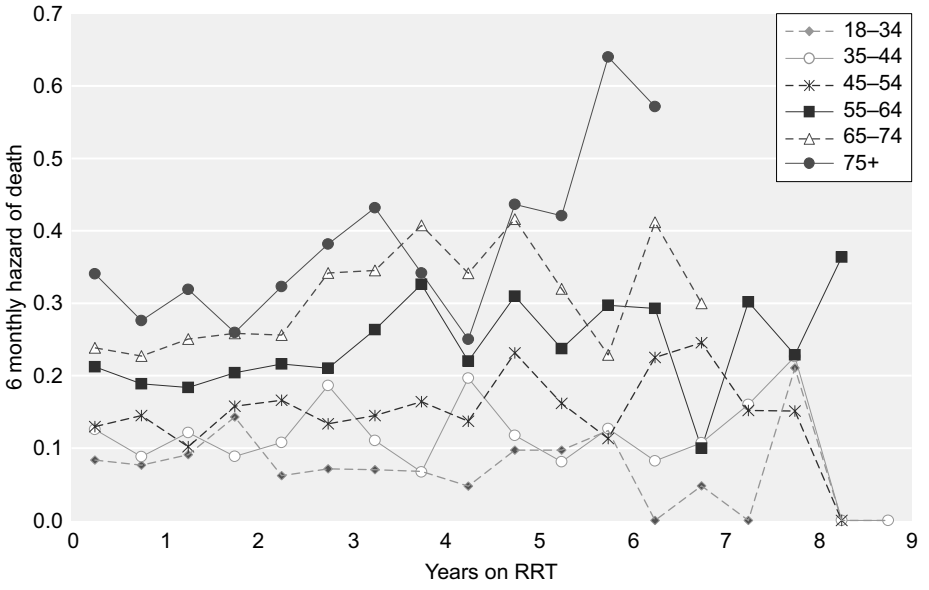

Figure 6.10: Six monthly hazard of death, by vintage and age band, 1997–2005 diabetic incident cohort after day 90

Time trend changes in incident patient survival, 1999–2005

The time trend changes are shown in Figure 6.11.

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2005 incident cohort is shown in Figure 6.12 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 6.16 and 6.17). The age adjusted individual centre survival for each of the last 7 years can also be found in Appendix 1, Table 6.18.

In the analysis of 2005 survival data, some of the smaller centres had wide confidence intervals (Figure 6.12). This can be addressed by including a larger cohort, which will also assess sustained performance. In the previous Report, the data were presented for the 4 year 2001 to 2004 cohort. The data this year are for the 4 year period 2002 to 2005.

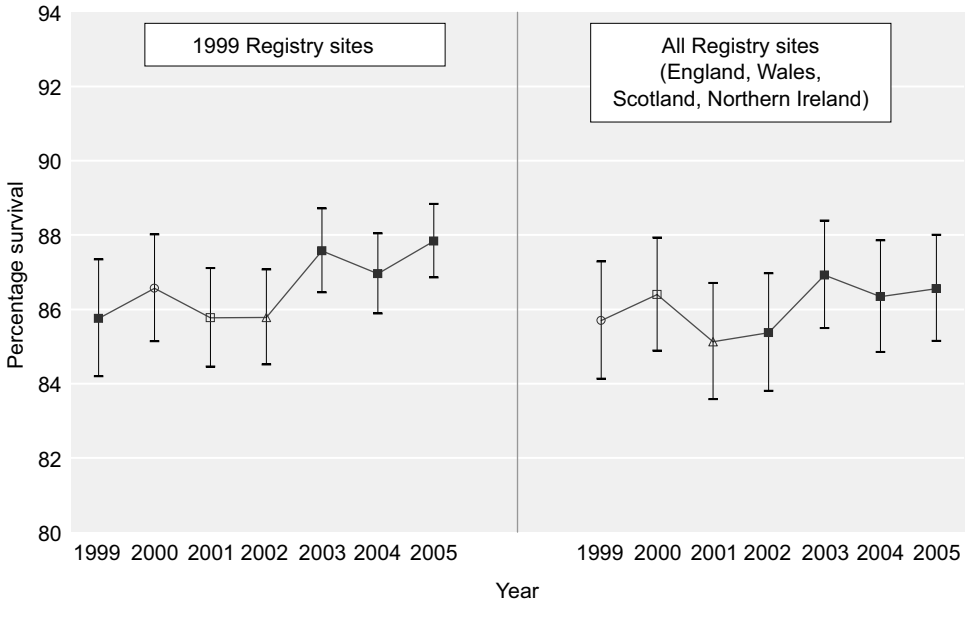

Figure 6.11: Change in one-year after 90 day adjusted (age 60) survival, 1999–2005
Showing 95% confidence intervals

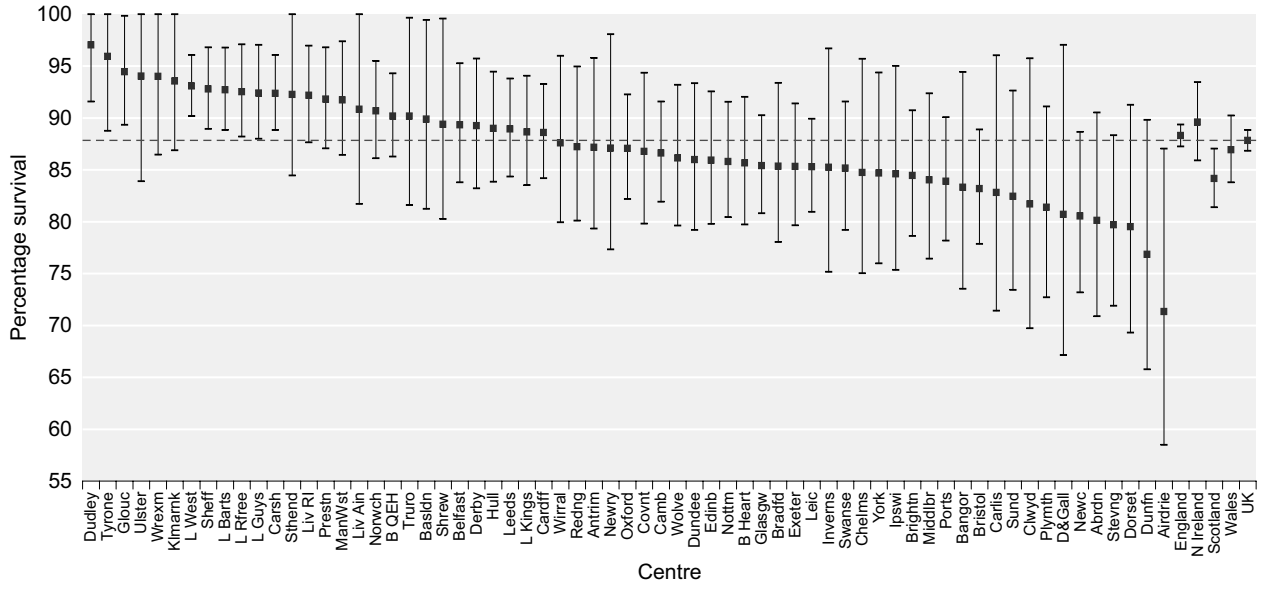

Figure 6.12: Survival one-year after 90 days, adjusted to age 60, 2005 cohort
Showing 95% confidence intervals

A few centres have been contributing data to the Renal Registry for only part of this period so they will have fewer years included. Following the well received approach last year, where these data were for the first time presented using a funnel plot, it was decided to continue with this method to identify possible outliers (Figure 6.13). From Figure 6.13, 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% confidence interval) or 3 standard deviations (dotted lines, 99.8% confidence interval). Table 6.11 helps centres to identify themselves on this graph by finding their number of patients and then looking up this number on the x-axis.

There are 3 centres that fall between 2 and 3 standard deviations below average (Aidrie, Sunderland and Middlesbrough) and 5 centres between 2 and 3 sds above average (Basildon, London Royal Free, Ipswich, Preston and London Guys). These data have not been adjusted for any patient related factor except age (i.e. not co-morbidity, primary renal disease or ethnicity).

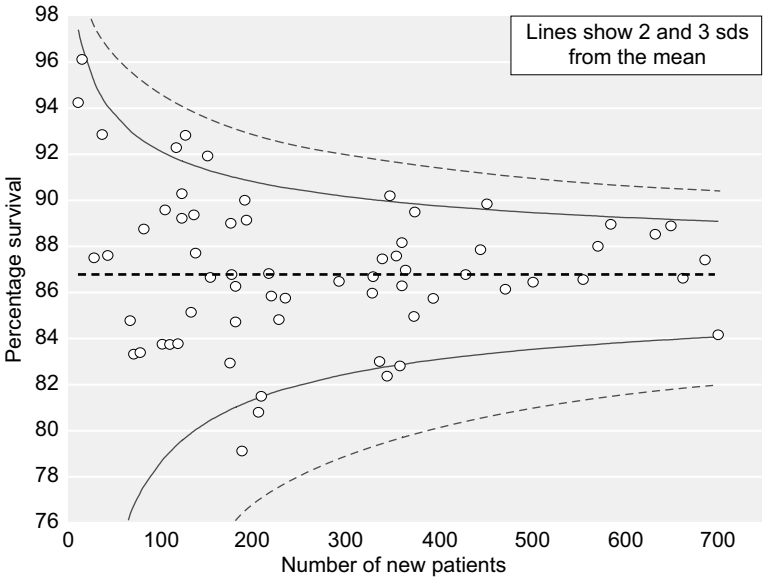

Figure 6.13: Funnel plot for age adjusted 1 year after 90 days survival; 2002–2005 cohort
(patients who died within the first 90 days have been excluded)

Table 6.11: Adjusted 1 year after 90 day survival 2002–2005

Centre	No. of incident pts	1 year after 90 day survival %	Centre	No. of incident pts	1 year after 90 day survival %
Ulster	11	94.2	Brightn	217	86.8
Tyrone	15	96.1	Abrdn	220	85.8
Newry	28	87.5	Bradfd	228	84.8
Liv Ain	37	92.9	Dundee	235	85.7
Antrim	43	87.6	Covnt	293	86.5
Clwyd	67	84.8	Wolve	329	86.0
D&Gall	71	83.3	B Heart	330	86.7
Chelms	78	83.4	Edinb	337	83.0
Shrew	82	88.7	ManWst	340	87.5
Bangor	102	83.7	Middlbr	345	82.4
Belfast	105	89.6	L Barts	348	90.2
Carlis	110	83.7	Prestn	355	87.6
Basldn	117	92.3	Swanse	359	82.8
Dunfn	119	83.8	Exeter	361	86.3
Sthend	123	89.2	Stevng	361	88.2
Wrexm	123	90.3	Hull	365	87.0
L Rfree	127	92.8	Newc	374	84.9
Inverns	133	85.1	B QEH	375	89.5
Dudley	136	89.4	Nottm	395	85.7
Klmarnk	138	87.7	Camb	430	86.8
Ipswi	151	91.9	L Kings	446	87.8
Dorset	154	86.6	L Guys	453	89.8
York	175	82.9	Liv RI	473	86.1
Norwch	176	89.0	Ports	503	86.4
Derby	177	86.8	Bristol	557	86.5
Glouc	181	86.2	Leeds	573	88.0
Wirral	181	84.7	Sheff	587	89.0
Airdrie	188	79.1	Oxford	635	88.5
Redng	191	90.0	Carsh	652	88.9
Truro	193	89.1	Cardff	665	86.6
Sund	206	80.8	Leic	689	87.4
Plymth	209	81.5	Glasgw	703	84.2

These data have not been censored at transplantation, so the effect of differing centre rates of transplantation was not taken into account.

There are known regional differences in the life expectancy of the general population within the UK. Table 6.12 shows differences in life expectancy between the UK countries[5,6]. The Registry is investigating ways to adjust centre survival for the differences in the underlying population.

Table 6.12: Life expectancy 2003–2005 in UK countries (source ONS)

	At Birth		At age 65	
	Male	Female	Male	Female
England	76.9	81.2	16.8	19.6
Wales	76.3	80.7	16.4	19.2
Scotland	74.2	79.3	15.5	18.4
Northern Ireland	76.0	80.8	16.4	19.3
UK	**76.6**	**81.0**	**16.6**	**19.4**

Analysis of the impact of adjustment for co-morbidity on the 1 year after 90 day survival

Co-morbidity returns to the Registry have remained static (Chapter 5). With the de-anonymisation of centre names, it is essential to show what the importance is of adjusting patient survival for co-morbidity.

Preliminary analysis (Figure 6.14a) showed that several centres demonstrated a large reduction in survival after adjusting for co-morbidity.

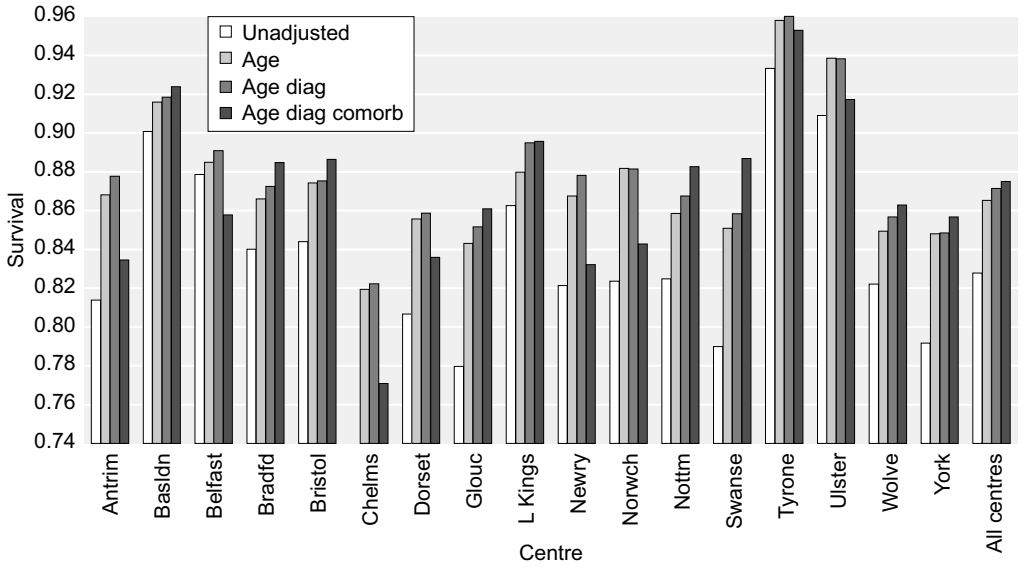

Figure 6.14a: Change in 1 year after 90 day survival after adjustment for age, diagnosis and co-morbidity, using centres with incorrect co-morbidity returns

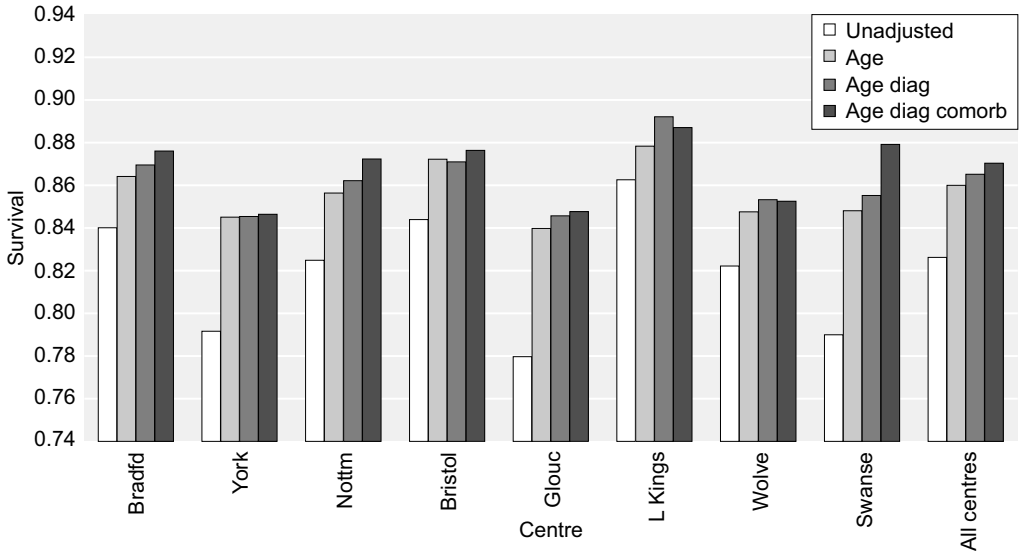

Figure 6.14b: Change in 1 year after 90 day survival after adjustment for age, diagnosis and co-morbidity, using only centres with correct co-morbidity returns

These centres were showing 100% completeness of data and more than the expected number of patients were recorded as having no co-morbidity. This anomaly was confined to centres using a specific renal software package and investigation revealed that a 'null co-morbidity entry' was being returned as 'no co-morbidity present'. Figure 6.14a has been included to highlight the effect of adjusting centre survival for centres with poor co-morbidity returns as if patients had no co-morbidity. Figure 6.14b shows the correct analysis with the centres returning incorrect data having been removed from the analysis.

Using the combined incident cohort from 2000–2004, 9 centres had returned co-morbidity data for more than 85% of patients. Adjustment was first performed to age 60, then to the average primary diagnosis mix for all the 9 centres. Further adjustment was then made to the average co-morbidity mix present at these centres (Figure 6.14b).

This highlights the importance of improving the quality of co-morbidity returns to the Renal Registry.

Prevalent patient survival

Table 6.13 demonstrates the effect on calculation of survival on dialysis, before and after censoring at the time of transplantation, overall there was a 0.5% increase in survival using the censored data.

In Table 6.14 the one year death is shown for dialysis patients. The median age of prevalent patients in Wales was older than those in England.

One year survival of prevalent dialysis patients by centre

The one year survival of dialysis patients in each centre is shown in Table 6.15 and is illustrated in Figures 6.16 and 6.17, dividing the data into those patients aged <65 years and those 65 years and over. Figure 6.19 shows the age adjusted data (60 years) in Figure 6.18, as a funnel plot. The solid lines showing the 2 standard deviation limit (95% CI) and the dotted lines the limits for 3 standard deviations (99.9%

Table 6.13: Prevalent 1 year KM survival of dialysis patients with and without censoring at transplantation (adjusted for age = 60)

	Censoring at transplant			Not censoring at transplant		
Centre	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI
Abrdn	88.5	84.5	92.7	88.7	84.8	92.8
Airdrie	79.2	73.4	85.5	79.7	74.1	85.9
Antrim	92.5	88.7	96.5	92.7	88.9	96.6
B Heart	86.5	83.3	89.8	86.5	83.4	89.8
B QEH	88.6	86.5	90.7	88.6	86.6	90.7
Bangor	90.4	85.2	95.9	90.5	85.3	96.0
Basldn	91.2	86.9	95.7	91.2	87.0	95.7
Belfast	87.1	83.7	90.6	86.5	83.1	90.2
Bradfd	82.1	77.2	87.2	82.3	77.6	87.4
Brightn	88.3	85.4	91.3	88.5	85.7	91.5
Bristol	87.9	85.3	90.6	87.5	84.9	90.2
Camb	88.8	85.9	91.9	88.7	85.7	91.7
Cardff	84.6	81.8	87.6	84.4	81.6	87.3
Carlis	83.5	76.6	90.9	83.9	77.3	91.2
Carsh	89.3	87.0	91.7	89.4	87.1	91.7
Chelms	84.7	79.0	90.8	84.9	79.3	90.9
Chestr	93.4	86.7	100.0	93.8	87.3	100.0
Clwyd	81.5	73.2	90.6	81.8	73.7	90.8
Covnt	85.7	82.3	89.3	85.9	82.5	89.5
D&Gall	82.0	74.0	90.9	82.5	74.6	91.2
Derby	89.2	85.7	92.8	89.3	85.9	92.8
Derry	84.9	62.8	100.0	97.0	91.3	100.0
Dorset	85.2	80.5	90.1	85.6	81.0	90.4
Dudley	87.5	82.6	92.6	87.1	82.2	92.3
Dundee	88.1	84.1	92.4	88.5	84.5	92.6
Dunfn	87.9	82.7	93.5	88.3	83.3	93.7
Edinb	87.4	83.9	91.1	87.4	83.8	91.1
Exeter	90.7	87.9	93.6	91.1	88.4	93.8
Glasgw	86.7	84.3	89.1	86.8	84.5	89.2
Glouc	90.9	87.2	94.8	91.0	87.3	94.8
Hull	84.7	81.2	88.5	85.2	81.7	88.8
Inverns	86.3	80.7	92.4	86.6	81.1	92.5
Ipswi	84.8	79.7	90.1	84.9	79.9	90.2
Klmarnk	91.9	87.8	96.2	92.3	88.3	96.4

Table 6.13: (continued)

Centre	Censoring at transplant			Not censoring at transplant		
	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI
L Barts	88.2	85.8	90.8	88.3	85.8	90.8
L Guys	87.9	85.1	90.8	88.2	85.5	91.0
L Kings	88.8	85.7	92.0	88.9	85.9	92.1
L Rfree	90.5	88.3	92.7	90.6	88.5	92.8
Leeds	89.7	87.3	92.2	89.8	87.4	92.3
Leic	84.7	82.2	87.2	84.6	82.1	87.1
Liv Ain	86.3	78.5	94.9	87.3	80.0	95.3
Liv RI	89.0	86.3	91.9	89.0	86.2	91.8
ManWst	86.8	83.4	90.4	87.3	84.1	90.8
Middlbr	85.2	81.2	89.4	85.3	81.3	89.4
Newc	85.6	81.7	89.6	85.0	81.0	89.1
Newry	87.8	82.3	93.8	88.0	82.5	93.9
Norwch	89.5	86.4	92.8	89.7	86.5	92.9
Nottm	83.8	80.6	87.1	83.7	80.5	87.0
Oxford	88.4	85.9	91.0	88.8	86.4	91.3
Plymth	83.8	78.9	89.0	84.1	79.2	89.2
Ports	84.9	81.6	88.3	85.0	81.8	88.3
Prestn	86.6	83.5	89.9	86.7	83.6	89.9
Redng	89.3	85.5	93.2	89.3	85.6	93.1
Sheff	89.3	87.2	91.6	89.6	87.5	91.8
Shrew	85.9	81.0	91.2	86.0	81.1	91.3
Stevng	89.9	87.4	92.6	90.0	87.5	92.7
Sthend	83.4	77.9	89.3	83.4	78.0	89.2
Sund	78.8	72.5	85.7	80.4	74.5	86.8
Swanse	86.0	82.6	89.5	86.1	82.8	89.6
Truro	91.8	88.4	95.4	92.0	88.7	95.5
Tyrone	84.2	78.3	90.5	80.7	73.7	88.2
Ulster	91.3	84.5	98.8	93.0	87.2	99.0
Wirral	87.8	83.1	92.8	88.1	83.4	93.0
Wolve	89.9	86.8	93.1	89.9	86.8	93.2
Wrexm	85.3	79.7	91.3	85.7	80.2	91.5
York	83.1	77.8	88.9	83.6	78.3	89.1
England	**88.0**	**87.4**	**88.5**	**88.1**	**87.5**	**88.6**
N Ireland	**88.1**	**85.9**	**90.3**	**88.1**	**86.0**	**90.3**
Scotland	**86.8**	**85.4**	**88.3**	**87.0**	**85.6**	**88.4**
Wales	**85.4**	**83.5**	**87.4**	**85.4**	**83.5**	**87.3**
UK	**87.7**	**87.2**	**88.2**	**87.8**	**87.3**	**88.3**

Table 6.14: One-year death rate per 1,000 dialysis patient years by country

	England	N Ireland	Scotland	Wales
Death rate	155	161	170	202
95% CI	150–161	131–195	151–190	175–233
Median age	63.1	64.6	63.6	64.7

Table 6.15: One-year survival of established prevalent RRT patients in UK (unadjusted unless stated otherwise)

Patient group	Patients	Deaths	KM survival	KM 95% CI
Transplant patients 2006				
Censored at dialysis	15,476	358	97.6	97.4–97.9
Not censored at dialysis	15,476	388	97.5	97.2–97.7
Dialysis patients 2006				
All 2006	20,079	2,834	85.3	84.8–85.8
All 2006 adjusted age = 60	20,079	2,834	87.7	87.2–88.2
2 year survival – dialysis patients 2005				
All 1/1/2005 (2 year)	19,069	4,951	72.0	71.3–72.6
Dialysis patients 2006				
All age <65	10,754	910	91.0	90.4–91.5
All age 65+	9,325	1,924	79.1	78.3–79.9
Non-diabetic <55	5,346	268	94.6	94.6–93.9
Non-diabetic 55–64	2,963	325	88.6	88.6–87.3
Non-diabetic 65–74	3,671	582	83.9	83.9–82.6
Non-diabetic 75+	3,583	900	74.7	74.7–73.3
Non-diabetic <65	8,309	593	92.4	91.8–93.0
Diabetic <65	1,759	275	83.5	81.6–85.2
Non-diabetic 65+	7,254	1,482	79.3	78.4–80.2
Diabetic 65+	1,508	357	76.1	73.8–78.1

KM = Kaplan–Meier survival.
Cohorts of patients alive 1/1/2006 unless indicated otherwise.

CI). With over 60 centres included, it would be expected by chance that 3 centres would fall outside the 95% (1 in 20) confidence intervals. The graph shows 6 centres outside the 2 sd interval, with 2 clearly below (Airdrie and Sunderland), 2 marginally below (Nottingham 83.8 v 2 sd 84.0 and Leicester 84.7 v 2 sd 84.8) and 2 above 2 sds (Antrim and London Royal Free). Similarly to the incident survival, one centre (London West) was demonstrating a survival that was beyond 3 sds better than expected.

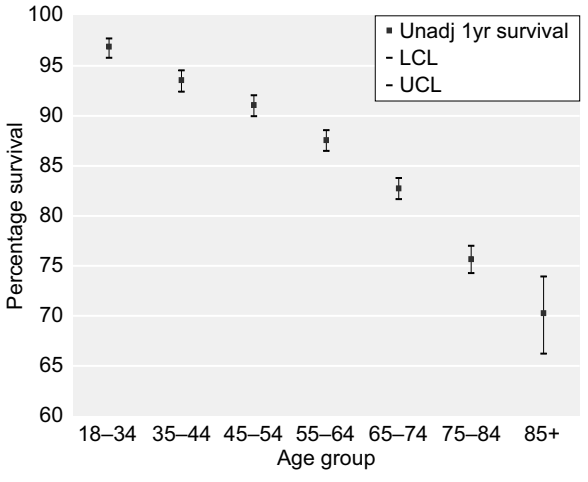

Figure 6.15: One year survival of prevalent dialysis patients in different age groups – 2006

This was a statistical outlier and excluded from calculation of the mean survival figure.

The 2006, one year death rate in prevalent dialysis patients by age band

The death rates on dialysis, by age band are shown in Figure 6.20. The younger patients are a selected higher risk group, as transplanted patients have been excluded. In younger patients, the death rate increased by about 25 per 1,000 patient years for a 10 year increase in age, while in the older age group it increased by about 100 per 1,000 patient years. This demonstrates the death rates for UK dialysis patients were lower than dialysis patients in the USA across all age bands (Figure 6.12 USRDS Report 2007).

One year survival of prevalent dialysis patients in England, Wales, Scotland and Northern Ireland from 1997–2006

For the year 2006 (Figure 6.21), there was a significant difference in the one year age

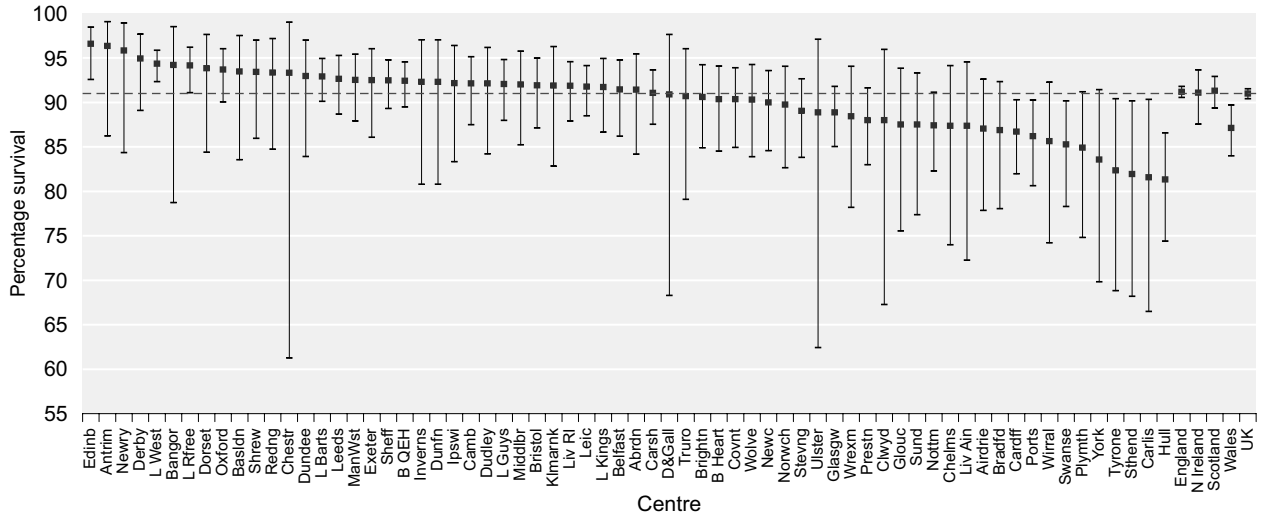

Figure 6.16: One year survival of prevalent dialysis patients aged under 65 in each centre

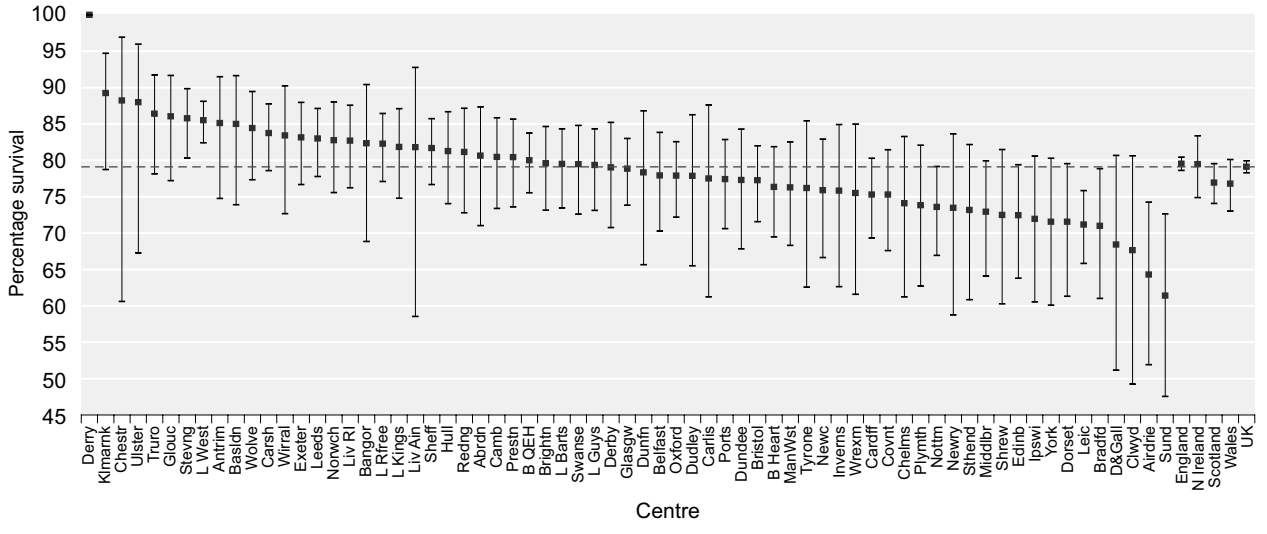

Figure 6.17: One year survival of prevalent dialysis patients aged 65 and over in each centre

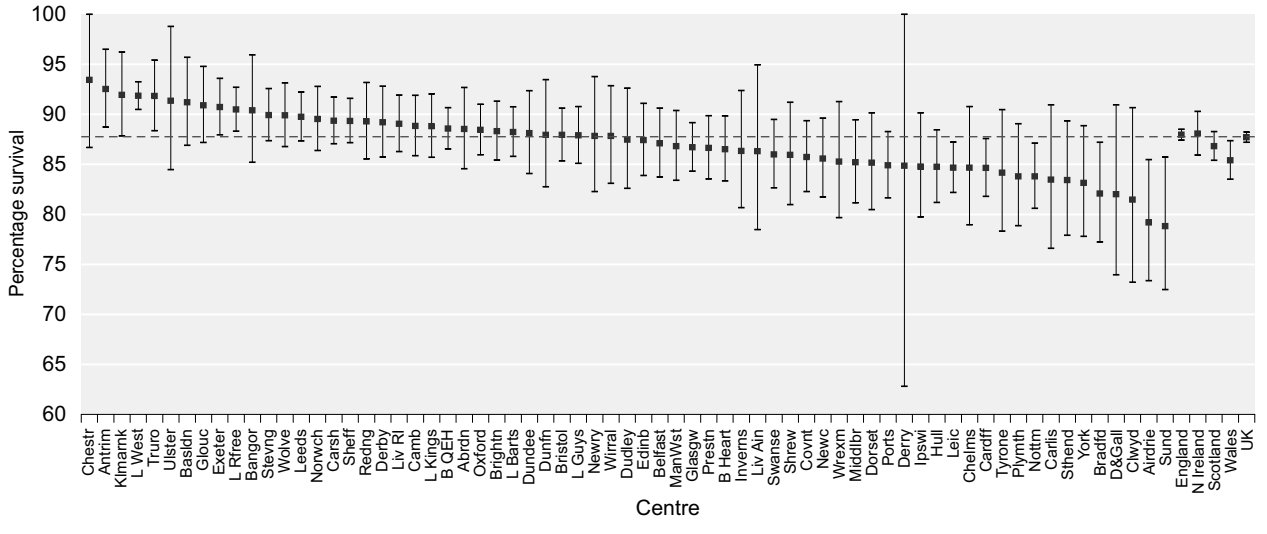

Figure 6.18: One year survival of prevalent dialysis patients in each centre adjusted to age 60

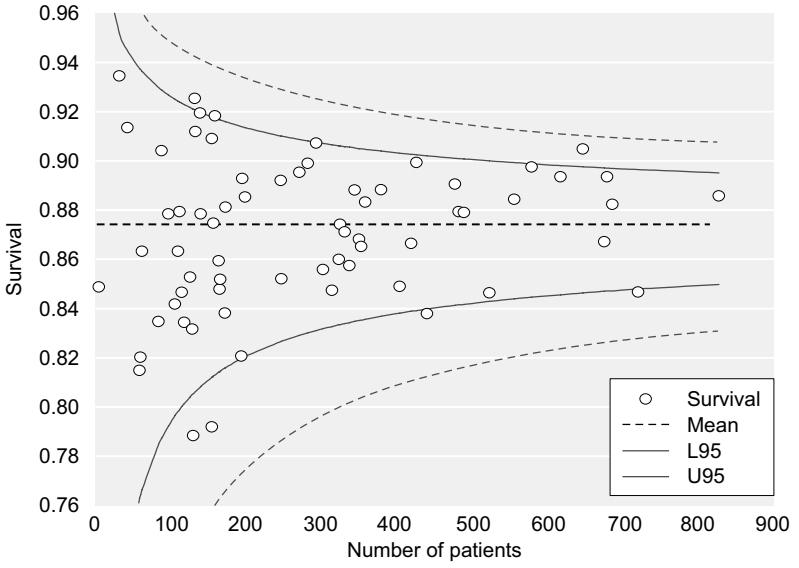

Figure 6.19: One year funnel plot of prevalent dialysis patients in each centre adjusted to age 60

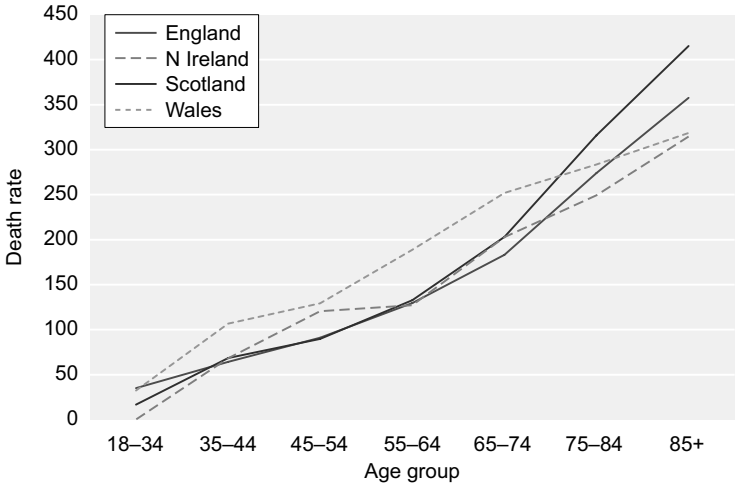

Figure 6.20: Death rate per 1,000 patients years by UK country and age group for prevalent dialysis patients

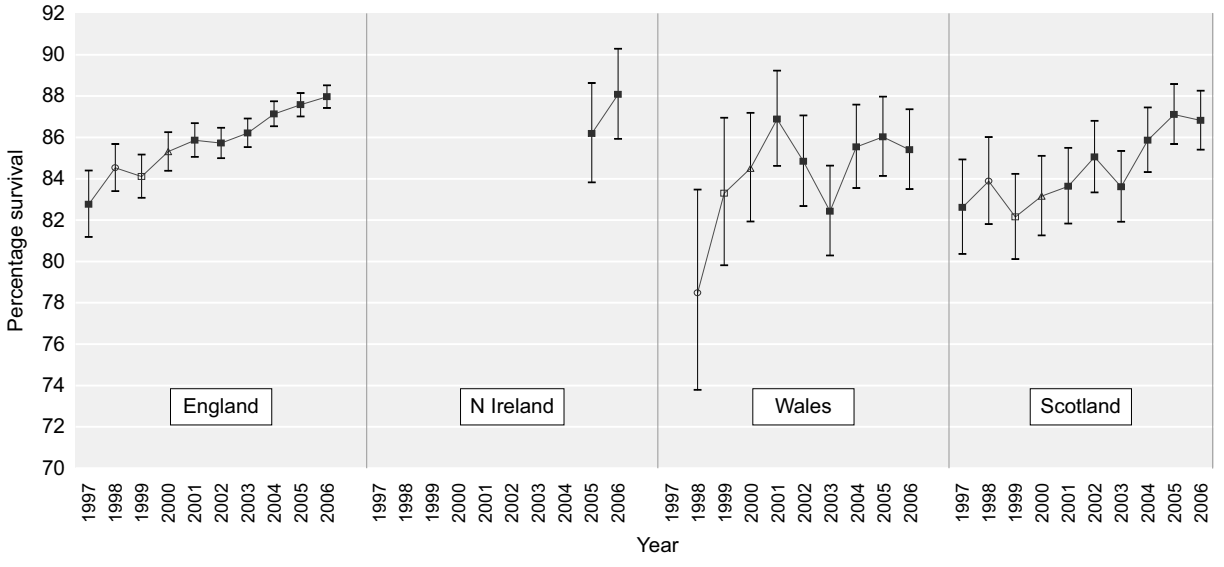

Figure 6.21: Serial one year survival for dialysis patients in England, Wales and Scotland from 1997–2006 adjusted to age 60

adjusted prevalent dialysis survival between UK countries ($p = 0.016$). The change in prevalent survival by centre over the years 2000 to 2006 is shown in Appendix 1, Table 6.19.

The data for Northern Ireland were only available for the last 2 years, so were not tested for trend. For England and Scotland, the test for a linear trend improvement in dialysis survival was significant ($p = <0.00001$ and $p = 0.0001$ respectively).

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6. Office for National Statistics http://www.statistics.gov.uk

Appendix 1: Survival tables

Table 6.16: 1 year after 90-day survival by centre for 2005 unadjusted and adjusted to age 60

Centre	Unadjusted 1 yr after 90d survival	Adjusted 1 yr after 90d survival	Adjusted 1 yr after 90d 95% CI
Abrdn	77.3	80.1	70.9–90.5
Airdrie	68.9	71.3	58.5–87.0
Antrim	81.4	87.2	79.3–95.8
B Heart	82.8	85.7	79.7–92.0
B QEH	88.3	90.2	86.3–94.3
Bangor	74.2	83.3	73.5–94.4
Basldn	85.7	89.9	81.2–99.5
Belfast	88.1	89.3	83.8–95.3
Bradfd	80.0	85.4	78.0–93.4
Brightn	77.5	84.5	78.6–90.7
Bristol	78.7	83.2	77.9–88.9
Camb	83.5	86.6	81.9–91.6
Cardff	86.3	88.6	84.2–93.3
Carlis	80.6	82.8	71.4–96.0
Carsh	90.3	92.4	88.8–96.1
Chelms	77.6	84.7	75.0–95.7
Clwyd	75.0	81.7	69.7–95.8
Covnt	84.1	86.8	79.8–94.4
D&Gall	70.1	80.7	67.1–97.0
Derby	85.1	89.3	83.2–95.7
Dorset	70.9	79.5	69.3–91.3
Dudley	96.9	97.0	91.6–100
Dundee	80.7	86.0	79.2–93.3
Dunfn	71.9	76.9	65.8–89.8
Edinb	83.1	85.9	79.8–92.6
Exeter	78.5	85.3	79.7–91.4
Glasgw	82.2	85.4	80.8–90.3
Glouc	91.3	94.4	89.3–99.8
Hull	86.0	89.0	83.8–94.5
Inverns	85.1	85.3	75.2–96.7
Ipswi	81.0	84.6	75.4–95.0
Klmarnk	92.2	93.6	86.9–100
L Barts	93.1	92.7	88.8–96.8
L Guys	91.8	92.4	88.0–97.0
L Kings	87.4	88.6	83.5–94.1
L Rfree	91.7	92.5	88.2–97.1
L West	91.7	93.1	90.2–96.1
Leeds	85.7	88.9	84.3–93.8
Leic	83.0	85.3	80.9–89.9
Liv Ain	89.9	90.9	81.7–100
Liv RI	91.1	92.2	87.7–97.0
ManWst	91.6	91.7	86.4–97.4
Middlbr	81.7	84.0	76.4–92.4
Newc	76.6	80.6	73.2–88.7
Newry	82.1	87.1	77.3–98.1
Norwch	85.5	90.7	86.1–95.5

Table 6.16: (continued)

Centre	Unadjusted 1 yr after 90d survival	Adjusted 1 yr after 90d survival	Adjusted 1 yr after 90d 95% CI
Nottm	82.2	85.8	80.4–91.5
Oxford	85.4	87.1	82.2–92.3
Plymth	75.0	81.4	72.7–91.1
Ports	82.6	83.9	78.2–90.1
Prestn	89.9	91.8	87.1–96.8
Redng	83.0	87.2	80.1–95.0
Sheff	91.1	92.8	89.0–96.8
Shrew	88.0	89.4	80.3–99.6
Stevng	76.9	79.7	71.9–88.3
Sthend	88.9	92.3	84.4–100
Sund	78.6	82.5	73.4–92.6
Swanse	78.9	85.2	79.2–91.6
Truro	85.9	90.2	81.6–99.7
Tyrone	93.3	95.9	88.8–100
Ulster	90.9	94.0	83.9–100
Wirral	82.9	87.6	79.9–96.0
Wolve	81.6	86.1	79.6–93.2
Wrexm	93.3	94.0	86.4–100
England	**85.5**	**88.3**	**87.3–89.4**
Scotland	**80.6**	**84.2**	**81.4–87.0**
Wales	**82.8**	**86.9**	**83.8–90.2**
N Ireland	**86.4**	**89.6**	**85.9–93.4**
UK	**84.8**	**87.8**	**86.8–88.8**

Table 6.17: 90-day survival by centre for 2005 unadjusted and adjusted to age 60

Centre	Unadjusted 90d survival	Adjusted 90d survival	Adjusted 90d 95% CI
Abrdn	95.3	96.6	92.8–100
Airdrie	94.9	95.7	90.2–100
Antrim	97.7	98.6	96.1–100
B Heart	96.4	97.4	94.9–99.9
B QEH	96.4	97.3	95.3–99.3
Bangor	81.6	89.5	82.4–97.1
Basldn	93.3	95.8	90.4–100
Belfast	88.2	91.3	86.9–95.8
Bradfd	91.0	94.0	89.5–98.8
Brightn	90.0	94.3	91.0–97.7
Bristol	86.3	90.5	86.9–94.3
Camb	95.8	97.0	94.8–99.2
Cardff	90.8	93.1	90.0–96.4
Carlis	100.0	100.0	–
Carsh	93.4	95.2	92.6–97.9
Chelms	78.0	86.4	78.5–95.1
Clwyd	88.9	92.9	85.9–100
Covnt	89.0	91.7	86.7–97.1
D&Gall	81.0	88.3	78.3–99.6

Table 6.17: (continued)

Centre	Unadjusted 90d survival	Adjusted 90d survival	Adjusted 90d 95% CI
Derby	97.1	98.1	95.6–100
Dorset	93.3	96.0	91.7–100
Dudley	85.0	87.8	79.3–97.2
Dundee	88.3	92.3	87.6–97.3
Dunfn	90.9	93.8	88.2–99.8
Edinb	96.0	97.0	94.2–99.9
Exeter	88.4	93.0	89.4–96.8
Glasgw	91.6	94.0	91.3–96.9
Glouc	88.5	93.5	88.6–98.7
Hull	89.6	92.8	89.0–96.7
Inverns	93.2	93.7	87.1–100
Ipswi	92.2	94.5	89.5–99.8
Klmarnk	90.7	93.0	86.7–99.7
L Barts	98.3	98.4	96.5–100
L Guys	97.8	98.1	95.9–100
L Kings	97.1	97.6	95.4–99.9
L Rfree	97.7	98.0	95.8–100
L West	97.3	98.0	96.5–99.5
Leeds	87.3	91.2	87.6–95.1
Leic	93.6	95.1	92.7–97.6
Liv Ain	93.9	95.1	88.7–100
Liv RI	87.4	89.8	85.3–94.6
ManWst	91.9	92.6	88.0–97.3
Middlbr	86.9	89.9	84.4–95.8
Newc	92.6	94.5	90.7–98.5
Newry	93.3	95.7	90.1–100
Norwch	83.8	90.9	86.9–95.0
Nottm	91.5	94.1	90.9–97.4
Oxford	95.1	96.0	93.4–98.8
Plymth	89.8	93.8	89.1–98.7
Ports	93.4	94.6	91.4–97.9
Prestn	92.9	94.8	91.4–98.4
Redng	90.0	93.8	89.4–98.3
Sheff	88.5	91.5	87.8–95.4
Shrew	92.5	94.2	88.2–100
Stevng	96.6	97.4	94.5–100
Sthend	79.4	87.5	79.5–96.4
Sund	93.2	95.3	90.9–99.9
Swanse	95.7	97.4	95.0–99.9
Truro	93.5	96.0	90.9–100
Tyrone	68.2	82.2	71.1–95.0
Ulster	84.6	90.9	80.0–100
Wirral	88.7	92.2	86.5–98.4
Wolve	90.0	93.5	89.5–97.7
Wrexm	80.4	85.8	77.2–95.4
England	**92.4**	**94.7**	**94.0–95.4**
Scotland	**92.1**	**94.5**	**92.9–96.0**
Wales	**89.9**	**93.4**	**91.3–95.5**
N Ireland	**88.6**	**92.7**	**89.9–95.5**
UK	**92.1**	**94.5**	**93.8–95.2**

Table 6.18: 1 year after 90-day survival by centre for incident cohort years 1999–2005 adjusted to age 60

	1 year after 90 days survival by centre						
Centre	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Abrdn	81.65	79.65	92.30	87.77	82.82	89.77	80.12
Airdrie	74.61	81.47	84.70	78.24	80.15	85.55	71.35
Antrim							87.17
B Heart	86.01	81.93	84.46	86.36	85.57	87.75	85.66
B QEH						88.24	90.20
Bangor				80.72	86.15	83.66	83.33
Basldn					91.61	95.08	89.89
Belfast							89.35
Bradfd			92.29	82.51	83.29	85.18	85.36
Brightn						87.96	84.46
Bristol	85.79	86.09	86.02	88.25	87.36	87.48	83.19
Camb			90.60	82.56	89.48	88.26	86.62
Cardff	88.16	89.07	84.00	82.79	89.69	86.28	88.61
Carlis	74.95	77.53	95.31	88.58	77.18	86.42	82.81
Carsh	85.62	85.73	75.76	85.27	90.37	86.74	92.38
Chelms						81.12	84.74
Clwyd				88.28	79.22	90.01	81.72
Covnt	78.76	82.87	88.45	90.80	82.18	85.48	86.78
D&Gall	87.17	87.20	74.35	77.92	85.37	88.98	80.72
Derby		87.90	85.00		83.55	86.65	89.26
Dorset					86.05	91.21	79.52
Dudley	89.14	85.82	90.12	88.10	88.22	85.35	97.04
Dundee	89.42	77.39	86.27	83.72	89.53	83.98	85.98
Dunfn	79.88	71.93	70.14	86.68	85.98	87.77	76.86
Edinb	84.74	80.27	80.31	82.34	83.49	80.40	85.94
Exeter	86.71	86.26	86.02	87.40	86.17	86.62	85.33
Glasgw	85.02	84.68	79.79	84.51	84.95	81.59	85.40
Glouc	88.01	95.00	80.63	80.62	83.62	86.09	94.45
Hull	87.82	86.40	89.74	85.19	87.48	86.22	88.99
Inverns	94.13	84.03	91.65	83.47	88.34	83.47	85.25
Ipswi				98.24	93.70	90.87	84.61
Klmarnk	90.43	91.40	88.18	87.22	85.22	83.85	93.57
L Barts						87.55	92.72
L Guys		89.20	88.08	84.67	95.46	88.18	92.41
L Kings				88.39	86.37	88.27	88.64
L Rfree							92.54
L West				92.57	94.62	91.99	93.08
Leeds	79.89	90.43	88.51	84.38	86.90	89.72	88.94
Leic	85.68	84.81	87.57	88.24	91.68	85.53	85.31
Liv Ain							90.85
Liv RI			87.70	84.68	82.54	83.28	92.19
ManWst					87.94	82.77	91.74
Middlbr	80.87	88.40	83.72	78.45	82.23	85.09	84.02
Newc				87.77	88.86	82.83	80.56
Newry							87.10
Norwch						86.10	90.68
Nottm	86.70	89.96	89.34	86.65	86.28	83.60	85.81
Oxford	94.17	89.89	85.63	88.22	87.40	90.70	87.07
Plymth	82.05	86.18	73.02	81.08	81.30	81.20	81.38

Table 6.18: (continued)

	1 year after 90 days survival by centre						
Centre	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Ports			87.11	85.94	88.14	87.49	83.91
Prestn	87.91	86.83	86.41	86.83	86.48	84.42	91.81
Redng		75.96	81.44	90.92	90.06	93.01	87.22
Sheff	85.21	94.75	93.74	83.54	89.99	88.87	92.80
Shrew						88.10	89.39
Stevng	86.83	91.35	80.77	87.29	94.80	87.86	79.70
Sthend	87.72	81.36	80.83	85.96	90.46	88.45	92.26
Sund	80.99	85.00	84.70	69.37	81.13	87.33	82.46
Swanse		84.95	84.18	82.64	81.25	82.76	85.17
Truro			91.40	83.60	88.46	93.16	90.18
Tyrone							95.95
Ulster							94.04
Wirral				76.01	94.15	80.97	87.59
Wolve	86.18	87.79	76.53	86.49	82.95	87.59	86.15
Wrexm	80.31	83.32	82.93	92.99	81.88	91.74	94.01
York		83.16	85.42	80.91	76.65	89.20	84.69
England	**85.50**	**87.50**	**86.26**	**86.09**	**87.99**	**87.47**	**88.30**
N Ireland							**89.60**
Scotland	**85.13**	**81.85**	**82.62**	**83.63**	**85.19**	**83.77**	**84.17**
Wales	**86.75**	**87.11**	**84.08**	**84.18**	**85.88**	**85.68**	**86.95**
UK	**85.52**	**86.41**	**85.59**	**85.59**	**87.47**	**86.95**	**87.83**

Chester and Derry have been excluded as these centres were too small to calculate a single year survival figure.

Table 6.19: 1 year survival by centre for prevalent cohort years 2000–2006 adjusted to age 60

	1 year survival by centre and year						
Centre	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Abrdn	85.8	89.3	87.2	80.4	85.3	87.4	88.5
Airdrie	77.3	76.8	81.2	83.6	84.2	82.6	79.2
Antrim						83.5	92.5
B Heart	86.6	87.4	87.8	87.4	87.3	87.8	86.5
B QEH					89.0	89.1	88.6
Bangor			86.0	81.5	89.7	86.7	90.4
Basldn				82.8	88.5	91.2	91.2
Belfast						86.5	87.1
Bradfd		77.6	87.9	82.6	87.9	86.1	82.1
Brightn					86.6	84.4	88.3
Bristol	87.2	86.3	87.8	89.0	86.9	87.6	87.9
Camb		85.9	86.6	87.1	87.5	87.8	88.8
Cardff	85.2	85.7	86.0	81.1	84.5	84.5	84.6
Carlis	82.8	88.8	80.6	83.0	82.5	85.8	83.5
Carsh	83.6	83.6	82.9	85.3	88.6	86.7	89.3
Chelms					86.4	81.7	84.7
Chestr				85.9	93.1	88.5	93.4
Clwyd			87.9	87.6	75.8	82.3	81.5
Covnt	87.2	85.7	85.1	87.8	88.6	89.5	85.7
D&Gall	87.2	83.9	84.6	86.3	83.1	91.3	82.0
Derby	88.8	89.5		86.5	88.8	88.4	89.2

Table 6.19: (continued)

	1 year survival by centre and year						
Centre	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Derry							84.9
Dorset				90.0	88.3	89.7	85.2
Dudley	85.4	83.3	83.2	84.7	86.7	86.3	87.5
Dundee	76.7	85.7	84.9	84.0	85.4	87.9	88.1
Dunfn	76.1	78.6	82.1	83.5	88.9	91.0	87.9
Edinb	83.7	82.5	84.8	83.8	86.3	86.5	87.4
Exeter	85.9	84.9	87.2	86.3	85.8	84.0	90.7
Glasgw	86.1	83.4	86.0	83.8	85.8	87.6	86.7
Glouc	89.0	78.7	83.7	81.7	89.0	88.3	90.9
Hull	81.0	86.7	87.5	85.3	85.8	84.7	84.7
Inverns	80.8	88.8	88.3	87.4	87.5	87.1	86.3
Ipswi			81.7	85.5	90.3	86.4	84.8
Klmarnk	80.2	85.3	82.5	82.0	86.9	84.5	91.9
L Barts					84.1	85.5	88.2
L Guys	86.1	86.9	86.2	88.7	88.7	89.3	87.9
L Kings			81.0	77.8	81.5	86.5	88.8
L Rfree						90.3	90.5
L West			90.2	91.5	91.3	92.1	91.9
Leeds	83.2	85.9	87.4	86.0	85.4	89.0	89.7
Leic	83.2	84.7	84.1	83.8	85.3	87.3	84.7
Liv Ain		92.5	90.5	90.5	86.4	96.8	86.3
Liv RI		81.4	82.4	85.2	86.4	84.1	89.0
ManWst				85.1	82.2	84.1	86.8
Middlbr	84.0	84.0	84.2	84.3	82.9	86.0	85.2
Newc			83.9	81.7	82.8	87.6	85.6
Newry						85.9	87.8
Norwch					86.3	86.9	89.5
Nottm	85.0	87.0	82.8	85.2	86.3	85.2	83.8
Oxford	87.9	88.5	85.5	86.8	87.9	87.7	88.4
Plymth	84.9	87.4	76.8	85.2	86.9	88.0	83.8
Ports		83.7	81.1	81.5	89.0	86.3	84.9
Prestn	85.6	87.1	86.2	84.5	85.8	85.6	86.6
Redng	83.5	78.3	84.9	82.9	89.8	87.2	89.3
Sheff	84.1	87.9	90.3	91.1	87.7	87.0	89.3
Shrew					84.8	87.8	85.9
Stevng		90.9	86.7	88.4	89.5	88.9	89.9
Sthend	85.1	88.7	88.7	86.9	88.7	86.3	83.4
Sund	76.7	79.3	77.6	75.5	82.8	86.5	78.8
Swanse	83.9	88.1	80.9	82.4	87.9	89.5	86.0
Truro		88.9	82.4	90.2	89.9	85.8	91.8
Tyrone						89.1	84.2
Ulster						85.9	91.3
Wirral			91.6	84.4	85.6	88.6	87.8
Wolve	84.2	90.1	86.3	83.5	86.6	87.9	89.9
Wrexm	83.9	87.7	86.9	85.3	85.7	84.2	85.3
York	87.1	78.9	84.6	81.6	82.6	89.0	83.1
England	**85.3**	**85.9**	**85.7**	**86.2**	**87.1**	**87.6**	**88.0**
N Ireland						**86.2**	**88.1**
Scotland	**83.2**	**83.6**	**85.1**	**83.6**	**85.9**	**87.1**	**86.8**
Wales	**84.5**	**86.9**	**84.8**	**82.4**	**85.5**	**86.0**	**85.4**
UK	**84.9**	**85.6**	**85.6**	**85.6**	**86.9**	**87.4**	**87.7**

Appendix 2: Statistical 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 are 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.

Validity of the centre adjustment for proportional hazards

For the Cox model to be used to adjust centre survival to a specific age (eg 60 years), the assumption of constant proportionality means that the relationship of survival (hazard of death) to age is similar in all centres within the time period studied. If one centre had a relationship of survival with age different from the other centres, the adjustment would not be valid. Testing showed the relationship to be similar for all centres.

Chapter 7: Haemodialysis Dose

Andrew J Williams, Daniel Ford, Anna Casula and Charlie Tomson

Summary

- This chapter summarises analyses of data submitted to the UK Renal Registry on urea reduction ratio (URR) in patients receiving haemodialysis in the UK in 2006. Sixty two of the seventy one centres providing treatment of adults in the UK submitted data on URR. Of these 62 centres, 46 returned URR data on 90% or more of prevalent haemodialysis patients, 14 provided data on between 50% and 90% and 2 centres provided data on less than 50% of prevalent patients.

- Overall, 80% of prevalent haemodialysis patients met the UK Renal Association standard for URR (>65%) in 2006. There was a linear relationship between the proportion of patients in a given centre attaining this standard and the median URR of patients treated in that centre.

- There has been an increase from 56% in 1998 to 80% in 2006 in the proportion of patients in the UK who achieved a URR >65%.

- The haemodialysis dose (URR) delivered to patients who had just started dialysis treatment was lower than that of patients who had been treated for longer and increased further with time.

Introduction

Amongst patients with established renal failure the delivered dose of haemodialysis was an important predictor of outcome[1] which has been shown to influence survival[2,3]. It depends on treatment (duration and frequency of dialysis; dialyser size; dialysate and blood flow rate) and patient (size; weight; haematocrit and vascular access) characteristics. There are two accepted methods of quantifying it. Firstly, there is a ratio (Kt/V) between the product of urea clearance (K, in ml/min) and dialysis session duration (t, in minutes) to the volume of distribution of urea in the body (V, in ml). Secondly, it can also be assessed by a related measure, the urea reduction ratio (URR).

Based on published evidence, clinical practice guidelines have been developed by various national and regional organisations which can be found at 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[4].

The UK Renal Association standard[5] in operation at the time these data were collected was 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. (Good practice)

Every patient receiving thrice weekly HD should show:

- ***either urea reduction ratio (URR) consistently >65%***
- ***or equilibrated Kt/V of >1.2 (calculated from pre- and post-dialysis urea values, duration of dialysis and weight loss during dialysis). (B)***

Patients receiving twice weekly dialysis for reasons of geography should receive a higher sessional dose of dialysis, with a total Kt/V urea (combined residual renal function and haemodialysis) of >1.8. 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. (Good practice)

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 to the Registry, data on pre- and post-dialysis urea values, duration of dialysis, and weight loss during dialysis. (Good practice)

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. (B)

During 2007, the Renal Association issued revised (4th Edition) Clinical Practice Guidelines for haemodialysis, which extend these recommendations.

Current evidence suggests that there is no survival advantage for patients undergoing thrice weekly haemodialysis in whom the dialysis dose (equilibrated Kt/V) is >1.5[6]. The impact of duration and frequency of dialysis independent of dialysis dose is uncertain[7] although there is some evidence that longer treatment time improves survival[8].

For pragmatic reasons (because most centres do not report duration of dialysis or weight loss during dialysis) the Registry has chosen URR rather than Kt/V for comparative audit. Data on post-dialysis sampling methods were last collected by telephone survey in 2002[9]. No reliable data are available to clarify whether the important variations in post-dialysis sampling methodology that were identified at that time persist.

The Registry collected data on recorded session time from most centres although a few centres reported prescribed session time. No data were collected on dialyser characteristics (eg surface area, clearance, flux, membrane type).

Several centres in the UK now use online measurement of ionic dialysance to measure small molecular clearance during haemodialysis, relying on studies that have demonstrated a close linear relationship between this measure and conventional measures of urea clearance[10]. However, the Registry 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.

Methods

Two groups of patients were included in the analyses. Firstly, analysis was undertaken using data from the prevalent patient population on 31st December 2006. For this analysis data for URR were taken from the last quarter of 2006 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 31st December, data from those patients who had died earlier in the year have not been included in the analysis. The second analysis involved the incident patient population for 2006. For these patients analysis was undertaken using the last recorded URR during the quarter in which the patient had started dialysis.

Data on frequency of dialysis were not routinely reported by all centres and were last collected systematically as part of the 2002 National Renal Survey[11]. Data from patients known to be receiving twice weekly dialysis were omitted. However, because not all centres report frequency of dialysis, it is possible that data from a small number of patients receiving dialysis less or more frequently than thrice weekly were included in the analyses. Due to the small numbers involved it is unlikely that this would have influenced the overall centre mean.

All patients with data were included in the statistical analysis, although centres with fewer than 20 patients, or providing less than 50% data completeness were excluded from centre level analyses.

Results

Data completeness

URR data were available from most centres (Table 7.1) on at least 90% of patients. Fourteen centres were included in the analysis but returned data from less than 90% of patients – Brighton (88%), Dumfries & Galloway (88%), Kilmarnock (86%), Preston (84%), Wolverhampton (83%), Guys (82%), Chelmsford (81%), Dundee (80%), Dudley (73%), Oxford (70%), Carshalton (64%), London West (59%), Swansea (54%) and Manchester West (53%). Seven centres

Table 7.1: Percentage completeness of URR data returns

Centre	% complete	Centre	% complete
Abrdn	98	L Kings	0
Airdrie	97	L Rfree	0
Antrim	100	L West	59
B Heart	93	Leeds	96
B QEH	95	Leic	98
Bangor	96	Liv Ain	94
Basldn	99	Liv RI	93
Belfast	95	ManWst	53
Bradfd	99	Middlbr	95
Brightn	88	Newc	0
Bristol	100	Newry	99
Camb	44	Norwch	92
Cardff	94	Nottm	98
Carlis	95	Oxford	70
Carsh	64	Plymth	93
Chelms	81	Ports	98
Chestr	98	Prestn	84
Clwyd	92	Redng	92
Covnt	94	Sheff	97
D&Gall	88	Shrew	92
Derby	97	Stevng	94
Derry	95	Sthend	90
Dorset	95	Sund	96
Dudley	73	Swanse	54
Dundee	80	Truro	96
Dunfn	98	Tyrone	94
Edinb	98	Ulster	100
Exeter	94	Wirral	3
Glasgw	97	Wolve	83
Glouc	97	Wrexm	0
Hull	96	York	99
Inverns	100	**England**	**75**
Ipswi	100	**N Ireland**	**97**
Klmarnk	86	**Scotland**	**95**
L Barts	0	**Wales**	**74**
L Guys	82	**UK**	**78**

(Cambridge, Kings, London Barts, Newcastle, Royal Free, Wirral and Wrexham) reporting on less than 50% of prevalent patients were not included in the centre level analyses. The number preceding the centre name in each figure indicates the percentage of missing data from that centre.

Achieved URR

The median URR and percentage of reported patients attaining the Renal Association standard of a URR >65% are shown in Figures 7.1 and 7.2.

Figure 7.3 illustrates the close relationship between the two.

Changes in URR over time

The change in median URR and attainment of the Renal Association standard (URR >65%) by each centre between 1998 and 2006 is shown in Figures 7.4 and 7.5. Figure 7.6 shows that whilst the median URR has risen from 67% to 72% between 1998 and 2006 there has been a rise in the proportion of patients attaining the RA standard from 56% to 80%.

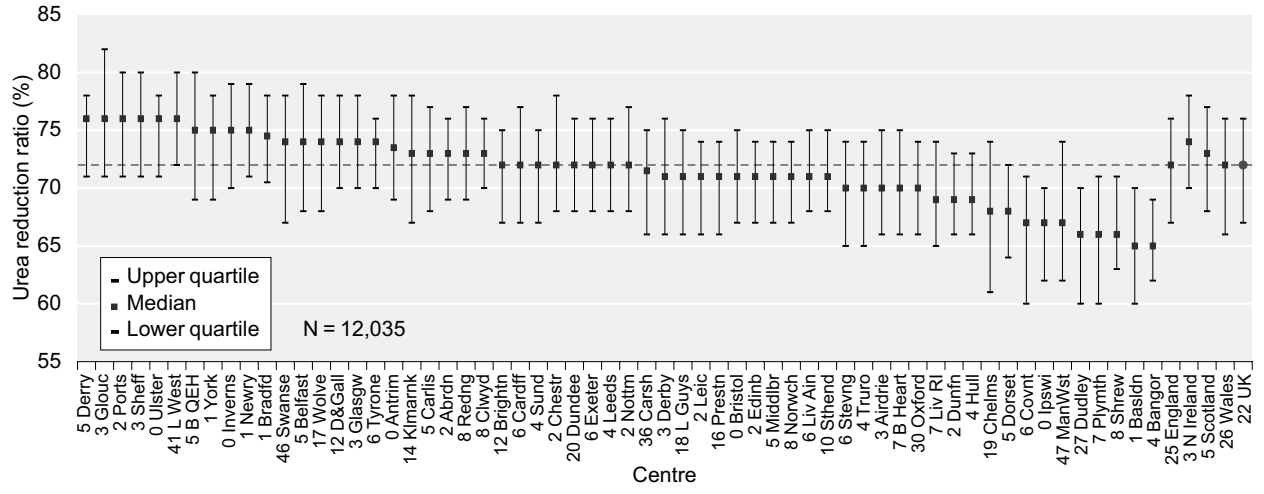

Figure 7.1: Median URR achieved in each centre, 2006

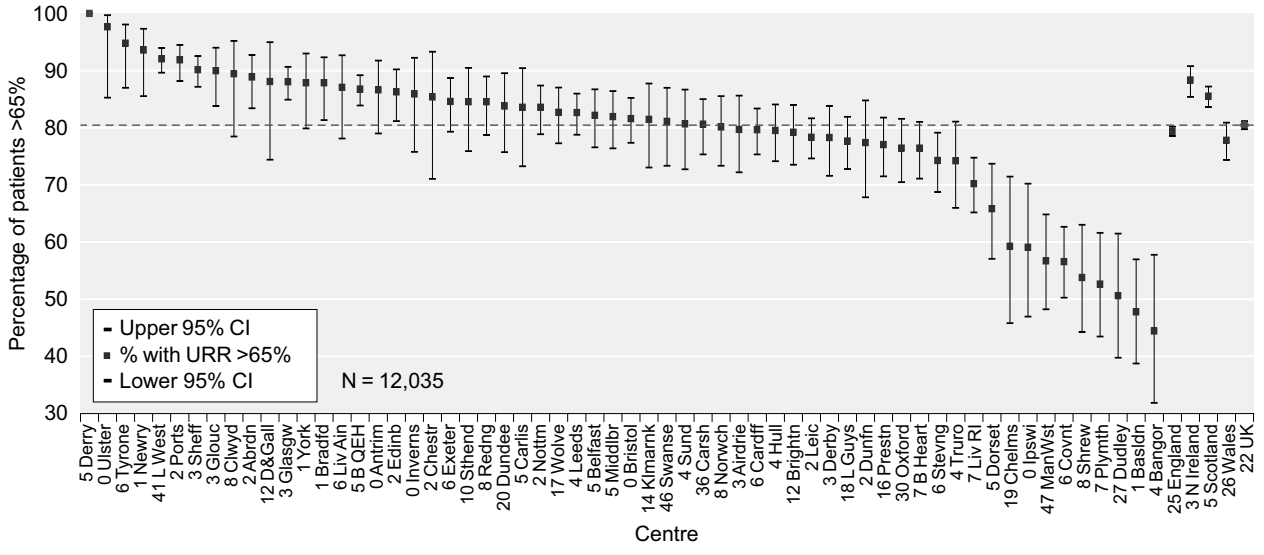

Figure 7.2: Percentage of patients with URR >65% in each centre, 2006

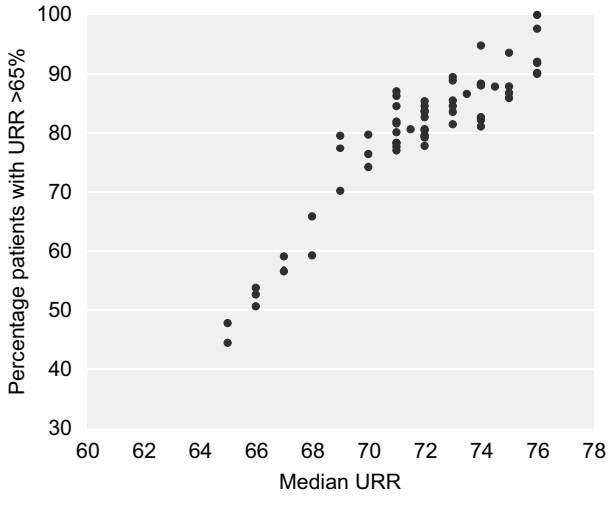

Figure 7.3: Relationship between achievement of the Renal Association standard for URR and the median URR in each centre, 2006

Variation of achieved URR with time on dialysis

The proportion of patients who attain the Renal Association standard increased in parallel with the time since those patients started dialysis (Figure 7.7). Of those dialysed for less than six months, 60% had a URR >65% whilst 85% of patients who had been dialysed for more than two years attained the standard.

The median URR during the first quarter after starting haemodialysis of the incident haemodialysis population in the UK in 2006 was 64% (Figure 7.8).

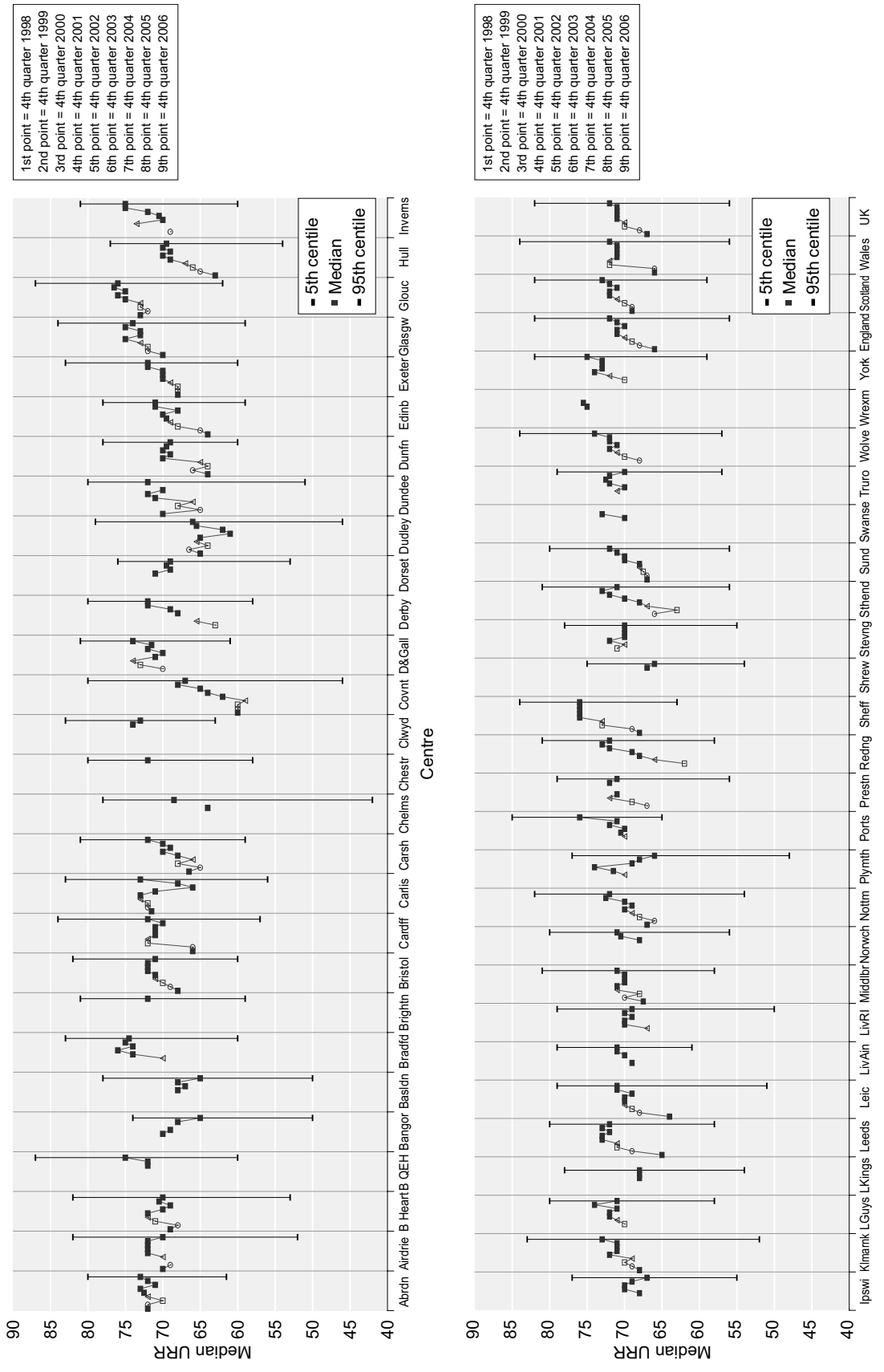

Figure 7.4: Change in median URR in each centre between 1998 and 2006

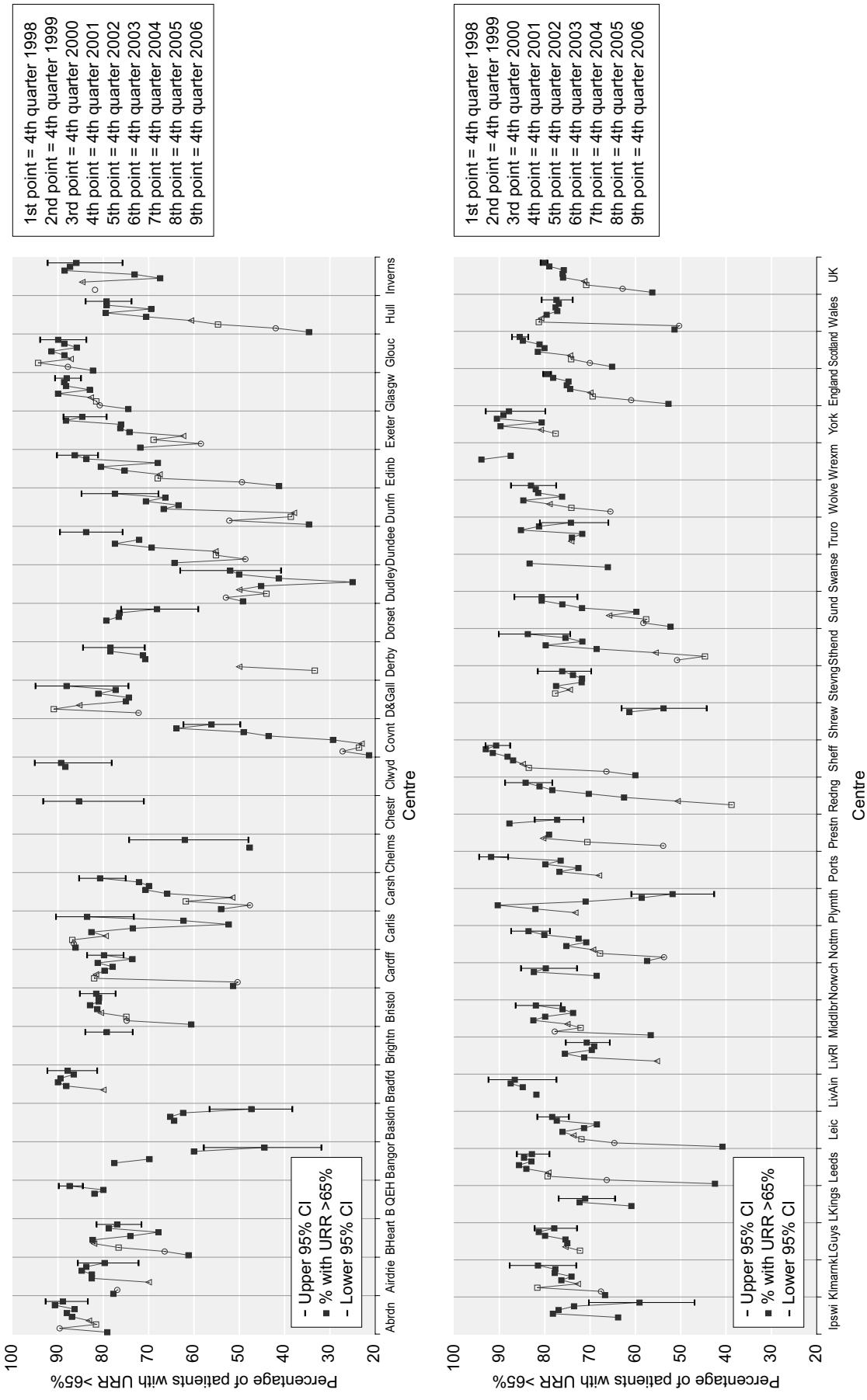

Figure 7.5: Change in achievement of the standard for URR in each centre between 1998 and 2006

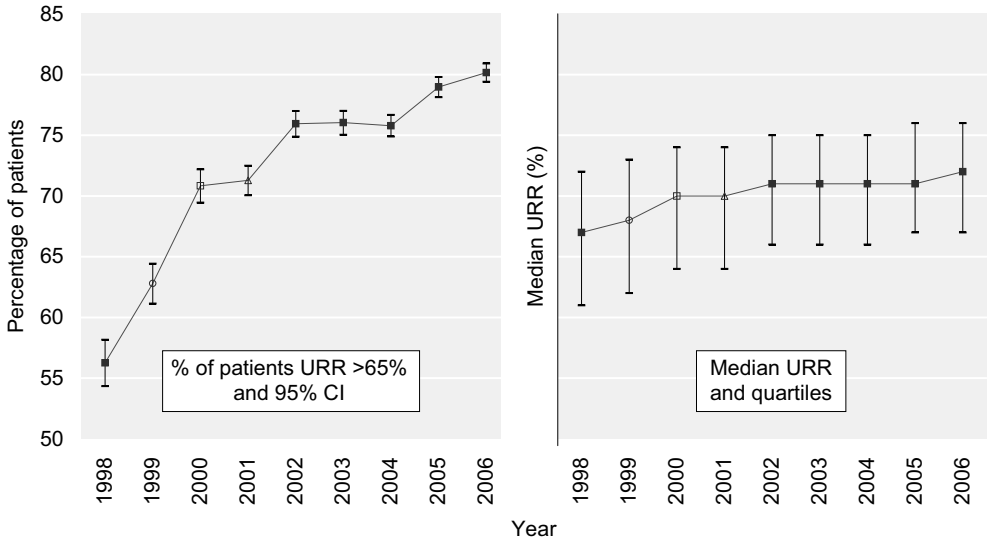

Figure 7.6: Change in the percentage of patients with URR >65% and the median URR between 1998 and 2006 in England, Wales and Scotland

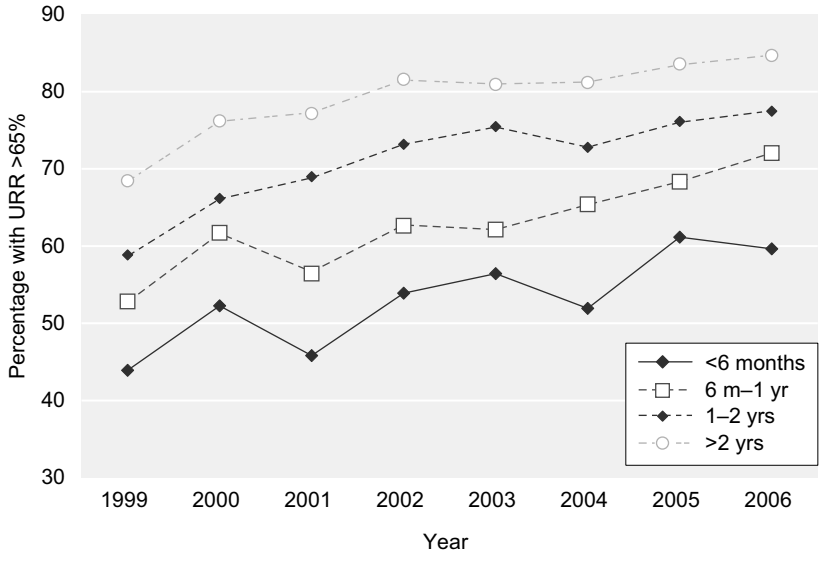

Figure 7.7: Percentage of prevalent haemodialysis patients achieving URR >65% against duration on haemodialysis between 1999 and 2006

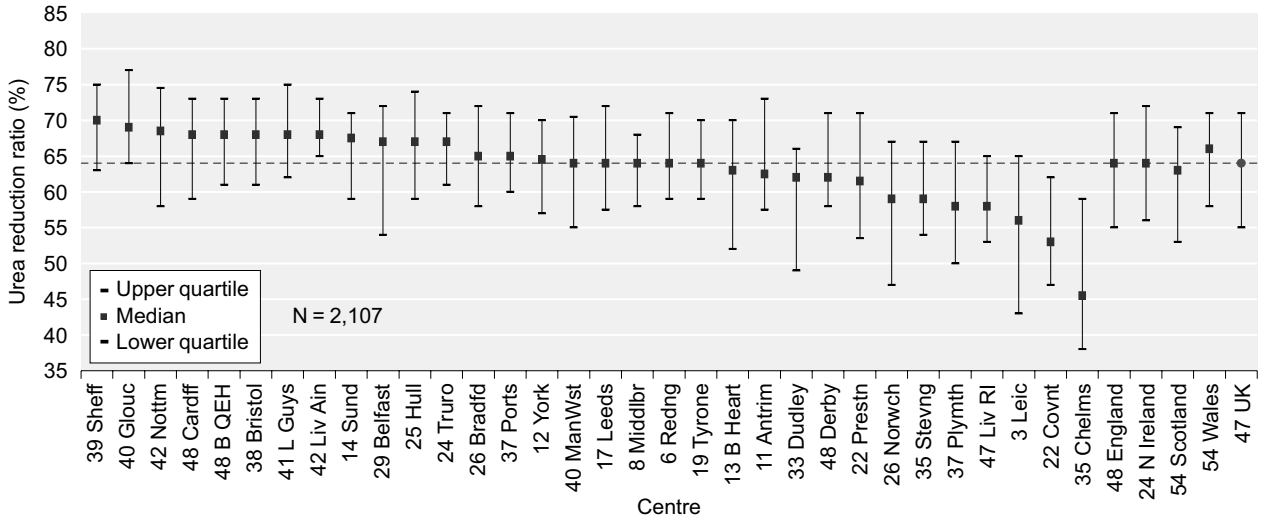

Figure 7.8: Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2006

Discussion

Haemodialysis dose has risen in most centres during the past eight years and approximately 80% of patients undergoing thrice weekly dialysis attain the target that has been set by the UK Renal Association.

Thus far there are no Clinical Practice Guidelines on which to base audit of patients undergoing more frequent haemodialysis regimens or haemofiltration.

There was a gradual rise in delivered haemodialysis dose as the length of time that patients had been on dialysis increased. However, because data regarding residual renal function was not available it is difficult to know whether this represented a change in overall urea clearance.

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Chapter 8: Management of Anaemia in Dialysis Patients

Donald Richardson, Daniel Ford, Julie Gilg and Andrew J Williams

Summary

- In the UK, 40% of patients commenced dialysis therapy with a Hb <10.0 g/dl. The median Hb at commencement of dialysis therapy was 10.4 g/dl. 80% and 86% of incident patients had a Hb ⩾10.0 g/dl by 3 and 6 months after commencement of dialysis treatment respectively.

- The median Hb of patients treated with haemodialysis (HD) in the UK was 11.8 g/dl with an inter-quartile range (IQR) of 10.7–12.8 g/dl. Of HD patients, 86% had a Hb ⩾10.0 g/dl. The median Hb of patients treated with peritoneal dialysis (PD) in the UK was 12.0 g/dl with an IQR of 11.0–12.9 g/dl. 90% of PD patients in the UK had a Hb ⩾10.0 g/dl.

- The median serum ferritin in UK HD patients was 418 μg/L (IQR 268–605) whilst 95% of UK HD patients had a ferritin ⩾100 μg/L. The median ferritin in UK PD patients was 250 μg/L (IQR 145–424) with 85% of UK PD patients having a ferritin ⩾100 μg/L.

- A higher proportion of HD patients required erythropoeisis stimulating agent (ESA) therapy than PD patients (93% vs 79%). The mean ESA dose was higher for HD than PD patients (9,223 vs 5,969 IU/week).

Introduction

This chapter describes data reported to the Renal Registry (UKRR) relating to management of renal anaemia during 2006. The chapter reports outcomes of submitted variables and analyses of these variables in the context of established guidelines and recommendations. More recently introduced NICE guidelines are also quoted to place current outcomes into context with future expectations.

Methods

This chapter analyses the incident and prevalent RRT cohorts for 2006. The Registry extracts quarterly data electronically from renal centres in England, Wales and Northern Ireland, data is sent annually from the Scottish Renal Registry. Patients treated with dialysis during the last quarter of 2006 were included in the analysis if they had been on the same modality of dialysis in the same centre for 3 months. The last available measurement of haemoglobin from each patient from the last two quarters of 2006 was used for analysis. Scottish renal centres only submit haemoglobin data for the final quarter of the year and therefore any patients commencing dialysis in the first three quarters of the year do not have a haemoglobin result at the start of dialysis. This has resulted in only one Scottish renal centre providing data for 20 or more incident dialysis patients. No summary statistics have been calculated for Scotland or Scottish renal centres because of this data incompleteness. Scottish patients with incident haemoglobin data are included in overall UK summary statistics.

The last available ferritin measurement was taken from the last three quarters of the year. For incident patients, data from their first quarter on 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. Analyses were also done on a combined dialysis group.

The completeness of data items were analysed at 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 are 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 Renal Association and other standards was also calculated for haemoglobin. The percentage of patients achieving serum ferritin $\geqslant 100\,\mu g/L$ and $\geqslant 200\,\mu g/L$ have also been 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 2006.

Data regarding ESAs were collected from all centres. Centres were excluded if fewer than 90% of patients were on the ESA file. Centres with fewer than 80% of HD patients or fewer than 65% of PD patients on ESAs were considered to have incomplete data and were also excluded from further analysis.

Results

Haemoglobin

The NSF part one[1] and the Renal Association minimum standards document 3rd edition[2] state that individuals with CKD should achieve a haemoglobin 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 haemoglobin measurement from patients 6 months after meeting a nephrologist. Some indication of compliance with the standard comes from the haemoglobin of the incident patient population (i.e. Hb at the start of RRT).

The European Best Practice Guidelines (EBPG)[3] set a minimum target of 11 g/dl for all patients and United States (KDOQI)[4] guidelines set a target haemoglobin range of 11–12 g/dl. The NICE guidelines published in 2006[5] recommend a target haemoglobin 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 of narrowing the distribution to between 11 and 12 g/dl. However, it should be recognised that much of the data collection for 2006 pre-dates the publication of these NICE guidelines and that care should be taken to avoid improving compliance with the 10.5–12.5 g/dl desired outcome range at the expense of the patients having a Hb <10.0 g/dl. The NICE guidelines highlight the benefit of increasing Hb up to 11 g/dl suggesting consideration of dose changes at 11 and 12 g/dl. The risks associated with low (<10 g/dl) and high haemoglobin (>13 g/dl) are not necessarily equivalent.

Haemoglobin in incident dialysis patients

The haemoglobin level 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 not receiving dialysis (conservative care) were by definition excluded from the current dataset. In the future the Registry plans to collect CKD stage 5 data from patients who subsequently commence RRT as well as those managed conservatively.

The percentage of data returned and outcome haemoglobin are listed in Table 8.1.

The current starting median haemoglobin in the UK was 10.4 g/dl with 60% of patients starting dialysis with a Hb $\geqslant 10$ g/dl. Thus, 40% of patients commenced dialysis therapy with a Hb <10.0 g/dl. There remained a wide range of compliance between centres, from 30 to 82%. The wide range of starting Hb may reflect different practices in referral to nephrologists or differences in funding for pre-dialysis ESA therapy.

The median starting Hb is shown in Figure 8.1 and the percentage starting with a Hb $\geqslant 10.0$ g/dl by centre is given in Figure 8.2. The distribution of haemoglobin in incident dialysis patients is shown in Figure 8.3. The median haemoglobin and the percentage of incident dialysis patients in 2005 with Hb $\geqslant 10$ g/dl, by time on dialysis are shown in Figures 8.4 and 8.5.

The change that has occurred in the haemoglobin of incident dialysis patients since 1997 is

Table 8.1: Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Antrim	55				
B Heart	94	10.0	7.6–12.6	9.0–11.3	53
B QEH	84	10.0	7.4–12.4	8.8–11.0	50
Bangor	93	11.0	9.2–13.6	9.5–11.6	72
Basldn	93	9.3	7.4–12.4	8.5–10.4	30
Belfast	83	10.1	7.5–12.6	8.8–11.1	53
Bradfd	98	10.5	8.5–12.8	9.2–12.1	58
Brightn	76	10.0	7.3–12.9	8.9–11.1	51
Bristol	100	10.4	7.9–13.2	9.5–11.3	62
Camb	73	10.0	7.8–12.4	9.1–11.0	53
Cardff	98	10.7	7.8–13.5	9.3–12.1	64
Carlis	100	10.1	7.8–12.4	9.3–11.3	56
Carsh	96	10.3	8.1–13.2	9.4–11.5	61
Chelms	91	10.7	8.6–12.9	9.9–11.3	68
Chestr	20				
Clwyd	93				
Covnt	94	10.3	7.8–12.4	9.4–11.1	60
Derby	82	9.8	7.8–12.2	8.6–10.8	43
Derry	100				
Dorset	100	10.2	8.3–14.3	9.6–12.0	63
Dudley	95	9.8	8.3–12.3	9.0–10.8	45
Exeter	100	10.1	7.8–12.8	8.9–11.3	54
Glouc	100	10.5	7.7–12.9	9.6–11.5	63
Hull	97	10.5	7.7–12.5	9.4–11.3	63
Ipswi	95	10.4	7.4–14.2	9.3–11.8	67
L Barts	24				
L Guys	72	10.5	7.6–13.0	9.3–11.9	65
L Kings	97	10.1	7.7–13.1	9.0–11.2	54
L Rfree	96	10.6	7.7–13.6	9.3–11.5	64
L West	99	11.2	8.5–13.9	10.2–12.1	81
Leeds	99	10.6	8.1–13.4	9.6–11.7	66
Leic	100	9.8	7.7–12.9	8.9–10.9	48
Liv Ain	88	10.4	8.5–13.3	9.0–11.2	57
Liv RI	96	11.1	7.9–13.9	9.7–12.1	70
ManWst	98	10.8	8.0–13.8	9.6–11.9	67
Middlbr	99	10.4	7.8–13.1	8.9–11.3	56
Newc	98	10.8	6.7–13.2	8.9–11.9	62
Newry	92				
Norwch	94	10.4	7.6–13.2	9.2–11.6	61
Nottm	99	10.3	8.3–12.3	9.5–11.6	61
Oxford	99	10.8	8.4–13.0	9.8–11.7	72
Plymth	71	10.5	7.5–13.0	10.0–11.5	76
Ports	100	10.4	7.9–13.5	9.3–11.8	62
Prestn	92	9.6	7.4–11.8	8.7–10.7	44
Redng	100	10.6	8.1–13.6	9.4–11.5	64
Sheff	100	10.2	8.1–13.1	9.4–11.6	56
Shrew	100	10.8	8.3–13.5	9.8–11.7	71
Stevng	94	10.1	7.9–13.1	8.8–11.0	53
Sthend	100	10.2	7.4–13.2	9.6–11.0	53
Sund	100	10.6	8.4–14.5	9.8–11.9	65
Swanse	99	10.3	8.2–13.0	9.1–11.3	55
Truro	100	10.9	8.5–13.7	10.2–11.9	82

Table 8.1: (continued)

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Tyrone	87	10.1	7.4–11.9	9.1–11.2	62
Ulster	100				
Wirral	63	10.9	8.3–14.1	9.4–13.3	59
Wolve	99	10.5	7.9–13.4	9.2–11.8	61
Wrexm	32				
York	98	10.4	7.9–13.8	9.4–11.7	67
England	**92**	**10.3**	**7.9–13.2**	**9.3–11.5**	**60**
N Ireland	**80**	**10.5**	**7.5–12.6**	**9.1–11.3**	**61**
Wales	**93**	**10.6**	**8.1–13.4**	**9.3–11.8**	**63**
Eng, NI, Wales	**91**	**10.4**	**7.8–13.2**	**9.3–11.5**	**60**

Blank cells – insufficient data for analysis.

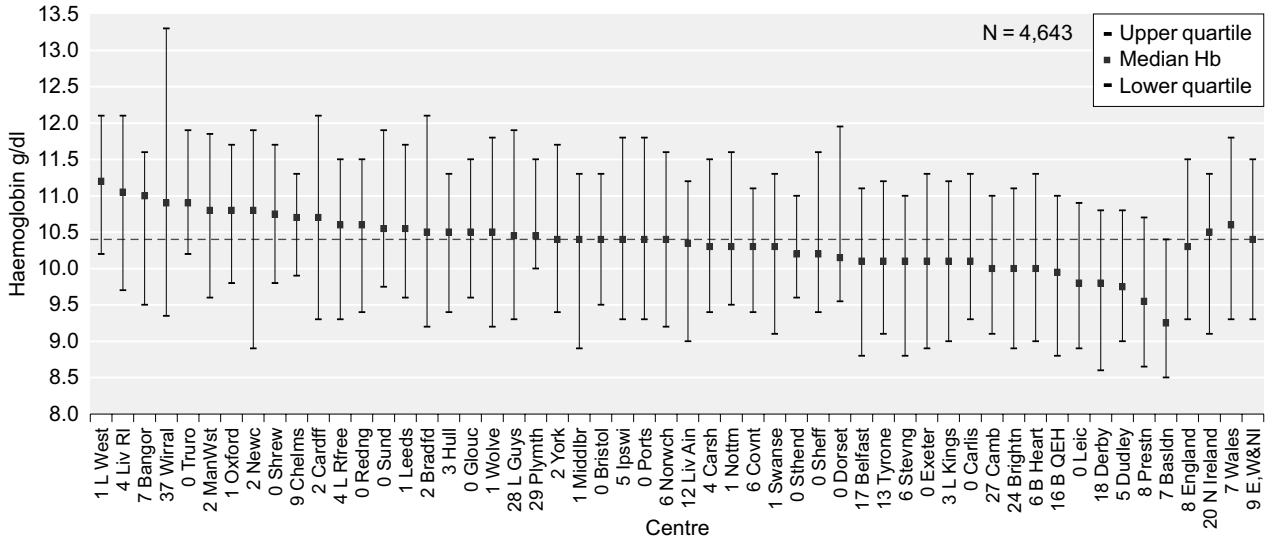

Figure 8.1: Median haemoglobin for incident dialysis patients at start of dialysis treatment

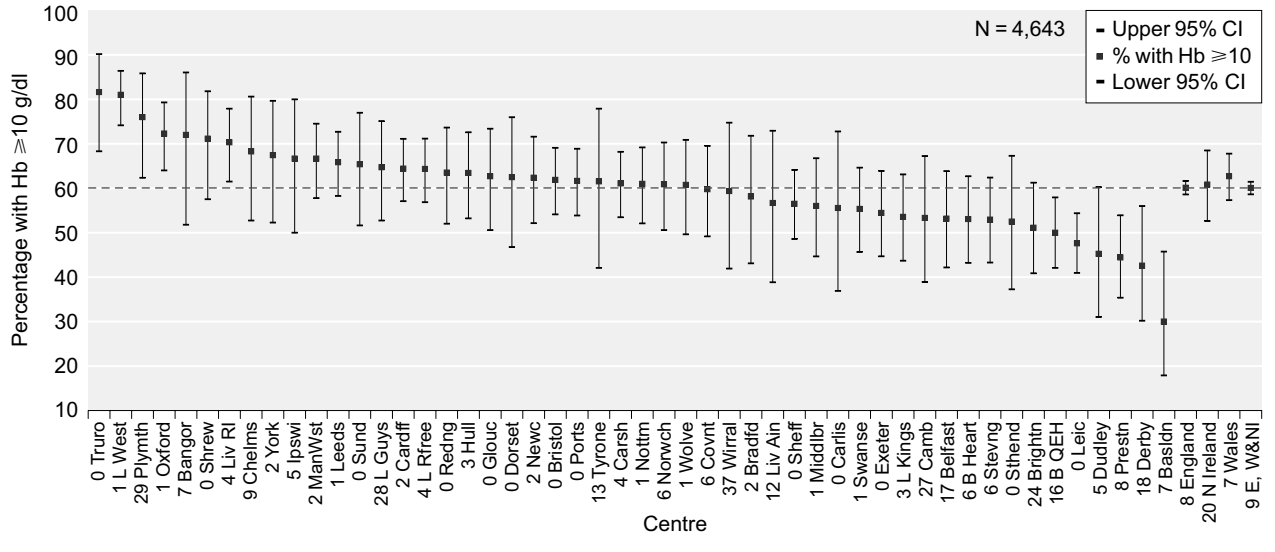

Figure 8.2: Percentage of incident dialysis patients with Hb ⩾10 g/dl at start of dialysis treatment

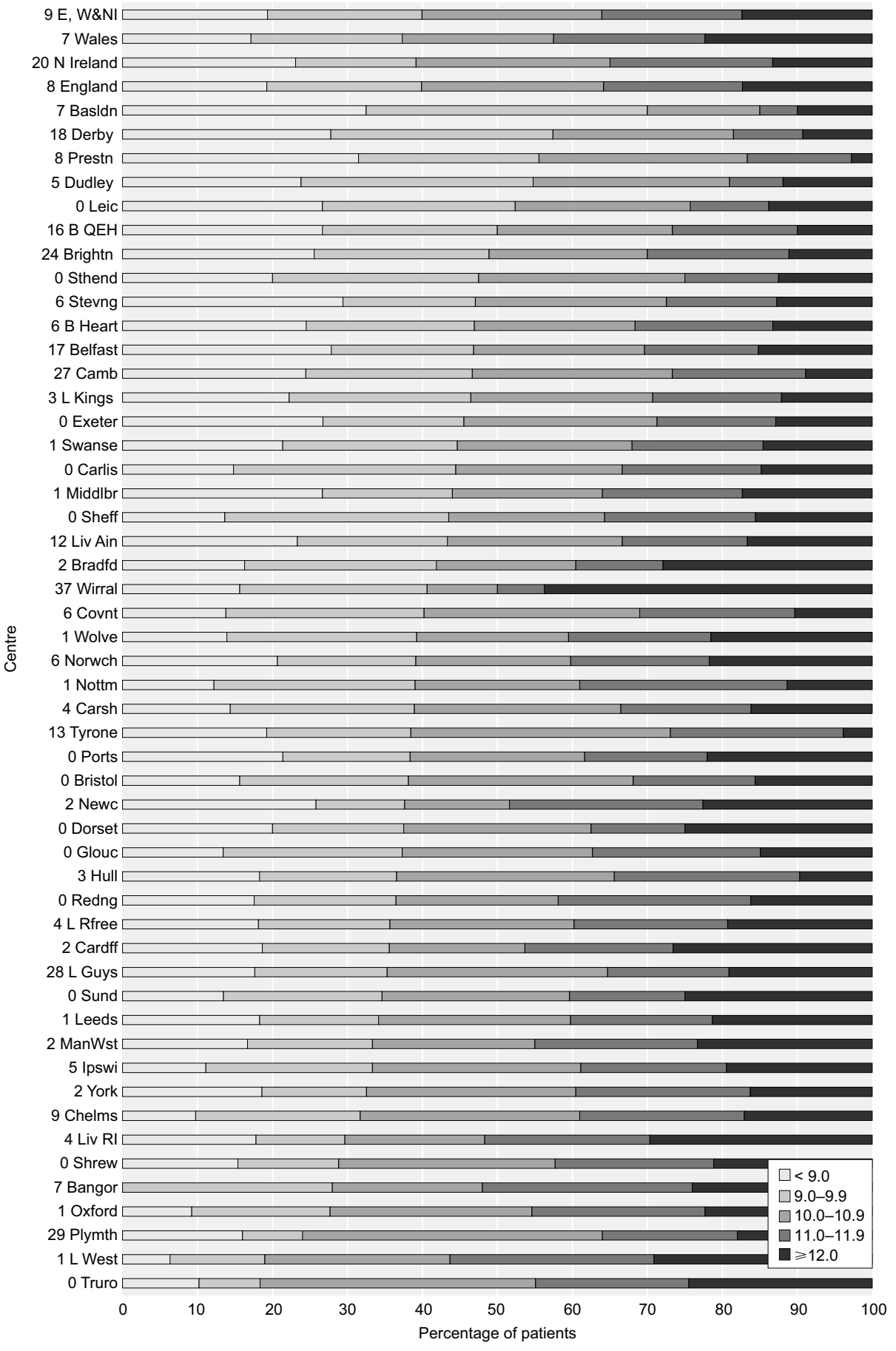

Figure 8.3: Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment

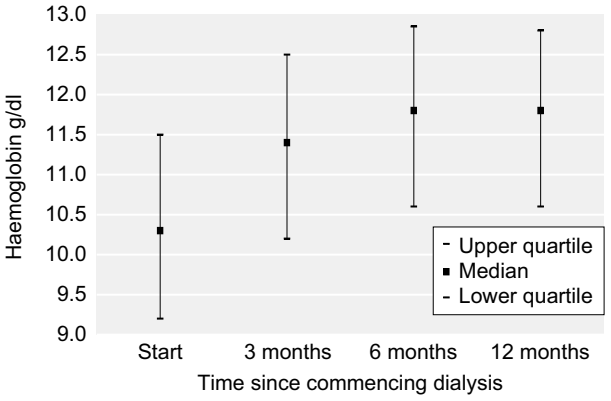

Figure 8.4: Median haemoglobin, by time on dialysis, for incident dialysis patients in 2005

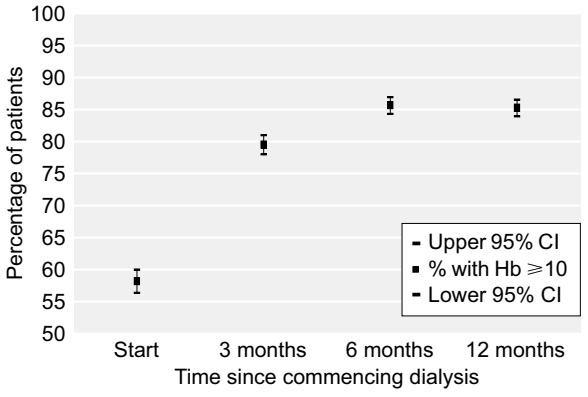

Figure 8.5: Percentage of incident dialysis patients in 2005 with Hb ⩾10 g/dl, by time on dialysis

shown in Figure 8.6. This shows an increase in the Hb for incident patients and probably represents the increased availability of renal anaemia therapy for pre-dialysis patients in the UK.

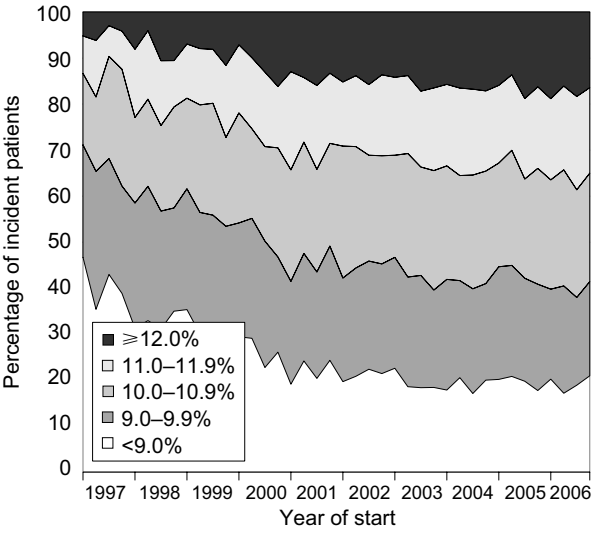

Figure 8.6: Distribution of haemoglobin in incident dialysis patients by year of start

Haemoglobin in prevalent haemodialysis patients

The compliance with data returns and haemoglobin outcome for prevalent HD patients are shown in Table 8.2.

The median Hb of patients on HD in the UK was 11.8 g/dl with an IQR of 10.7–12.8 g/dl. In the UK, 86% of HD patients had a Hb ⩾10.0 g/dl. The median haemoglobin for HD patients by centre, compliance with the UK minimum standard Hb ⩾10 g/dl and EBPG standard of Hb ⩾11 g/dl are shown in Figures 8.7, 8.8 and 8.9 respectively. The distribution of Hb in HD patients by centre is shown in Figure 8.10. The

Table 8.2: Haemoglobin data for prevalent patients on haemodialysis

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	11.9	9.1–14.0	10.6–12.7	11.7	1.4	88	68
Airdrie	99	12.4	9.4–14.1	11.3–13.2	12.2	1.5	91	78
Antrim	97	12.2	10.6–14.1	11.5–13.0	12.2	1.1	99	85
B Heart	92	11.7	9.0–13.7	10.3–12.7	11.4	1.6	81	64
B QEH	97	12.1	8.3–14.5	10.8–13.1	11.9	1.9	83	73
Bangor	97	11.7	9.7–14.1	10.6–12.5	11.6	1.3	90	69
Basldn	98	11.3	8.2–13.2	10.2–12.1	11.1	1.5	76	60
Belfast	95	11.8	9.4–13.8	10.6–12.7	11.7	1.5	89	68
Bradfd	100	12.2	9.3–14.6	11.1–13.2	12.1	1.6	89	77
Brightn	73	11.0	8.3–13.3	9.7–12.1	10.9	1.5	70	52
Bristol	100	11.7	8.9–14.2	10.7–12.8	11.7	1.6	86	71
Camb	66	11.4	8.8–13.5	10.2–12.4	11.3	1.5	78	61
Cardff	98	12.0	9.4–14.6	10.8–12.8	11.9	1.6	89	72
Carlis	95	12.0	9.3–14.3	11.0–13.1	11.9	1.6	87	75
Carsh	84	11.5	8.8–13.7	10.3–12.4	11.4	1.5	83	63
Chelms	98	11.7	9.6–13.7	11.0–12.4	11.6	1.3	90	75
Chestr	81	12.9	9.9–15.4	12.2–13.9	12.9	1.5	94	91

Table 8.2: (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
Clwyd	92	12.2	9.8–14.3	11.1–13.1	12.2	1.4	95	80
Covnt	98	11.3	9.1–13.8	10.3–12.5	11.4	1.5	82	58
D&Gall	96	12.3	10.6–13.9	11.4–13.3	12.3	1.3	96	89
Derby	99	11.3	8.7–13.6	10.3–12.3	11.3	1.6	80	62
Derry	39							
Dorset	98	11.6	9.3–14.0	10.5–12.5	11.6	1.5	86	63
Dudley	85	11.2	8.2–14.1	10.1–12.1	11.1	1.7	77	55
Dundee	98	12.0	9.4–14.3	10.8–13.0	11.9	1.5	87	75
Dunfn	98	12.1	8.8–15.2	10.8–13.3	12.0	1.8	86	74
Edinb	98	12.4	9.9–14.3	11.5–13.1	12.3	1.3	95	85
Exeter	99	11.3	9.1–13.2	10.6–12.2	11.3	1.3	84	61
Glasgw	98	11.8	8.8–14.3	10.6–12.8	11.7	1.7	85	69
Glouc	100	11.8	8.8–14.0	10.8–12.8	11.7	1.6	87	72
Hull	99	11.6	8.8–14.0	10.8–12.4	11.5	1.4	86	70
Inverns	100	12.1	9.6–14.7	11.1–13.1	12.2	1.6	93	79
Ipswi	100	11.5	8.9–13.1	10.5–12.3	11.4	1.3	86	67
Klmarnk	99	11.8	9.2–13.8	10.7–12.8	11.7	1.5	89	69
L Barts	100	11.2	7.9–13.8	9.8–12.4	11.1	1.8	74	55
L Guys	88	11.7	8.9–13.7	10.6–12.6	11.6	1.5	85	68
L Kings	100	11.7	8.8–14.0	10.5–12.7	11.6	1.7	84	69
L Rfree	87	12.2	8.7–14.2	11.0–13.1	12.0	1.7	88	76
L West	99	12.2	9.7–14.2	11.3–13.1	12.1	1.4	93	82
Leeds	99	12.3	9.4–15.0	11.1–13.3	12.2	1.7	90	79
Leic	99	12.1	8.7–14.4	11.0–13.2	11.9	1.7	86	75
Liv Ain	97	11.7	9.1–14.4	10.6–12.8	11.6	1.6	88	61
Liv RI	97	12.7	9.3–15.1	11.4–13.8	12.5	1.7	92	80
ManWst	81	11.7	8.7–14.4	10.3–12.8	11.6	1.9	81	67
Middlbr	99	11.9	9.0–14.4	10.6–13.0	11.9	1.7	85	71
Newc	100	12.3	9.3–14.3	11.3–13.0	12.1	1.5	91	79
Newry	99	11.6	9.2–14.1	10.5–12.3	11.5	1.5	86	71
Norwch	96	11.7	9.1–13.8	10.8–12.6	11.7	1.4	89	72
Nottm	99	11.7	9.1–13.8	10.7–12.5	11.6	1.5	88	68
Oxford	99	12.1	8.9–14.4	11.0–12.9	11.9	1.6	87	75
Plymth	93	11.5	8.8–13.6	10.5–12.4	11.4	1.5	84	64
Ports	99	11.6	9.0–14.2	10.4–12.8	11.6	1.6	84	63
Prestn	97	11.6	8.6–14.2	10.5–12.5	11.5	1.6	85	65
Redng	100	11.8	9.4–14.3	11.0–12.7	11.9	1.5	89	76
Sheff	99	11.7	9.3–13.8	10.8–12.6	11.7	1.4	88	71
Shrew	100	12.0	10.0–14.0	11.0–13.0	12.0	1.3	96	77
Stevng	83	11.4	9.1–13.4	10.6–12.2	11.3	1.3	84	63
Sthend	99	11.2	8.5–13.1	10.4–12.1	11.1	1.3	83	58
Sund	97	11.7	9.5–13.7	10.8–12.5	11.6	1.4	89	71
Swanse	99	11.8	9.3–14.2	11.1–12.8	11.9	1.4	92	78
Truro	99	11.6	9.6–13.4	10.9–12.5	11.6	1.1	92	73
Tyrone	96	12.1	9.3–14.2	11.0–12.8	11.9	1.5	86	75
Ulster	100	11.5	9.3–13.1	10.8–12.4	11.5	1.3	84	73
Wirral	95	11.9	8.7–14.5	10.6–12.8	11.7	1.7	84	68
Wolve	99	12.6	9.7–15.2	11.7–13.7	12.6	1.6	92	83
Wrexm	2							
York	99	12.6	9.4–14.7	11.6–13.4	12.5	1.6	94	86
England	**95**	**11.8**	**8.9–14.2**	**10.7–12.8**	**11.7**	**1.6**	**86**	**70**
N Ireland	**94**	**11.8**	**9.4–14.0**	**10.8–12.7**	**11.8**	**1.4**	**89**	**73**
Scotland	**98**	**12.0**	**9.1–14.3**	**10.9–13.0**	**11.9**	**1.6**	**88**	**74**
Wales	**88**	**11.9**	**9.5–14.4**	**10.9–12.8**	**11.9**	**1.5**	**91**	**74**
UK	**95**	**11.8**	**9.0–14.2**	**10.7–12.8**	**11.8**	**1.6**	**86**	**71**

Blank cells – insufficient data for analysis.

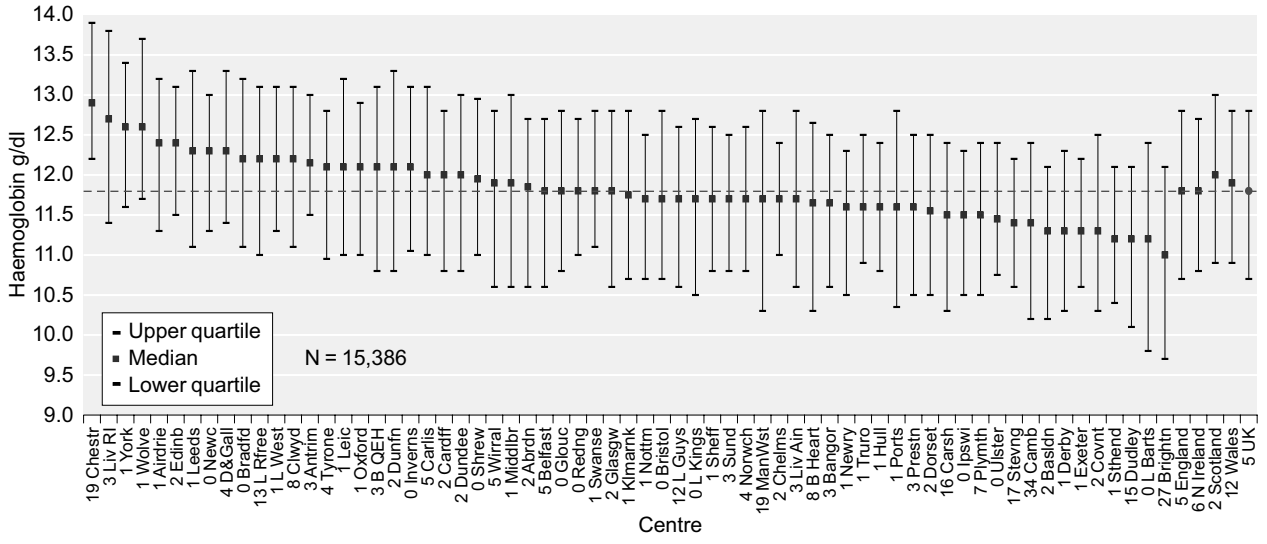

Figure 8.7: Median haemoglobin: HD

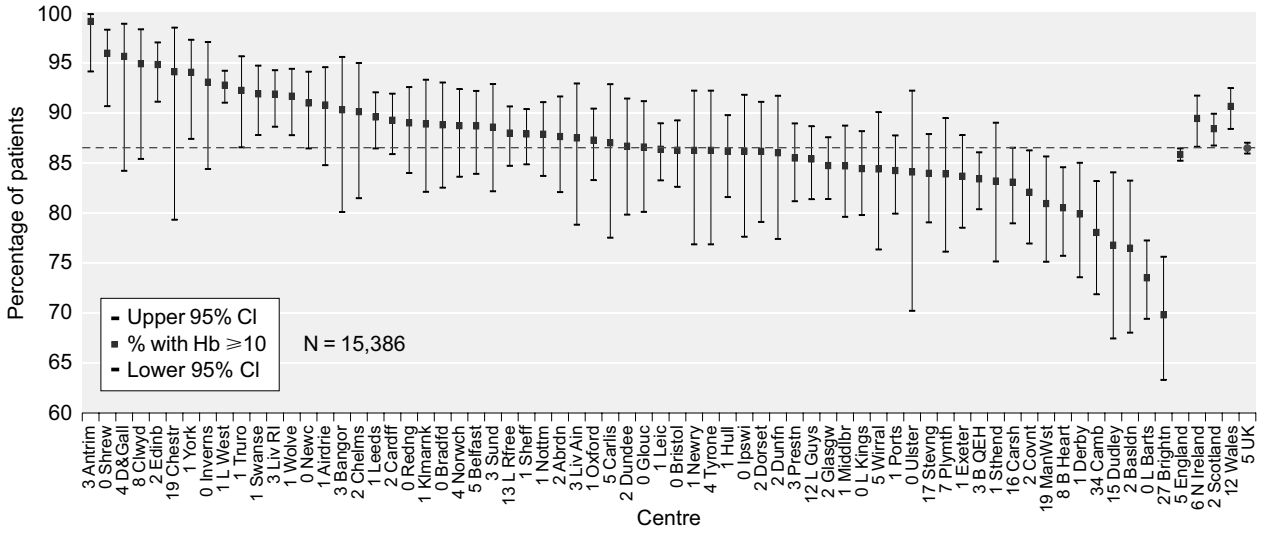

Figure 8.8: Percentage of HD patients with Hb ⩾10 g/dl

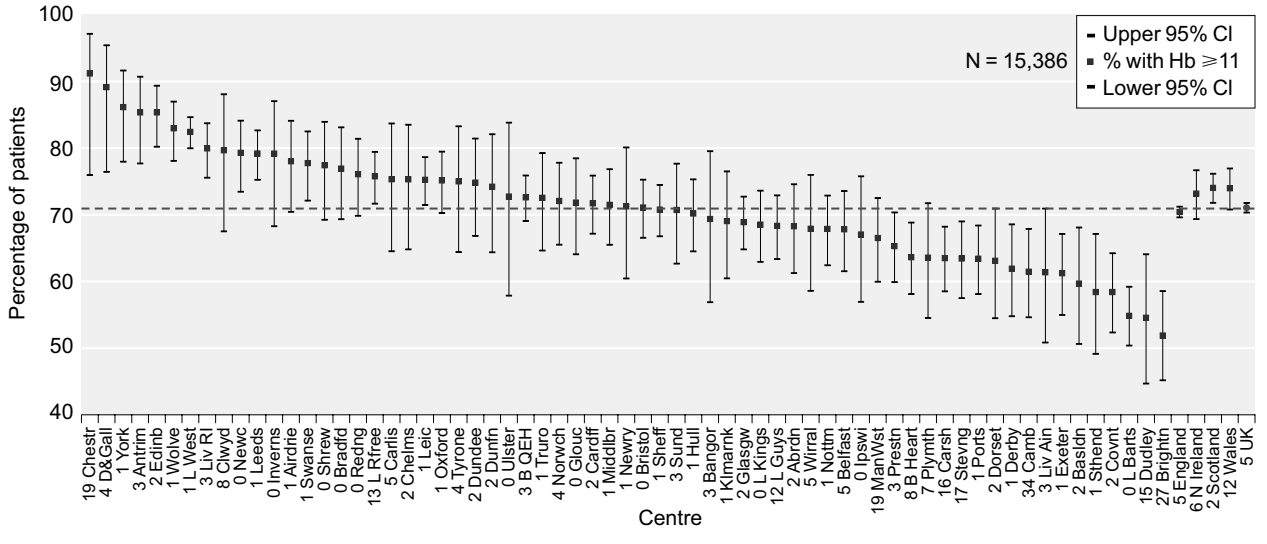

Figure 8.9: Percentage of HD patients with Hb ⩾11 g/dl

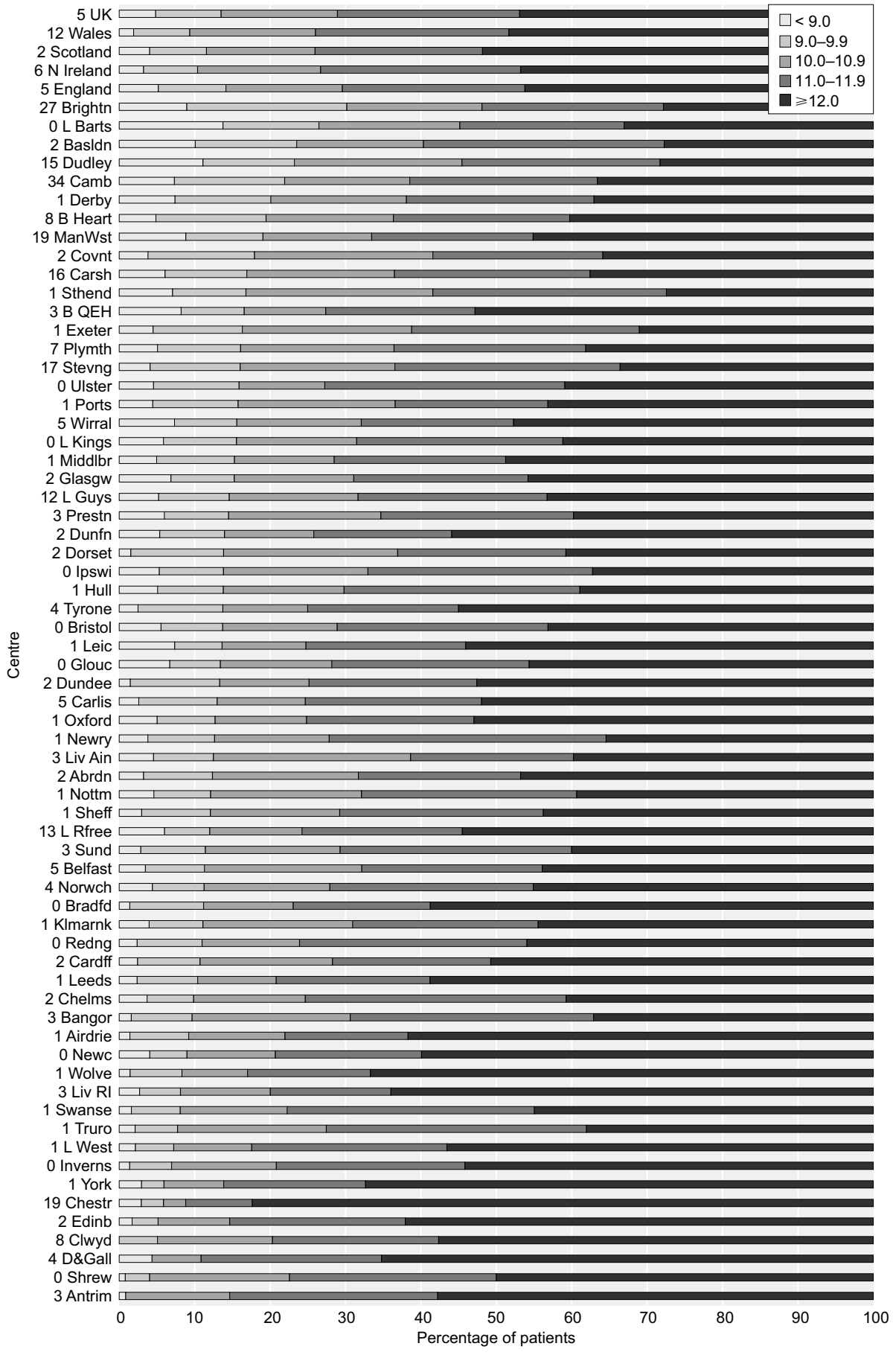

Figure 8.10: Distribution of haemoglobin in patients on HD

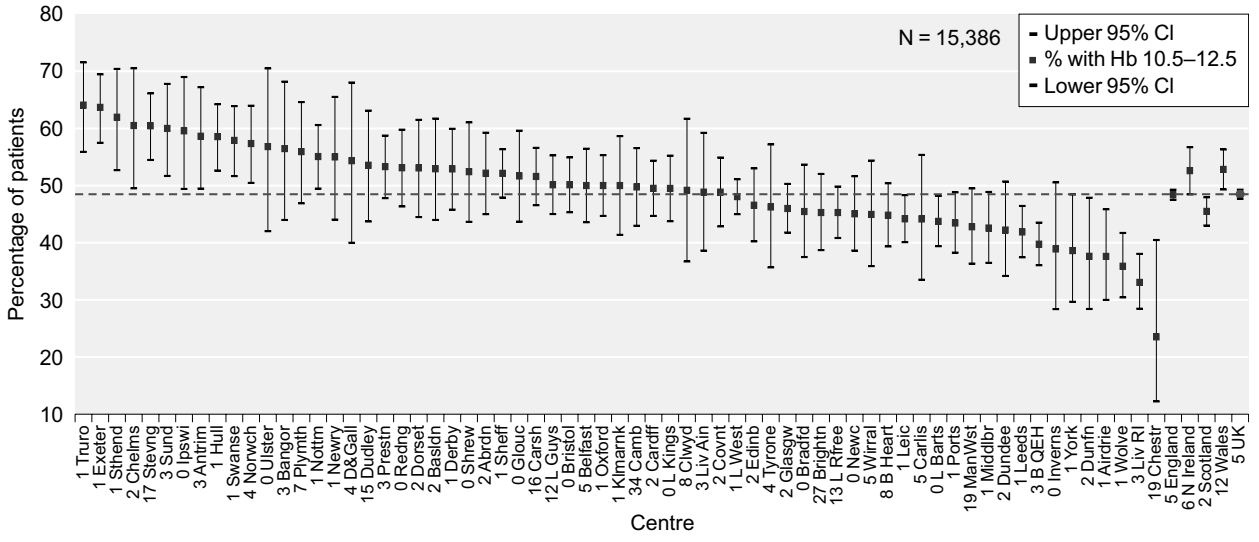

Figure 8.11: Percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

compliance with the NICE recommended range of 10.5–12.5 g/dl is shown in Figure 8.11. At this point it is worth highlighting that although centres can comply well with respect to both outcomes it is also possible to fall within 2 to 3 SDs of the mean in the funnel plot for percentage of patients with Hb ⩾10.5 and ⩽12.5 g/dl (Figure 8.12) and yet have a poor compliance with percentage Hb ⩾10 g/dl (Figure 8.13). The examples of the London Barts and Brighton centres, demonstrate that compliance with one standard (i.e. % Hb 10.5–12.5 g/dl) can be achieved without compliance with another standard (% Hb ⩾10 g/dl). Figures 8.12 and 8.13 should be used in conjunction with Table 8.3 to identify centres.

Haemoglobin in prevalent peritoneal dialysis patients

In the UK, 90% of patients on PD had a Hb ⩾10.0 g/dl (Table 8.4). The median Hb of patients on PD in the UK was 12.0 g/dl with an IQR of 11.0–12.9 g/dl (Table 8.4). The median haemoglobin by centre, compliance with the UK minimum standard Hb ⩾10 g/dl and EBPG standard of Hb ⩾11 g/dl are shown in

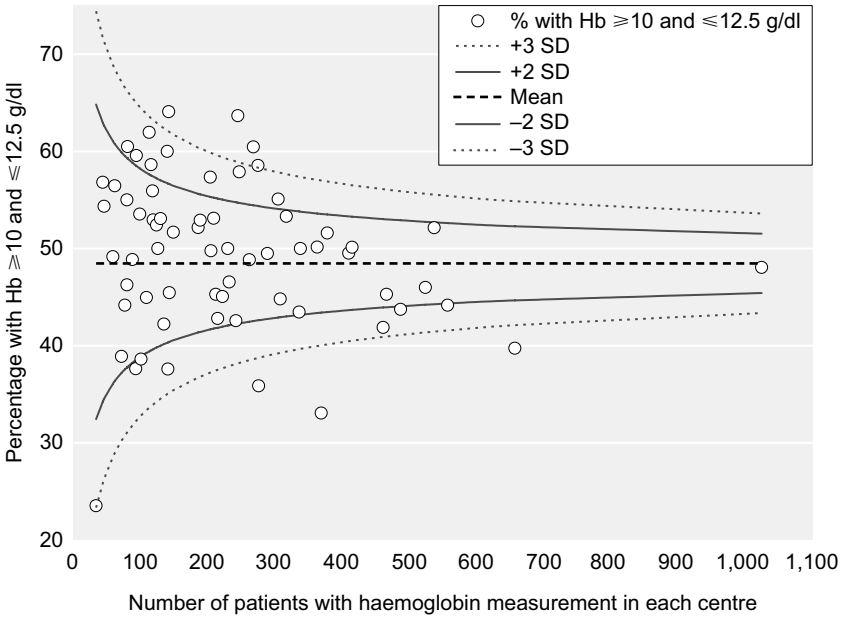

Figure 8.12: Funnel plot for percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

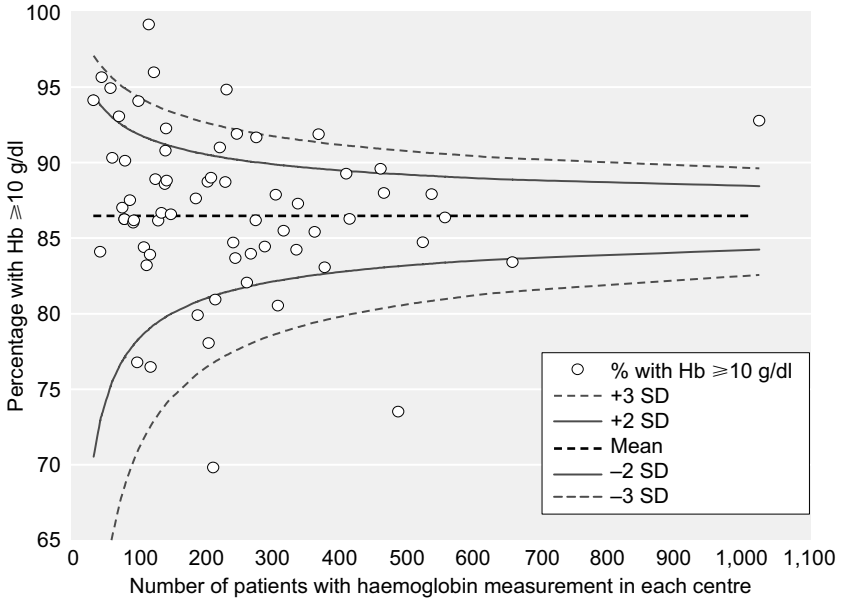

Figure 8.13: Funnel plot for percentage of HD patients with Hb ⩾10 g/dl

Table 8.3: Percentage of HD patients achieving Hb ⩾10 g/dl and Hb 10.5–12.5 g/dl

Centre	No pts with Hb	% with Hb ⩾10 g/dl	% Hb 10.5–12.5 g/dl	Centre	No pts with Hb	% with Hb ⩾10 g/dl	% Hb 10.5–12.5 g/dl
Chestr	34	94	24	Redng	209	89	53
Ulster	44	84	57	Brightn	212	70	45
D&Gall	46	96	54	ManWst	215	81	43
Clwyd	59	95	49	Newc	222	91	45
Bangor	62	90	56	Belfast	230	89	50
Inverns	72	93	39	Edinb	232	95	47
Carlis	77	87	44	Middlbr	242	85	43
Newry	80	86	55	Exeter	245	84	64
Tyrone	80	86	46	Swanse	247	92	58
Chelms	81	90	60	Covnt	262	82	49
Liv Ain	88	88	49	Stevng	268	84	60
Dunfn	93	86	38	Hull	275	86	59
Ipswi	94	86	60	Wolve	276	92	36
Dudley	99	77	54	L Kings	289	84	49
York	101	94	39	Nottm	305	88	55
Wirral	109	84	45	B Heart	308	81	45
Sthend	113	83	62	Prestn	317	85	53
Antrim	116	99	59	Ports	336	84	43
Plymth	118	84	56	Oxford	338	87	50
Basldn	119	76	53	L Guys	363	85	50
Shrew	124	96	52	Liv RI	369	92	33
Klmarnk	126	89	50	Carsh	378	83	52
Dorset	130	86	53	Cardff	410	89	50
Dundee	135	87	42	Bristol	415	86	50
Sund	140	89	60	Leeds	461	90	42
Airdrie	141	91	38	L Rfree	466	88	45
Truro	142	92	64	L Barts	487	74	44
Bradfd	143	89	45	Glasgw	524	85	46
Glouc	149	87	52	Sheff	537	88	52
Abrdn	186	88	52	Leic	557	86	44
Derby	189	80	53	B QEH	657	83	40
Norwch	204	89	57	L West	1,024	93	48
Camb	205	78	50				

Table 8.4: Haemoglobin data for prevalent patients on peritoneal dialysis

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	12.3	9.7–14.3	11.6–12.6	12.2	1.5	90	86
Airdrie	100	12.0	9.4–13.4	10.8–12.8	11.8	1.3	88	75
Antrim	92	12.8	10.8–14.3	11.4–13.3	12.6	1.3	100	91
B Heart	95	12.0	10.0–14.4	11.4–12.9	12.2	1.4	97	83
B QEH	94	11.3	7.5–13.6	10.8–12.2	11.2	1.7	85	66
Bangor	100	12.3	9.6–15.6	11.6–13.2	12.3	1.6	88	82
Basldn	100	11.7	9.6–14.4	11.1–12.6	11.7	1.5	86	79
Belfast	95	11.9	8.9–14.5	11.0–12.9	11.9	1.6	93	76
Bradfd	100	11.7	9.1–14.1	10.9–12.7	11.7	1.7	86	74
Brightn	99	11.9	9.2–14.6	10.7–13.4	12.0	1.7	87	73
Bristol	100	12.1	9.9–14.1	11.0–12.9	12.0	1.3	94	76
Camb	100	12.1	10.0–14.7	11.0–12.7	12.0	1.4	97	80
Cardff	100	12.2	9.3–14.7	11.0–13.0	12.1	1.7	91	77
Carlis	100							
Carsh	98	11.8	9.3–14.3	10.9–12.8	11.8	1.5	90	74
Chelms	100	12.1	9.4–14.6	11.5–12.8	12.1	1.4	93	87
Chestr	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Clwyd	88							
Covnt	100	11.9	9.3–13.8	10.9–12.6	11.7	1.3	91	72
D&Gall	100							
Derby	97	11.8	9.6–13.5	11.0–12.5	11.7	1.2	90	77
Derry	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dorset	100	12.6	9.2–14.8	11.2–13.7	12.4	1.7	88	79
Dudley	100	12.3	9.2–14.5	11.0–13.4	12.1	1.6	88	78
Dundee	100	12.1	10.7–13.5	11.1–12.8	12.0	1.1	95	86
Dunfn	100	11.9	8.9–14.3	11.3–12.6	11.8	1.5	88	84
Edinb	98	11.9	9.6–13.6	10.9–12.8	11.8	1.4	91	74
Exeter	100	11.8	9.3–13.7	10.9–12.7	11.7	1.3	85	74
Glasgw	98	11.8	9.4–14.3	10.7–12.6	11.8	1.4	91	72
Glouc	100	11.8	9.5–13.9	10.8–12.4	11.6	1.4	91	72
Hull	93	11.7	9.0–14.2	10.8–13.0	11.7	1.8	86	75
Inverns	24							
Ipswi	96	12.2	10.9–14.3	11.4–13.5	12.4	1.2	98	92
Klmarnk	95	12.0	9.7–14.5	10.7–13.3	11.9	1.7	90	68
L Barts	86	12.4	8.7–15.2	11.1–13.6	12.2	2.0	88	78
L Guys	99	11.9	9.6–13.6	11.2–12.8	11.8	1.3	89	77
L Kings	99	12.7	9.9–14.9	11.9–13.6	12.6	1.6	94	90
L Rfree	94	11.3	8.8–14.6	10.5–12.4	11.5	1.7	84	64
L West	97	11.6	9.0–14.3	11.1–12.6	11.7	1.4	90	77
Leeds	98	12.1	9.9–14.9	11.3–13.3	12.3	1.7	94	85
Leic	97	11.8	8.8–14.0	10.6–12.6	11.6	1.6	85	69
Liv Ain	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Liv RI	92	12.4	10.0–14.4	11.6–13.4	12.4	1.4	95	87
ManWst	89	12.0	8.6–14.4	10.7–12.8	11.8	1.7	87	67
Middlbr	96	12.4	9.8–14.7	11.2–13.1	12.2	1.6	93	81
Newc	98	12.0	9.3–15.1	11.0–13.4	12.1	1.9	87	75
Newry	86							
Norwch	98	12.3	10.6–14.6	11.8–13.1	12.5	1.4	98	93
Nottm	100	11.6	9.1–14.5	10.7–12.5	11.7	1.5	89	69

Table 8.4: (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
Oxford	100	12.1	9.3–14.5	10.9–12.9	11.9	1.7	90	75
Plymth	92	11.9	9.0–14.2	11.0–12.7	11.8	1.5	85	76
Ports	100	12.1	9.0–14.8	10.9–13.3	12.0	1.7	92	73
Prestn	99	11.8	9.1–14.8	10.8–12.8	11.8	1.6	88	69
Redng	100	12.4	9.7–15.9	11.6–13.6	12.6	1.8	95	85
Sheff	100	11.9	9.1–14.7	10.7–13.1	11.9	1.7	86	72
Shrew	100	12.2	10.1–14.6	11.6–13.3	12.3	1.3	97	85
Stevng	98	12.1	9.9–14.2	11.0–12.8	11.9	1.3	93	75
Sthend	94							
Sund	100							
Swanse	97	11.8	9.3–13.9	10.8–12.4	11.7	1.4	89	71
Truro	100	11.9	9.9–13.9	11.2–12.8	11.9	1.1	94	84
Tyrone	86							
Ulster	100							
Wirral	55							
Wolve	98	12.5	10.1–15.1	11.3–13.8	12.5	1.7	96	80
Wrexm	0							
York	95	12.3	8.5–15.6	11.7–13.7	12.4	2.5	90	86
England	**96**	**12.0**	**9.2–14.5**	**11.0–13.0**	**11.9**	**1.6**	**90**	**76**
N Ireland	**92**	**12.1**	**9.8–14.5**	**11.1–13.1**	**12.1**	**1.5**	**95**	**84**
Scotland	**91**	**11.9**	**9.4–14.3**	**11.0–12.8**	**11.9**	**1.4**	**91**	**76**
Wales	**87**	**12.1**	**9.3–14.5**	**11.0–12.9**	**12.0**	**1.6**	**90**	**75**
UK	**95**	**12.0**	**9.3–14.5**	**11.0–12.9**	**11.9**	**1.6**	**90**	**76**

Blank cells – insufficient data for analysis.
n/a – not applicable.

Figures 8.14, 8.15 and 8.16 respectively. The compliance with the NICE recommended range of 10.5–12.5 g/dl is shown in Figure 8.17. The distribution of Hb in PD patients by centre is shown in Figure 8.18. The funnel plot for % Hb ⩾10 g/dl is shown in Figure 8.19. Figure 8.19 should be used in conjunction with Table 8.5 to identify centres.

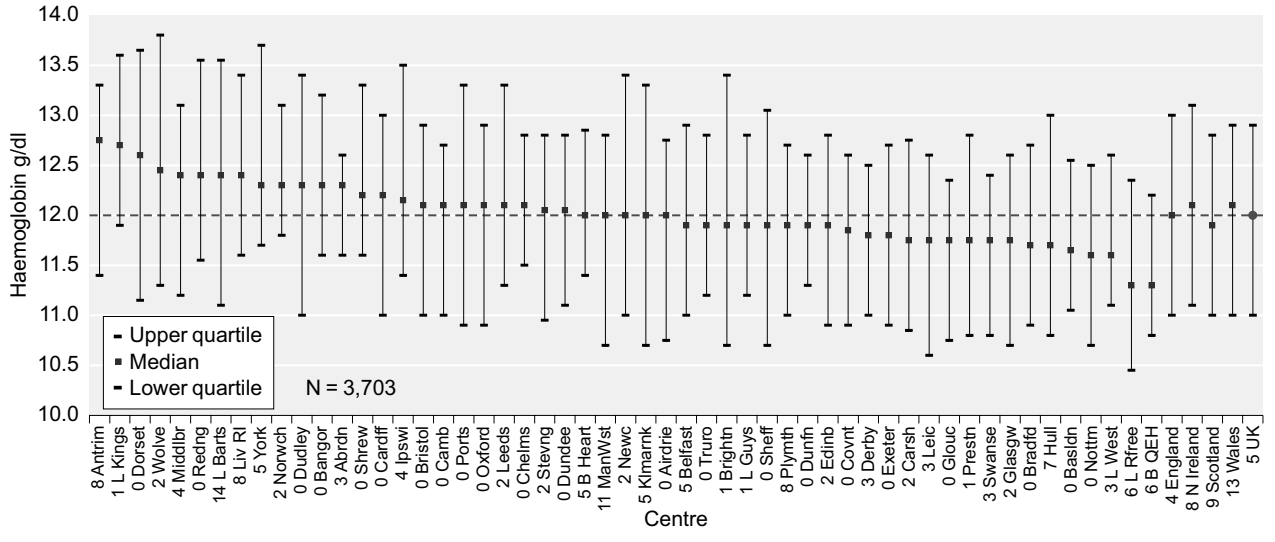

Figure 8.14: Median haemoglobin: PD

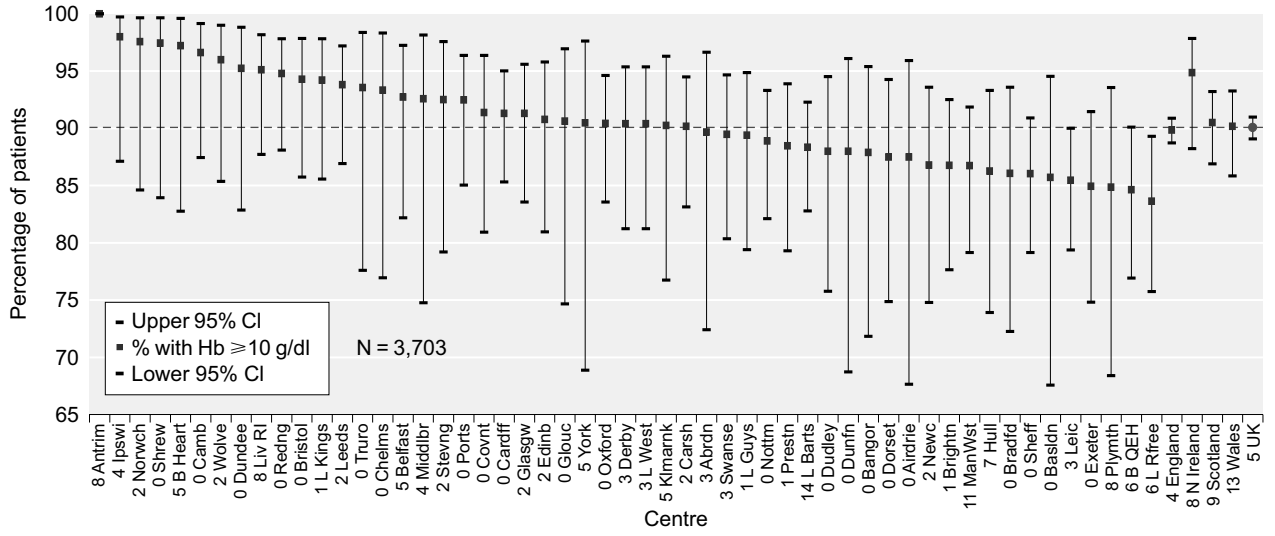

Figure 8.15: Percentage of PD patients with Hb ⩾10 g/dl

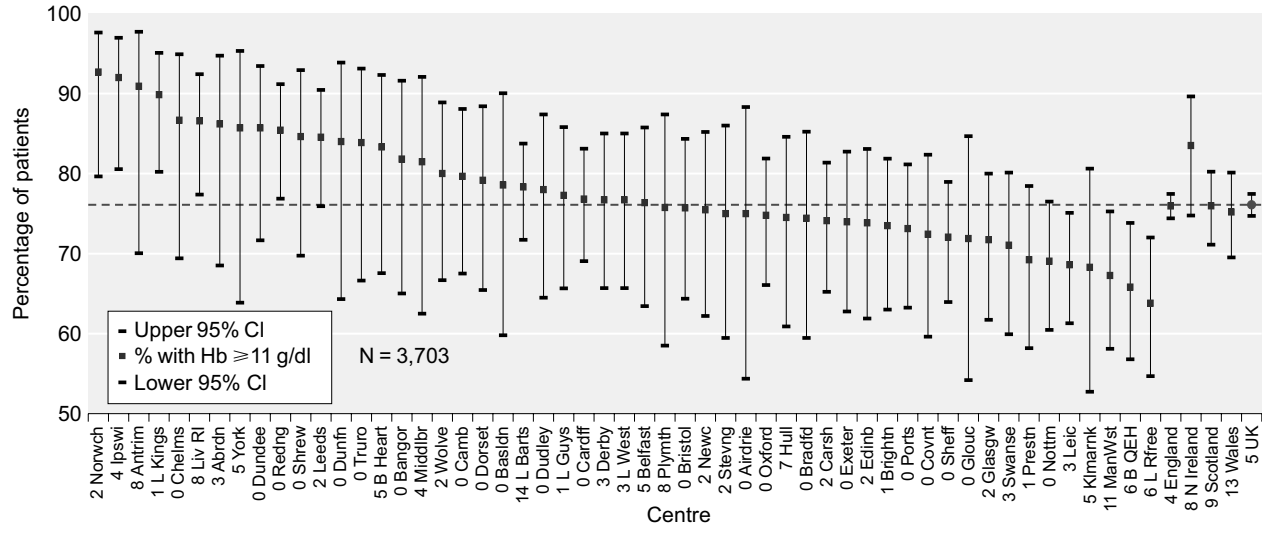

Figure 8.16: Percentage of PD patients with Hb ⩾11 g/dl

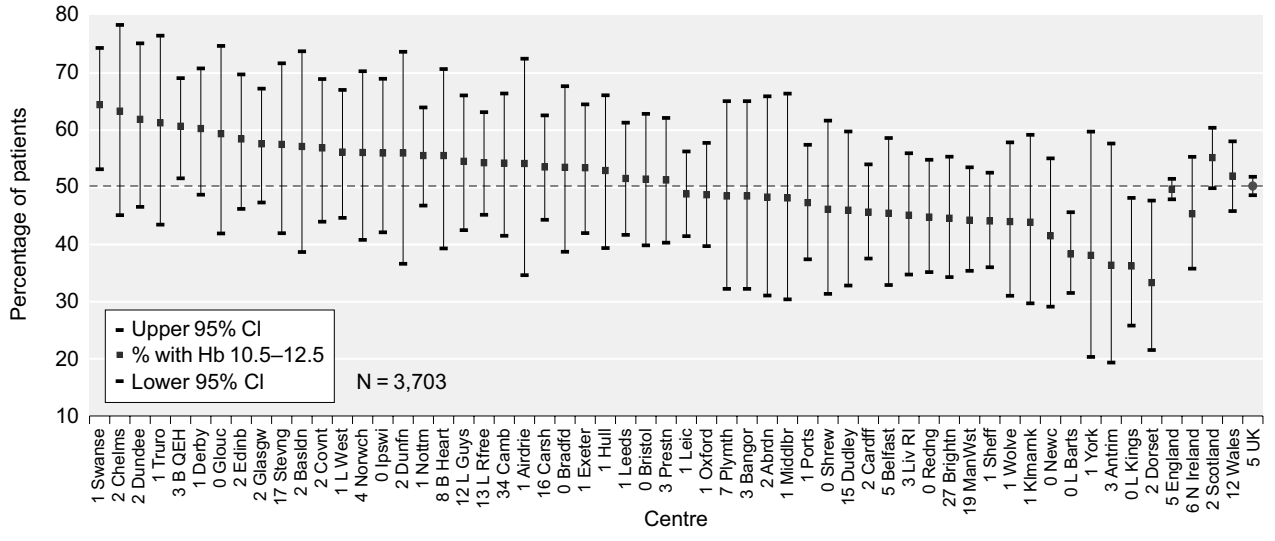

Figure 8.17: Percentage of PD patients with Hb ⩾10.5 and ⩽12.5 g/dl

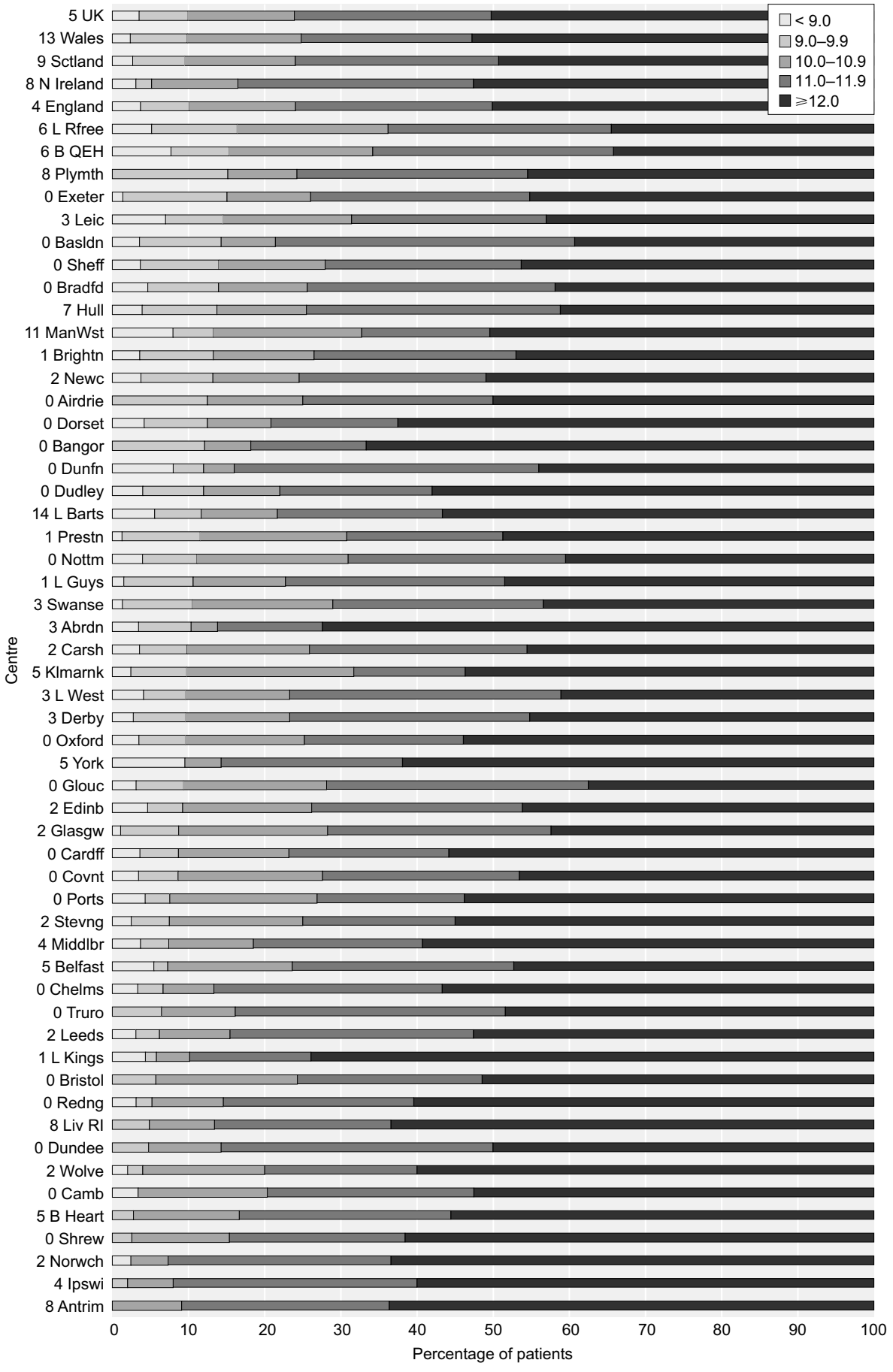

Figure 8.18: Distribution of haemoglobin in patients on PD

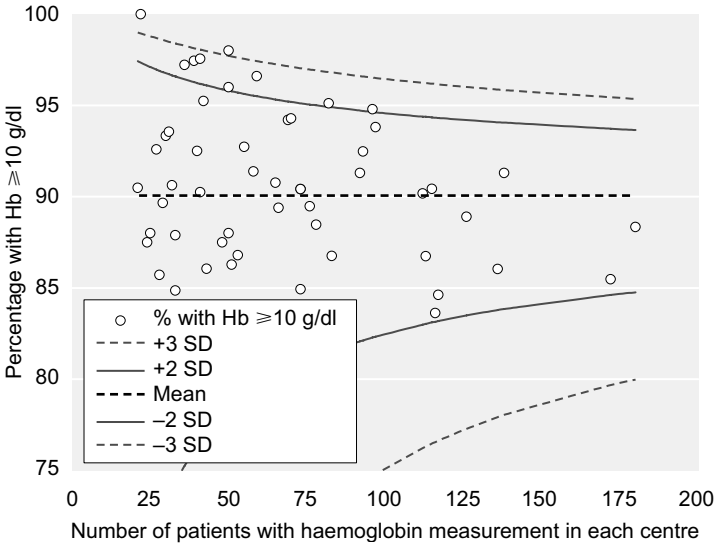

Figure 8.19: Funnel plot for percentage of PD patients with Hb ⩾10 g/dl

Table 8.5: Percentage of PD patients achieving Hb ⩾10 g/dl

Centre	No pts with Hb	% with Hb ⩾10 g/dl	Centre	No pts with Hb	% with Hb ⩾10 g/dl
York	21	90	Camb	59	97
Antrim	22	100	Edinb	65	91
Airdrie	24	88	L Guys	66	89
Dunfn	25	88	L Kings	69	94
Middlbr	27	93	Bristol	70	94
Basldn	28	86	Derby	73	90
Abrdn	29	90	Exeter	73	85
Chelms	30	93	L West	73	90
Truro	31	94	Swanse	76	89
Glouc	32	91	Prestn	78	88
Bangor	33	88	Liv RI	82	95
Plymth	33	85	Brightn	83	87
B Heart	36	97	Glasgw	92	91
Shrew	39	97	Ports	93	92
Stevng	40	93	Redng	96	95
Klmarnk	41	90	Leeds	97	94
Norwch	41	98	Carsh	112	90
Dundee	42	95	ManWst	113	87
Bradfd	43	86	Oxford	115	90
Dorset	48	88	L Rfree	116	84
Dudley	50	88	B QEH	117	85
Ipswi	50	98	Nottm	126	89
Wolve	50	96	Sheff	136	86
Hull	51	86	Cardff	138	91
Newc	53	87	Leic	172	85
Belfast	55	93	L Barts	180	88
Covnt	58	91			

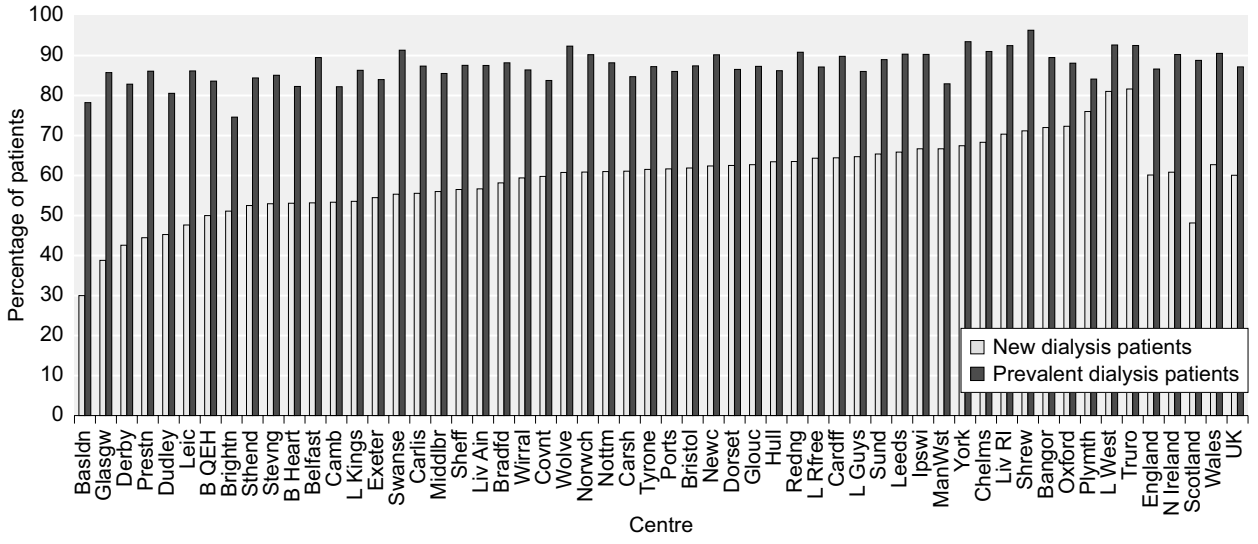

Figure 8.20: Percentage of new and prevalent dialysis patients with Hb $\geqslant$10 g/dl

Relationship between Hb in incident and prevalent dialysis patients in 2006

The relationship between the percentage of new and prevalent dialysis (HD and PD combined) patients who have had a Hb $\geqslant$10 g/dl is demonstrated in Figure 8.20.

Correlation between median haemoglobin and compliance with clinical guidelines

The use of Rose-Day plots has now become well established in demonstrating the relationship between the population mean (and standard deviation) and the compliance with minimum standards. The plots for Hb $\geqslant$10 g/dl and Hb $\geqslant$11 g/dl for HD and PD populations are given in Figures 8.21 to 8.24.

The compliance with the minimum standards over time between 1997 and 2006 are shown in Figure 8.25 for prevalent patients and in Figure 8.26 for incident and prevalent patients between 1998 and 2006.

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 8.27) but did not do so in patients

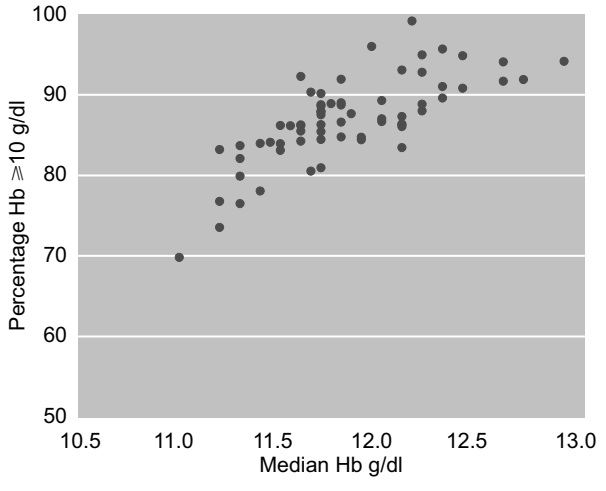

Figure 8.21: Percentage of patients with Hb $\geqslant$10 g/dl plotted against median haemoglobin: HD

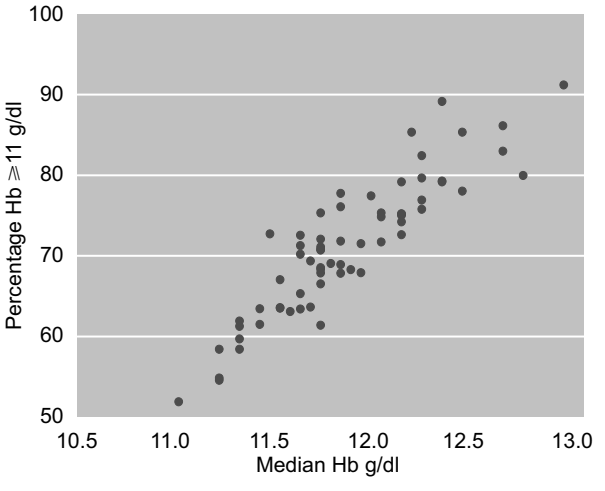

Figure 8.22: Percentage of patients with Hb $\geqslant$11 g/dl plotted against median haemoglobin: HD

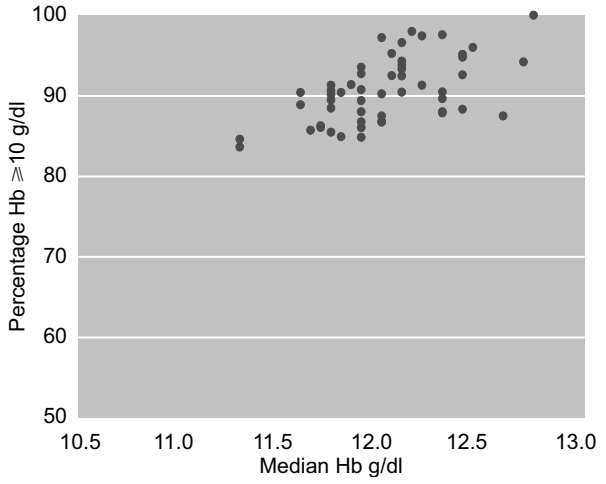

Figure 8.23: Percentage of patients with Hb ⩾10 g/dl plotted against median haemoglobin: PD

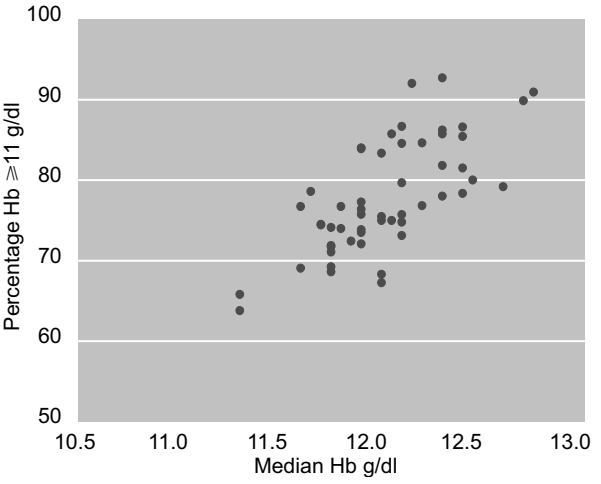

Figure 8.24: Percentage of patients with Hb ⩾11 g/dl plotted against median haemoglobin: PD

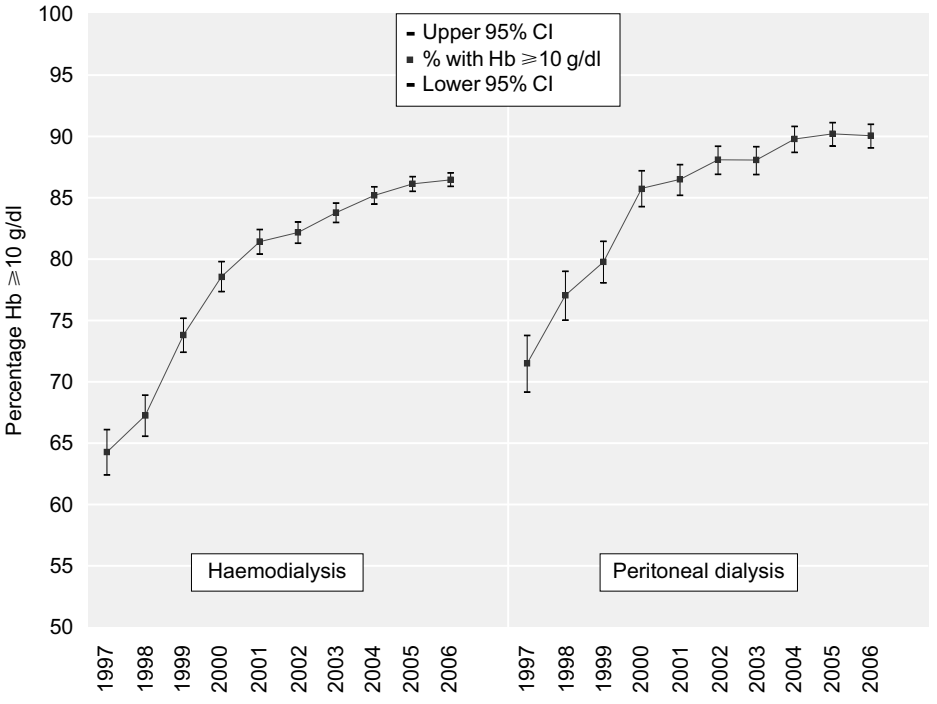

Figure 8.25: Percentage of prevalent HD and PD patients with Hb ⩾10 g/dl: 1997–2006

treated with PD (Figure 8.28). The median Hb (11.3 g/dl) of HD patients (Figure 8.27) during the 6 months after starting dialysis treatment during 2006 was higher than in previous years. By contrast Hb during the 6 months after starting treatment in PD patients (Figure 8.28) had remained stable (12.1 g/dl) for the last 6 years and was higher than in HD patients.

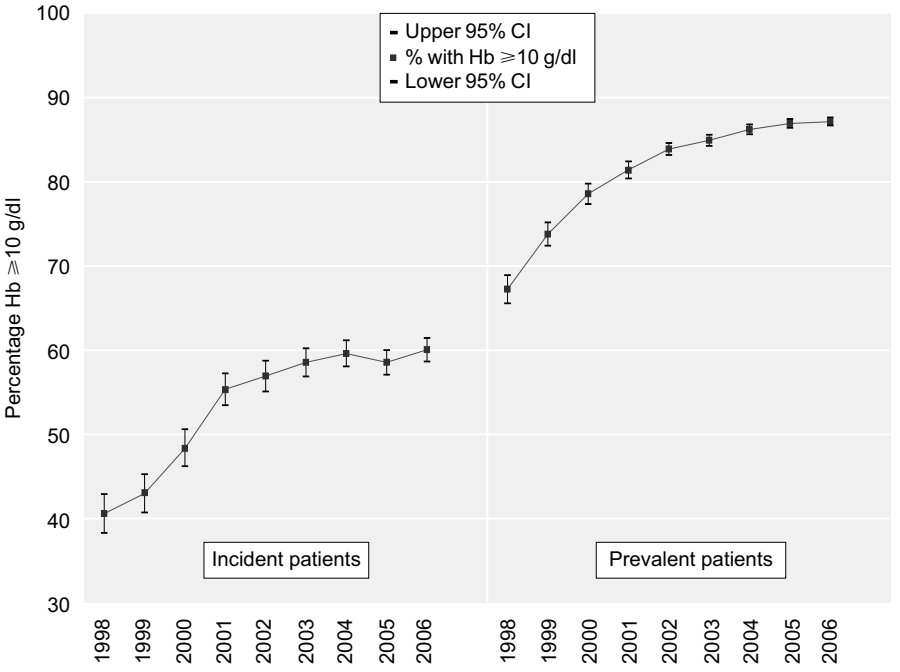

Figure 8.26: Percentage of incident and prevalent dialysis patients with Hb ⩾10 g/dl: 1998–2006

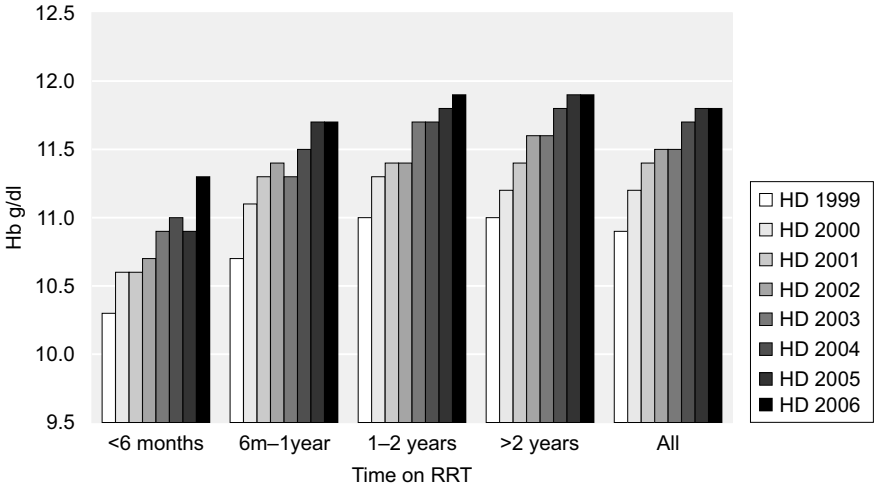

Figure 8.27: Median haemoglobin by length of time on RRT: HD

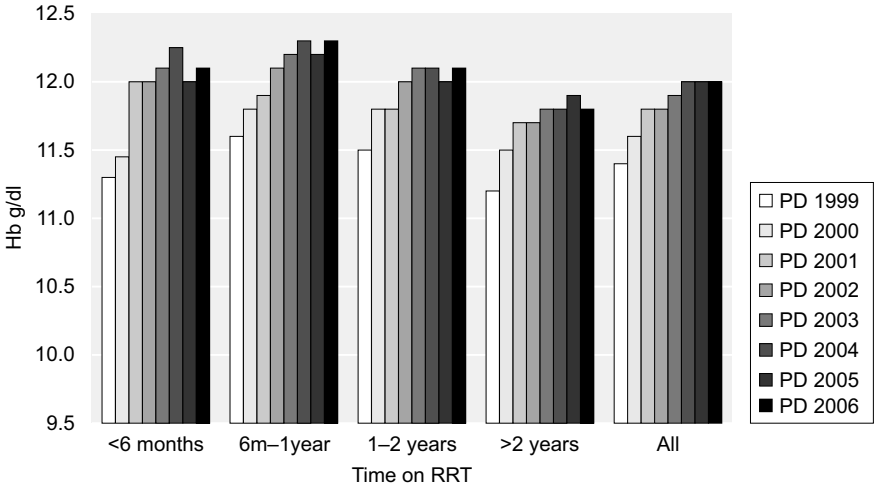

Figure 8.28: Median haemoglobin by length of time on RRT: PD

Factors affecting haemoglobin

National and international recommendations for target iron status in chronic kidney disease remained unchanged from previous reports. The 2007 Renal Association standards document (SDIV)[6], revised European Best Practice Guidelines (EBPGII)[3], Dialysis Outcomes Quality Initiatives (DOQI)[4] guidelines and UK NICE[5] anaemia guidelines all recommend:

a target serum ferritin greater than 100 μg/L and percentage transferrin saturation (TSAT) more than 20% in patients with chronic kidney disease

SDIV and EBPGII recommend:

less than 10% hypochromic red cells (HRC) (evidence level B)

in addition, EBPGII adds:

a target reticulocyte Hb content (CHr) greater than 29 pg/cell (evidence level B)

KDOQI recommends:

Ferritin >200 μg/L for HD patients

The NICE guidelines suggest:

a hypochromic red cells value >6% suggests ongoing iron deficiency (HRC)

To achieve adequate iron status across a patient population, SDIV 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 iron 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 several 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.

Serum ferritin

Completeness of serum ferritin returns for HD and PD

The completeness of serum ferritin returns to the Registry is shown in Table 8.6. Not all sites used serum ferritin as the sole indicator of iron status. Completeness of data for serum ferritin returned from England and Wales improved again compared with last year's report. For Scotland, lack of an automated biochemistry link into the IT renal system is thought to account for a very low rate of return. A '0%' compliance for ferritin data in Scotland persists. In other cases of missing data, renal centres may need to address organisational processes in addition to dealing with automatic download facilities to ensure that serum ferritin is checked.

Serum ferritin in prevalent dialysis patients

Percentage returns, serum ferritin concentrations and interquartile ranges are presented in Tables 8.7 and 8.8 for HD and PD respectively. The percentage of patients with a ferritin $\geqslant$800 μg/L by centre for HD and PD patients is shown in Table 8.9.

The median and IQR for serum ferritin for HD and PD patients, by centre is given in Figures 8.29 and 8.30 respectively. The percentage of patients with a serum ferritin $\geqslant$100 μg/L, $\geqslant$200 μg/L and $\geqslant$800 μg/L are shown in Figures 8.31, 8.32 and 8.33 for HD and Figures 8.34, 8.35 and 8.36 for PD respectively.

Table 8.6: Completeness of serum ferritin returns

Centre	HD %	PD %	Centre	HD %	PD %
Abrdn	1	0	L Kings	100	100
Airdrie	0	0	L Rfree	86	98
Antrim	97	100	L West	100	96
B Heart	92	95	Leeds	99	98
B QEH	97	92	Leic	87	93
Bangor	97	97	Liv Ain	91	n/a
Basldn	99	100	Liv RI	95	98
Belfast	94	95	ManWst	57	88
Bradfd	99	100	Middlbr	96	89
Brightn	63	92	Newc	100	100
Bristol	100	100	Newry	99	86
Camb	77	100	Norwch	97	98
Cardff	96	98	Nottm	99	100
Carlis	95	100	Oxford	97	98
Carsh	84	96	Plymth	97	92
Chelms	99	97	Ports	97	88
Chestr	7	n/a	Prestn	100	100
Clwyd	92	88	Redng	94	88
Covnt	97	97	Sheff	99	100
D&Gall	0	0	Shrew	98	97
Derby	90	61	Stevng	100	88
Derry	100	n/a	Sthend	98	94
Dorset	100	98	Sund	97	100
Dudley	74	96	Swanse	99	97
Dundee	0	0	Truro	98	100
Dunfn	1	0	Tyrone	51	100
Edinb	0	0	Ulster	100	100
Exeter	98	100	Wirral	95	55
Glasgw	0	0	Wolve	99	100
Glouc	99	97	Wrexm	2	0
Hull	99	87	York	99	100
Inverns	0	0	**England**	**93**	**92**
Ipswi	99	88	**N Ireland**	**90**	**95**
Klmarnk	0	0	**Scotland**	**0**	**0**
L Barts	94	51	**Wales**	**88**	**86**
L Guys	90	99	**UK**	**84**	**83**

n/a – not applicable.

Table 8.7: Serum ferritin in HD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
Antrim	97	465	119–976	297–606	97.4
B Heart	92	195	23–524	107–303	77.5
B QEH	97	349	156–687	266–437	97.9
Bangor	97	445	142–976	288–568	100.0
Basldn	99	298	71–480	195–375	89.2
Belfast	94	516	170–1,061	335–723	99.1
Bradfd	99	491	159–888	350–655	97.2
Brightn	63	384	140–1,137	267–565	96.2
Bristol	100	417	103–852	286–557	95.2
Camb	77	335	60–720	229–489	92.9
Cardff	96	473	142–1,166	321–675	97.0

Table 8.7: (continued)

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
Carlis	95	370	186–773	308–497	98.7
Carsh	84	339	58–870	236–466	91.8
Chelms	99	575	315–1,078	452–791	100.0
Chestr	7				
Clwyd	92	363	162–686	266–464	100.0
Covnt	97	294	72–977	192–470	91.6
Derby	90	288	70–914	178–475	89.5
Derry	100	591	43–1,270	381–925	91.3
Dorset	100	413	96–844	293–570	93.9
Dudley	74	327	61–845	155–458	80.2
Exeter	98	280	98–591	199–384	94.3
Glouc	99	363	51–914	222–595	89.8
Hull	99	384	148–786	281–505	98.2
Ipswi	99	420	66–1,136	218–608	91.4
L Barts	94	408	137–904	275–552	97.2
L Guys	90	409	98–892	254–567	94.9
L Kings	100	452	141–1,180	295–662	95.8
L Rfree	86	379	63–1,203	200–582	90.2
L West	100	555	241–1,267	389–780	98.1
Leeds	99	500	145–873	379–626	97.0
Leic	87	321	63–1,019	193–493	89.4
Liv Ain	91	441	85–1,230	193–725	94.0
Liv RI	95	581	117–1,619	335–934	95.8
ManWst	57	610	174–1,769	411–947	96.1
Middlbr	96	336	58–1,308	183–695	87.6
Newc	100	469	200–989	326–639	98.2
Newry	99	450	166–1,182	292–618	100.0
Norwch	97	573	169–1,139	381–750	98.1
Nottm	99	554	277–1,009	448–664	99.0
Oxford	97	288	83–692	204–406	92.8
Plymth	97	449	129–1,255	284–630	96.8
Ports	97	252	70–742	169–368	90.3
Prestn	100	724	177–1,821	471–976	96.6
Redng	94	553	221–1,247	435–691	99.0
Sheff	99	465	101–1,017	302–632	95.3
Shrew	98	210	63–628	133–334	83.6
Stevng	100	403	119–848	257–563	96.9
Sthend	98	298	77–797	238–388	92.9
Sund	97	520	258–1,032	380–667	99.3
Swanse	99	391	112–825	259–563	97.2
Truro	98	440	187–733	333–563	97.9
Tyrone	51	570	164–1,440	301–819	97.6
Ulster	100	457	204–1,124	311–651	100.0
Wirral	95	644	348–1,683	501–835	100.0
Wolve	99	493	189–964	389–617	98.6
Wrexm	2				
York	99	603	326–965	486–706	98.0
England	**93**	**415**	**96–1,069**	**265–601**	**94.6**
N Ireland	**90**	**493**	**155–1,154**	**317–684**	**98.5**
Wales	**88**	**434**	**129–976**	**298–608**	**97.5**
Eng, NI & Wales	**84**	**418**	**99–1,070**	**268–605**	**94.9**

Blank cells – insufficient data for analysis.

Table 8.8: Serum ferritin in PD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
Antrim	100	183	18–498	136–376	83.3
B Heart	95	198	27–1,567	87–352	72.2
B QEH	92	199	31–676	106–339	79.8
Bangor	97	399	45–1,140	270–569	90.6
Basldn	100	192	49–600	123–325	82.1
Belfast	95	254	46–1,218	125–536	78.2
Bradfd	100	331	53–776	139–504	81.4
Brightn	92	349	65–1,449	205–535	89.6
Bristol	100	237	56–675	124–385	80.0
Camb	100	220	47–699	146–350	89.8
Cardff	98	215	48–824	146–373	88.9
Carlis	100				
Carsh	96	169	33–590	85–279	72.7
Chelms	97	241	67–725	169–527	82.8
Chestr	n/a	n/a	n/a	n/a	n/a
Clwyd	88				
Covnt	97	217	53–1,171	134–371	80.4
Derby	61	274	56–726	203–423	89.1
Derry	n/a	n/a	n/a	n/a	n/a
Dorset	98	248	42–579	206–378	87.2
Dudley	96	184	28–675	126–367	81.3
Exeter	100	172	54–352	115–241	80.8
Glouc	97	217	40–763	141–303	83.9
Hull	87	301	45–732	212–423	93.8
Ipswi	88	229	43–687	86–379	73.9
L Barts	51	282	84–1,194	182–467	90.7
L Guys	99	224	72–791	157–317	86.4
L Kings	100	192	59–548	128–327	81.4
L Rfree	98	313	36–987	188–520	90.0
L West	96	240	107–981	179–378	95.8
Leeds	98	282	47–717	161–439	88.7
Leic	93	244	39–933	143–431	84.2
Liv Ain	n/a	n/a	n/a	n/a	n/a
Liv RI	98	235	68–888	162–428	92.0
ManWst	88	270	44–917	155–443	84.8
Middlbr	89	284	90–827	136–451	88.0
Newc	100	300	62–1,123	179–433	87.0
Newry	86				
Norwch	98	526	118–993	359–768	95.1
Nottm	100	299	88–749	214–460	94.4
Oxford	98	181	34–895	104–345	75.2
Plymth	92	261	25–1,567	140–473	84.9
Ports	88	224	43–606	123–351	81.7
Prestn	100	234	36–941	111–382	76.0
Redng	88	449	66–972	285–624	94.1
Sheff	100	274	49–706	182–422	88.2
Shrew	97	266	45–741	120–400	86.8
Stevng	88	151	44–765	109–224	80.6
Sthend	94				
Sund	100				
Swanse	97	248	35–707	156–438	85.5
Truro	100	196	115–556	135–308	96.8

Table 8.8: (continued)

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
Tyrone	100				
Ulster	100				
Wirral	55				
Wolve	100	213	42–756	103–383	78.4
Wrexm	0				
York	100	322	87–1,071	190–411	86.4
England	**92**	**251**	**49–834**	**145–424**	**85.4**
N Ireland	**95**	**245**	**46–965**	**133–455**	**82.0**
Wales	**86**	**241**	**45–755**	**153–419**	**86.8**
Eng, NI & Wales	**83**	**250**	**48–834**	**145–424**	**85.4**

Blank cells – insufficient data for analysis.
n/a – not applicable.

Table 8.9: Percentage of patients with serum ferritin ⩾800 µg/L

	HD		PD	
Centre	% ferritin ⩾800 µg/L	95% CI	% ferritin ⩾800 µg/L	95% CI
Antrim	11.2	6.6–18.4	0.0	n/a
B Heart	1.0	0.3–3.0	5.6	1.4–19.7
B QEH	2.6	1.6–4.1	3.5	1.3–9.0
Bangor	12.9	6.6–23.7	6.3	1.6–21.8
Basldn	0.8	0.1–5.7	3.6	0.5–21.4
Belfast	17.1	12.8–22.6	12.7	6.2–24.4
Bradfd	11.3	7.0–17.6	4.7	1.2–16.8
Brightn	8.2	5.0–13.1	10.4	5.3–19.4
Bristol	7.2	5.1–10.2	1.4	0.2–9.5
Camb	3.3	1.7–6.5	1.7	0.2–11.1
Cardff	15.4	12.2–19.3	5.9	3.0–11.4
Carlis	3.9	1.3–11.4		
Carsh	6.9	4.7–9.9	0.9	0.1–6.2
Chelms	22.0	14.3–32.2	3.5	0.5–20.8
Chestr			n/a	n/a
Clwyd	0.0	n/a		
Covnt	7.7	5.0–11.6	3.6	0.9–13.2
Derby	7.0	4.0–11.9	2.2	0.3–13.9
Derry	34.8	18.4–55.7	n/a	n/a
Dorset	6.8	3.6–12.6	2.1	0.3–13.6
Dudley	5.8	2.4–13.2	4.2	1.0–15.2
Exeter	3.3	1.7–6.4	0.0	n/a
Glouc	10.2	6.3–16.2	0.0	n/a
Hull	4.4	2.5–7.6	2.1	0.3–13.4
Ipswi	10.8	5.9–18.8	0.0	n/a
L Barts	6.6	4.6–9.2	5.6	2.5–11.8
L Guys	9.4	6.8–12.8	3.0	0.8–11.3
L Kings	14.6	11.0–19.2	1.4	0.2–9.5
L Rfree	12.9	10.1–16.3	10.0	5.8–16.8
L West	22.6	20.1–25.2	8.3	3.8–17.3
Leeds	8.2	6.1–11.1	2.1	0.5–7.9

Table 8.9: (continued)

Centre	HD		PD	
	% ferritin ⩾800 µg/L	95% CI	% ferritin ⩾800 µg/L	95% CI
Leic	9.6	7.3–12.5	6.1	3.3–10.9
Liv Ain	16.9	10.3–26.5	n/a	n/a
Liv RI	32.2	27.6–37.2	5.8	2.4–13.1
ManWst	33.6	26.5–41.4	5.4	2.4–11.4
Middlbr	20.5	15.8–26.2	8.0	2.0–26.9
Newc	11.3	7.7–16.1	5.6	1.8–15.9
Newry	17.5	10.7–27.4		
Norwch	19.0	14.2–25.0	24.4	13.7–39.7
Nottm	14.8	11.2–19.2	4.8	2.2–10.2
Oxford	3.6	2.1–6.2	6.2	3.0–12.4
Plymth	17.1	11.4–24.8	12.1	4.6–28.2
Ports	4.2	2.5–7.0	4.9	1.8–12.3
Prestn	42.0	36.8–47.5	8.9	4.3–17.4
Redng	14.7	10.4–20.3	10.7	5.7–19.3
Sheff	11.4	8.9–14.3	3.7	1.5–8.5
Shrew	3.3	1.2–8.4	2.6	0.4–16.5
Stevng	8.0	5.5–11.5	2.8	0.4–17.3
Sthend	3.6	1.4–9.1		
Sund	15.1	10.1–22.1		
Swanse	5.7	3.4–9.3	2.6	0.7–9.9
Truro	3.6	1.5–8.2	0.0	n/a
Tyrone	28.6	17.0–43.9		
Ulster	13.6	6.3–27.2		
Wirral	28.4	20.8–37.6		
Wolve	10.9	7.7–15.1	3.9	1.0–14.4
Wrexm				
York	13.9	8.4–22.1	9.1	2.3–30.0
England	**11.9**	**11.3–12.5**	**5.3**	**4.5–6.2**
N Ireland	**17.3**	**14.3–20.7**	**8.0**	**4.1–15.2**
Wales	**10.9**	**8.9–13.3**	**4.8**	**2.8–8.3**
Eng, NI & Wales	**12.0**	**11.5–12.6**	**5.4**	**4.6–6.2**

Blank cells – insufficient data for analysis.
n/a – not applicable.

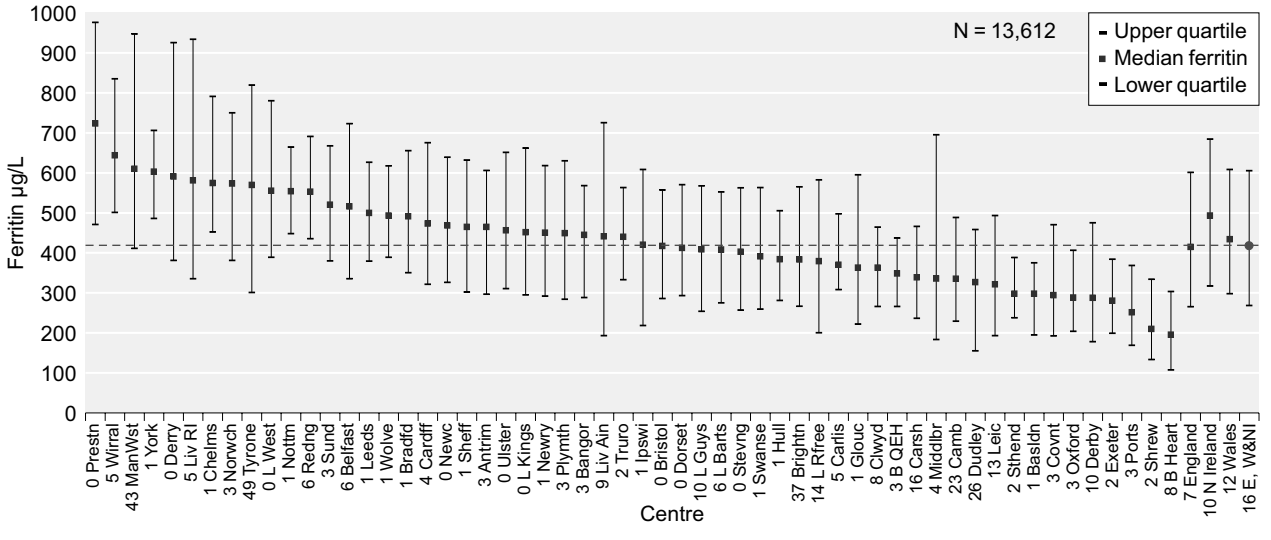

Figure 8.29: Median serum ferritin: HD

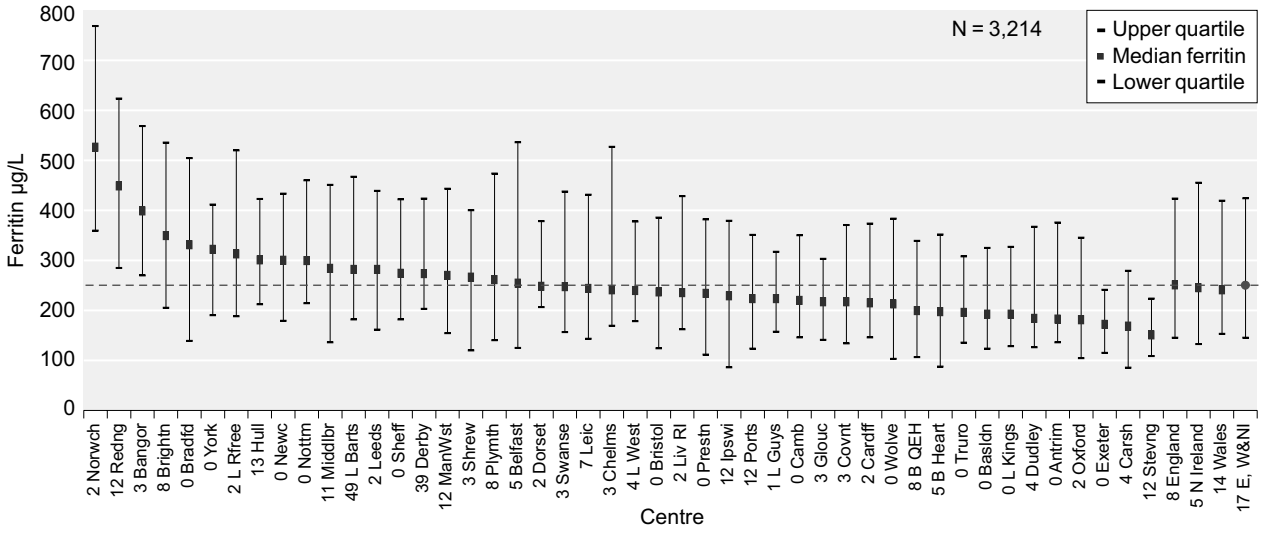

Figure 8.30: Median serum ferritin: PD

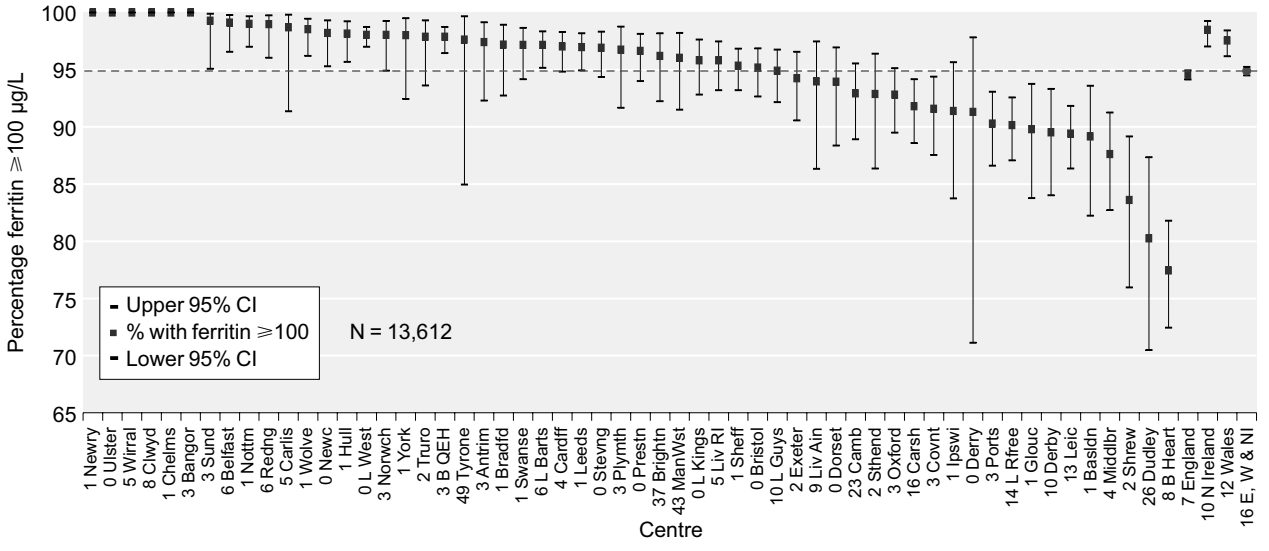

Figure 8.31: Percentage of HD patients with serum ferritin ⩾100 µg/L

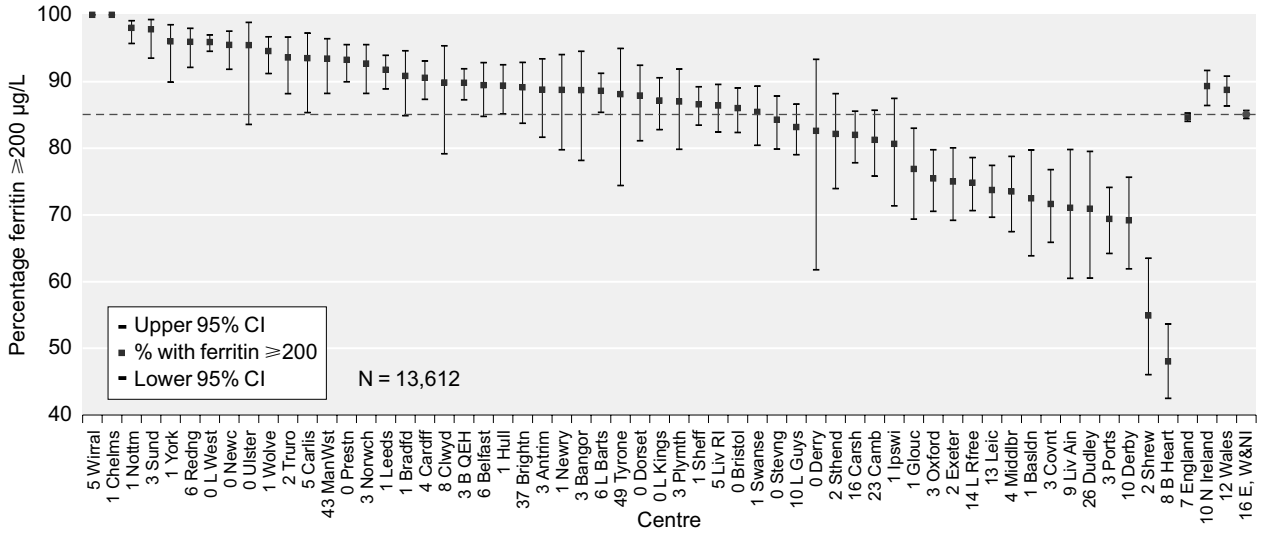

Figure 8.32: Percentage of HD patients with serum ferritin ⩾200 µg/L

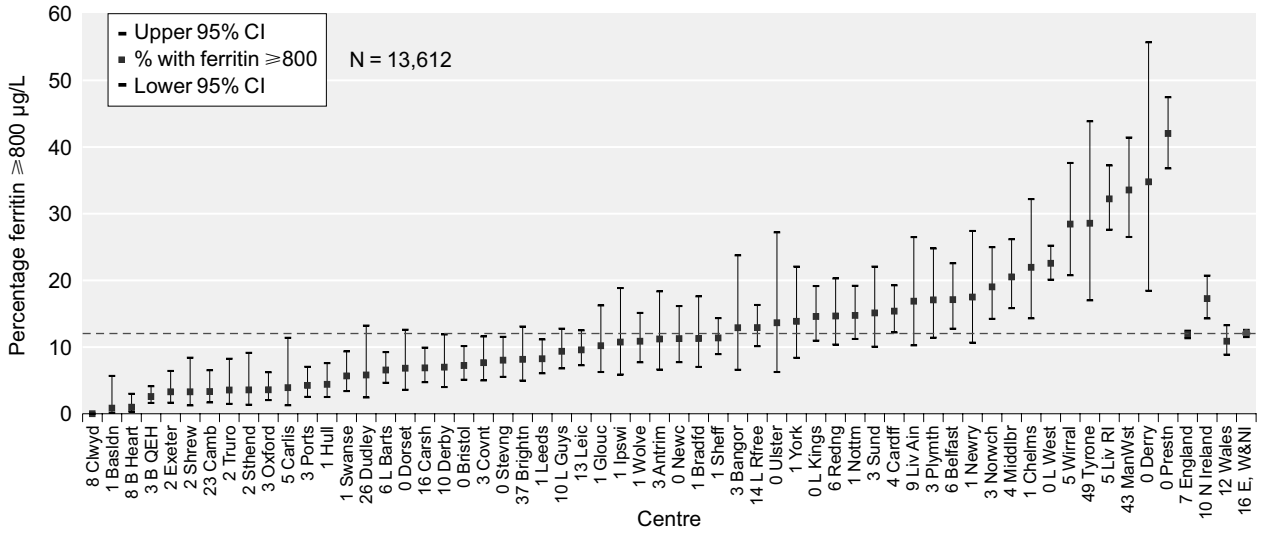

Figure 8.33: Percentage of HD patients with serum ferritin ⩾800 µg/L

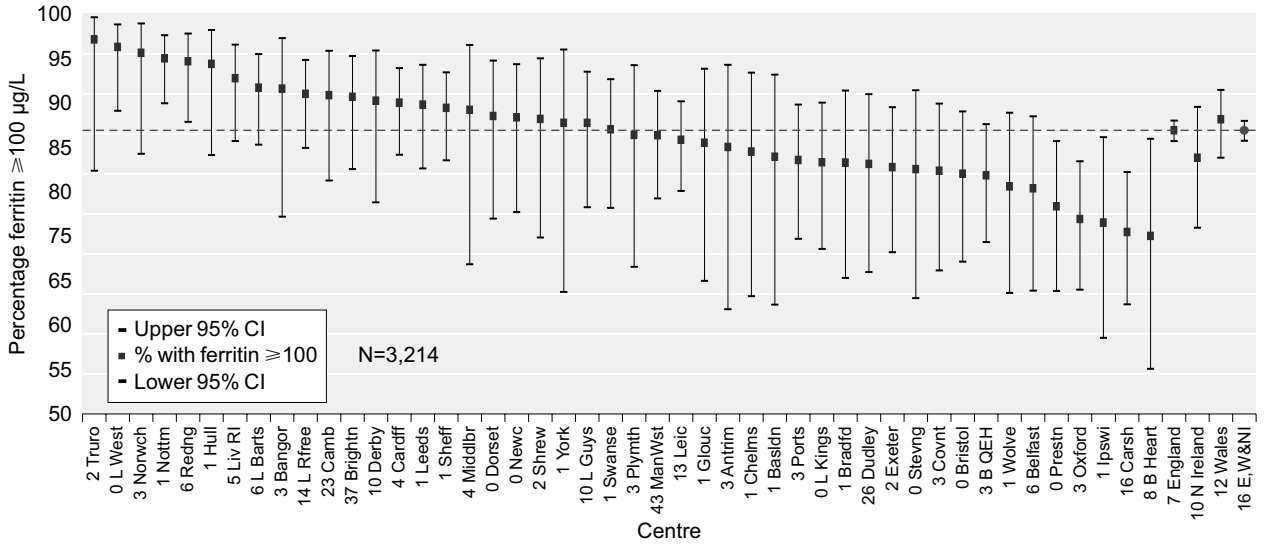

Figure 8.34: Percentage of PD patients with serum ferritin ⩾100 µg/L

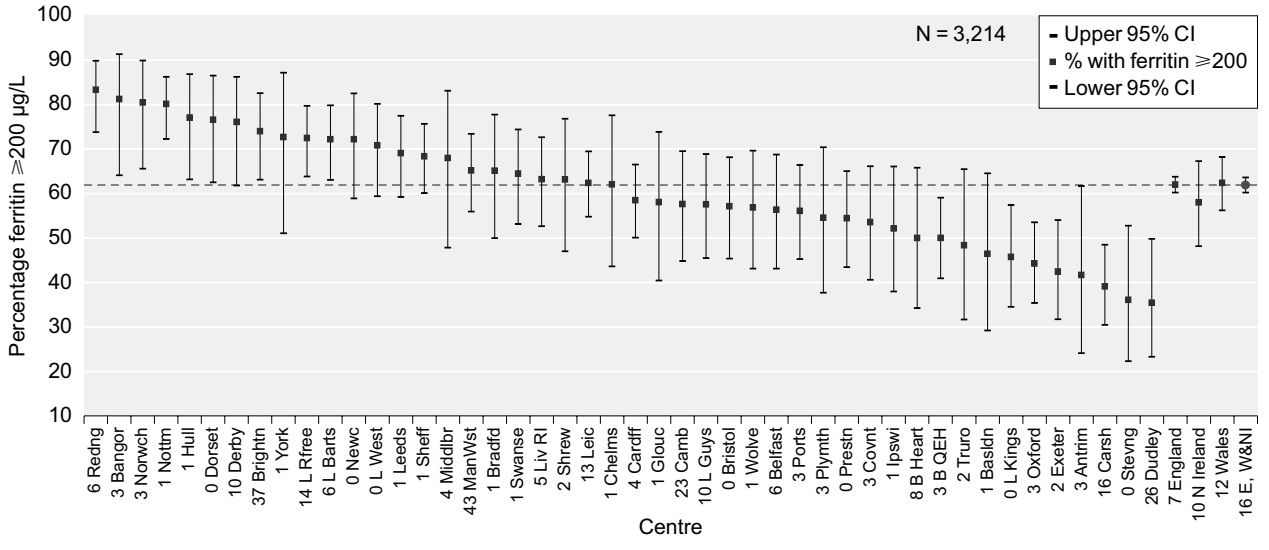

Figure 8.35: Percentage of PD patients with serum ferritin ⩾200 µg/L

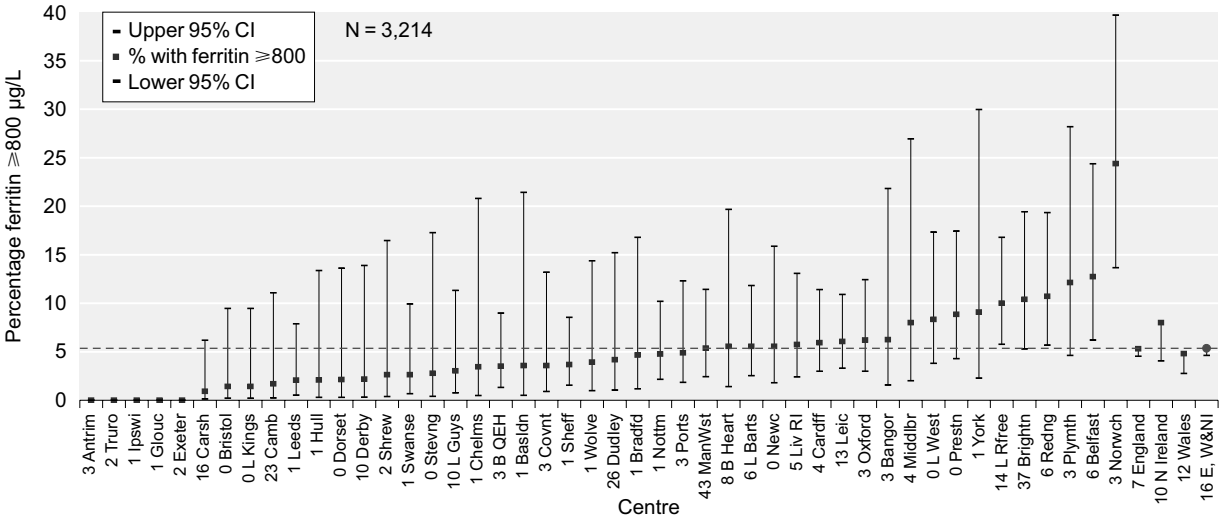

Figure 8.36: Percentage of PD patients with serum ferritin ⩾800 µg/L

All centres achieved greater than 75% compliance with a serum ferritin over 100 µg/L for HD. The PD population had a lower median ferritin value (250 µg/L, IQR 145–424) vs HD (418 µg/L, IQR 268–605) but all centres had median values for PD greater than 100 µg/L and 43/46 centres had a 25th centile for ferritin greater than 100 µg/L.

Changes in serum ferritin 1999–2006

During the last 4 years compliance with guidelines for serum ferritin ⩾100 µg/L has been stable at ~95% and ~85% for HD and PD patients respectively. The serial values are shown in Figure 8.37. The difference between compliance in HD and PD patients probably reflects the higher Hb outcomes for PD patients with lower ESA requirements which resulted in a lower requirement to supplement with intravenous iron. The median serum ferritin outcome over time is shown in Figure 8.38.

Serum ferritin and length of time on renal replacement therapy

The median ferritin outcome achieved appeared to increase and then plateau early for HD patients whereas there was a slower increase over time for PD patients. It would appear

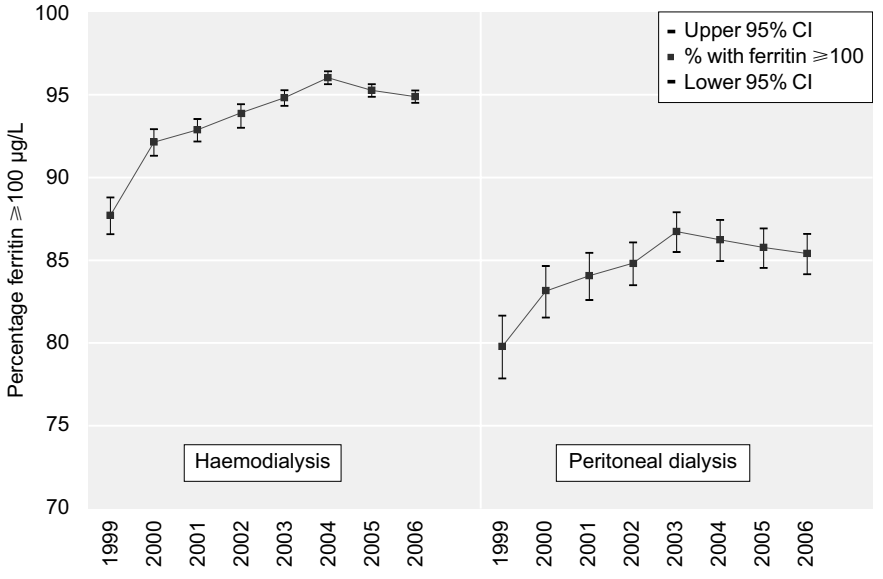

Figure 8.37: Change in achievement of serum ferritin ⩾100 µg/L: 1999–2006

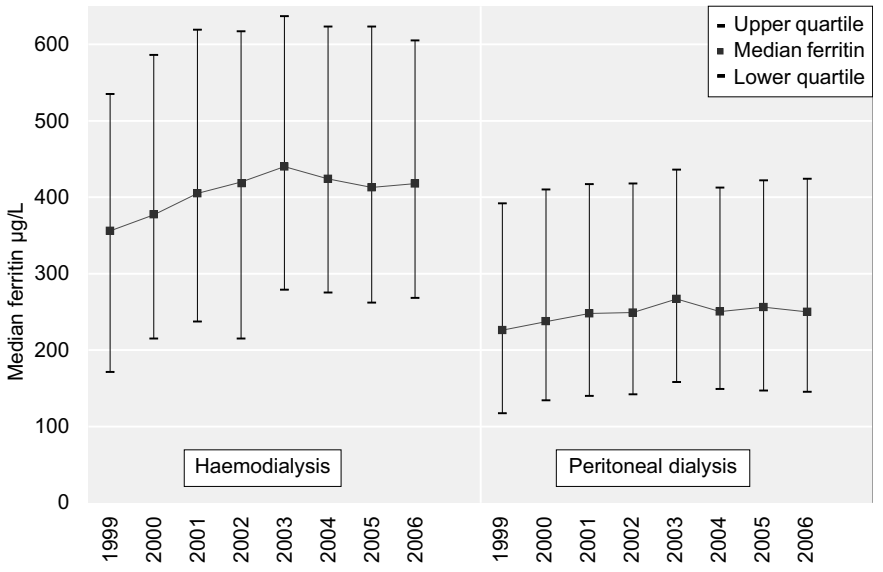

Figure 8.38: Change in median serum ferritin: 1999–2006

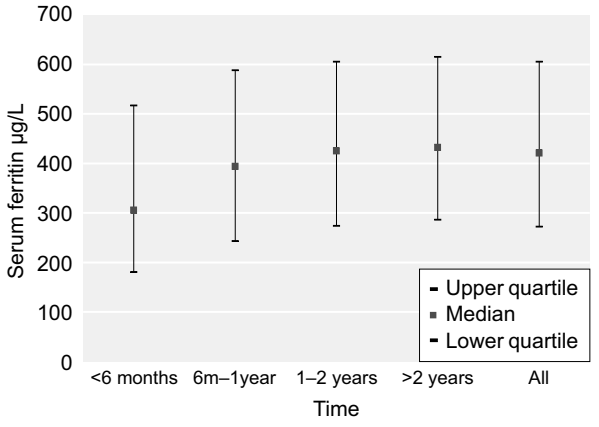

Figure 8.39: Median serum ferritin by length of time on RRT: HD

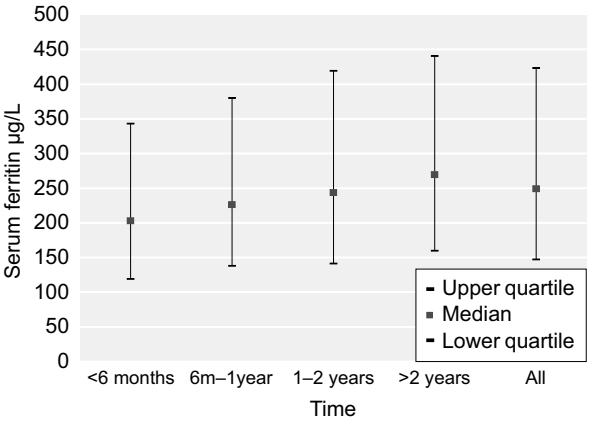

Figure 8.40: Median serum ferritin by length of time on RRT: PD

there was a tendency to supplement PD patients with iron later in their dialysis careers. Outcomes by length of time on dialysis for HD and PD patients are shown in Figures 8.39 and 8.40 respectively.

Erythropoiesis stimulating agents

Data regarding ESAs were collected from all centres. Centres were excluded if fewer than 90% of patients were on the ESA file. Centres with fewer than 80% of HD patients or fewer than 65% of PD patients on ESAs were considered to have incomplete data and were also excluded from further analysis.

Work continues to establish more comprehensive ESA returns. Data are presented as total weekly erythropoietin dose. Doses of darbepoietin were harmonised with erythropoietin data by multiplying by 200 and correcting for any frequency of administration less than weekly. No adjustments were made with regard to route of administration.

In a similar way to the rest of the Registry data the ESA data was collected from renal IT systems, although as previously, in contrast to the automated laboratory links, this relied on manual data entry. The reliability of these data depended on who was entering the data (doctor, ESA nurse or data clerk), whether the renal centre was prescribing the ESA directly (within

the renal centre budget) or whether ESAs were prescribed by the GP (i.e. from the PCT budget). In the latter case, the data in the renal IT system may not always have been updated with that from the GP letter or the GP may decline to prescribe ESAs at the higher dose advised by the nephrologist.

Patients treated and dose variation – ESA prescription and modality

ESA data including percentage treated and dose for HD patients are shown in Table 8.10. Equivalent data for PD patients are shown in Table 8.11.

Table 8.10: ESA prescribing in HD patients

Centre	% on ESA	Mean weekly dose for pts on ESA	Median weekly dose for pts on ESA	% with Hb <10 g/dl for pts on ESA	% with Hb ⩾10 g/dl and not on ESA
Antrim	96	8,868	8,000	100	4
B Heart	89	10,177	9,000	93	8
Bangor	92	9,322	6,000	83	5
Basldn	94	9,588	8,500	100	5
Belfast	92	7,752	6,000	100	5
Bradfd	96	6,410	6,000	100	4
Bristol	94	10,123	8,000	96	6
Chelms	98	10,370	8,000	100	2
Derry	100	6,174	6,000	100	0
Dorset	96	12,921	12,000	89	2
Dudley	85	7,186	6,000	70	11
Exeter	92	8,581	6,000	98	7
Glouc	96	11,007	9,000	100	4
Ipswi	95	10,765	9,000	100	5
Leeds	93	7,499	6,000	100	6
Leic	93	9,060	8,000	99	6
Liv Ain	89	8,048	6,000	91	7
Liv RI	94	9,058	8,000	87	4
Middlbr	88	7,208	6,000	92	10
Newry	96	8,159	6,000	100	4
Norwch	95	9,455	8,000	96	1
Oxford	91	10,150	8,000	88	7
Plymth	92	9,887	9,000	100	5
Redng	90			96	10
Sheff	92	11,277	10,000	97	8
Shrew	95	10,132	8,000	100	5
Sthend	96	9,761	8,000	100	4
Sund	91	8,058	6,000	100	7
Swanse	89	9,063	8,000	85	9
Truro	97	7,022	4,000	100	1
Tyrone	94	9,052	8,000	100	4
Ulster	100	8,795	7,000	100	0
Wolve	94	9,593	8,000	100	6
York	97	7,879	6,000	100	3
England	**93**	**9,334**	**8,000**	**95**	**6**
N Ireland	**95**	**8,234**	**6,000**	**100**	**4**
Wales	**90**	**9,117**	**8,000**	**85**	**8**
Eng, NI & Wales	**93**	**9,223**	**8,000**	**95**	**6**

Blank cells – insufficient data for analysis.

Table 8.11: ESA prescribing in PD patients

Centre	% on ESA	Mean weekly dose for pts on ESA	Median weekly dose for pts on ESA	% with Hb <10 g/dl for pts on ESA	% with Hb ⩾10 g/dl and not on ESA
Antrim	83	3,788	3,000		18
B Heart	71	5,778	6,000	100	25
Bangor	79	5,923	6,000	100	21
Belfast	69	4,231	4,000	100	29
Bradfd	77	5,917	4,500	100	23
Bristol	77	5,148	4,000	100	23
Camb	80	6,289	5,000	100	20
Cardff	86			100	14
Carlis	70	8,000	8,000	100	30
Chelms	87	5,715	5,500	100	13
Clwyd	75	7,000	5,000	100	14
Dorset	83	5,763	4,500	83	15
Dudley	88	5,747	5,500	100	12
Exeter	82	4,982	4,000	100	18
Glouc	78	7,740	4,000	100	22
Ipswi	80	5,502	4,000	100	20
Leeds	70	5,970	4,000	83	28
Leic	73	5,210	4,000	96	26
Liv RI	89	5,537	4,000	100	9
Middlbr	68	5,526	4,000	100	30
Norwch	69	4,316	3,000	100	29
Oxford	94	6,172	6,000	91	5
Plymth	86	5,484	4,000	100	15
Sheff	77	8,943	6,000	100	23
Shrew	82	7,690	8,000	100	18
Sthend	69	6,545	8,000	100	27
Sund	71	4,000	2,000	100	29
Swanse	78	7,967	6,000	88	18
Truro	94	4,094	4,000	100	6
Tyrone	71	2,600	2,000		33
Ulster	100	6,500	6,500		0
Wolve	69	5,514	4,000	100	32
York	82	4,667	4,000	100	14
England	**79**	**5,969**	**4,000**	**97**	**20**
N Ireland	**74**	**4,042**	**3,000**	**100**	**26**
Wales	**82**	**7,333**	**6,000**	**96**	**16**
Eng, NI & Wales	**79**	**5,969**	**4,000**	**97**	**20**

Blank cells – insufficient data for analysis.

Age and ESA provision

Patients on PD continued to maintain Hb without recourse to ESA to a greater degree than HD patients (Figure 8.41).

The percentage of dialysis patients receiving ESA by age and modality is given in Figure 8.42.

Figure 8.43 gives data on the percentage of patients who were anaemic with Hb <10.0 g/dl who were receiving an ESA. This shows that 95% of HD patients and 97% of PD patients with a Hb <10 g/dl were being treated with an ESA. If patients have been declared unresponsive to an ESA then they may be anaemic and no longer on treatment with an ESA. Alternatively they were anaemic but were still not receiving ESA for whatever reason.

ESA prescription and gender

Provision of ESA by age and gender for HD and PD patients are shown in Figures 8.44 and 8.45.

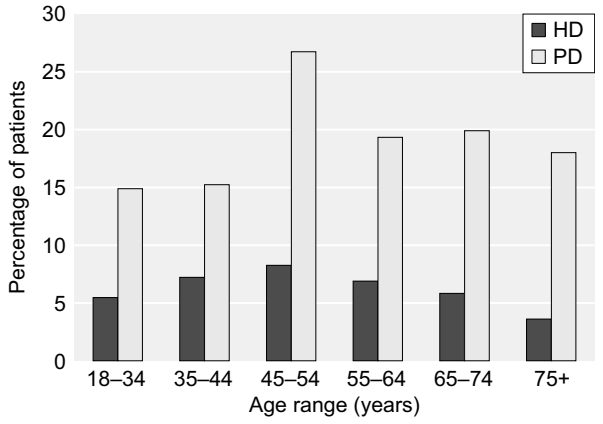

Figure 8.41: Percentage of patients who are not on ESA and have Hb $\geqslant$10 g/dl, by age group and modality

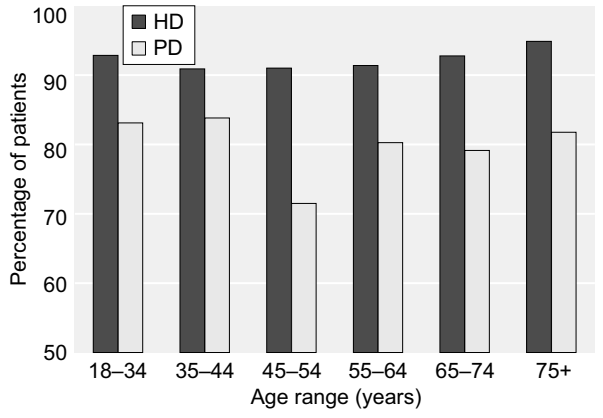

Figure 8.42: Percentage of dialysis patients on ESA, by age group and modality

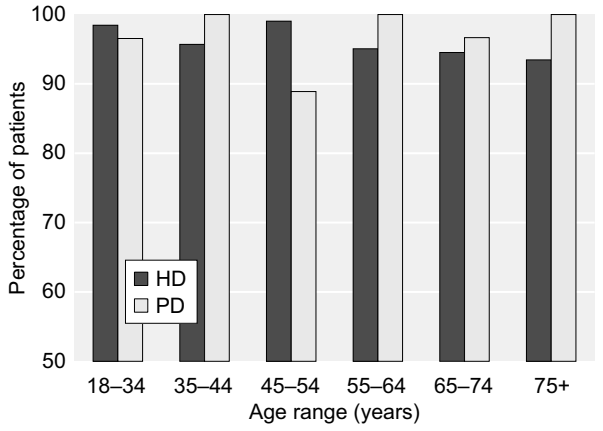

Figure 8.43: Percentage of patients with Hb <10 g/dl who are on ESA, by age group and modality

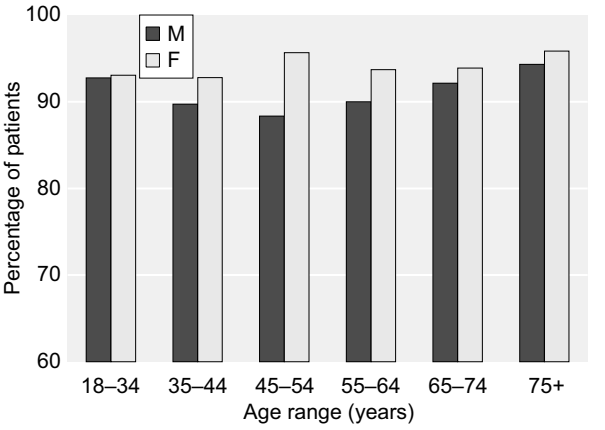

Figure 8.44: Provision of ESA by age and gender: HD

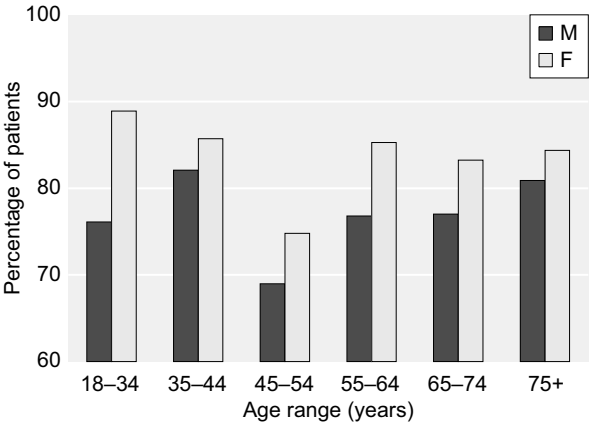

Figure 8.45: Provision of ESA by age and gender: PD

ESAs and time on renal replacement therapy

The percentage of PD patients requiring an ESA began to converge with that of the HD population after year 5 of therapy (Figure 8.46).

ESA dose and success with guideline compliance

There appeared to be no clear relationship between ESA dose and median Hb outcome in HD patients (Figure 8.47). This was similar for the PD population (chart not shown). This may be because of the wide spectrum of ESAs, routes and frequency of administration and

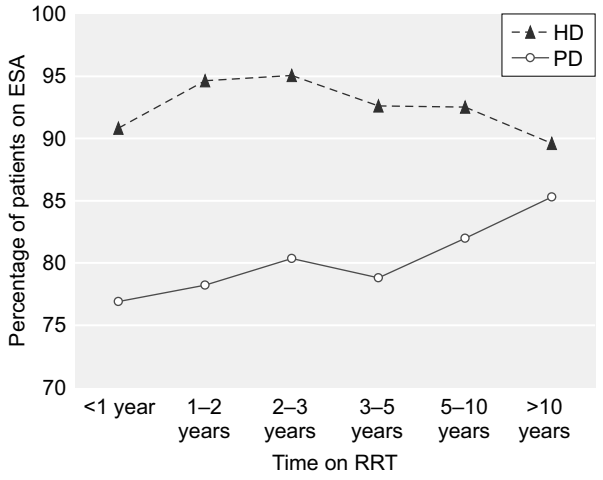

Figure 8.46: Percentage of patients on ESA by time on RRT

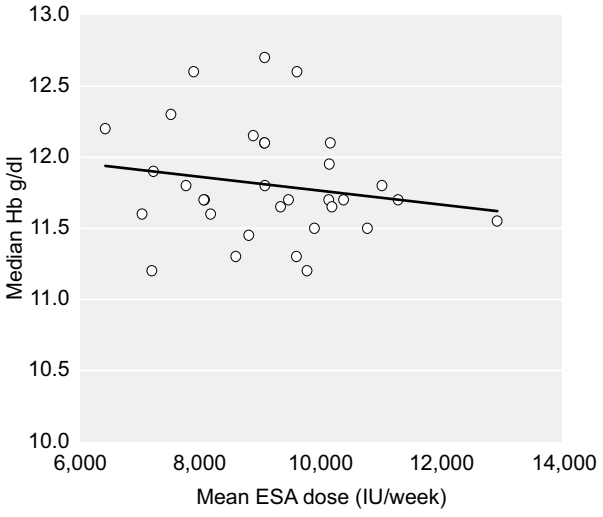

Figure 8.47: Median haemoglobin versus mean ESA dose in haemodialysis patients

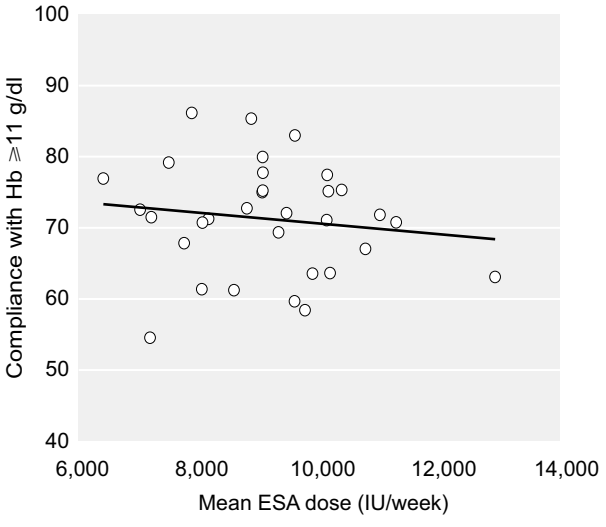

Figure 8.48: Compliance with European Best Practice Guidelines versus mean ESA dose in haemodialysis patients

wide range of documented iron supplementation outcomes. The same was true for compliance with the EBPG minimum standard for Hb by ESA dose in HD (Figure 8.48) and PD populations.

Conclusion

Haemoglobin outcomes for patients on HD and PD in the UK were compliant with Renal Association minimum standards. Haemoglobin outcomes reside below the EBPG that declares all patients should achieve a haemoglobin $\geqslant 11.0$ g/dl. Recently published NICE guidance however suggests that higher outcomes are not cost effective. The presentation of funnel plots for compliance with Hb $\geqslant 10$ g/dl and Hb between 10.5–12.5 (Figures 8.12 and 8.13) may enable centres to plan their desired future Hb outcome in light of the NICE guidance. Caution should be maintained however, that improvement in this specific measure is not at the expense of maintaining Hb $\geqslant 10.0$ g/dl. Use of the 10.5–12.5 compliance alone would infer equivalent risk of Hb >12.5 g/dl as for Hb <10.5 g/dl. The NICE guidance limiting upper Hb was primarily a health economic decision and not on the grounds of safety. The evidence for improving Hb to $\geqslant 10.0$ g/dl remains unchanged.

Ferritin outcome appeared to have reached a steady state in the UK dialysis population and the percentage of patients with serum ferritin greater than 100 µg/L seen in this year's report showed that the provision of intravenous iron for UK dialysis patients was maintained.

Haemoglobin outcome did not show a clear relationship with prescribed ESA dose amongst the dataset submitted to the UKRR. However ESA type, frequency of administration and route of administration may all affect the dose requirements in addition to other variables that can affect erythropoietic response.

Overall, the data demonstrate that UK renal centres continued to accord a high priority to the management of factors influencing haemoglobin. Local priorities in the treatment of renal anaemia may need to continue to be adjusted in line with NICE guidance in conjunction with previously established measures of compliance with Hb $\geqslant 10.0$ g/dl.

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Chapter 9: Management of Biochemical Variables

Alex Hodsman, Ed Lamb, Anna Casula and Graham Warwick

Summary

- The biochemical data analysed in this chapter were: calcium, phosphate, calcium*-phosphate product, parathyroid hormone, aluminium, bicarbonate and total cholesterol for patients in England, Wales and Northern Ireland for 2006.
- A serum phosphate of <1.8 mmol/L was achieved by 67% of dialysis patients (65% of HD patients, 73% of PD patients).
- An adjusted serum calcium concentration between $\geqslant 2.2$–$\leqslant 2.6$ mmol/L was achieved by 75% of dialysis patients (74% of HD patients, 79% of PD patients).
- A serum calcium*phosphate product within the KDOQI guidelines (<4.4 mmol^2/L^2) was achieved by 71% of dialysis patients (70% of HD patients, 75% of PD patients).
- A serum PTH <32 pmol/L was achieved by 61% of dialysis patients (61% of HD patients, 60% of PD patients).
- Serum bicarbonate of $\geqslant 20$–$\leqslant 26$ mmol/L was achieved by 70% of HD patients. Serum bicarbonate of $\geqslant 25$–$\leqslant 29$ mmol/L was achieved by 53% of PD patients.
- A total serum cholesterol concentration of <5 mmol/L was achieved by 83% of dialysis patients (85% of HD patients and 71% of PD patients). A total serum cholesterol <5 mmol/L was achieved by 67% of transplant patients.
- There remained inter-centre variability in achievement of Renal Association biochemical standards. The use of funnel plot analysis enabled identification of statistically outlying centres.
- Longitudinal analysis continued to show year-on-year improvement in achievement of Renal Association biochemical standards.
- With recent revision of Renal Association standards (4th edition still in draft), there may be heterogeneity in application of clinical practice guidelines between UK centres. Achievement of 'new' Renal Association standards where possible are therefore reported as a baseline analysis to allow comparison to be made in subsequent years.

Introduction

The UK Renal Registry (UKRR) collected routine biochemical data on a quarterly basis from patients in centres in England, Wales and Northern Ireland. This chapter is primarily a series of cross-sectional analyses of centre performance using Renal Association clinical practice guidelines or other surrogate guidelines as audit standards.

In addition to the indices reported in the chapter, the Registry collected additional biochemical data eg albumin which may be used in original epidemiological research studies but were not included in this report. There is ongoing work to expand the laboratory dataset collected by the Registry in order to provide innovative analyses.

The Renal Association is in the process of revising guidelines[1] to incorporate new evidence and the 4th edition is currently in draft format[2].

It is assumed that UK centres internally audit performance against Renal Association standards (as opposed to other guidelines) and so where possible the Registry does the same. However, it may be that individual centres have developed centre based guidelines that take account of local differences in policy and practice. A number of changes have also been made during revision of the Renal Association guidelines, and although these are still in draft, this may also have created heterogeneity between

centre guideline usages. For this reason, and to provide a baseline for subsequent analysis, achievement of standards this year (for 2006 data) were audited against both the 3rd and 4th edition of the Renal Association standards[1,2]. There are also a number of clinical practice guidelines internationally and these can be compared at www.kdigo.org[3].

It is widely recognised that performance data is open to misinterpretation[4]. To facilitate interpretation of performance data reported by the Registry, funnel plots were introduced for the analysis of biochemical data in 2006[5]. These enabled detection of 'outlying centres' where there were statistically significant differences between centres in achievement of Renal Association standards. The publication of these data should encourage centres to explore the differences in clinical processes of care which may underlie the statistical differences.

To complement this further, new exploratory analyses were undertaken this year to test the confidence of the rankings attributed to centres and the Registry welcomes feedback from centres on the usefulness of these data[6].

Methods

This chapter analysed the prevalent RRT cohort for England, Wales and Northern Ireland for 2006. The cohort definition for biochemical analyses has been previously described and can be found at www.renalreg.com[7].

The Registry extracted quarterly data electronically from centres. Quarterly values were extracted for the last two quarters for calcium, phosphate and bicarbonate, the last three quarters for PTH and the entire year for cholesterol and aluminium. Patients who did not have these data were excluded from the relevant analyses. Patients were analysed both as a complete cohort and also divided by RRT modality into groups. Some analyses were also performed on a combined dialysis group. 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 the figures showing centre performance. Data were also excluded from plots when there were less than 20 patients with data both at centre and country level. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

Summary statistics

These data were analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges) and are represented as caterpillar plots showing median values and quartile ranges. Where applicable, the percentage achieving Renal Association or other surrogate standard was also calculated and represented as caterpillar plots with 95% confidence intervals. For 2006, data was also audited against the 'new' Renal Association standards (taken from the draft 4th edition).

Funnel plot analysis

Funnel plot analysis has been used to identify 'outlying centres'. The percentage achieving each standard was plotted against centre size along with the upper and lower 95% and 99.9% confidence intervals. The methodology for funnel plot analysis and further guidance on interpretation of the data was more extensively described in the 2006 report.

Longitudinal analysis

Longitudinal analysis has also been performed for some data to calculate overall changes in achievement of standards annually from 1998 to 2006.

Methodology for testing confidence in centre rankings

A new analysis to test the statistical certainty of centre ranking has been performed using phosphate data for HD patients. The rank of each centre has a degree of statistical uncertainty as denoted by the surrounding confidence intervals. The distribution of the proportion of patients achieving the phosphate standard can be modelled as a normal distribution for each centre. For each centre, a random proportion was sampled from this normal distribution and the centres were then ranked. This random sampling and ranking was repeated 10,000 times. From these sampled ranks it was possible

to identify the median rank and its 95% confidence interval for each centre i.e. a measure of the statistical certainty of that rank.

Results

Phosphate

The 3rd edition of the Renal Association standards document states:

> ***Serum phosphate (measured before a dialysis session in HD patients) should be below 1.8 mmol/L (1).***

The draft 4th edition of the Renal Association standards clinical practice guidelines states:

> ***Serum phosphate in dialysis patients (measured before a 'short gap' dialysis session in HD patients) should be maintained between 1.1 and 1.8 mmol/L (2).***

Results

Data quality

The completeness of data by modality is shown in Table 9.1. A technical problem with the Registry extraction of phosphate data for haemodialysis patients from four centres was identified. The data have been corrected for Bristol and Exeter but Hull and Coventry were excluded this year from the figures until the problem can be rectified. Retrospective data for all four centres are also being re-extracted.

Table 9.1: Percentage data completeness by centre for serum phosphate by modality

	HD	PD	Transplants		HD	PD	Transplants
Antrim	100	100	83	Leic	99	98	90
B Heart	95	95	79	Liv Ain	96	n/a	n/a
B QEH	96	94	86	Liv RI	98	98	92
Bangor	97	100	n/a	ManWst	82	90	89
Basldn	99	100	89	Middlbr	99	96	93
Belfast	96	95	95	Newc	100	98	96
Bradfd	100	100	85	Newry	99	86	83
Brightn	97	99	83	Norwch	96	98	95
Bristol	100	100	96	Nottm	99	100	76
Camb	64	100	91	Oxford	98	100	96
Cardff	97	99	97	Plymth	98	100	93
Carlis	95	100	91	Ports	99	90	79
Carsh	82	97	89	Prestn	100	100	77
Chelms	100	100	87	Redng	100	99	94
Chestr	100	n/a	n/a	Sheff	99	100	97
Clwyd	92	88	86	Shrew	99	100	100
Covnt	98	100	77	Stevng	94	98	70
Derby	99	91	0	Sthend	99	94	91
Derry	100	n/a	67	Sund	96	100	98
Dorset	100	98	68	Swanse	99	97	96
Dudley	84	98	99	Truro	99	100	94
Exeter	98	100	91	Tyrone	96	86	90
Glouc	100	100	97	Ulster	100	100	100
Hull	100	91	91	Wirral	95	55	n/a
Ipswi	100	96	94	Wolve	99	98	95
L Barts	100	89	82	Wrexm	3	0	67
L Guys	87	99	92	York	99	91	96
L Kings	100	100	94	**England**	**96**	**96**	**89**
L Rfree	86	94	82	**N Ireland**	**98**	**94**	**93**
L West	100	97	96	**Wales**	**88**	**87**	**97**
Leeds	99	98	94	**E, W & NI**	**95**	**95**	**89**

n/a = no patients treated for that modality in centre.

The UKRR has also identified several centres which reported serum phosphate to only one decimal place (compared to two decimal places for most centres). This has introduced a digit bias into measuring performance against the RA phosphate standard for these centres. For example, when analysing the percentage of patients achieving a phosphate <1.8 mmol/L in centres reporting data to one decimal place the audit standard was actually 1.75 mmol/L due to rounding. The effect of this was to artificially lower the percentage of patients achieving the standard in these centres. The Registry has contacted the centres affected in order to rectify the problem.

Summary statistics

The summary statistics are shown in Figures 9.1 to 9.8. 65% of HD and 73% of PD patients achieved a serum phosphate <1.8 mmol/L (Figures 9.4 and 9.7). This represented a further small improvement compared to 2005 against this audit standard (Figure 9.1).

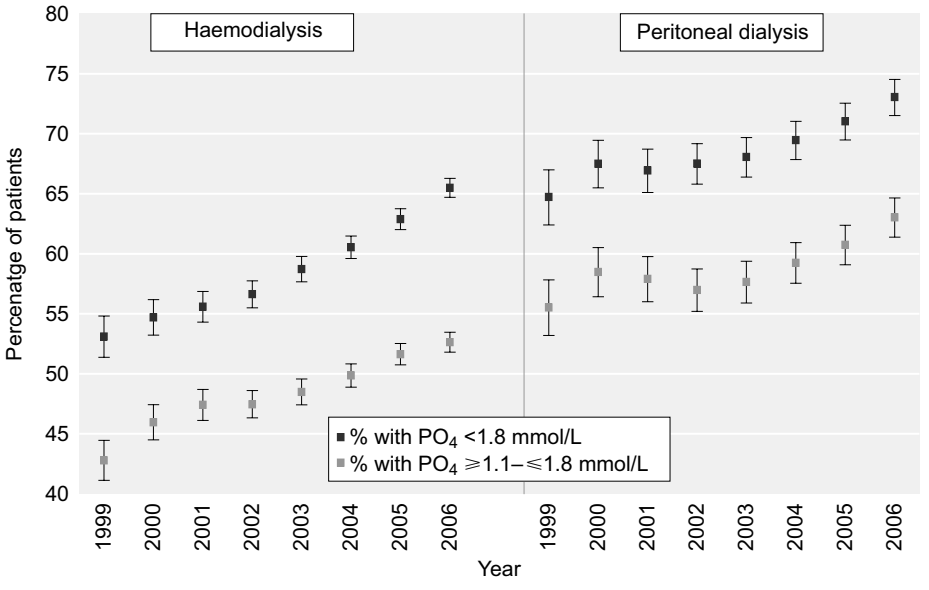

Figure 9.1: Annual change in percentage of dialysis patients with serum phosphate <1.8 mmol/L and with serum phosphate ⩾1.1–⩽1.8 mmol/L between 1999–2006

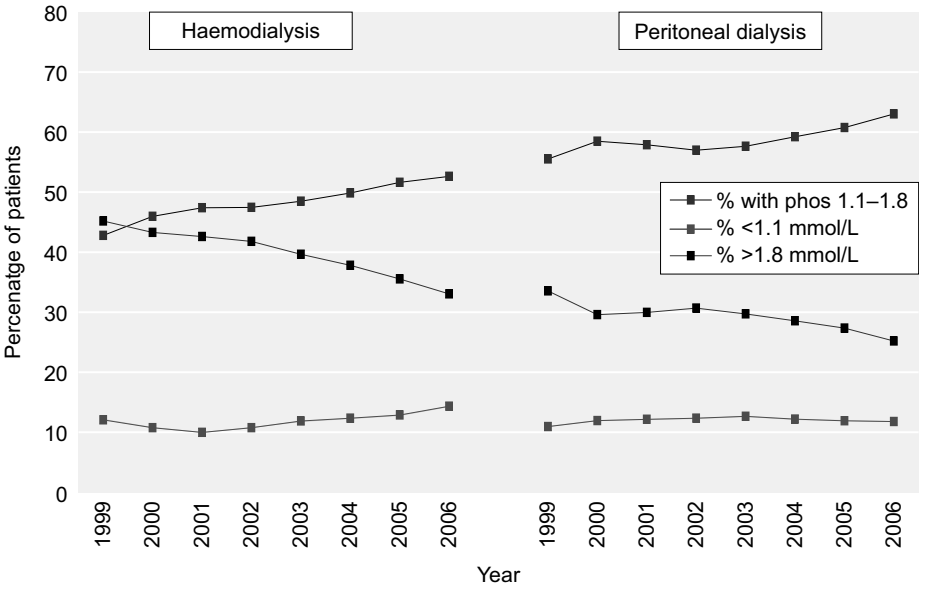

Figure 9.2: Annual change in percentage with serum phosphate ⩾1.1–⩽1.8 mmol/L, >1.8 mmol/L and <1.1 mmol/L between 1999–2006

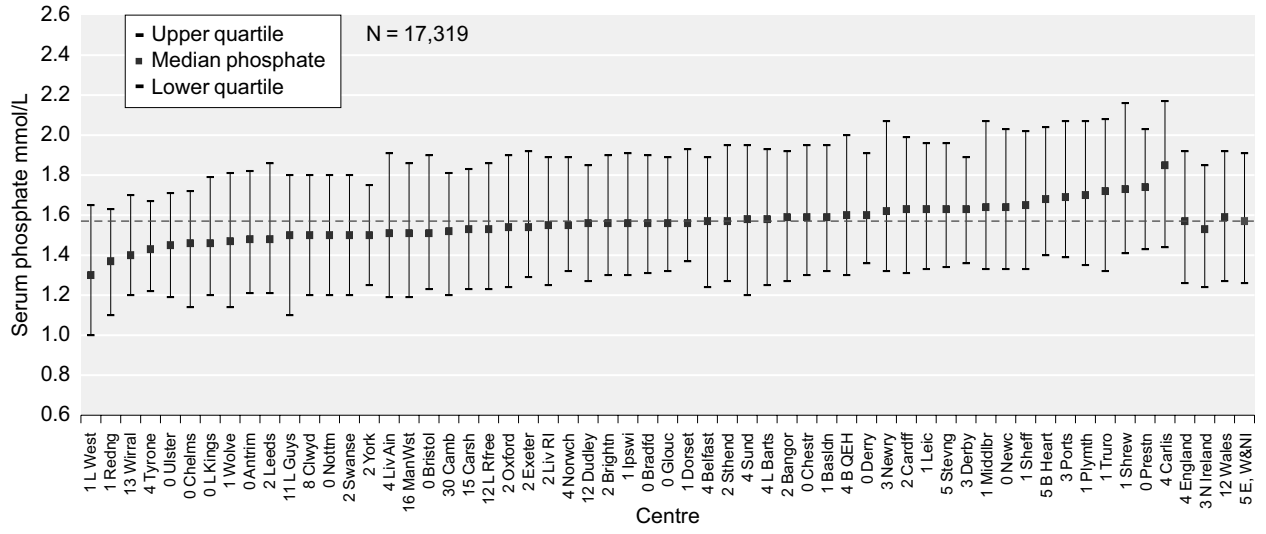

Figure 9.3: Median phosphate in dialysis patients by centre

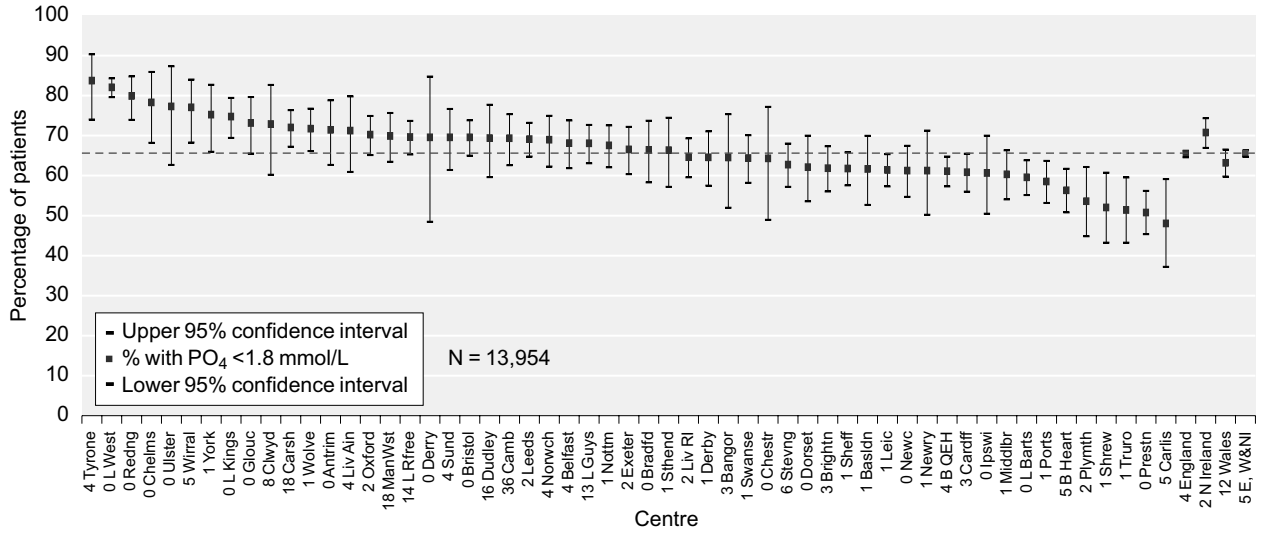

Figure 9.4: Percentage of HD patients with serum phosphate <1.8 mmol/L by centre

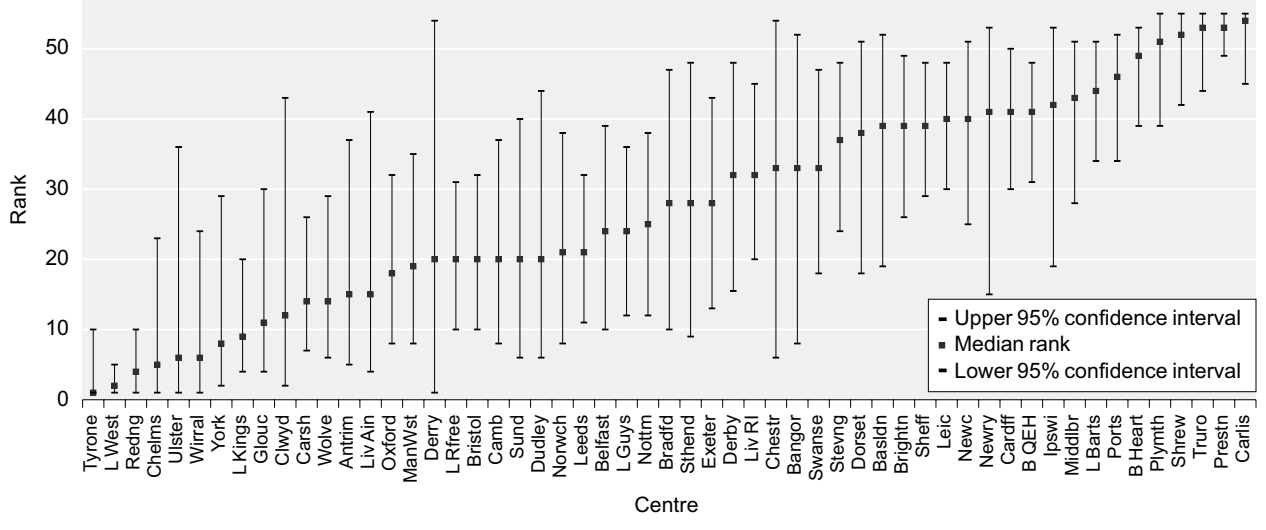

Figure 9.5: Confidence in centre ranking for percentage of HD patients with serum phosphate <1.8 mmol/L
Median rank from repeated sampling (10,000 iterations) with 95% confidence intervals

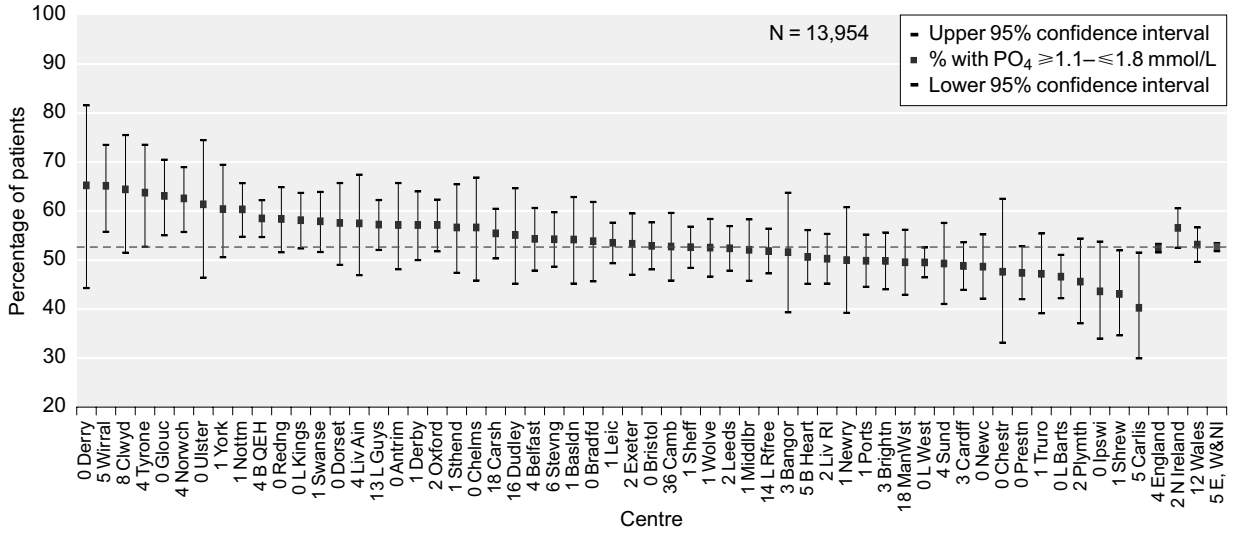

Figure 9.6: Percentage of HD patients with serum phosphate ⩾1.1–⩽1.8 mmol/L by centre

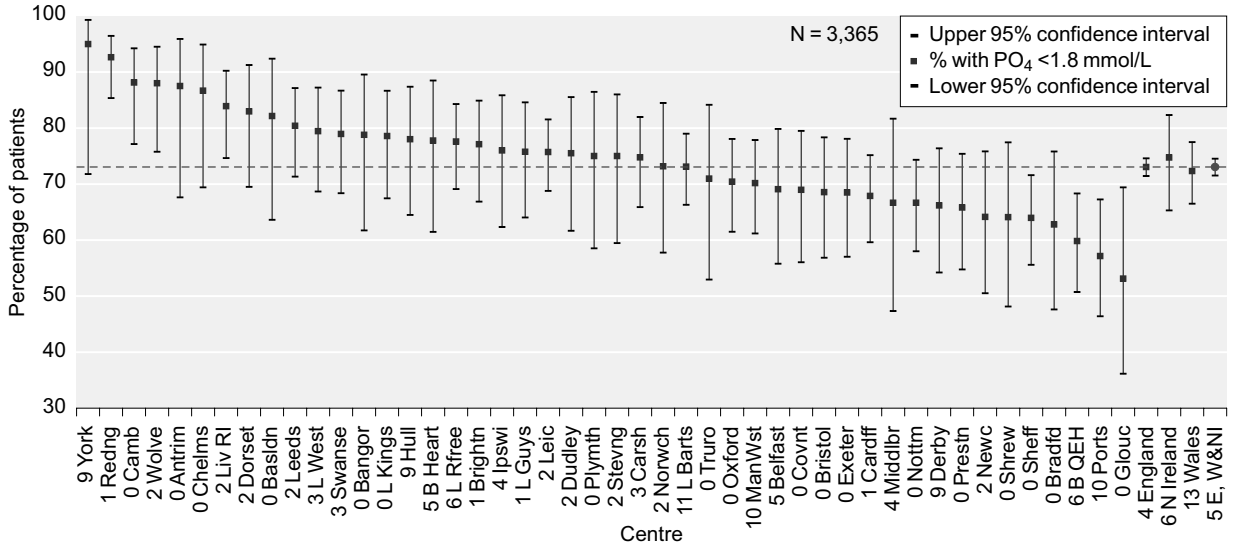

Figure 9.7: Percentage of PD patients with serum phosphate <1.8 mmol/L by centre

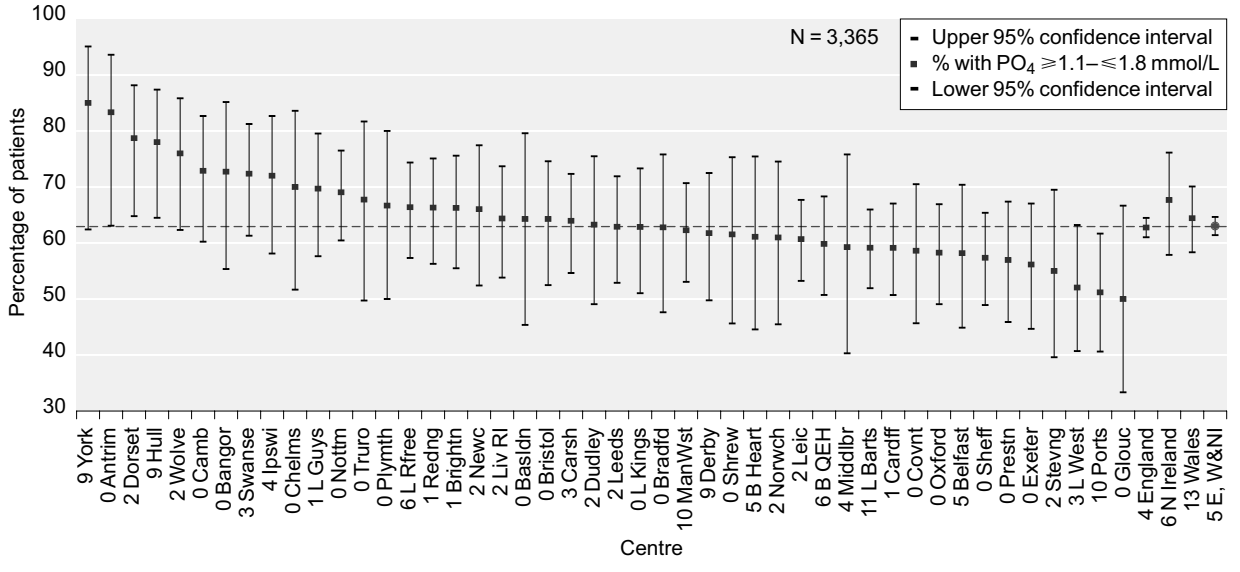

Figure 9.8: Percentage of PD patients with serum phosphate ⩾1.1–⩽1.8 mmol/L by centre

Analysing performance against the new RA guidelines, 53% of HD and 63% of PD patients achieved a serum phosphate $\geqslant 1.1 - \leqslant 1.8$ mmol/L (Figures 9.6 and 9.8). Thus applying the new RA standards, 12% of HD and 10% of PD of patients previously thought to have good phosphate control were relatively hypophosphataemic. The distribution of serum phosphate by dialysis modality is shown in Figure 9.9.

Testing the confidence in centre rankings

Figure 9.5 shows the measure of statistical uncertainty around the rankings plotted in Figure 9.4. The widely overlapping confidence intervals show that other than centres at the extremes of the plot it is difficult to be certain of centre rank.

Funnel plot analysis

There was unexplained variability between centres in achievement of the serum phosphate standard. Funnel plots identify where these differences are statistically significant.

The funnel plot for achievement of serum phosphate <1.8 mmol/L showed a number of centres outlying the upper and lower 95% and 99.9% confidence intervals both for HD and PD (Figure 9.10 and Table 9.2 (HD), Figure 9.12

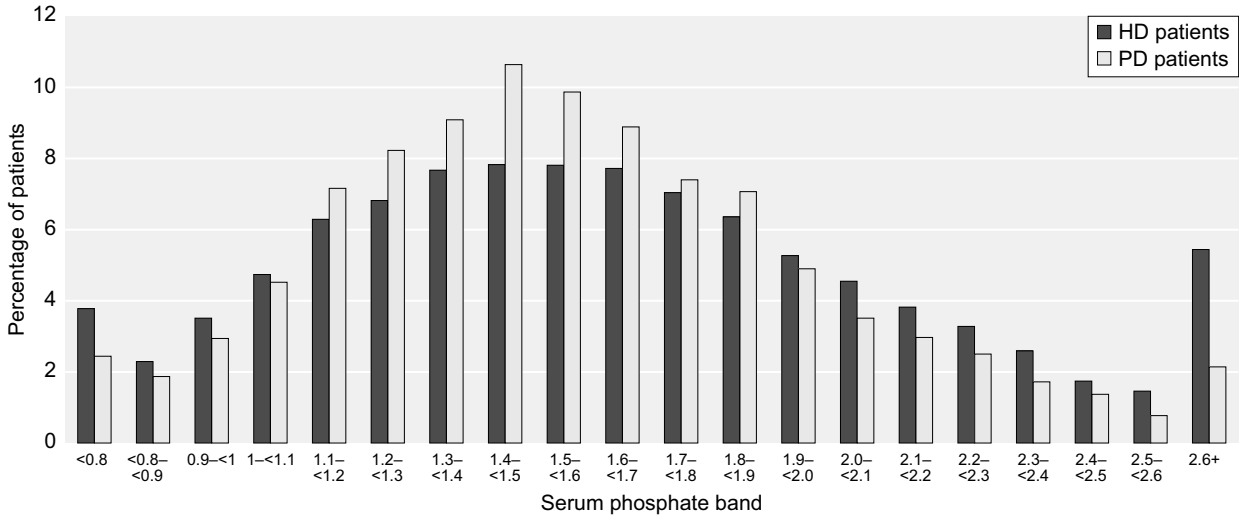

Figure 9.9: Percentage of dialysis patient split by phosphate bands and dialysis modality

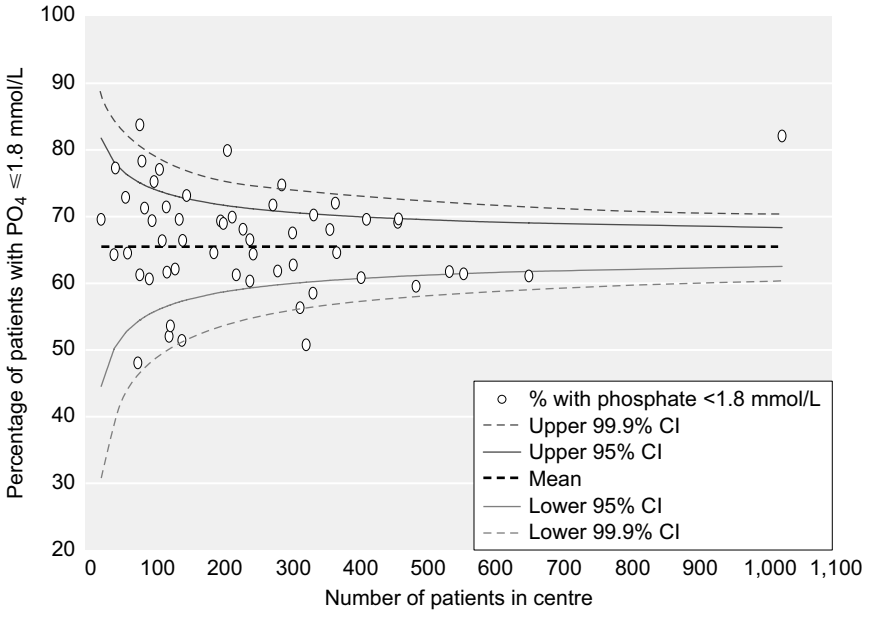

Figure 9.10: Funnel plot for the percentage of HD patients with serum phosphate <1.8 mmol/L by centre size

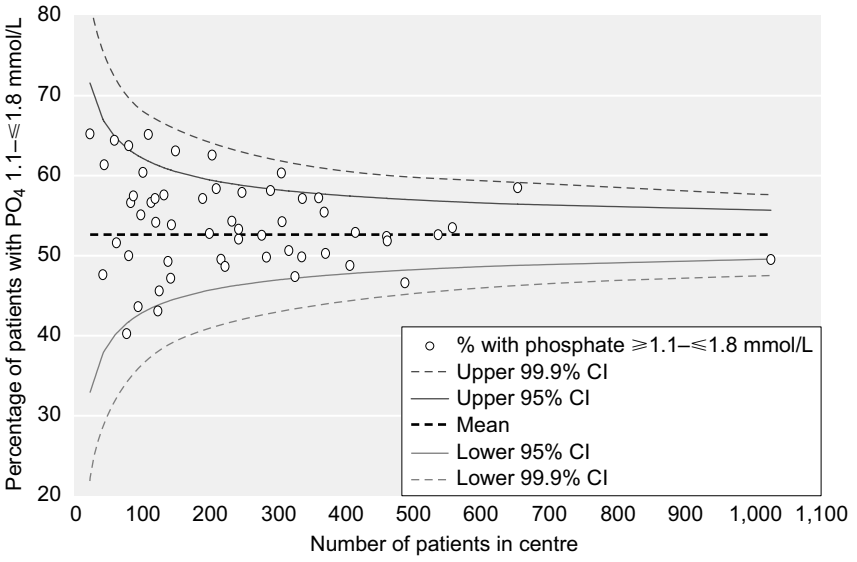

Figure 9.11: Funnel plot for the percentage of HD patients with serum phosphate ⩾1.1–⩽1.8 mmol/L by centre size

Table 9.2: Centre size and percentage of HD patients with serum phosphate <1.8 mmol/L and ⩾1.1–⩽1.8 mmol/L to enable centre identification in Figures 9.10 and 9.11

Treatment centre	Total pts	% with PO_4 <1.8 mmol/L	% with PO_4 ⩾1.1–⩽1.8 mmol/L	Treatment centre	Total pts	% with PO_4 <1.8 mmol/L	% with PO_4 ⩾1.1–⩽1.8 mmol/L
Derry	23	70	65	ManWst	216	70	50
Chestr	42	64	48	Newc	222	61	49
Ulster	44	77	61	Belfast	232	68	54
Clwyd	59	73	64	Middlbr	242	60	52
Bangor	62	65	52	Exeter	242	67	53
Carlis	77	48	40	Swanse	247	64	58
Newry	80	61	50	Wolve	276	72	53
Tyrone	80	84	64	Brightn	283	62	50
Chelms	83	78	57	L Kings	289	75	58
Liv Ain	87	71	57	Nottm	305	68	60
Ipswi	94	61	44	Stevng	306	63	54
Dudley	98	69	55	B Heart	316	56	51
York	101	75	60	Prestn	325	51	47
Wirral	109	77	65	Ports	335	59	50
Sthend	113	66	57	Oxford	336	70	57
Antrim	119	71	57	L Guys	360	68	57
Basldn	120	62	54	Carsh	368	72	55
Shrew	123	52	43	Liv RI	370	65	50
Plymth	125	54	46	Cardff	406	61	49
Dorset	132	62	58	Bristol	414	70	53
Sund	138	70	49	Leeds	460	69	52
Truro	142	51	47	L Rfree	461	70	52
Bradfd	143	66	54	L Barts	487	60	47
Glouc	149	73	63	Sheff	536	62	53
Derby	189	65	57	Leic	557	61	54
Camb	199	69	53	B QEH	653	61	59
Norwch	203	69	63	L West	1,026	82	50
Redng	209	80	58				

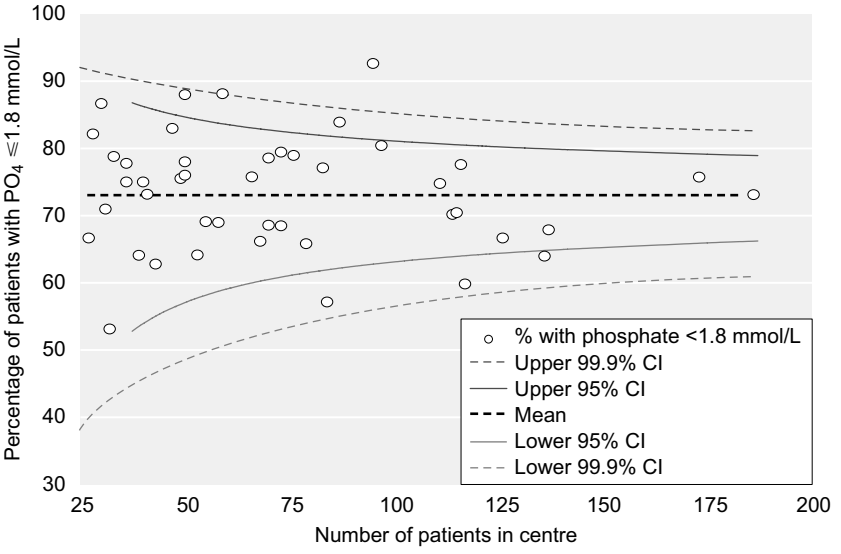

Figure 9.12: Funnel plot for the percentage of PD patients with serum phosphate <1.8 mmol/L by centre size

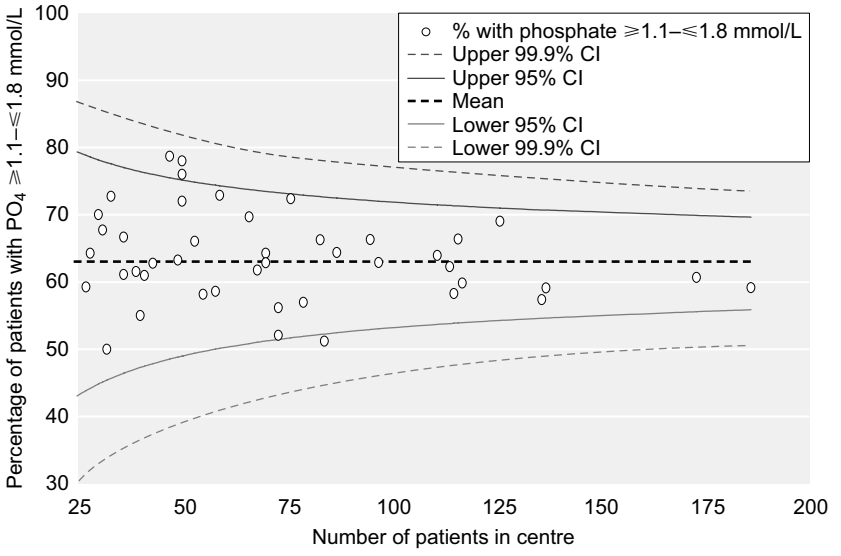

Figure 9.13: Funnel plot for the percentage of PD patients with serum phosphate ⩾1.1–⩽1.8 mmol/L by centre size

and Table 9.3 (PD)). The data for London West (which lies above the upper 99.9% confidence interval on the funnel plot) was difficult to interpret as this was amalgamated data from Hammersmith & Charing Cross and St Mary's (not previously submitting data to the UKRR). When broken down to satellite level data, the median phosphate was lower in haemodialysis patients treated at St Mary's and its satellites (median 1.18 mmol/L, quartiles 0.92–1.48 mmol/L) than in patients treated at Hammersmith & Charing Cross and satellite units (median 1.41 mmol/L, quartiles 1.09–1.82 mmol/L).

The funnel plots for achievement of phosphate ⩾1.1–⩽1.8 mmol/L (Figure 9.11 and Table 9.2 (HD), Figure 9.13 and Table 9.3 (PD)) had a notably different appearance with most centres clustered within the funnel. No centres out lie the upper or lower 99.9% confidence intervals although there were centres lying between the 95% and 99.9% confidence intervals. There was also redistribution of centres within the funnel plot when performance against 1.1–1.8 mmol/L was audited. For some centres, performance deteriorated when audited against the 'new' standard because median serum phosphate was relatively low as shown in Figure 9.3. Redistribution of centres also occurred due to centre change in achievement of standard (old vs. new) relative to the change in the UK mean achievement of standard.

Table 9.3: Centre size and percentage of PD patients with serum phosphate <1.8 mmol/L and ⩾1.1–⩽1.8 mmol/L to enable centre identification in Figures 9.12 and 9.13

Treatment centre	Total pts	% with PO_4 <1.8 mmol/L	% with PO_4 ⩾1.1–⩽1.8 mmol/L	Treatment centre	Total pts	% with PO_4 <1.8 mmol/L	% with PO_4 ⩾1.1–⩽1.8 mmol/L
York	20	95	85	L Guys	66	76	70
Antrim	24	88	83	Derby	68	66	62
Middlbr	27	67	59	Bristol	70	69	64
Basldn	28	82	64	L Kings	70	79	63
Chelms	30	87	70	Exeter	73	68	56
Truro	31	71	68	L West	73	79	52
Glouc	32	53	50	Swanse	76	79	72
Bangor	33	79	73	Prestn	79	66	57
Plymth	36	75	67	Brightn	83	77	66
B Heart	36	78	61	Ports	84	57	51
Shrew	39	64	62	Liv RI	87	84	64
Stevng	40	75	55	Redng	95	93	66
Norwch	41	73	61	Leeds	97	80	63
Bradfd	43	63	63	Carsh	111	75	64
Dorset	47	83	79	ManWst	114	70	62
Dudley	49	76	63	Oxford	115	70	58
Hull	50	78	78	L Rfree	116	78	66
Ipswi	50	76	72	B QEH	117	60	60
Wolve	50	88	76	Nottm	126	67	69
Newc	53	64	66	Sheff	136	64	57
Belfast	55	69	58	Cardff	137	68	59
Covnt	58	69	59	Leic	173	76	61
Camb	59	88	73	L Barts	186	73	59

Commentary

The new standard specifies measuring phosphate before a 'short gap' dialysis. The Registry does not currently identify whether the quarterly data extracted from centres was measured before a 'short gap' dialysis and this might introduce bias when comparing centre performance.

Some centres performed 'better than expected' when audited against a phosphate of 1.8 mmol/L and 'worse than expected' when audited against 1.1–1.8 mmol/L and vice versa. This can be explained by considering the properties of the distribution of patients in each centre. Serum phosphate was normally distributed and each centre had an individual median and standard deviation. The centre median and standard deviation were important determinants of performance against each audit measure. Centres with lower median values will perform better when audited against phosphate <1.8 mmol/L. However centres with a smaller standard deviation i.e. those with less variability will perform better when audited against a phosphate of 1.1–1.8 mmol/L. The relative contribution of each of these factors explains the observed differences in both simple rankings and on the funnel plots.

The underlying clinical explanations for these differences were unknown but may be due to differences in case mix and/or processes of care between centres. The longitudinal data might support the hypothesis that processes of care i.e. modifiable factors were important. This data shows year-on-year improvement of the percentage of patients with both serum phosphate <1.8 mmol/L and serum phosphate ⩾1.1–⩽1.8 mmol/L and the proportion of patients with a low phosphate (not previously included as an audit standard) was stable over time (Figure 9.2).

Introduction of a lower limit for the phosphate standard also has implications for interpreting these data. Although both hyper and hypophosphataemia are associated with

increased mortality in dialysis patients, both the underlying biological explanation and the magnitude of risk are probably different[8]. For this reason when the 4th edition of the standards are formalised the Registry plans to analyse hyper and hypophosphataemic patients separately.

Calcium

The 3rd edition of the Renal Association standards document states:

Serum calcium, adjusted for albumin concentration, should be between 2.2 and 2.6 mmol/L, in HD (pre-dialysis sample) and in PD patients (1).

The draft 4th edition of the Renal Association clinical practice guidelines states:

Serum calcium, adjusted for albumin concentration, should be maintained within the normal reference range for the laboratory used (measured before a 'short gap' dialysis session in HD patients) and ideally kept below 2.5 mmol/L (2).

Results

Data quality

The completeness of data by modality is shown in Table 9.4.

Table 9.4: Percentage data completeness by centre for adjusted calcium by modality

	HD	PD	Transplants		HD	PD	Transplants
Antrim	100	100	83	Leic	99	97	89
B Heart	95	95	79	Liv Ain	96	n/a	n/a
B QEH	97	95	87	Liv RI	98	98	90
Bangor	97	100	n/a	ManWst	82	89	89
Basldn	99	100	100	Middlbr	99	96	94
Belfast	96	95	95	Newc	100	98	96
Bradfd	100	100	90	Newry	99	86	83
Brightn	97	99	84	Norwch	96	98	95
Bristol	100	100	97	Nottm	99	100	77
Camb	64	100	91	Oxford	98	100	96
Cardff	97	99	97	Plymth	98	100	94
Carlis	95	100	92	Ports	99	91	85
Carsh	82	97	89	Prestn	100	100	84
Chelms	100	100	87	Redng	100	99	94
Chestr	100	n/a	n/a	Sheff	99	100	97
Clwyd	92	88	86	Shrew	99	100	100
Covnt	98	100	84	Stevng	95	98	70
Derby	99	91	n/a	Sthend	99	94	91
Derry	100	n/a	67	Sund	96	100	98
Dorset	100	98	90	Swanse	99	97	96
Dudley	84	98	99	Truro	99	100	94
Exeter	99	100	93	Tyrone	96	86	90
Glouc	100	100	98	Ulster	100	100	100
Hull	100	91	91	Wirral	95	55	n/a
Ipswi	100	96	94	Wolve	99	98	97
L Barts	100	89	82	Wrexm	3	n/a	67
L Guys	87	99	92	York	90	91	53
L Kings	100	100	95	**England**	**96**	**96**	**90**
L Rfree	86	94	82	**N Ireland**	**98**	**94**	**93**
L West	100	97	96	**Wales**	**88**	**87**	**97**
Leeds	99	98	91	**E, W & NI**	**95**	**96**	**90**

n/a = no patients treated for that modality in centre.

Summary statistics

The summary statistics are shown in Figures 9.14 to 9.17 and Table 9.5. The median adjusted calcium was 2.35 mmol/L (interquartile range 2.24–2.47 mmol/L) for HD patients and 2.38 mmol/L (interquartile range 2.28–2.5 mmol/L) for PD patients with 74% of HD (Figure 9.15) and 79% of PD patients (Figure 9.17) achieving an adjusted serum calcium between 2.2–2.6 mmol/L. The percentage of patients achieving the standard was similar to 2005. Improvement in this standard seems to have levelled off in recent years. This may be due to increasing concern about raising calcium*phosphate product.

Commentary

Comparative audit in this area remained difficult, due to differences in analytical methods between centres (and even between satellites managed by one centre), different formulae being applied to adjust serum calcium for serum albumin concentration and different methods in analysing serum albumin (see the Registry reports 1999–2003). However, as discussed in previous Registry reports, since nephrologists in each centre will be making clinical decisions based on their locally adjusted calcium results, these data are in some sense the most valid[9]. Some centres provided data already adjusted for albumin concentration and these were analysed directly; unadjusted

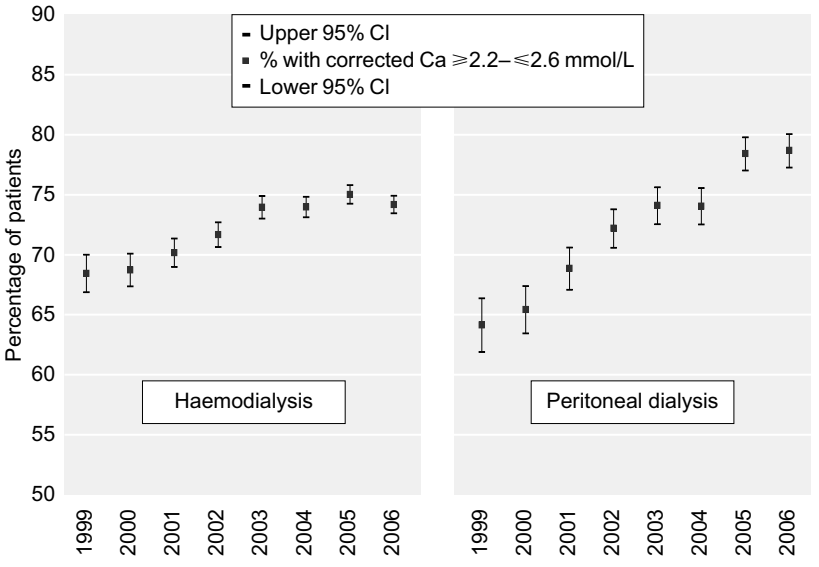

Figure 9.14: Annual change in percentage of dialysis patients with adjusted serum calcium ⩾2.2–⩽2.6 mmol/L split by modality 1999–2006

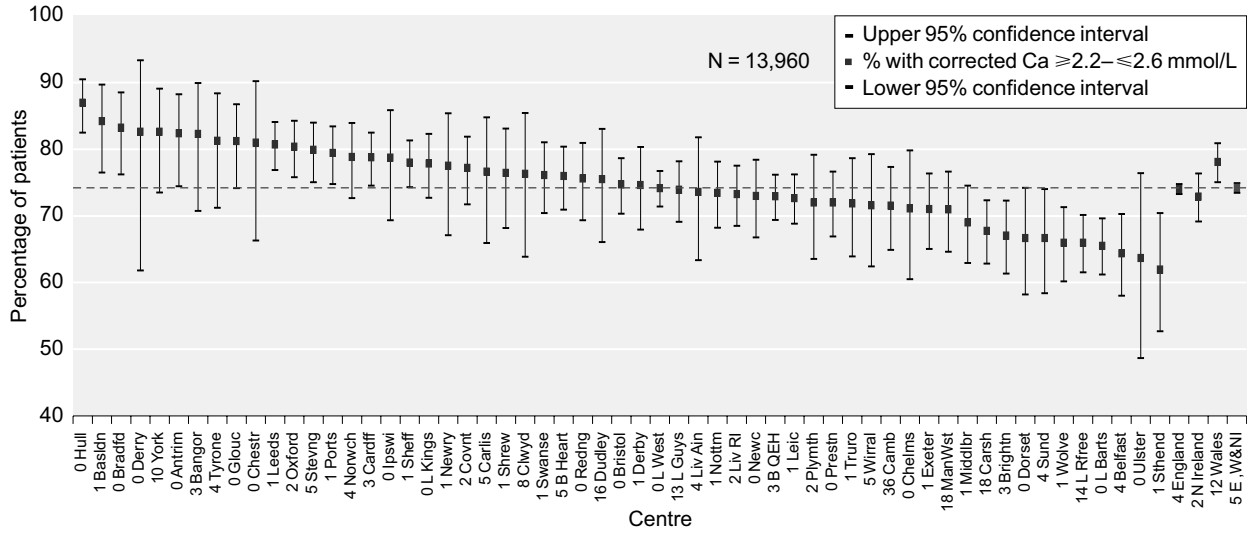

Figure 9.15: Percentage of HD patients with adjusted serum calcium ⩾2.2–⩽2.6 mmol/L by centre

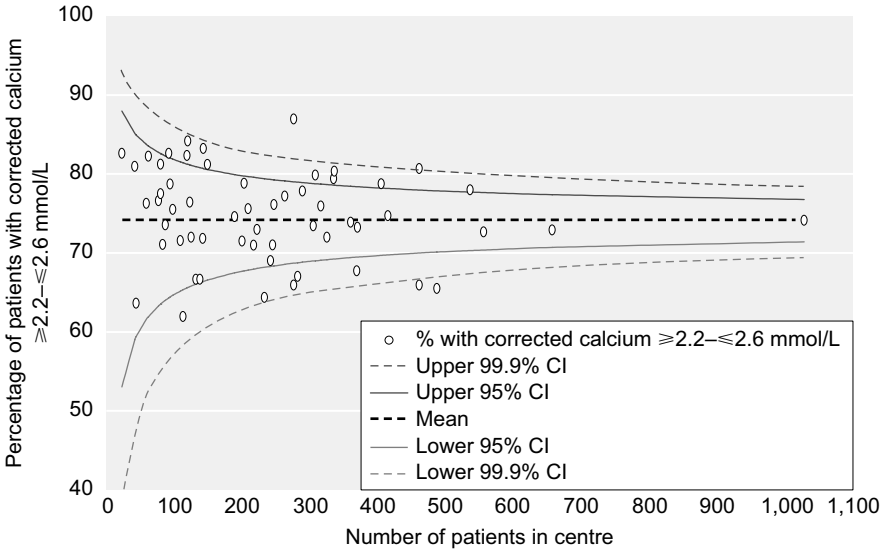

Figure 9.16: Funnel plot of percentage of HD patients with adjusted serum calcium ⩾2.2–⩽2.6 mmol/L by centre size

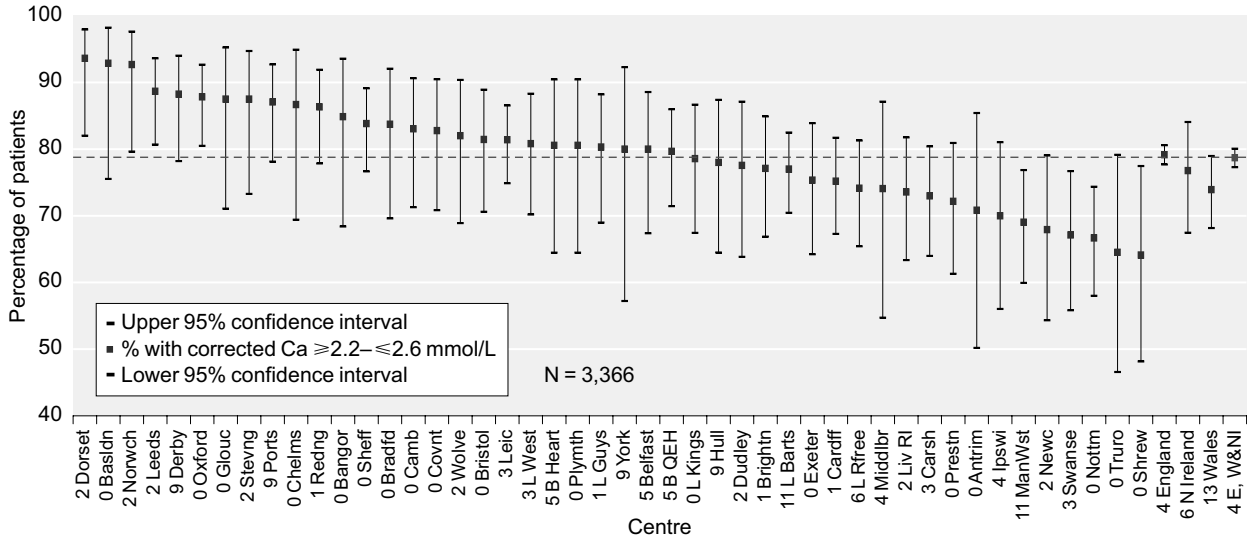

Figure 9.17: Percentage of PD patients with adjusted serum calcium 2.2–2.6 mmol/L by centre

Table 9.5: Centre size and percentage of HD patients with adjusted serum calcium ⩾2.2–⩽2.6 mmol/L and with calcium* phosphate product <4.4 mmol²/L² to enable centre identification in Figures 9.16 and 9.20

Treatment centre	Total pts	% with corrected Ca ⩾2.2–⩽2.6 mmol/L	% with $Ca^{*}PO_4$ product <4.4 mmol²/L²
Derry	23	83	74
Chestr	42	81	67
Ulster	44	64	77
Clwyd	59	76	75
Bangor	62	82	71
Carlis	77	77	56
Newry	80	78	65
Tyrone	80	81	81
Chelms	83	71	76

Table 9.5: (continued)

Treatment centre	Total pts	% with Corrected Ca ⩾2.2–⩽2.6 mmol/L	% with $Ca^{*}PO_4$ product <4.4 $mmol^2/L^2$
Liv Ain	87	74	75
York	92	83	80
Ipswi	94	79	65
Dudley	98	76	71
Wirral	109	72	81
Sthend	113	62	73
Antrim	119	82	75
Basldn	120	84	60
Shrew	123	76	51
Plymth	125	72	64
Dorset	132	67	66
Sund	138	67	71
Truro	142	72	57
Bradfd	143	83	65
Glouc	149	81	75
Derby	189	75	66
Camb	200	72	74
Norwch	203	79	74
Redng	209	76	83
ManWst	217	71	72
Newc	222	73	64
Belfast	233	64	73
Middlbr	242	69	66
Exeter	245	71	70
Swanse	247	76	73
Covnt	263	77	Phosphate data unreliable
Hull	276	87	Phosphate data unreliable
Wolve	276	66	76
Brightn	282	67	69
L Kings	289	78	80
Nottm	305	73	68
Stevng	308	80	69
B Heart	316	76	62
Prestn	325	72	63
Ports	335	79	62
Oxford	336	80	71
L Guys	360	74	76
Carsh	369	68	78
Liv RI	370	73	65
Cardff	405	79	64
Bristol	415	75	69
L Rfree	461	66	74
Leeds	461	81	76
L Barts	487	66	66
Sheff	536	78	69
Leic	556	73	67
B QEH	657	73	70
L West	1,028	74	86

calcium data provided by some centres was adjusted using a formula in widespread use:

$$\text{Adjusted calcium} = \text{unadjusted calcium} + [(40 - \text{albumin}) \times 0.02]$$

For this reason, 2006 data has been audited against adjusted serum calcium of 2.2–2.6 mmol/L.

The Registry will need to consider how to apply the statement of 'within the normal reference range' in the 4th edition of the RA standards to future analyses.

Calcium* phosphate product

The 3rd edition of the Renal Association standards document has no guideline for the calcium*phosphate product. The 2003 KDOQI clinical practice guideline states:

> ***The serum calcium–phosphorus product should be maintained at $<55\ mg^2/dL^2$ ($4.4\ mmol^2/L^2$) (1).***

The 4th edition of the Renal Association clinical practice guidelines states:

> ***The serum albumin corrected calcium phosphorus product should be kept below $4.8\ mmol^2/L^2$ and ideally below $4.2\ mmol^2/L^2$ in all CKD patients (2).***

Results

Summary statistics

The summary statistics are shown in Figures 9.18, 9.19 and 9.21 to 9.23. Dialysis patients

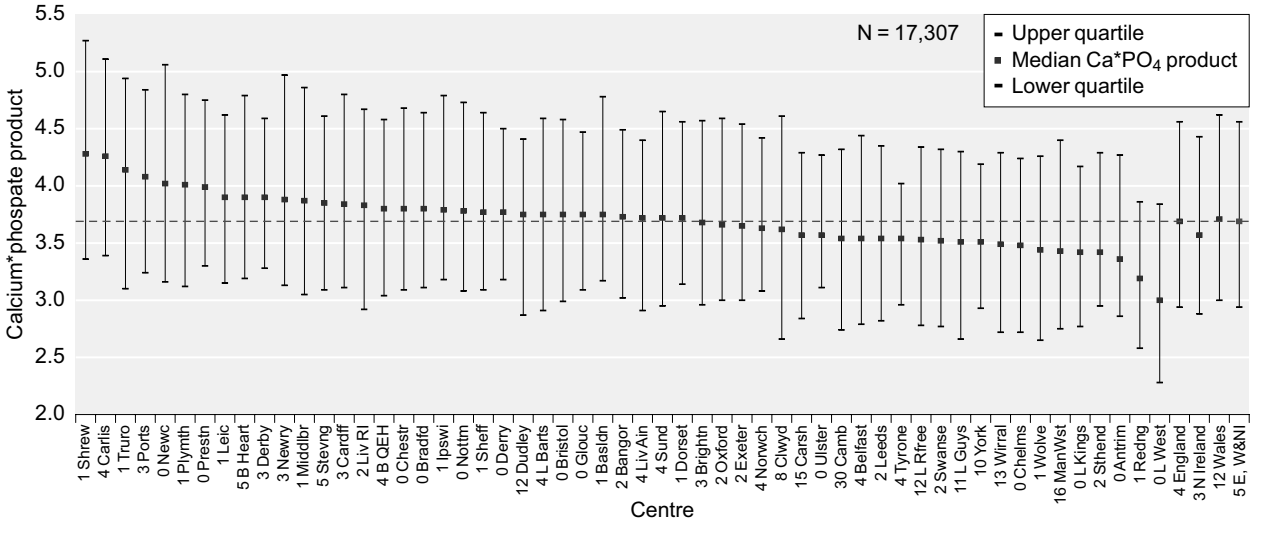

Figure 9.18: Median calcium*phosphate product for dialysis patients by centre

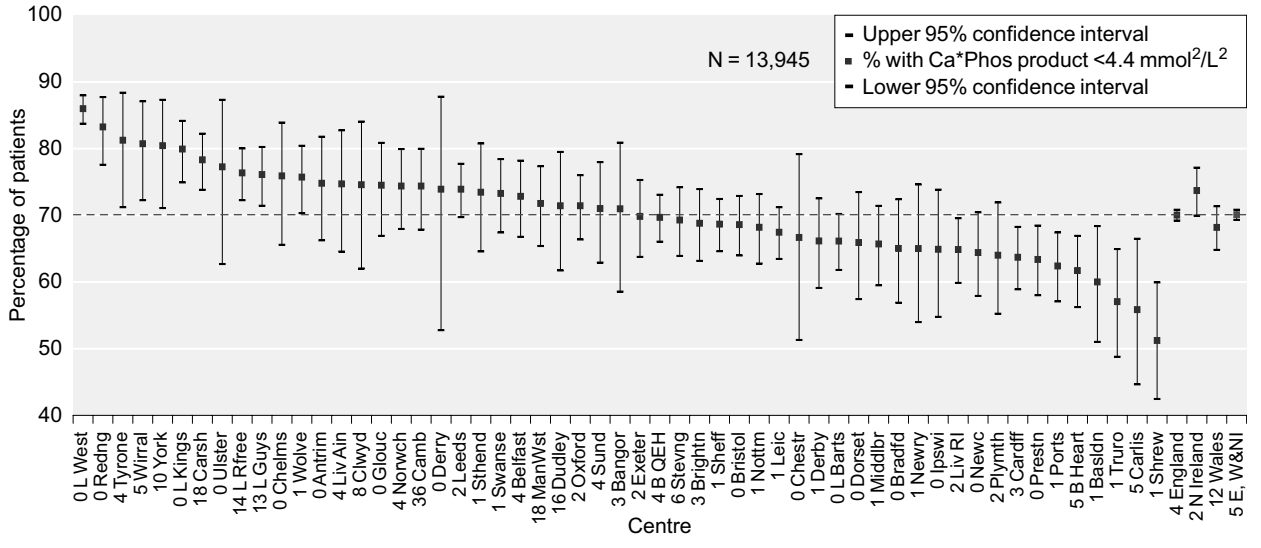

Figure 9.19: Percentage of HD patients with calcium*phosphate product $<4.4\ mmol^2/L^2$ by centre

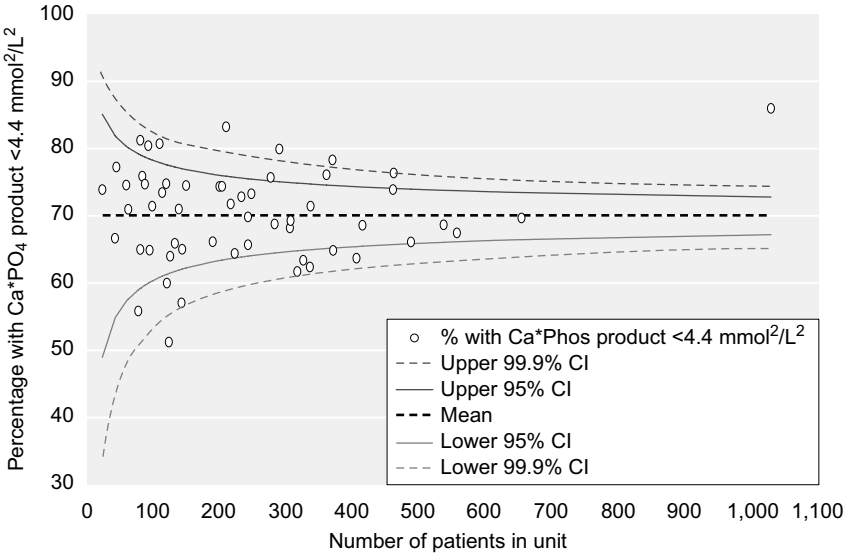

Figure 9.20: Funnel plot for percentage of HD patients with calcium*phosphate product $<4.4\,mmol^2/L^2$ by centre

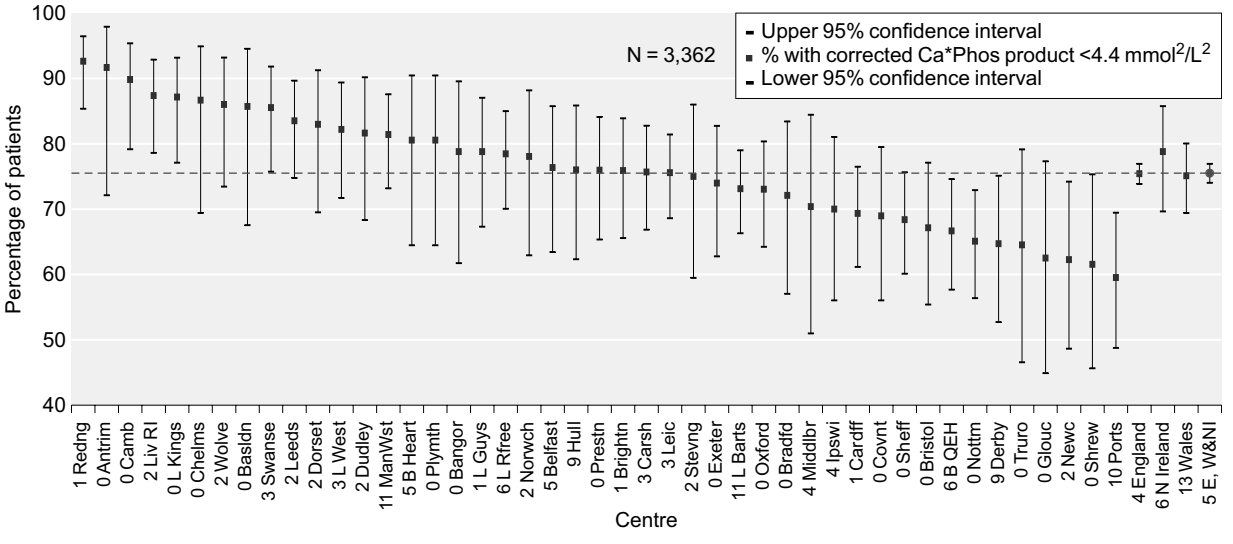

Figure 9.21: Percentage of PD patients with calcium*phosphate product $<4.4\,mmol^2/L^2$ by centre

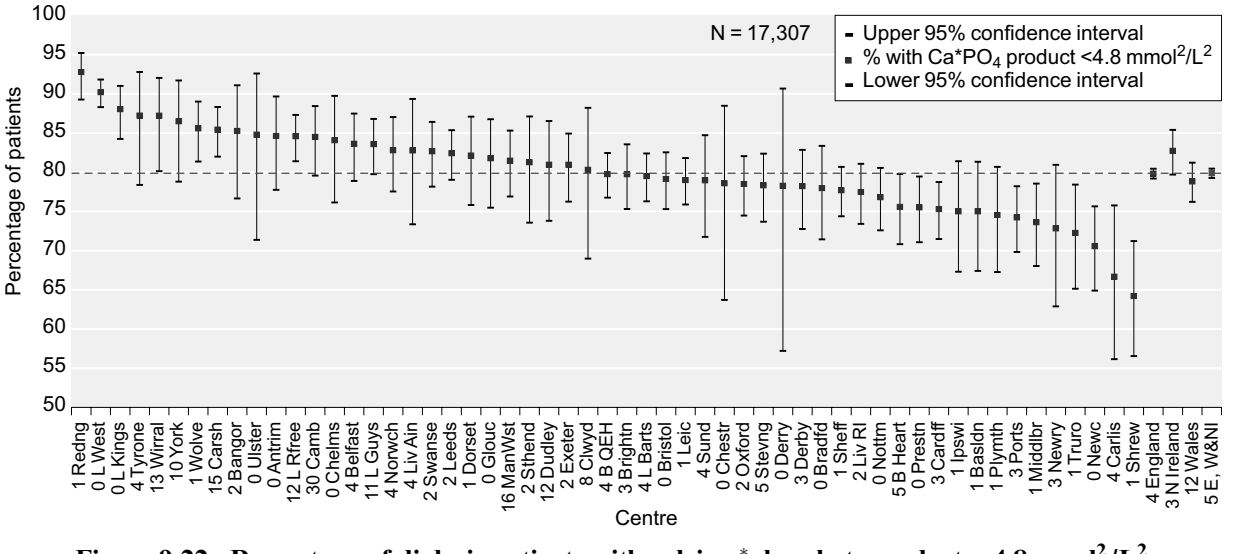

Figure 9.22: Percentage of dialysis patients with calcium*phosphate product $<4.8\,mmol^2/L^2$

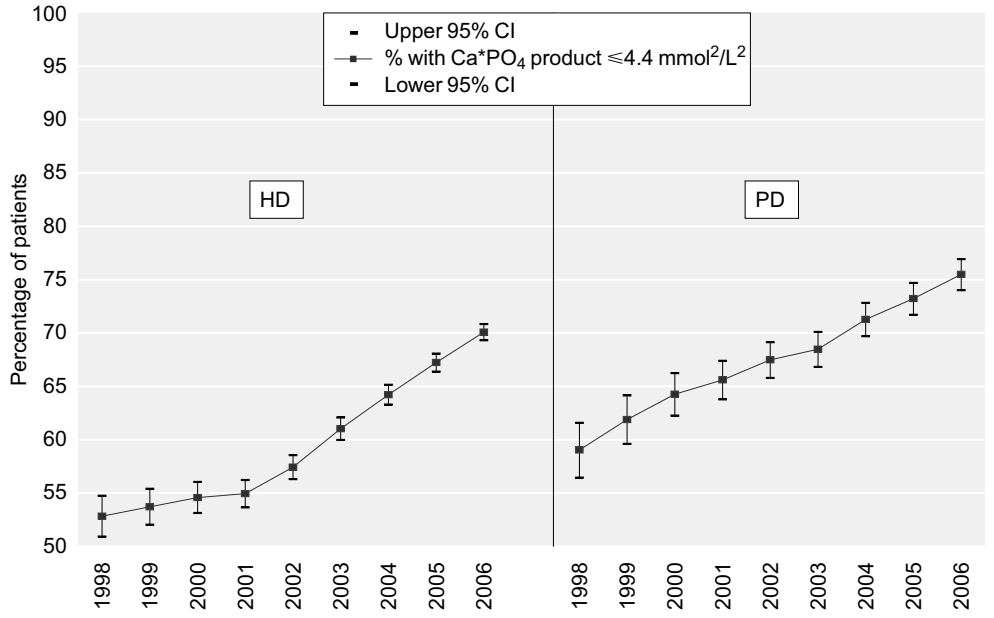

Figure 9.23: Annual change in percentage of dialysis patients with adjusted serum calcium*phosphate product $<4.4\,mmol^2/L^2$ split by modality 1998–2006

median calcium*phosphate product was $3.7\,mmol^2/L^2$ (inter quartile range 2.9–$4.6\,mmol^2/L^2$ (HD patients $= 3.7\,mmol^2/L^2$ and PD patients $= 3.6\ mmol^2/L^2$).

The percentage of patients who achieved a calcium*phosphate product of $<4.4\,mmol^2/L^2$ was 71% (HD = 70%, PD = 75%). When data was audited against $<4.8\,mmol^2/L^2$, 80% (HD = 79%, PD = 85%) of patients achieved a calcium*phosphate product within the draft RA upper standard.

Funnel plot analysis

The funnel plot analysis is shown for HD patients in Figure 9.20 and Table 9.5. The pattern of outlying centres resembles the funnel plot showing the percentage of patients with phosphate <1.8 mmol/L (Figure 9.10) rather than the plot showing percentage of patients with serum adjusted calcium 2.2–2.6 mmol/L (Figure 9.16).

Commentary

The figures shown have predominantly been selected to reflect the current use of the KDOQI guideline as an audit standard. Dialysis patients as a group have been audited against the new RA guideline as a preliminary analysis to allow comparison in subsequent years.

The funnel plot data emphasise that phosphate was a more powerful determinant than calcium in achievement of the standard for calcium*phosphate product because serum calcium fluctuates within a narrower range than serum phosphate.

Audited against a calcium*phosphate product of $4.4\,mmol^2/L^2$ there has been a further small improvement compared to 2005 (Figure 9.23).

Parathyroid hormone

The 3rd edition of the Renal Association standards document states:

> ***Parathyroid hormone (PTH) concentration should be less than four times the upper limit of normal of the assay used in patients being managed for chronic renal failure or after transplantation and in patients who have been on HD or PD for longer than three months (1).***

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 (2).***

Results

Data quality

The completeness of data by modality is shown in Table 9.6.

Summary statistics

The summary statistics are shown in Figures 9.24 to 9.26. The median PTH for dialysis patients was 24 pmol/L (interquartile range 11–48 pmol/L). The median values were slightly higher for PD patients (26 pmol/L) than HD patients (24 pmol/L) with similar interquartile ranges.

Overall 61% of dialysis patients (HD = 61%, PD = 60%) have a serum PTH <32 pmol/L but only 25% (HD = 24%, PD = 28%) have a PTH between 16–32 pmol/L. The overall spread of data remained large ranging from 42% to 80% compliance with PTH <32 pmol/L.

Commentary

Comparison of serum PTH values from different centres was difficult due to the variety of methods and reference ranges in use and this may explain some of the large inter-centre variability in PTH[9,10]. To enable some form of comparative audit, the Registry has expressed all results in pmol/L and chosen an upper limit of four times the median upper lab value: this equates to 32 pmol/L. This was also similar to the upper limit of the KDOQI guidelines (31 pmol/L). The revised guidelines have

Table 9.6: Data completeness by centre for serum PTH split by RRT modality

	HD	PD	Transplant		HD	PD	Transplant
Antrim	100	100	13	Leic	89	79	60
B Heart	83	84	14	Liv Ain	78	n/a	n/a
B QEH	66	76	51	Liv RI	94	91	62
Bangor	95	100	n/a	ManWst	74	84	78
Basldn	98	100	64	Middlbr	92	64	15
Belfast	95	91	20	Newc	99	91	45
Bradfd	100	93	36	Newry	98	86	20
Brightn	86	94	17	Norwch	92	86	27
Bristol	98	96	77	Nottm	98	97	72
Camb	58	100	77	Oxford	92	93	31
Cardff	92	96	15	Plymth	81	56	36
Carlis	94	100	9	Ports	86	52	9
Carsh	70	82	15	Prestn	98	99	43
Chelms	99	97	27	Redng	95	92	55
Chestr	7	n/a	n/a	Sheff	98	87	19
Clwyd	91	13	43	Shrew	93	95	49
Covnt	82	66	19	Stevng	97	88	32
Derby	99	97	7	Sthend	86	75	7
Derry	100	n/a	0	Sund	94	100	96
Dorset	84	85	23	Swanse	97	96	29
Dudley	71	76	43	Truro	97	81	31
Exeter	96	100	27	Tyrone	90	86	30
Glouc	96	94	29	Ulster	95	50	33
Hull	91	78	40	Wirral	93	55	n/a
Ipswi	93	96	33	Wolve	97	96	67
L Barts	79	58	13	Wrexm	1	0	33
L Guys	84	93	19	York	98	86	27
L Kings	0	0	0	**England**	**80**	**80**	**35**
L Rfree	0	0	0	**N Ireland**	**96**	**91**	**20**
L West	58	92	17	**Wales**	**85**	**83**	**17**
Leeds	97	98	24	**E, W & NI**	**81**	**80**	**34**

n/a = no patients treated for that modality in centre.

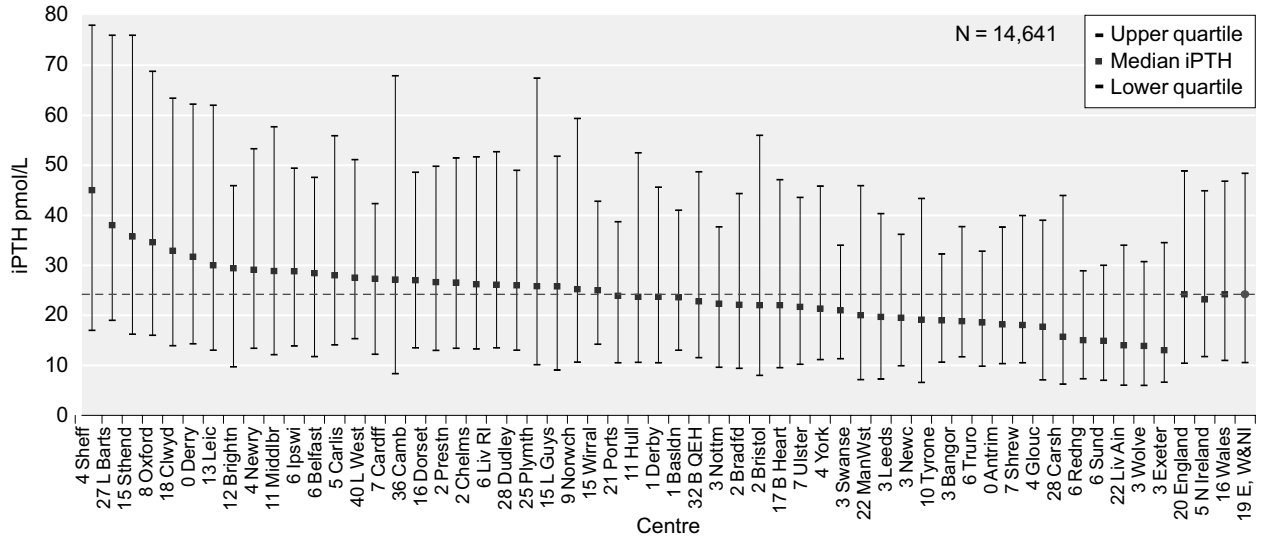

Figure 9.24: Median PTH for dialysis patients by centre

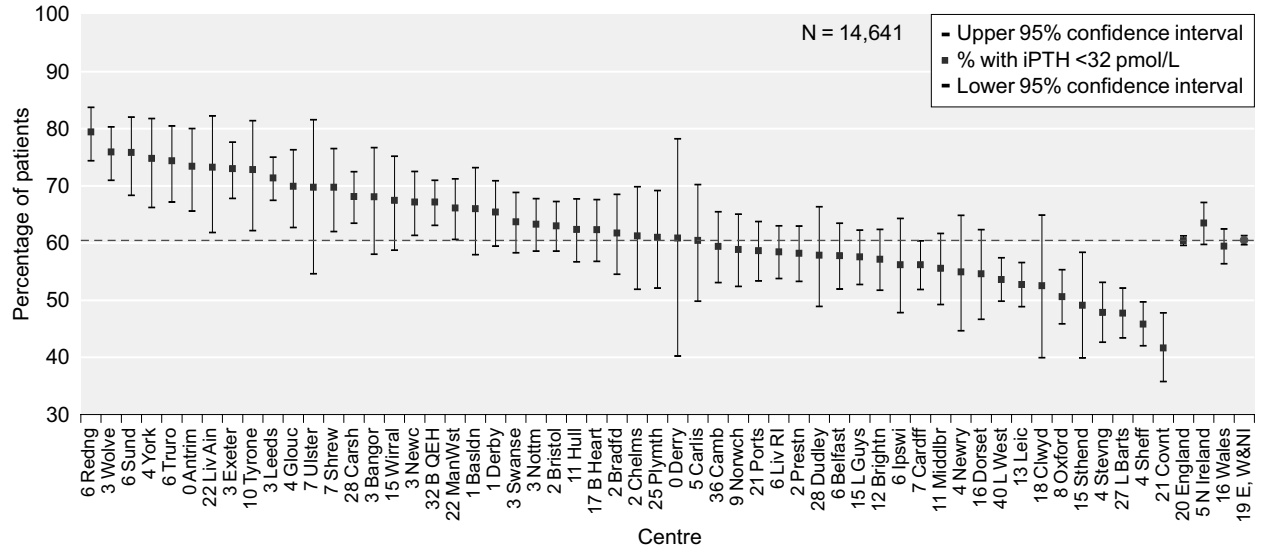

Figure 9.25: Percentage of dialysis patients with PTH <32 pmol/L by centre

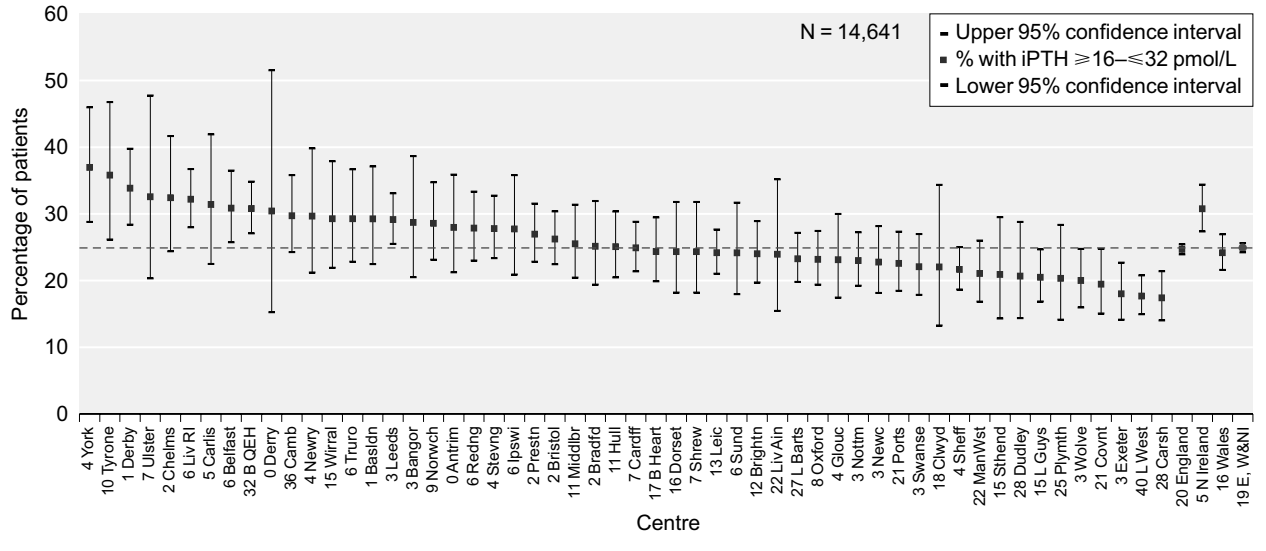

Figure 9.26: Percentage of dialysis patients with PTH $\geqslant 16$–$\leqslant 32$ pmol/L

introduced a lower limit for PTH. Using the same principle to calculate the lower limit this equated to 16 pmol/L (KDOQI recommended 15 pmol/L).

When audited against PTH of 16–32 pmol/L compared to <32 pmol/L there was considerable redistribution of some centres within the caterpillar plots. This suggested that some centres had processes of care which shifted the whole distribution and reduced median PTH whereas others were able to narrow their distribution and reduce PTH variability. This also means that there was variability between centres in the proportion of patients with a PTH <16 pmol/L. This may be an important finding given the concerns about over suppression of PTH with respect to risks of adynamic bone disease and vascular calcification.

Aluminium

The 3rd edition of the Renal Association standards document states:

> ***Serum aluminium concentration should be measured every three months in all patients on HD and in all PD patients receiving oral aluminium hydroxide (1).***

The 4th edition of the Renal Association clinical practice guidelines state:

> ***Aluminum toxicity can occur in stage 4 and 5 CKD and in dialysis patients. If clinically suspected serum aluminum levels should be determined. Care needs to be taken to avoid aluminum contamination of the blood sample.***
>
> ***Serum aluminium concentration should be measured every three months in all patients receiving oral aluminium phosphate binders.***
>
> ***Serum levels should be less than 20 μg/L. A desferrioxamine test should be performed to support the diagnosis where random serum levels are indeterminate. A bone biopsy provides confirmation of aluminium bone disease (2).***

Commentary

Overall of the 14,637 HD patients and 3,524 PD patients who were included in this analysis, 5,542 (38%) of HD and 309 (9%) of PD patients had serum aluminium measured in 2006. This was similar to 2005 data where 36% of HD and 9% of PD patients had a serum aluminium measurement.

There remained large variability in centre reporting for aluminium data and it was possible that the Registry was not capturing all of the aluminium monitoring that was taking place, not least because aluminium measurement was not generally available in local laboratories and there may therefore be practical limitations in respect of data transmission back to the renal centre database. A retrospective study looking at aluminium reporting to the UKRR between 2000 and 2004 identified a reduction in the proportion of patients having routine samples taken for aluminium monitoring and a reduced proportion with high aluminium levels over time[11]. The more pragmatic approach of the 4th edition of the RA guidelines probably more accurately reflect current practice for aluminium monitoring in the UK.

Bicarbonate

The 3rd edition of the Renal Association standards document states:

> ***Serum bicarbonate, before a haemodialysis (HD) session, measured with minimal delay after venepuncture should be between 20 and 26 mmol/l.***
>
> ***For continuous ambulatory peritoneal dialysis (CAPD) patients serum bicarbonate, measured with minimal delay after venepuncture, should be between 25 and 29 mmol/l (1).***

The standards are essentially unchanged in the 4th edition of the Renal Association guidelines other than the PD guideline now states that serum bicarbonate should be maintained within the normal range.

Results

Data quality

The percentage completeness of data by modality is shown in Table 9.7.

Table 9.7: Percentage data completeness by centre for serum bicarbonate by modality

	HD	PD		HD	PD
Antrim	100	100	Leic	89	94
B Heart	93	95	Liv Ain	96	n/a
B QEH	96	90	Liv RI	98	98
Bangor	97	94	ManWst	0	1
Basldn	99	100	Middlbr	98	96
Belfast	97	95	Newc	100	98
Bradfd	99	100	Newry	99	71
Brightn	97	96	Norwch	96	98
Bristol	100	100	Nottm	78	21
Camb	60	100	Oxford	98	78
Cardff	83	97	Plymth	98	100
Carlis	95	100	Ports	99	77
Carsh	80	97	Prestn	84	85
Chelms	100	100	Redng	99	99
Chestr	100	n/a	Sheff	99	100
Clwyd	92	88	Shrew	100	100
Covnt	19	48	Stevng	95	98
Derby	99	91	Sthend	99	94
Derry	100	n/a	Sund	97	100
Dorset	100	100	Swanse	99	97
Dudley	81	96	Truro	99	90
Exeter	94	100	Tyrone	98	86
Glouc	100	100	Ulster	100	100
Hull	99	89	Wirral	95	59
Ipswi	99	96	Wolve	99	98
L Barts	100	88	Wrexm	2	0
L Guys	87	99	York	99	95
L Kings	0	0	**England**	**81**	**80**
L Rfree	0	0	**N Ireland**	**98**	**92**
L West	47	96	**Wales**	**81**	**85**
Leeds	99	98	**E, W & NI**	**82**	**81**

n/a = no patients treated for that modality in centre.

Summary statistics

The summary statistics are shown in Figures 9.27, 9.28, 9.30 and 9.31. The median serum bicarbonate was 23 mmol/L (interquartile range 21–25 mmol/L) in HD patients and 26 mmol/L (interquartile range 24–28 mmol/L) in PD patients. 70% of HD and 53% of PD patients achieved the RA standard for serum bicarbonate but there was a large spread of data between centres. For HD patients compliance in centres ranged from 39–89% and for PD patients from 24–68%.

Funnel plots

The funnel plot data is shown in Figure 9.29 and Table 9.8 (HD) and Figure 9.32 and Table 9.9 (PD). The distribution of centres for bicarbonate data was different to that for other biochemical variables. Centres that lie outwith the lower 99.9% confidence interval comprise both centres with high and low median serum bicarbonates whereas centres which lie outwith the upper 95% confidence interval lie in the middle of the plot showing median serum bicarbonate with a median value similar to the UK average.

Commentary

The Registry has previously conducted a survey into the cause of between centre variation in achievement of the bicarbonate standard and few of these causes of variation have been eliminated[12].

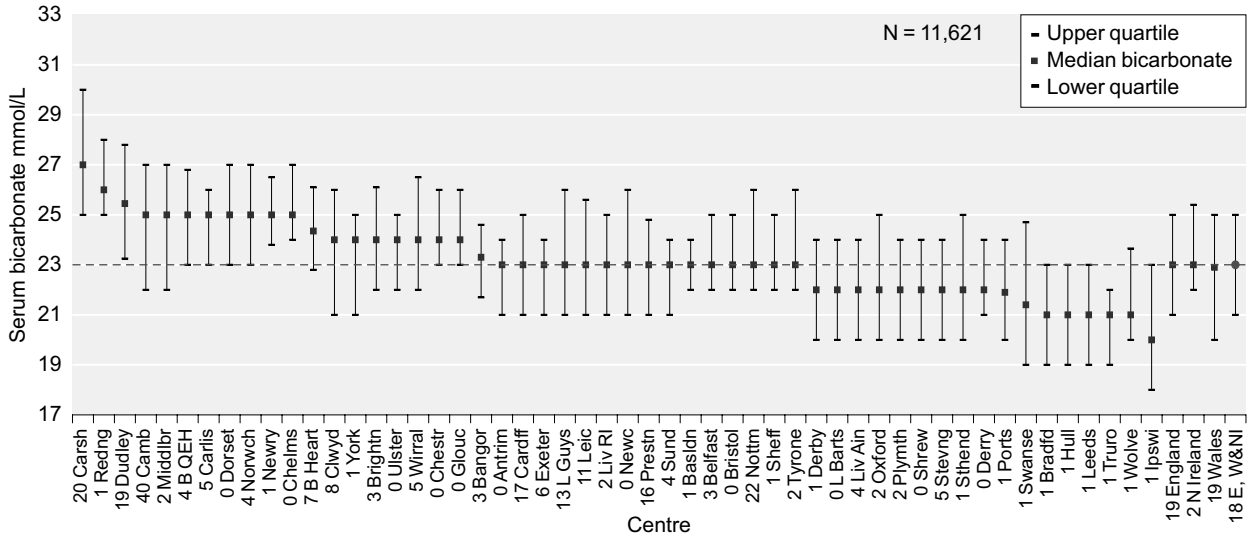

Figure 9.27: Median serum bicarbonate in HD patients by centre

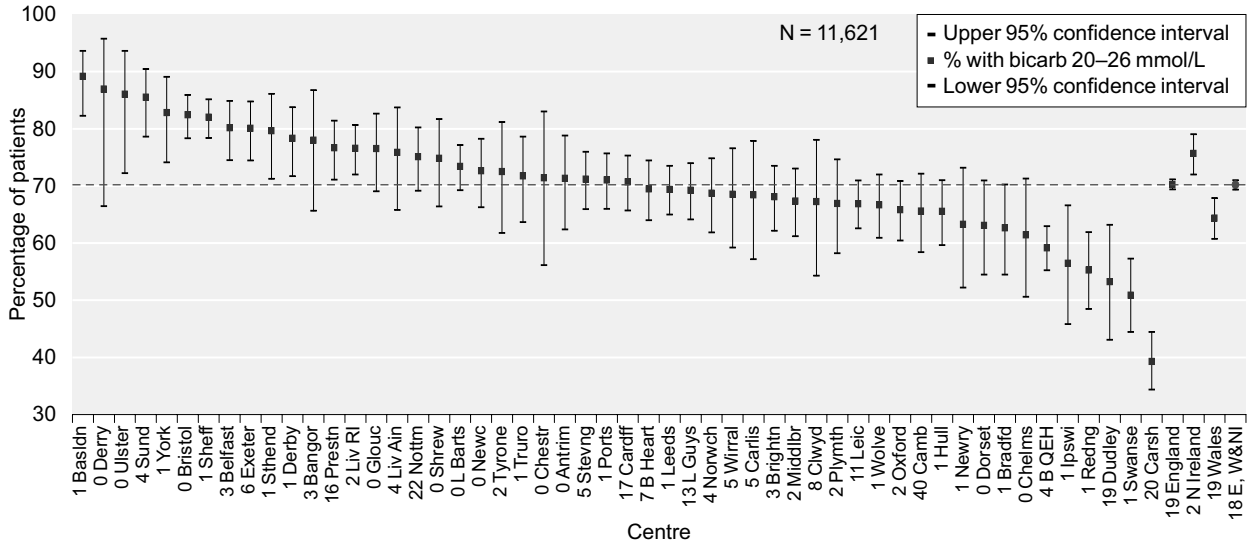

Figure 9.28: Percentage of HD patients with serum bicarbonate ⩾20–⩽26 mmol/L by centre

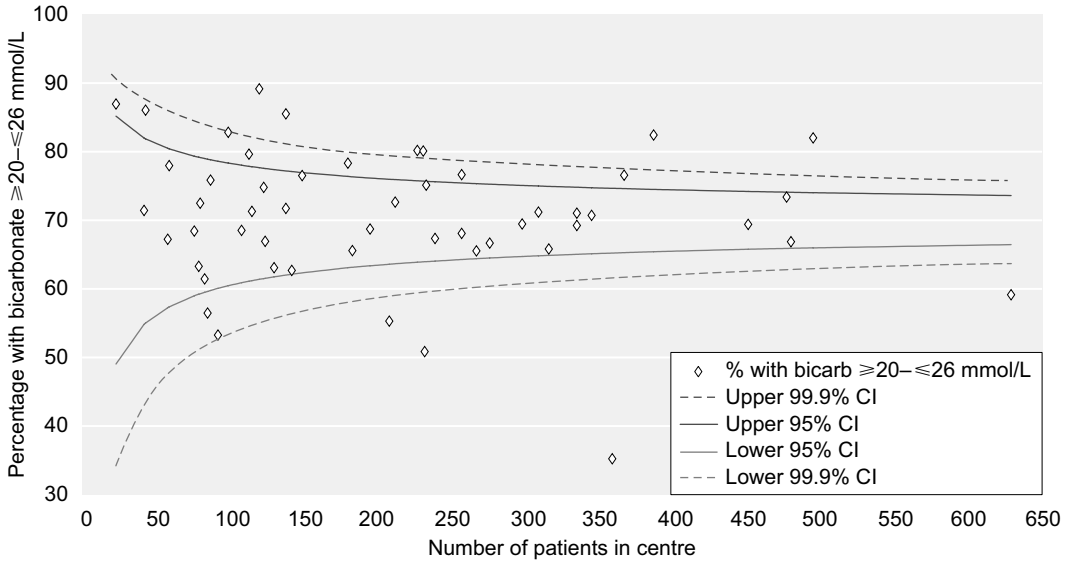

Figure 9.29: Funnel plot of percentage of HD patients with serum bicarbonate ⩾20–⩽26 mmol/L by centre size

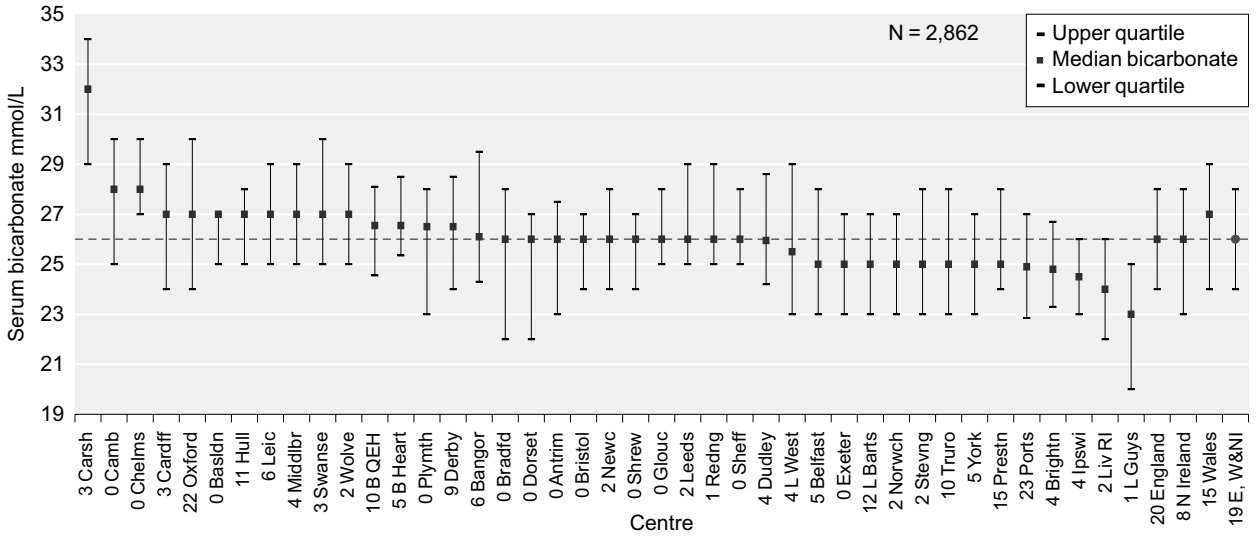

Figure 9.30: Median serum bicarbonate in PD patients by centre

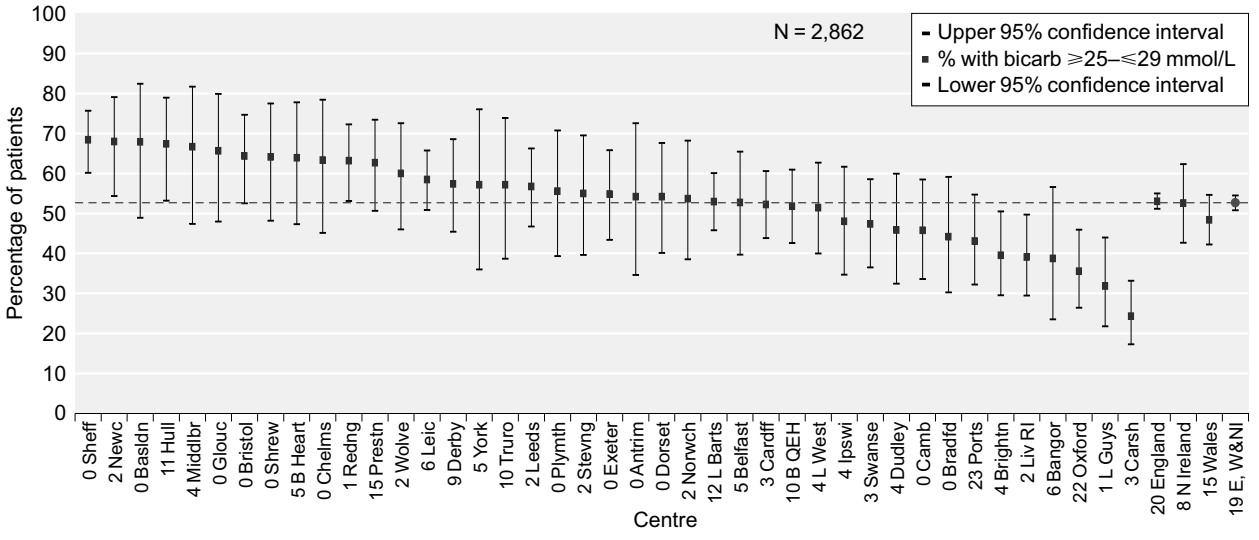

Figure 9.31: Percentage of PD patients with serum bicarbonate ⩾25–⩽29 mmol/L by centre

The funnel plot data might suggest that there were differences in centre processes but that these may not all be within direct control of clinicians altering patient management. Certain centres, in particular Carshalton which had significantly higher median serum bicarbonate in both HD and PD patients, can be identified as statistical outliers in these analyses. It is possible that differences in sample processing may explain the observed differences instead of, or in addition to, dialysis and oral bicarbonate prescription.

Total cholesterol

There has been little change for the cholesterol standard. The 4th edition of the Renal Association standards document states:

3 hydroxy-3 methylglutaryl-Co-enzyme A reductase inhibitors (statins) should be considered for primary prevention in all CKD patients with a 10-year risk of coronary disease, calculated as 30% according to the Joint British Societies' chart or the coronary risk calculator, ignoring the fact that these calculations may not be accurate in patients with renal disease. A total cholesterol of <5 mmol/l or a 30% reduction from baseline, or a fasting low density lipoprotein (LDL)-cholesterol of <3 mmol/l, 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

Table 9.8: Centre size and percentage of HD patients with serum bicarbonate ⩾20–⩽26 mmol/L by centre size to enable centre identification in Figure 9.29

Treatment centre	Total pts	% with bicarbonate ⩾20–⩽26 mmol/L	Treatment centre	Total pts	% with bicarbonate ⩾20–⩽26 mmol/L
Derry	23	87	Norwch	195	69
Chestr	42	71	Redng	208	55
Ulster	43	86	Newc	212	73
Clwyd	58	67	Belfast	227	80
Bangor	59	78	Exeter	231	80
Carlis	76	68	Swanse	232	51
Newry	79	63	Nottm	233	75
Tyrone	80	73	Middlbr	239	67
Chelms	83	61	Brightn	257	68
Ipswi	85	56	Prestn	257	77
Liv Ain	87	76	Hull	267	66
Dudley	92	53	Wolve	276	67
York	99	83	B Heart	298	69
Wirral	108	69	Stevng	309	71
Sthend	113	80	Oxford	316	66
Antrim	115	71	Ports	335	71
Basldn	120	89	L Guys	335	69
Shrew	123	75	Cardff	345	71
Plymth	124	67	Carsh	359	39
Dorset	130	63	Liv RI	367	77
Truro	138	72	Bristol	387	82
Sund	138	86	Leeds	451	69
Bradfd	142	63	L Barts	477	73
Glouc	149	77	Leic	480	67
Derby	180	78	Sheff	495	82
Camb	183	66	B QEH	629	59

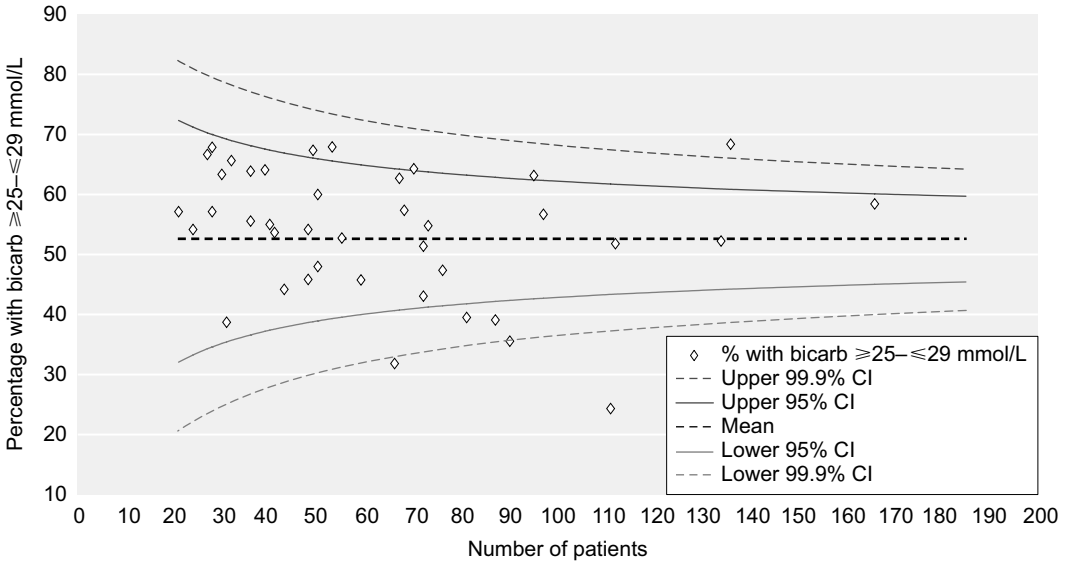

Figure 9.32: Funnel plot of percentage of PD patients with serum bicarbonate ⩾25–⩽29 mmol/L by centre size

Table 9.9: Centre size and percentage of PD patients with serum bicarbonate ⩾25–⩽29 mmol/L by centre size to enable centre identification in Figure 9.32

Treatment centre	Total pts	% with bicarbonate ⩾25–⩽29 mmol/L	Treatment centre	Total pts	% with bicarbonate ⩾25–⩽29 mmol/L
York	21	57	Camb	59	46
Antrim	24	54	L Guys	66	32
Middlbr	27	67	Prestn	67	63
Basldn	28	68	Derby	68	57
Truro	28	57	Bristol	70	64
Chelms	30	63	Ports	72	43
Bangor	31	39	L West	72	51
Glouc	32	66	Exeter	73	55
Plymth	36	56	Swanse	76	47
B Heart	36	64	Brightn	81	40
Shrew	39	64	Liv RI	87	39
Stevng	40	55	Oxford	90	36
Norwch	41	54	Redng	95	63
Bradfd	43	44	Leeds	97	57
Dorset	48	54	Carsh	111	24
Dudley	48	46	B QEH	112	52
Hull	49	67	Cardff	134	52
Ipswi	50	48	Sheff	136	68
Wolve	50	60	Leic	166	58
Newc	53	68	L Barts	185	53
Belfast	55	53			

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) (2).

Results

Data quality

The percentage data completeness by modality is shown in Table 9.10.

Summary statistics

The summary statistics are shown in Figures 9.33 to 9.36. The median total cholesterol in HD patients was 3.8 mmol/L (inter quartile range 3.2–4.5 mmol/L) and 85% of patients had a serum total cholesterol ⩽5 mmol/L. The median total cholesterol in PD patients was 4.3 mmol/L (inter quartile range 3.6–5.0 mmol/L) and 73% of patients had a serum total cholesterol ⩽5 mmol/L. Transplanted patients had a median serum total cholesterol of 4.6 mmol/L (inter quartile range 4.0–5.2 mmol/L) and 67% of patients had a serum total cholesterol ⩽5 mmol/L.

The distribution of cholesterol split by modality is shown in Figure 9.35 which shows that dialysis patients had a total lower serum cholesterol than transplanted patients with the whole distribution shifted to the left. HD patients also had lower total cholesterol than PD patients. Figure 9.36 shows an improvement in the proportion of patients with a serum total cholesterol ⩽5 mmol/L over time.

Commentary

The cause of differences between serum cholesterol between treatment modalities is unknown but probably multifactorial. The Registry does not currently collect prescribing data to enable this to be linked to a lipid-lowering treatment effect and these data were confounded by the known associations between chronic disease, inflammation, malnutrition and hypocholesterolaemia. Likewise, higher cholesterol concentrations in transplant recipients may reflect improved appetite or the hypercholesterolaemic

Table 9.10: Percentage data completeness by centre for serum total cholesterol by modality

	HD	PD	Transplants		HD	PD	Transplants
Antrim	100	100	74	Leic	95	93	89
B Heart	60	89	60	Liv Ain	76	n/a	n/a
B QEH	96	94	89	Liv RI	10	1	22
Bangor	89	100	n/a	ManWst	74	89	91
Basldn	99	100	100	Middlbr	99	96	83
Belfast	89	97	97	Newc	93	100	97
Bradfd	89	95	92	Newry	99	86	85
Brightn	17	76	57	Norwch	95	98	97
Bristol	92	89	93	Nottm	97	96	88
Camb	58	100	89	Oxford	87	89	74
Cardff	83	99	89	Plymth	92	69	96
Carlis	95	90	92	Ports	46	42	60
Carsh	75	94	79	Prestn	100	99	90
Chelms	99	93	53	Redng	97	98	97
Chestr	83	n/a	n/a	Sheff	94	79	88
Clwyd	84	75	86	Shrew	100	97	91
Covnt	1	0	1	Stevng	51	78	68
Derby	0	0	7	Sthend	87	94	74
Derry	100	n/a	67	Sund	96	100	99
Dorset	81	92	91	Swanse	99	97	98
Dudley	49	72	84	Truro	97	94	81
Exeter	95	78	90	Tyrone	98	86	95
Glouc	91	100	69	Ulster	100	100	100
Hull	91	58	70	Wirral	94	52	n/a
Ipswi	85	94	81	Wolve	93	82	88
L Barts	99	81	82	Wrexm	27	24	33
L Guys	86	94	92	York	95	68	88
L Kings	94	94	91	**England**	**80**	**81**	**80**
L Rfree	88	95	90	**N Ireland**	**95**	**95**	**93**
L West	86	99	98	**Wales**	**83**	**89**	**90**
Leeds	94	94	95	**E, W & NI**	**81**	**83**	**81**

n/a = no patients treated for that modality in centre.

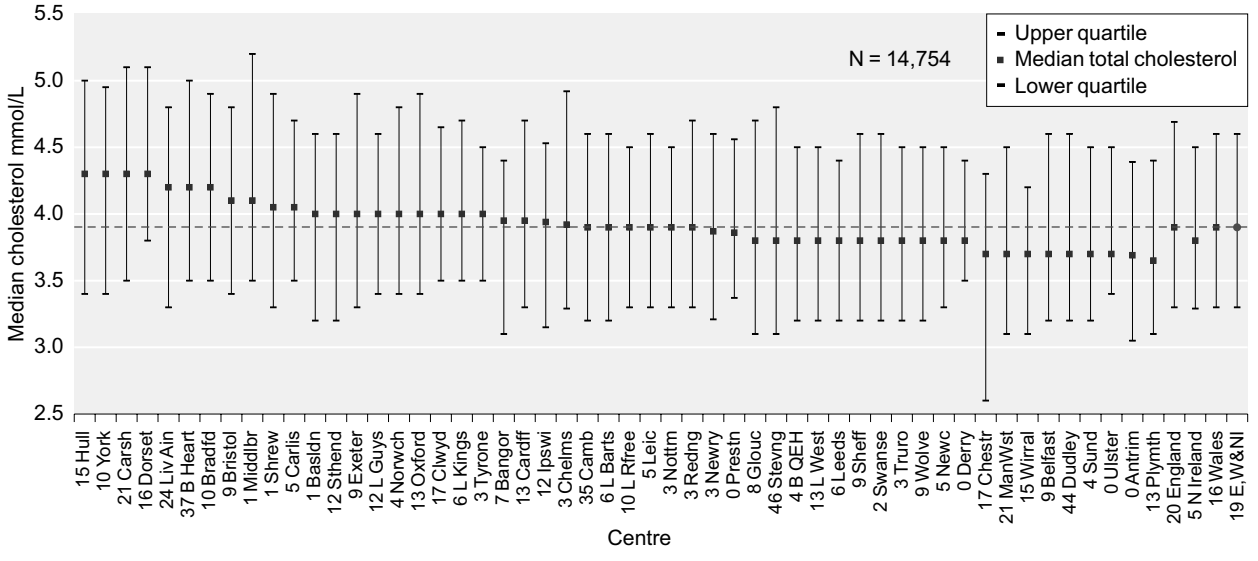

Figure 9.33: Median serum total cholesterol in dialysis patients by centre

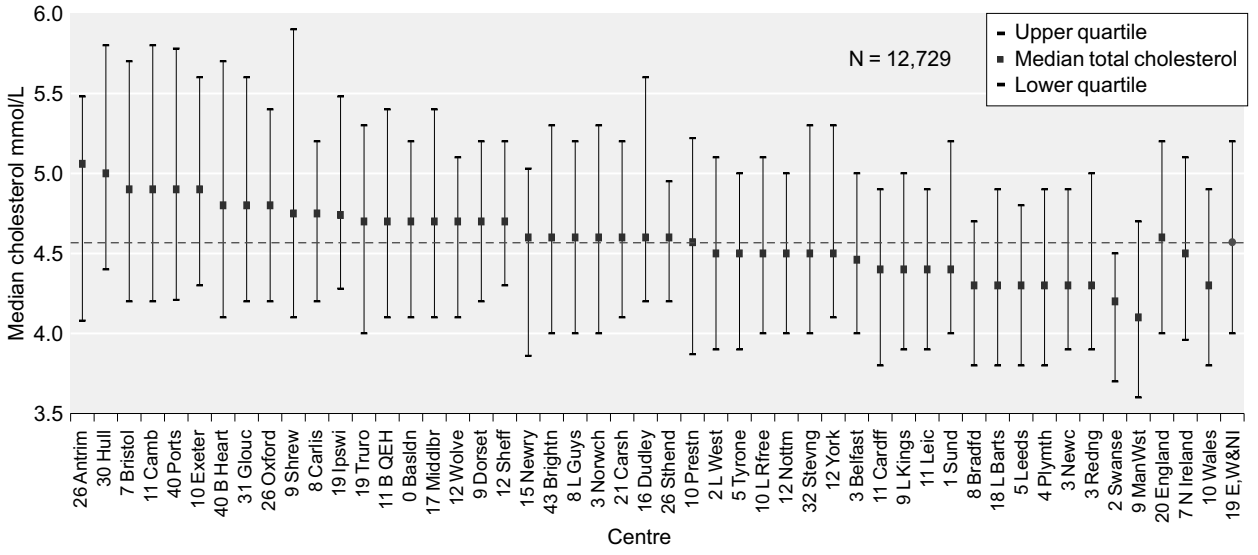

Figure 9.34: Median serum total cholesterol in transplant patients by centre

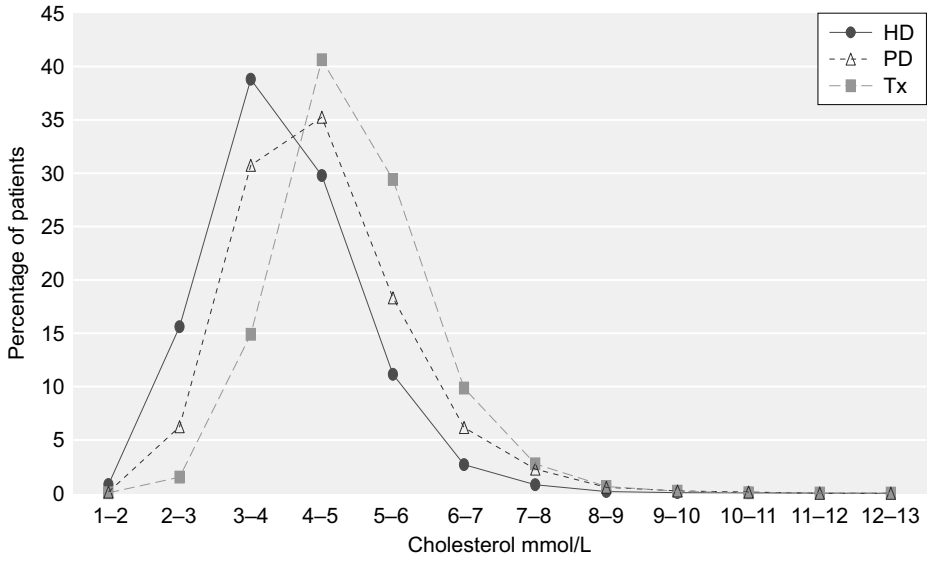

Figure 9.35: Distribution of serum total cholesterol by band, by modality

influence of steroids, calcineurin inhibitors and sirolimus.

The Registry is in the process of expanding the dataset to collect both more detailed lipid profiles and statin use to provide renal centres with a more comprehensive picture. The results of the SHARP and AURORA trials should help to clarify the benefits of statin use in CKD and dialysis populations.

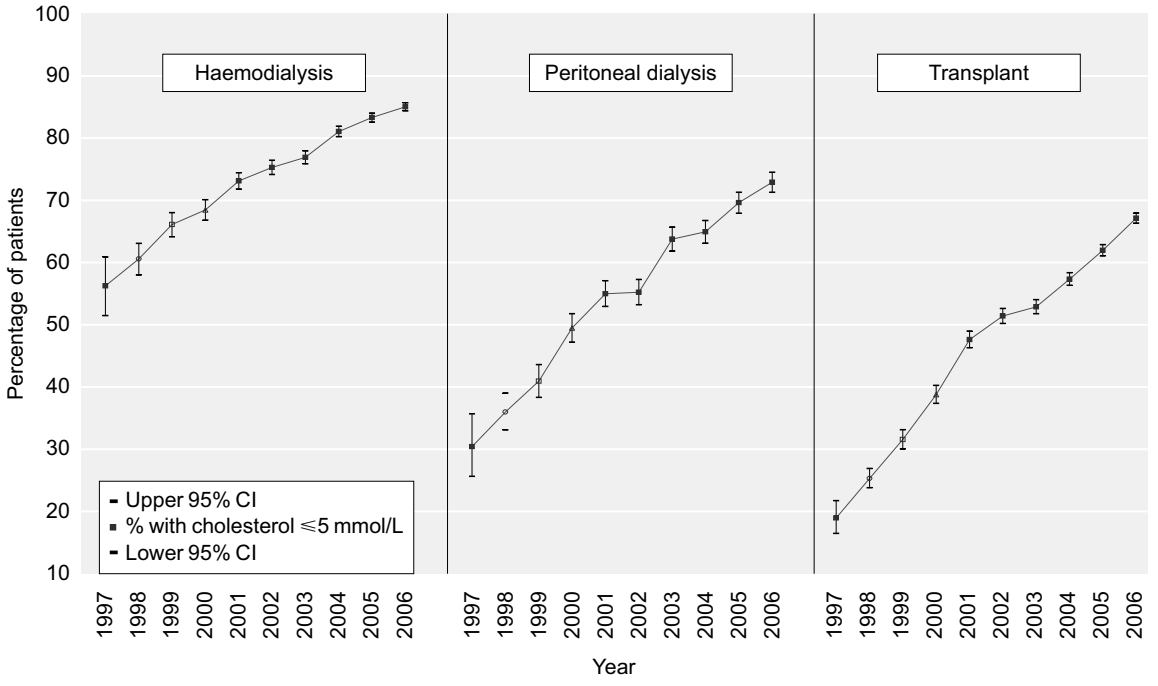

Figure 9.36: Annual change in percentage of RRT patients with serum total cholesterol ⩽5 mmol/L, 1997–2006

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Chapter 10: Blood Pressure in Prevalent RRT Patients

Janice Harper, Daniel Ford, Anna Casula and Andrew J Williams

Summary

- Many centres still failed to collect blood pressure data in a format that could be sent to the UK Renal Registry (UKRR).
- In England, Northern Ireland and Wales, 44% of patients achieved the combined blood pressure standard pre-dialysis (<140/90 mmHg) (inter-unit range 17–65%) and 48% post-dialysis (<130/80) (inter-unit range 16–62%). On average 30% (17–48%) of PD patients and 25% (13–39%) of renal transplant recipients achieved the standard of <130/80.
- Over the last nine years there has been no significant change in systolic or diastolic blood pressure achievement. This suggests poorly achieving centres have failed to adopt a systematic approach to blood pressure control.
- Co-morbidity data is needed for each patient on the UKRR database to perform blood pressure survival analyses.

Introduction

National and international organisations recommend a target blood pressure <130/80 mmHg for patients with chronic kidney disease (CKD) to reduce cardiovascular risk and progression to renal failure. There is extensive evidence that shows a linear relationship between systolic blood pressure (SBP) or diastolic blood pressure (DBP) and cardiovascular death in the general population. A meta-analysis including over one million individuals in hypertension trials showed the benefit is evident down to 120/75 mmHg[1]. By contrast, the relationship between blood pressure and one year all cause mortality in incident haemodialysis (HD) patients is U-shaped, with both high and low blood pressure associated with increased risk of death[2,3]. The Irbesartan Diabetic Nephropathy Trial also showed an increase in all cause mortality for SBP below 120 mmHg[4]. Recent community based studies showed an increased risk of stroke for individuals with CKD stages 3 to 4 and SBP below 120 mmHg (hazard ratio 2.51) compared to individuals with CKD and SBP 120 to 129 mmHg[5]. These observations raise concern that low blood pressure may be harmful to some patients with renal failure. The crucial question is whether low blood pressure is of itself harmful even in fit individuals without established cardiac disease. A study of 16,959 incident HD patients went some way to address this. It showed a baseline SBP below 120 mmHg was associated with a higher risk of death initially but increased survival after three years[6]. Cardiac failure was the most likely explanation for the early deaths but again the study lacked co-morbidity data to prove causal association.

In renal transplant (Tx) recipients low blood pressure is associated with increased survival, as seen in the general population[7–10]. A recent landmark study of peritoneal dialysis (PD) patients in England and Wales explained this observation[11]. The authors used activation on the renal transplant waiting list in the first year on dialysis as a surrogate marker for low co-morbidity. They showed both high and low SBP was associated with an increased risk of death for the entire cohort. However, for patients activated on the renal transplant waiting list, low blood pressure (SBP and DBP) was associated with increased survival. Cardiovascular disease was the main reason patients were not listed for renal transplant in the UK. This study showed for the first time higher mortality is linked to cardiac disease rather than low blood pressure per se.

Many factors influence blood pressure in dialysis patients. The recently revised UK Renal Association blood pressure guidelines acknowledge the key role of sodium balance. They promote control of extracellular volume by

dietary salt restriction, ultrafiltration to dry weight and lower dialysate sodium for HD patients. A study of 52 prevalent HD patients showed reducing dialysate sodium from 141 to 138 mmol/L reduced SBP by 5–10 mmHg after 8 months[12]. The largest reduction occurred in patients with higher initial blood pressure. An audit of 469 prevalent HD patients dialysing in seven centres showed significantly lower pre- and post-SBP for patients on a low dialysate sodium (137–139 mmol/L) and restricted salt intake (5 g/day)[13]. Neither study reported an increased frequency of symptomatic intradialytic hypotension using low sodium dialysate. UK centres that adopt a strict salt balance approach consistently report higher achievement of the blood pressure standard. To date little attention has been paid to sodium restriction in hypertensive renal transplant recipients. A small study of 32 transplant recipients suggested this was an effective intervention. Patients were randomly assigned to sodium restriction (80–100 mmol/day) or normal diet in addition to their usual antihypertensive medication. After 3 months SBP fell from 146+/−21 to 116+/−11 mmHg and DBP from 89+/−8 to 72+/−10 mmHg in the salt restricted group[14].

Each year UKRR data shows the prevalence of hypertension varies in a predictable fashion according to the underlying renal disease. Hypertension is more common in patients with vascular diseases (diabetes, renovascular disease or hypertension) than in those with glomerulonephritis and is even less frequent in patients with tubular disorders. The same pattern was observed in the PRESDIAL study of 387 prevalent HD patients[15]. In this study the percentage of patients achieving the pre-HD standard with vascular, glomerular and tubular disorders were 19%, 39% and 48% respectively. Patients in the PRESDIAL study with the highest blood pressure readings were prescribed the largest number of different antihypertensive drugs. This was also the case for other HD cohorts where drug information was available. If the same is true of dialysis patients in the UK (UKRR does not collect drug data) then hypertension in these groups reflects a state of salt and water overload. Patients with diabetes and renovascular disease tend to be much sicker than other patients on dialysis, have more cardiac comorbidity and substantially higher mortality (5-year survival rate 18% for age group >65 years)[16,17]. Even young diabetics (18–54 years) have double the risk of death compared with non-diabetics despite adjusting for known comorbidities. Fluid overload may contribute to this poor prognosis as hospitalisation for emergency treatment is associated with a 5-year survival rate of only 20%[18]. Salt restriction and ultrafiltration to dry weight should improve blood pressure control in these two groups but non-conventional dialysis schedules may be required to achieve this safely. It is not clear whether this approach would definitely improve survival but certainly warrants further study.

Blood pressure standard

The UK Renal Association revised its Clinical Practice Guidelines in 2007 (www.renal.org/guidelines). The blood pressure guideline does not set a target blood pressure for HD patients either pre- or post-dialysis but is otherwise unchanged. Blood pressure standards from 2002 apply to data collected in 2006 so these have been used for the statistical analyses in this blood pressure audit:

Pre-haemodialysis blood pressure <140/90 mmHg.

Post-haemodialysis, peritoneal dialysis and renal transplant blood pressure <130/80 mmHg.

Methods

The UKRR extracted quarterly blood pressure data electronically from 58 centres in England, Northern Ireland and Wales. A single blood pressure reading was taken for each patient – the last blood pressure recorded in quarter 4. If this was not available the last reading from quarter 3 was taken. Patients with no blood pressure data for the last two quarters of 2006 were excluded. All patients with data were included in the statistical analysis. Centres with sparse data for a given treatment modality (data for less than 50% of patients or less than 20 patients) were omitted from the figures. Several analyses were performed each year and the methodology has been described in detail[19]. This report presents data for the prevalent cohort on RRT during 2006.

Results

Data returns

Blood pressure data were extracted from 58 centres in England, Northern Ireland and Wales (Table 10.1). Poor returns were obtained from 17 of 58 centres for pre-HD data, from 20 of 58 centres for post-HD data, from 31 of 55 centres for PD data and from 37 of 54 centres for transplant data. These centres need to ensure blood pressure data is entered on their IT systems for extraction by the UKRR.

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

Distribution of blood pressure by modality

Figure 10.1 shows systolic, diastolic and pulse pressure distributions for HD, PD and transplant (post-HD data is shown). Median blood pressure for HD, PD and transplant is 129/69, 135/79 and 136/80 mmHg respectively. Median pulse pressure for each group was 59, 56 and 57 mmHg respectively. The HD population had the widest spread for blood pressure. Standard deviations (SBP/DBP) pre-HD, post-HD, PD and transplant were 25/15, 25/14, 23/13 and 19/11 respectively (compared with 18/10 for a hypertensive population). The UKRR does not collect drug data to assess whether the wider blood pressure distributions for dialysis

Table 10.1: Percentage of patients with complete returns of blood pressure values by modality

	% completed data					% completed data			
	Pre-HD	**Post-HD**	**PD**	**Tx**		**Pre-HD**	**Post-HD**	**PD**	**Tx**
Antrim	73	59	4	30	Leic	99	96	98	25
B Heart	93	93	0	1	Liv Ain	2	1	n/a	n/a
B QEH	64	0	0	0	Liv RI	13	2	35	78
Bangor	95	94	97	n/a	ManWst	0	0	0	0
Basldn	99	99	96	7	Middlbr	97	95	96	50
Belfast	93	92	29	17	Newc	0	0	0	0
Bradfd	1	0	100	89	Newry	99	98	0	2
Brightn	0	0	0	94	Norwch	96	96	0	1
Bristol	100	99	97	70	Nottm	99	98	100	90
Camb	61	61	0	1	Oxford	81	80	71	8
Cardff	19	0	3	95	Plymth	94	0	3	0
Carlis	95	94	0	0	Ports	0	99	0	0
Carsh	64	64	1	0	Prestn	0	0	0	0
Chelms	100	100	93	73	Redng	97	36	98	95
Chestr	2	0	n/a	n/a	Sheff	99	97	99	95
Clwyd	0	2	75	86	Shrew	100	98	33	16
Covnt	99	98	86	56	Stevng	99	99	0	0
Derby	99	99	96	7	Sthend	96	96	6	0
Derry	100	100	n/a	0	Sund	96	96	0	0
Dorset	98	98	100	4	Swanse	92	92	18	6
Dudley	80	80	96	78	Truro	98	97	45	46
Exeter	96	95	95	33	Tyrone	95	95	29	3
Glouc	97	0	0	0	Ulster	98	98	100	33
Hull	96	96	82	0	Wirral	53	0	52	n/a
Ipswi	97	97	85	93	Wolve	3	97	98	94
L Barts	1	0	2	0	Wrexm	0	0	0	0
L Guys	61	59	1	0	York	99	99	95	95
L Kings	0	0	0	0	**England**	**57**	**54**	**46**	**28**
L Rfree	0	0	0	0	**N Ireland**	**91**	**87**	**21**	**15**
L West	0	0	0	0	**Wales**	**42**	**33**	**19**	**80**
Leeds	96	95	97	70	**E, W & NI**	**58**	**54**	**43**	**31**

n/a not applicable

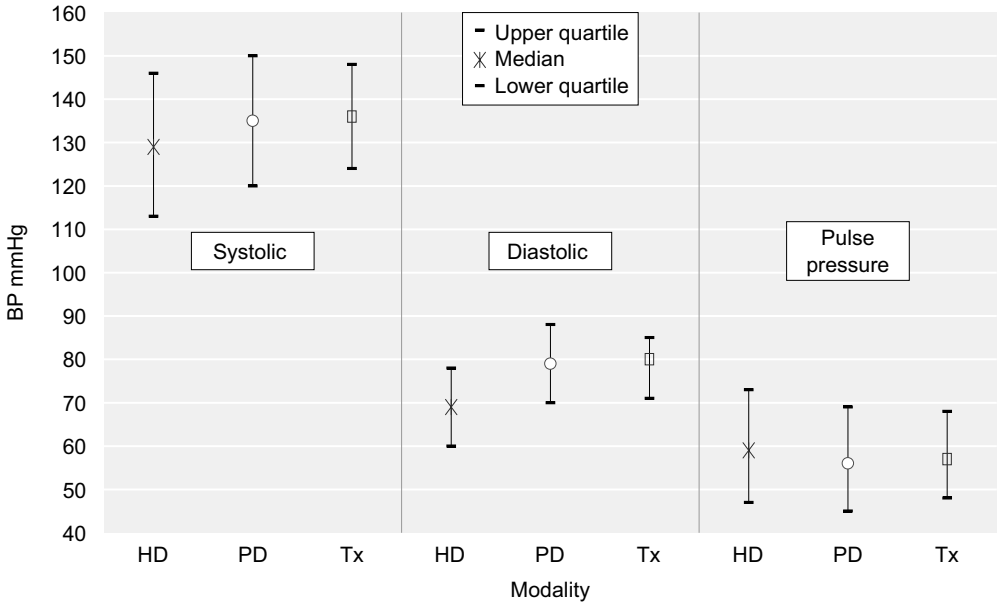

Figure 10.1: Summary of BP achievements

patients are caused by saline overload or inadequate drug therapy. The data is similar to last year which does suggest poorly achieving centres have not adopted a systematic approach to improve blood pressure control during 2006.

Achievement of combined systolic and diastolic standard

Figures 10.2 to 10.5 show a wide variation between centres achieving the combined blood pressure standard for each modality. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 44% (inter-unit range 17–65%) and post-dialysis averaged 48% (range 16–62%). Only 30% of PD patients achieved the standard (range 17–48%) and 25% of transplant patients (range 13–39%). Chi-squared testing indicated the variation between centres for achieving the combined standard was significant for HD and transplant ($p \leqslant 0.001$) but not for PD. The variation between nations was also significant ($p \leqslant 0.045$) except for pre-HD. The results showed hypertension control was inadequate across all treatment modalities but particularly for PD and transplant patients. Centres with consistently poor results need to review their protocols for hypertension control.

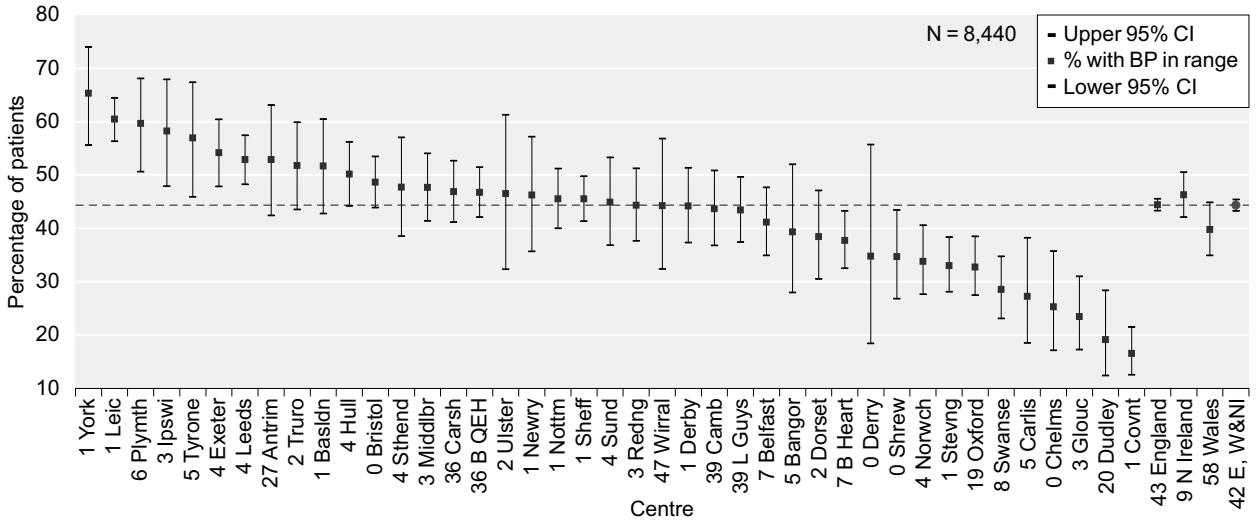

Figure 10.2: Percentage of patients with BP <140/90 mmHg: pre-HD

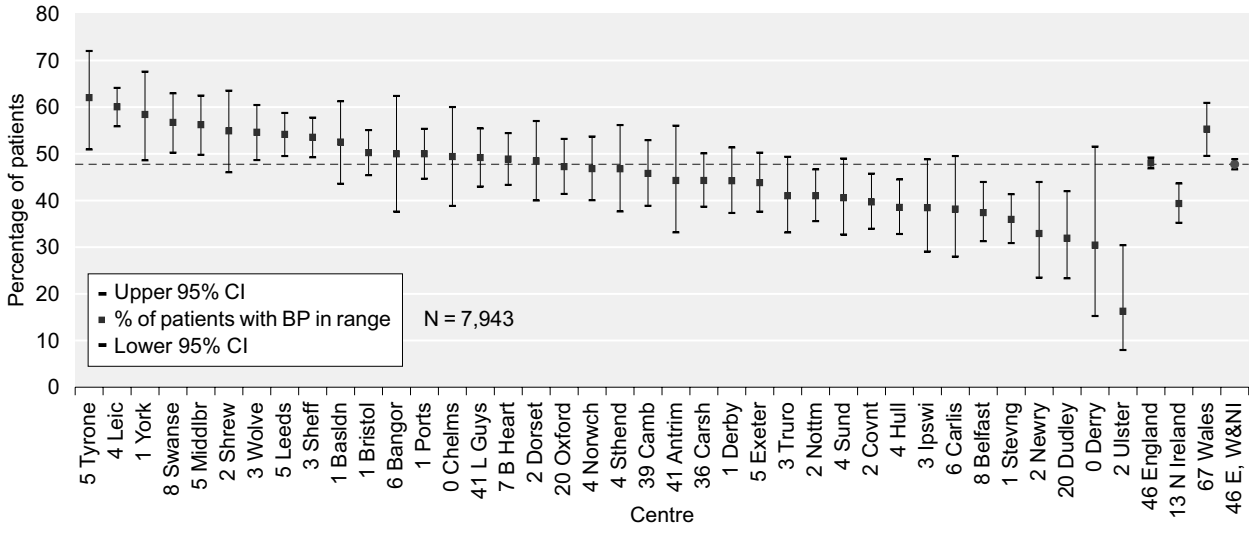

Figure 10.3: Percentage of patients with BP <130/80 mmHg: post-HD

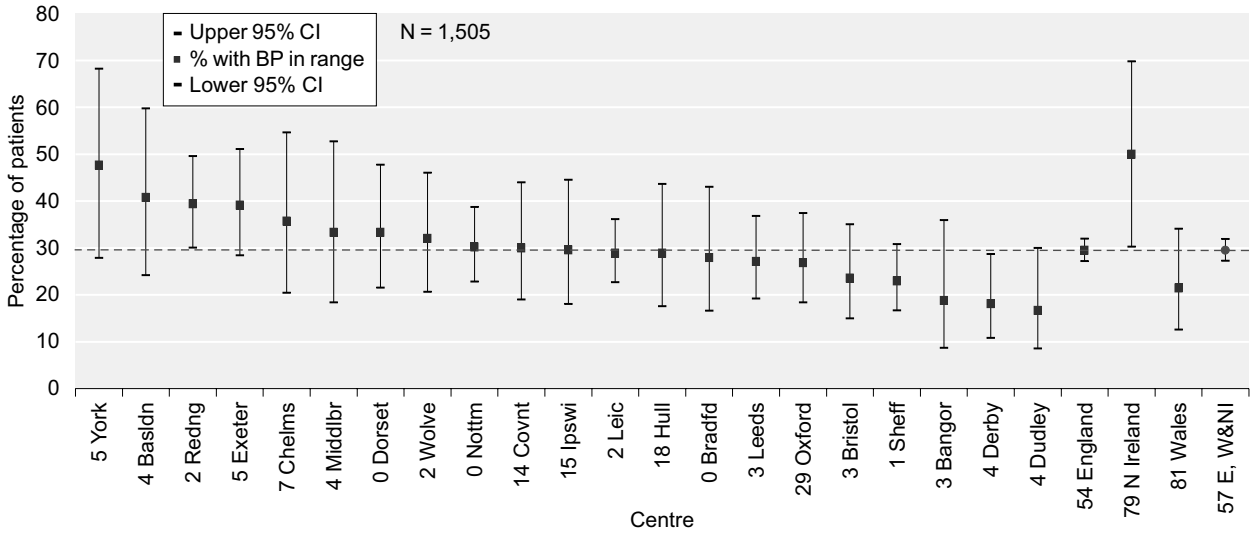

Figure 10.4: Percentage of patients with BP <130/80 mmHg: PD

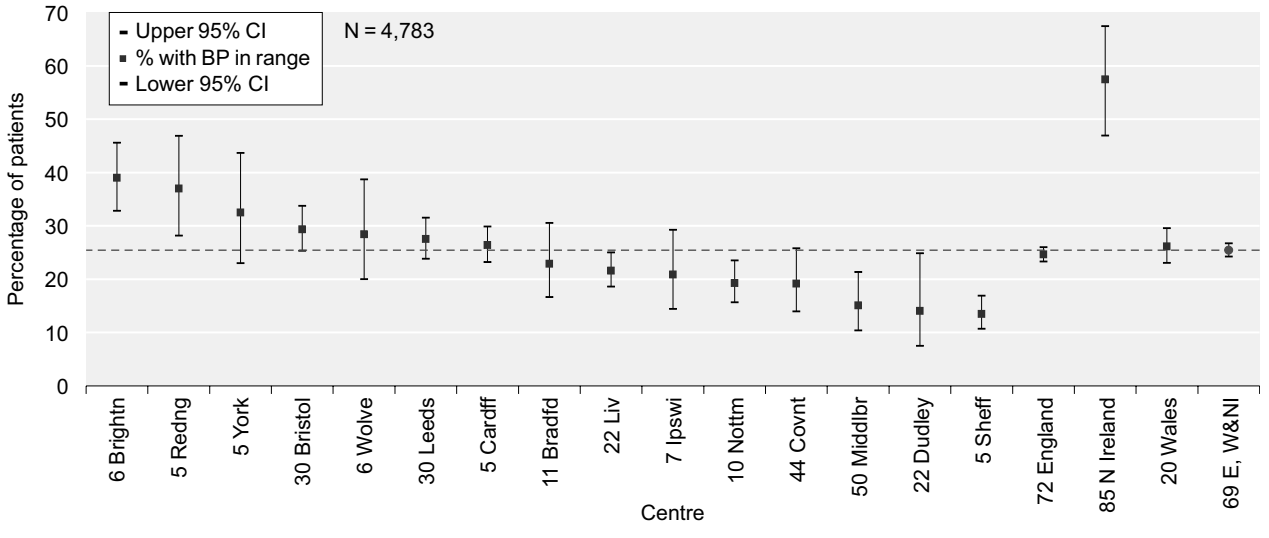

Figure 10.5: Percentage of patients with BP <130/80 mmHg: Tx

Systolic pressure alone

Figures 10.6 to 10.13 show a wide variation between centres achieving the systolic blood pressure standard. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 46% (range 17–66%) and post-dialysis 51% (range 21–65%). On average, 39% of PD patients achieved the standard (range 19–76%) and 35% of transplant patients (range 18–55%). Chi-squared testing indicated the variation between centres was significant for each treatment modality ($p \leqslant 0.001$). The variation between nations was significant for post-HD and transplant ($p < 0.001$) but not for pre-HD or PD. Median SBP for pre-HD, post-HD, PD and transplant was 142, 129, 135 and 136 mmHg respectively.

Diastolic pressure alone

Figures 10.14 to 10.21 show wide variation between centres achieving the diastolic blood pressure standard. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 85% (range 62–97%) and post-dialysis 77% (range 57–92%). On average 51% of PD patients achieved the standard (range 38–68%) and 50% of transplant patients (range 30–70%). Chi-squared testing indicated the variation between centres was significant for each treatment modality ($p \leqslant 0.025$). The variation

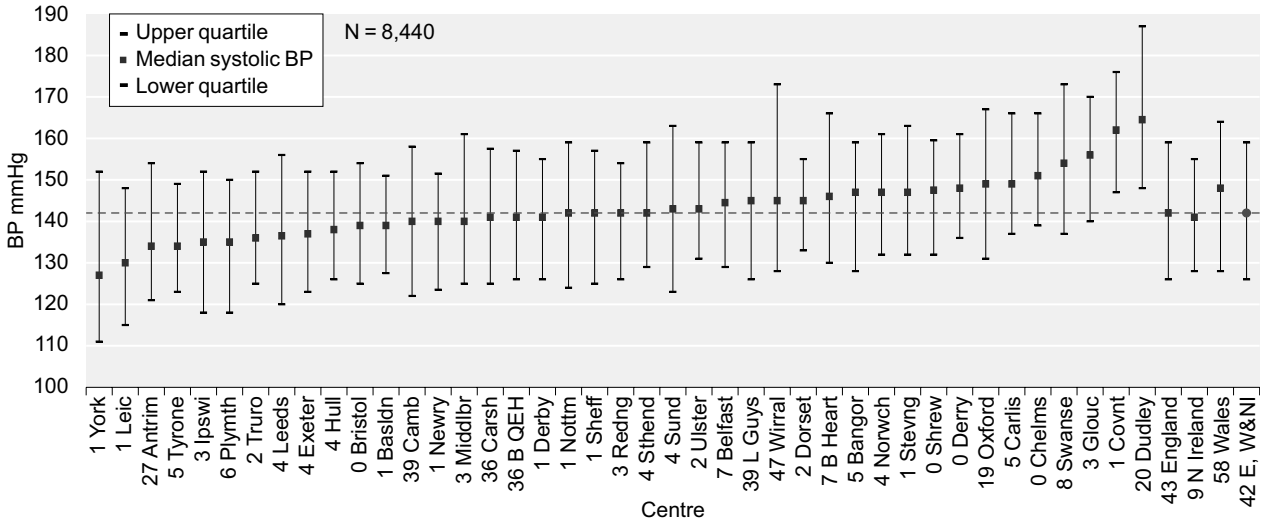

Figure 10.6: Median systolic BP: pre-HD

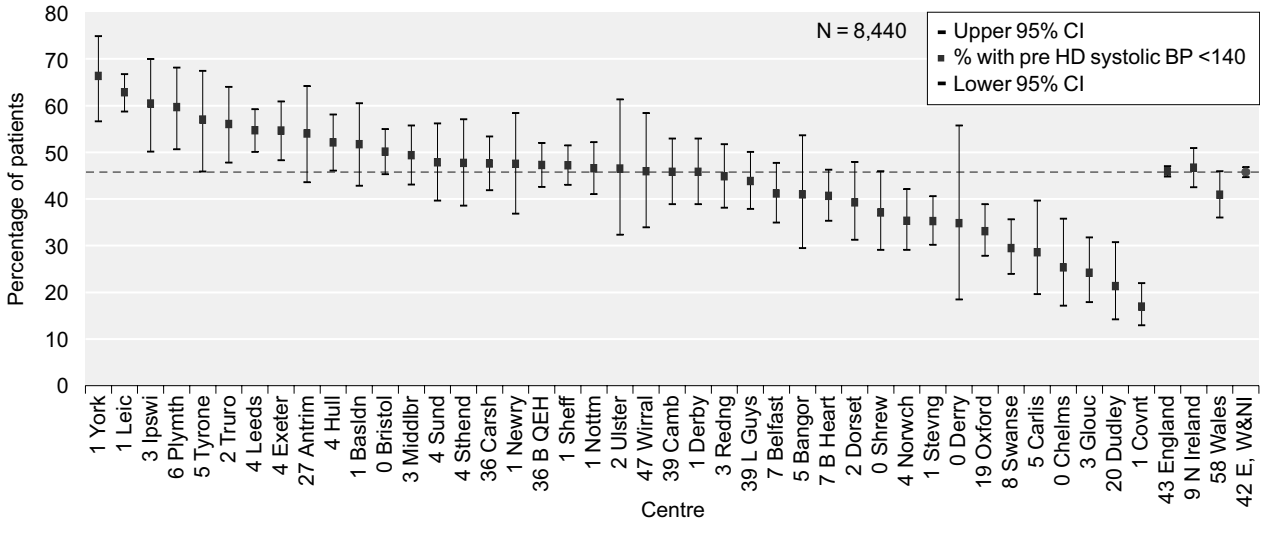

Figure 10.7: Percentage of patients with systolic BP <140 mmHg: pre-HD

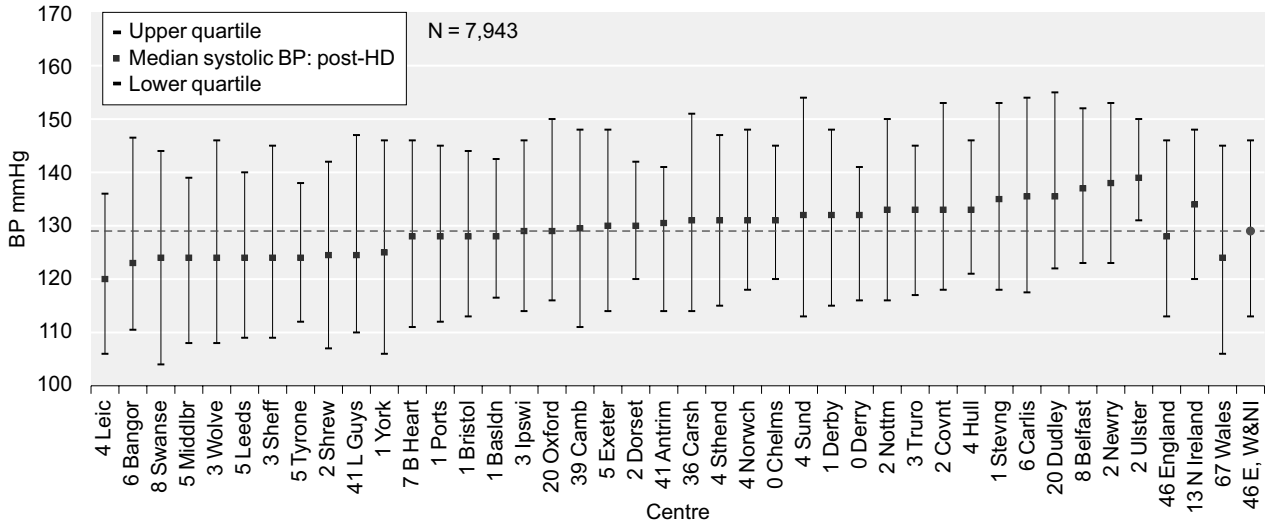

Figure 10.8: Median systolic BP <130 mmHg: post-HD

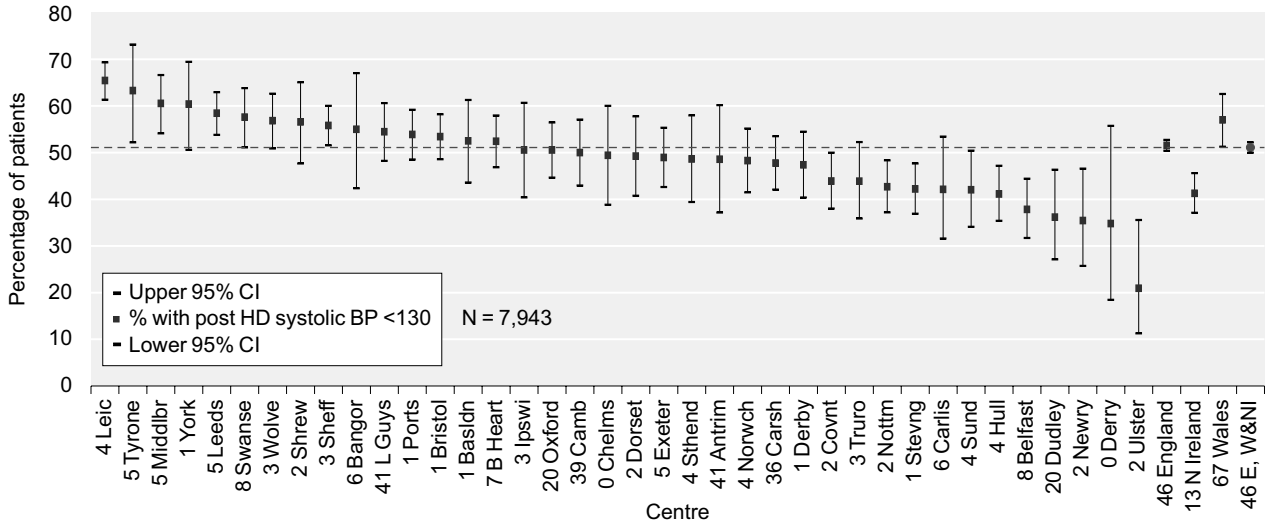

Figure 10.9: Percentage of patients with systolic BP <130 mmHg: post-HD

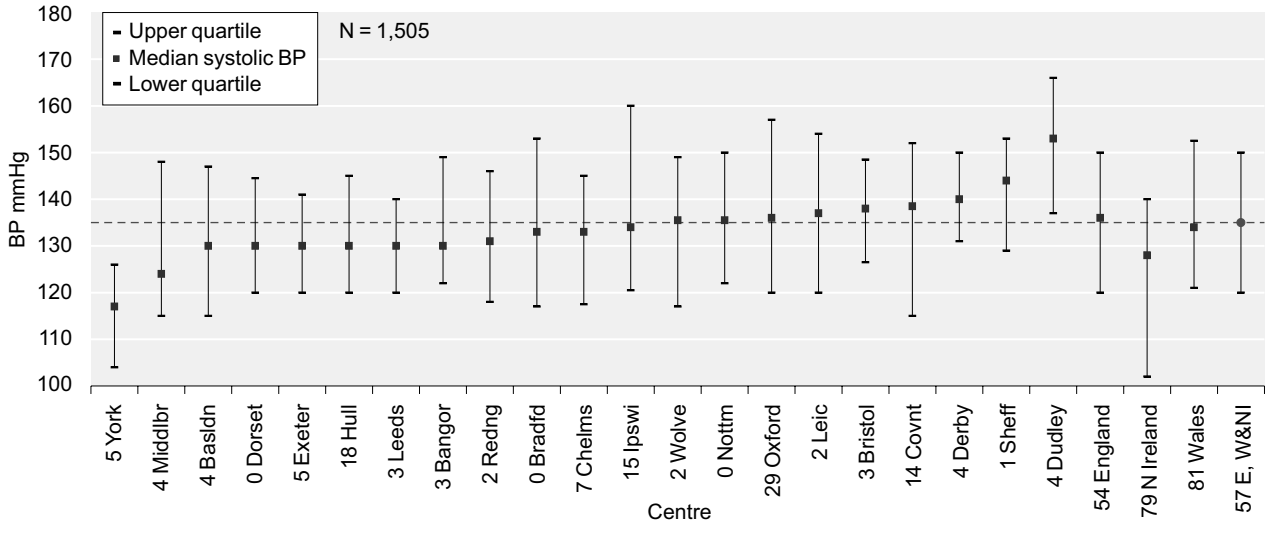

Figure 10.10: Median systolic BP: PD

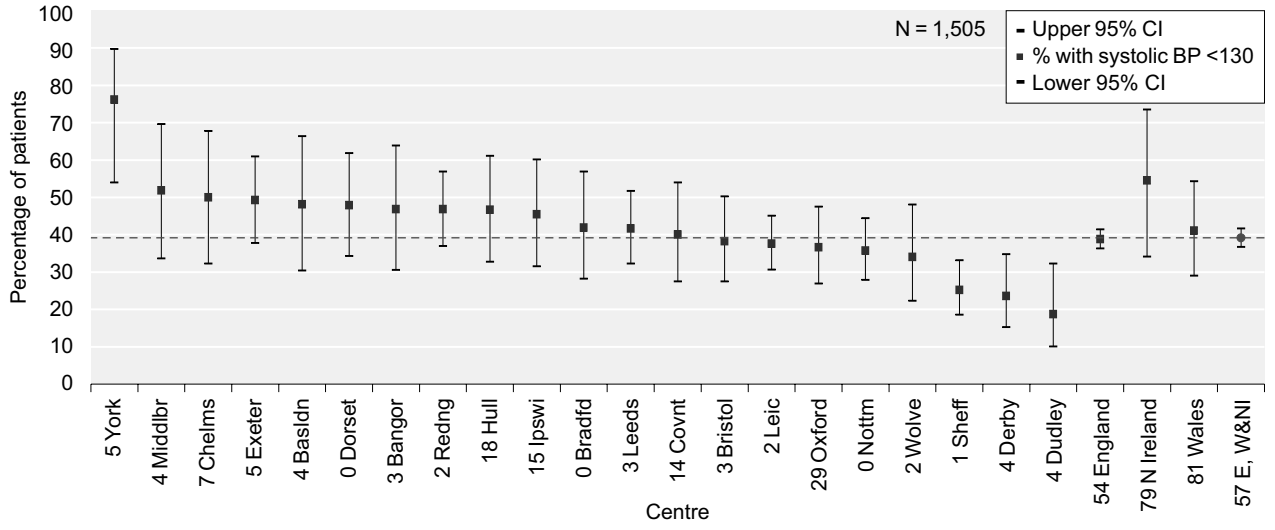

Figure 10.11: Percentage of patients with systolic BP <130 mmHg: PD

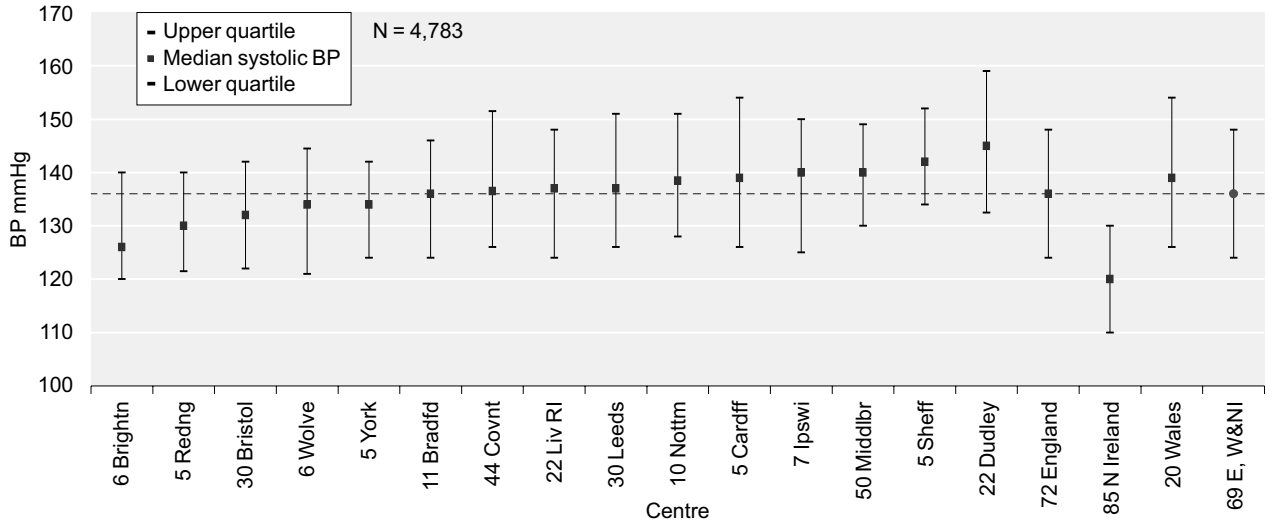

Figure 10.12: Median systolic BP: Tx

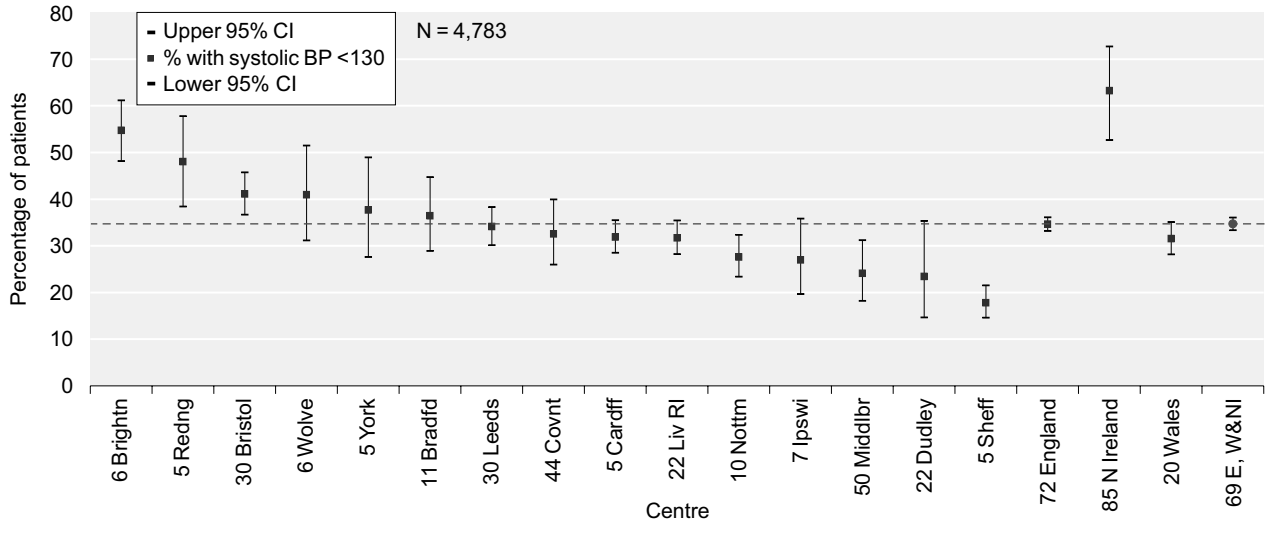

Figure 10.13: Percentage of patients with systolic BP <130 mmHg: Tx

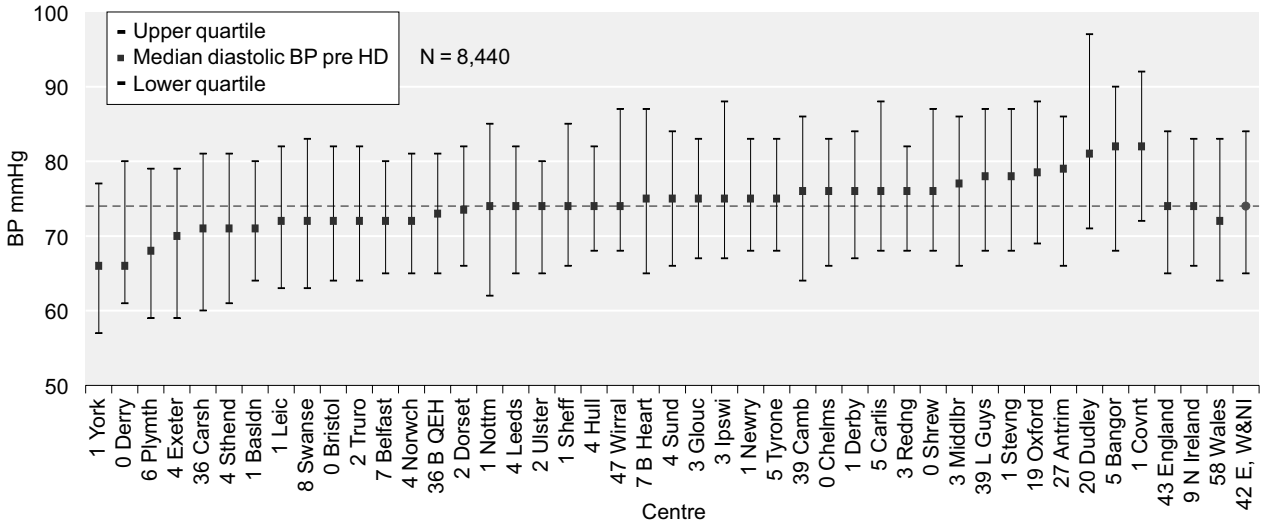

Figure 10.14: Median diastolic BP: pre-HD

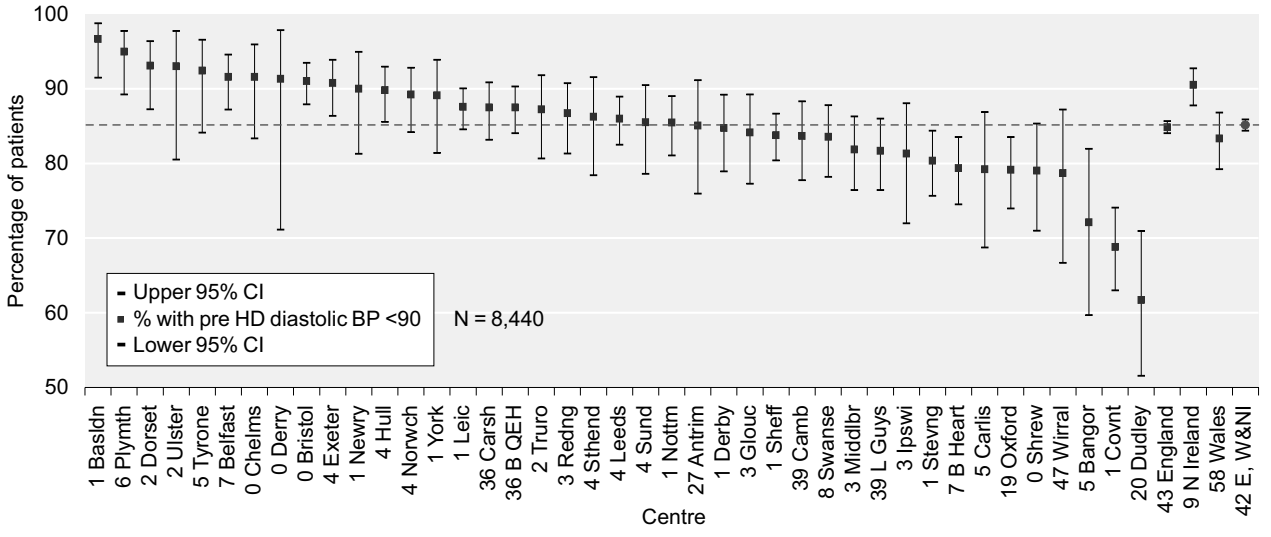

Figure 10.15: Percentage of patients with diastolic BP <90 mmHg: pre-HD

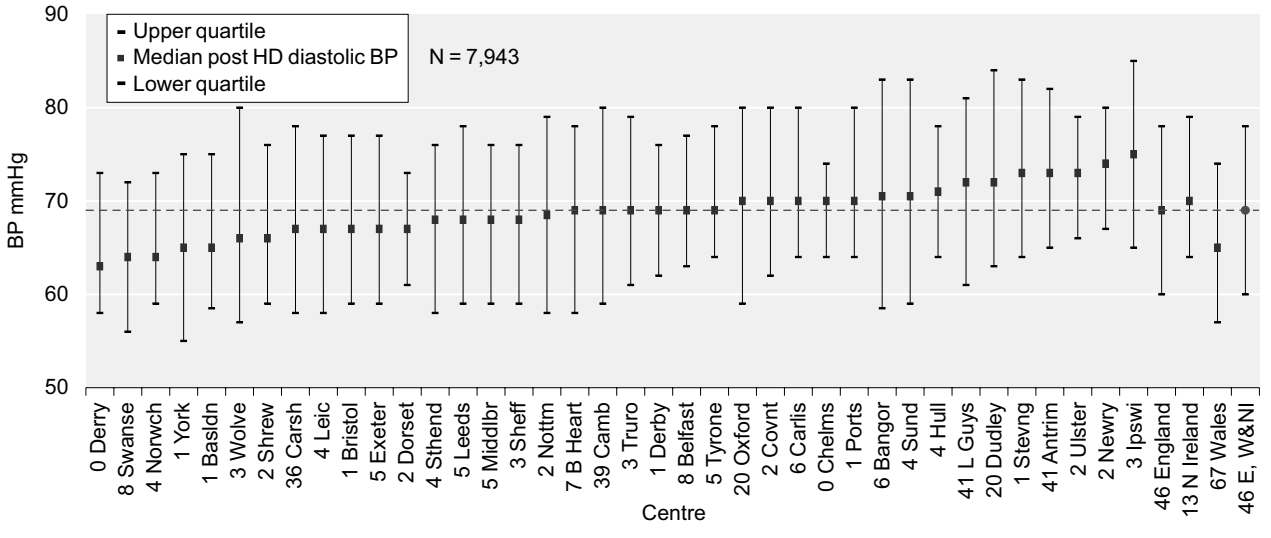

Figure 10.16: Median diastolic BP: post-HD

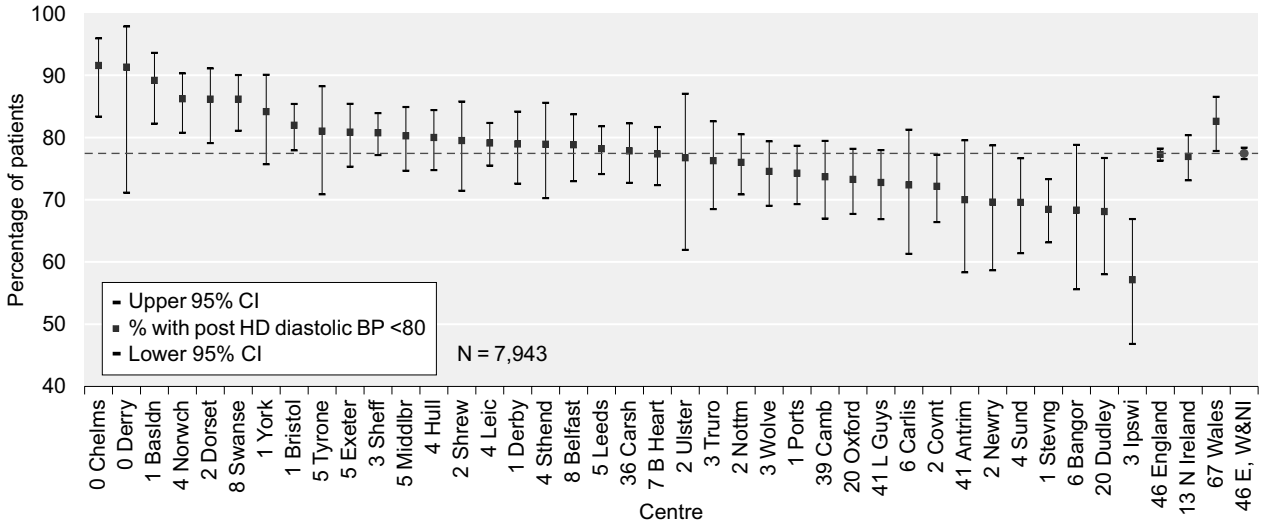

Figure 10.17: Percentage of patients with diastolic BP <80 mmHg: post-HD

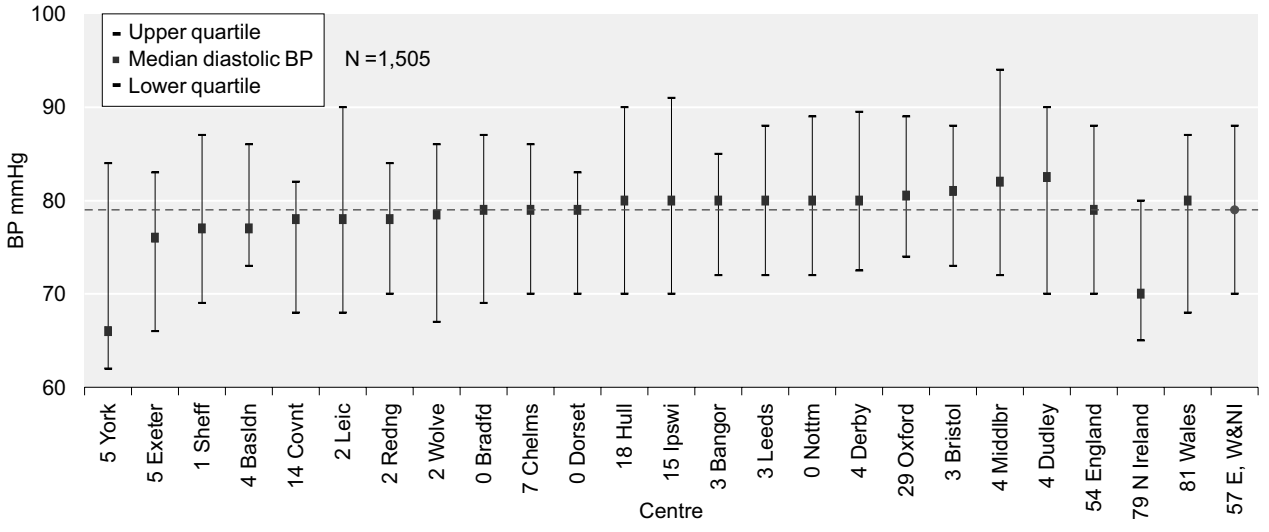

Figure 10.18: Median diastolic BP: PD

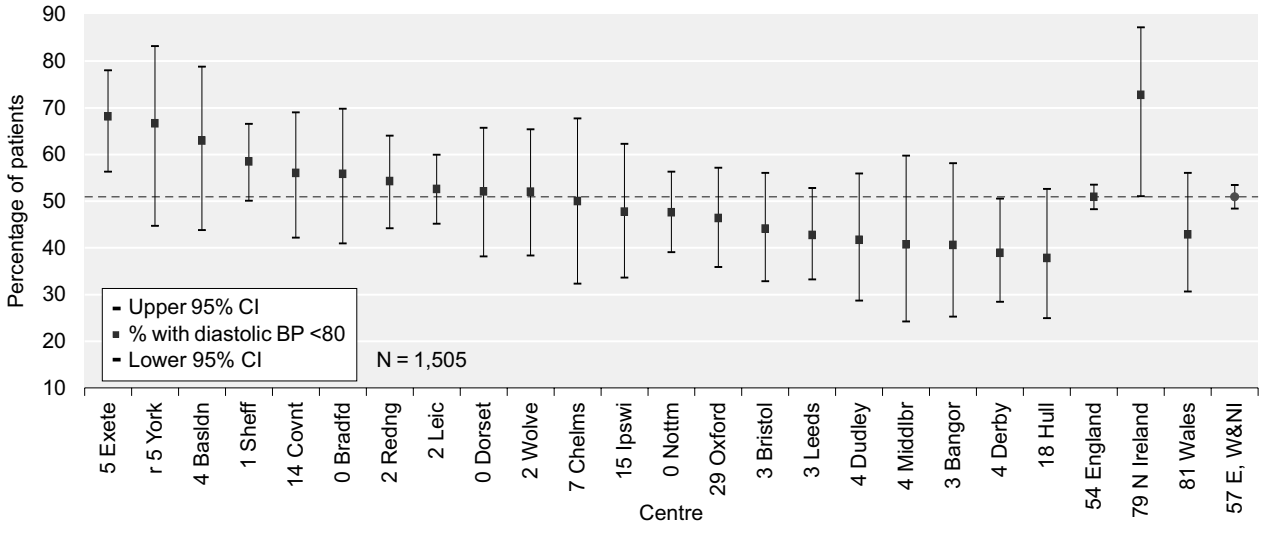

Figure 10.19: Percentage of patients with diastolic BP <80 mmHg: PD

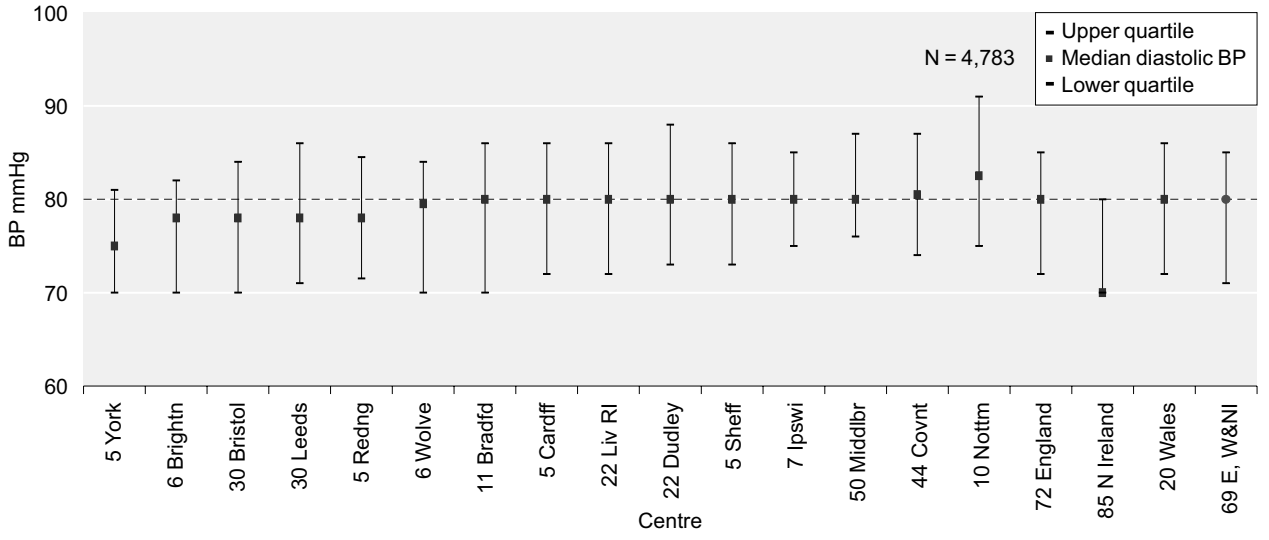

Figure 10.20: Median diastolic BP: Tx

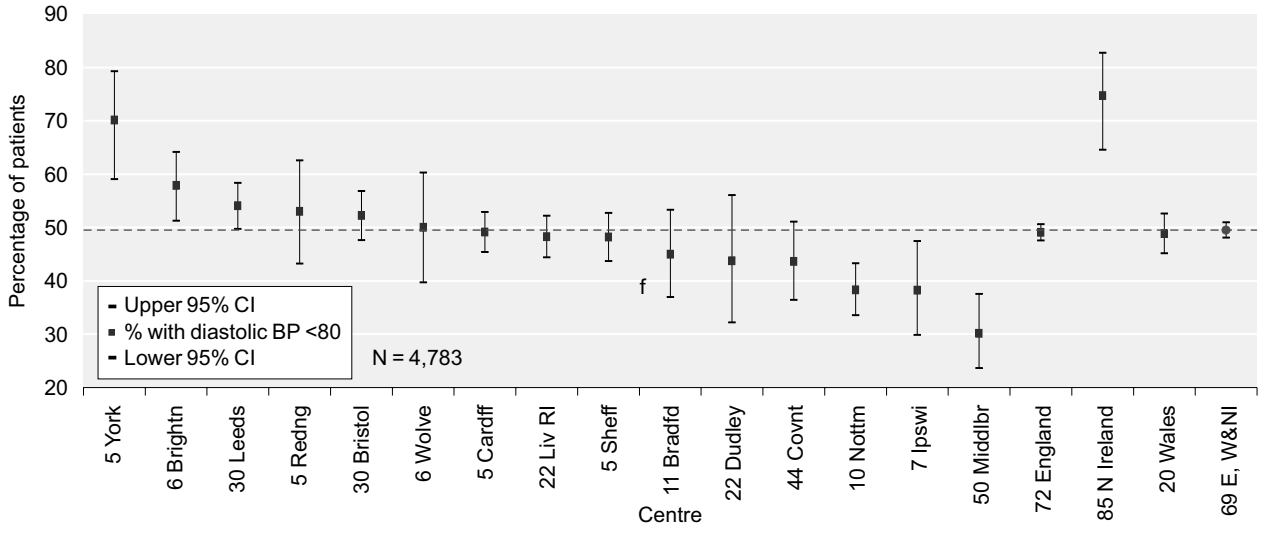

Figure 10.21: Percentage of patients with diastolic BP <80 mmHg: Tx

between nations was significant for pre-HD and transplant ($p < 0.0001$) but not for post-HD or PD. The median DBP for pre-HD, post-HD, PD and transplant was 74, 69, 79 and 80 mmHg respectively. The lower DBP recorded post-HD may reflect hypovolaemia in older patients with stiff arteries (DBP falls after 60 years of age in the general population).

Mean arterial pressure

Figures 10.22 to 10.29 show wide variation between centres achieving the desired mean arterial pressure (MAP). MAP was calculated as DBP plus one third of the pulse pressure. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 74% (range 45–89%) and post-dialysis 69% (range 48–78%). On average 50% of PD patients achieved the standard (range 31–86%) and 47% of transplant patients (range 28–65%). Chi-squared testing indicated the variation between centres for each treatment modality was significant ($p < 0.001$). The variation between nations was also significant ($p \leqslant 0.015$) except for pre-HD. The median MAP for pre-HD, post-HD, PD and transplant was 97, 89, 97 and 98 mmHg respectively.

Pulse pressure

Figures 10.30 to 10.33 show the variation between centres for pulse pressure (PP). PP was calculated as SBP minus DBP. The median

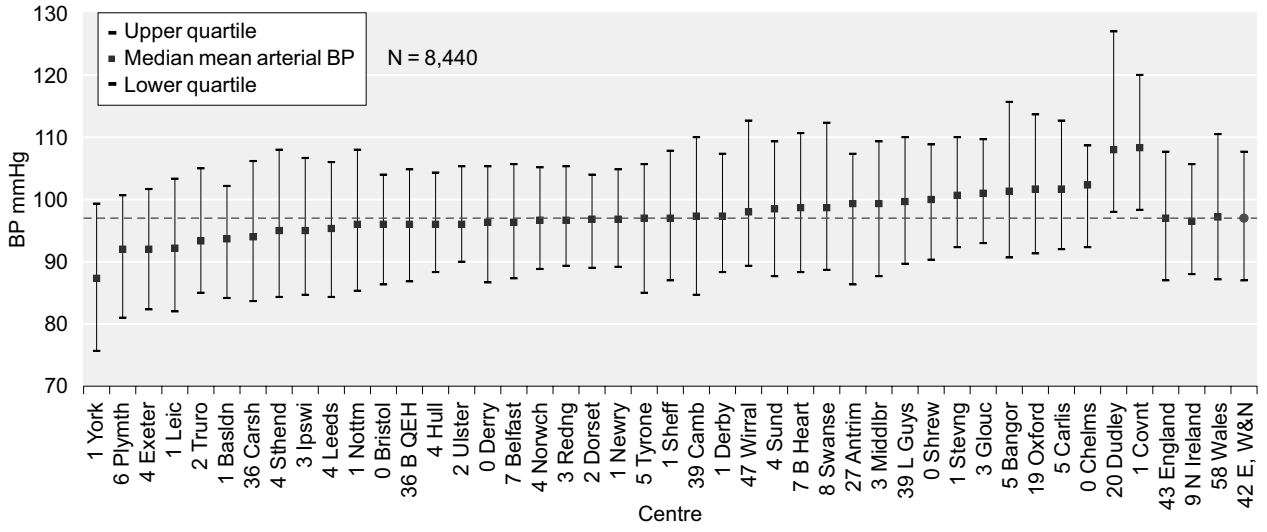

Figure 10.22: Median MAP: pre-HD

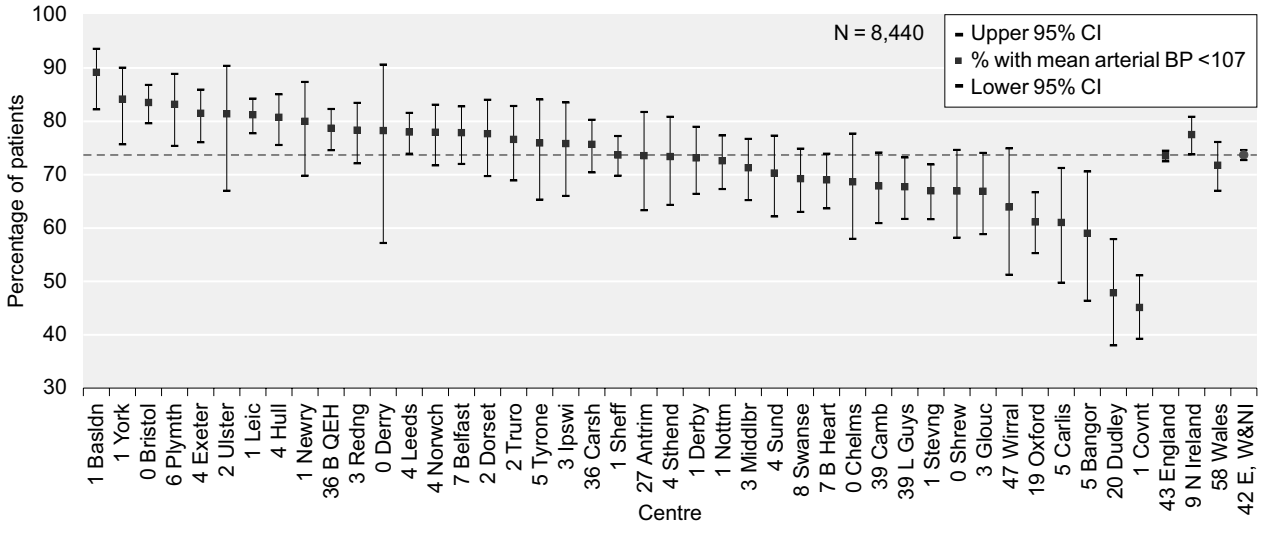

Figure 10.23: Percentage of patients with MAP <107 mmHg: pre-HD

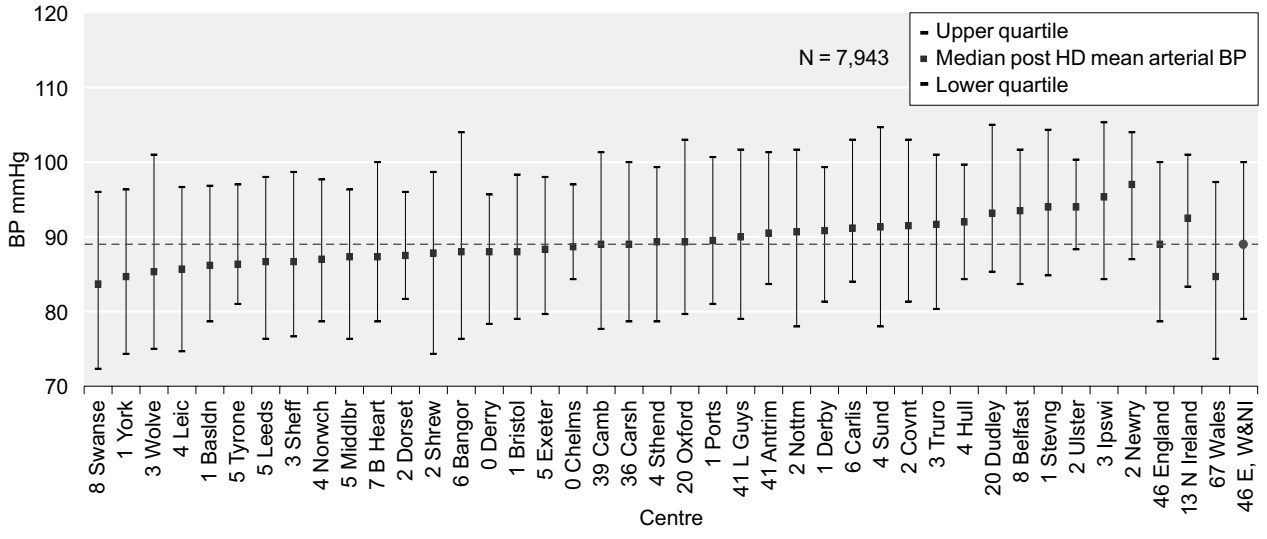

Figure 10.24: Median MAP: post-HD

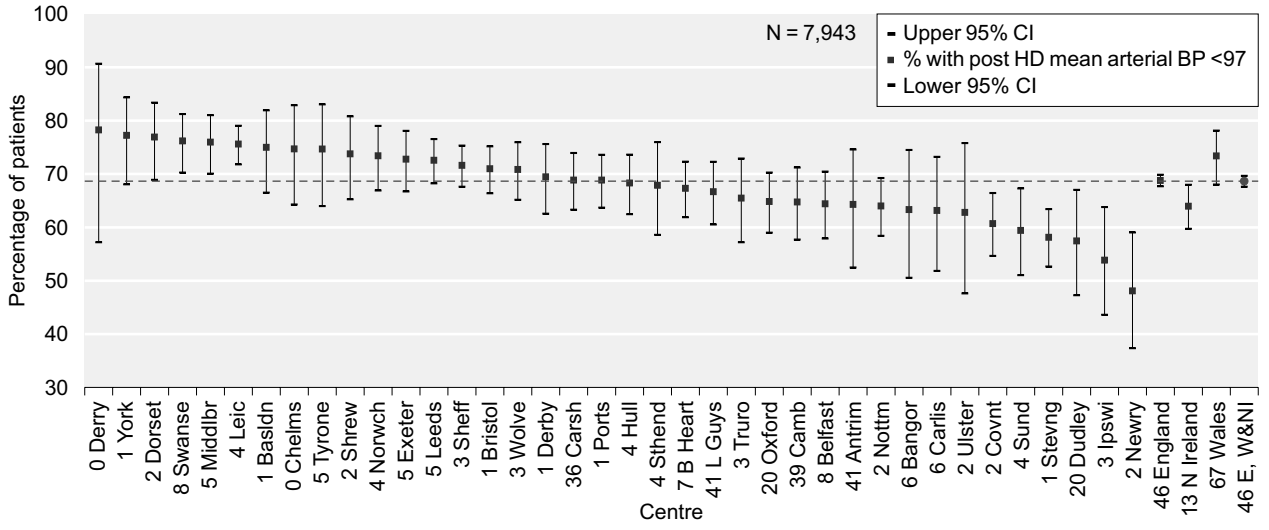

Figure 10.25: Percentage of patients with MAP <97 mmHg: post-HD

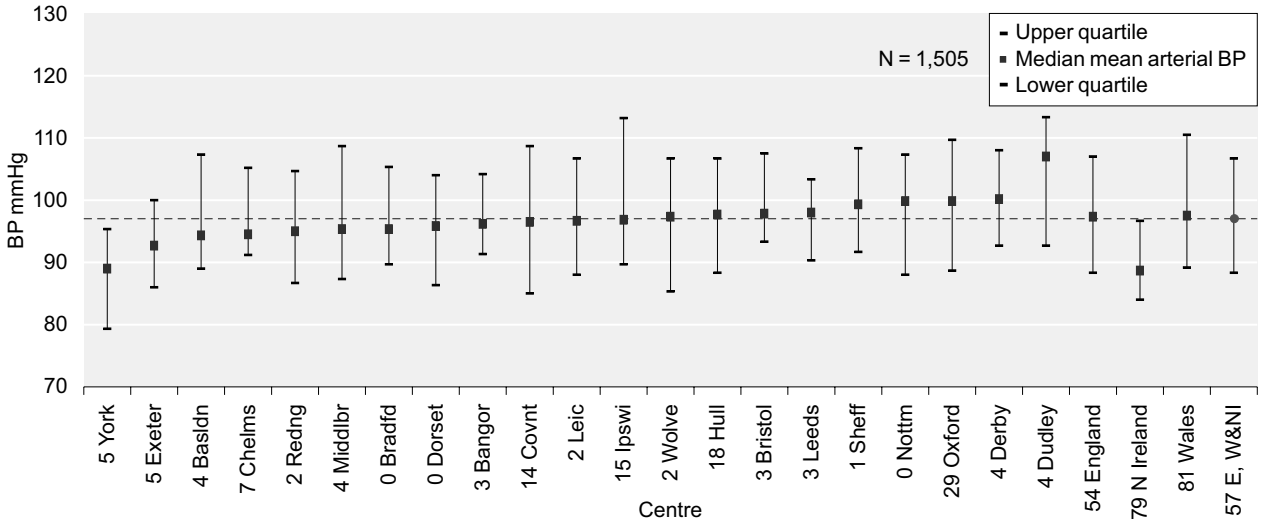

Figure 10.26: Median MAP: PD

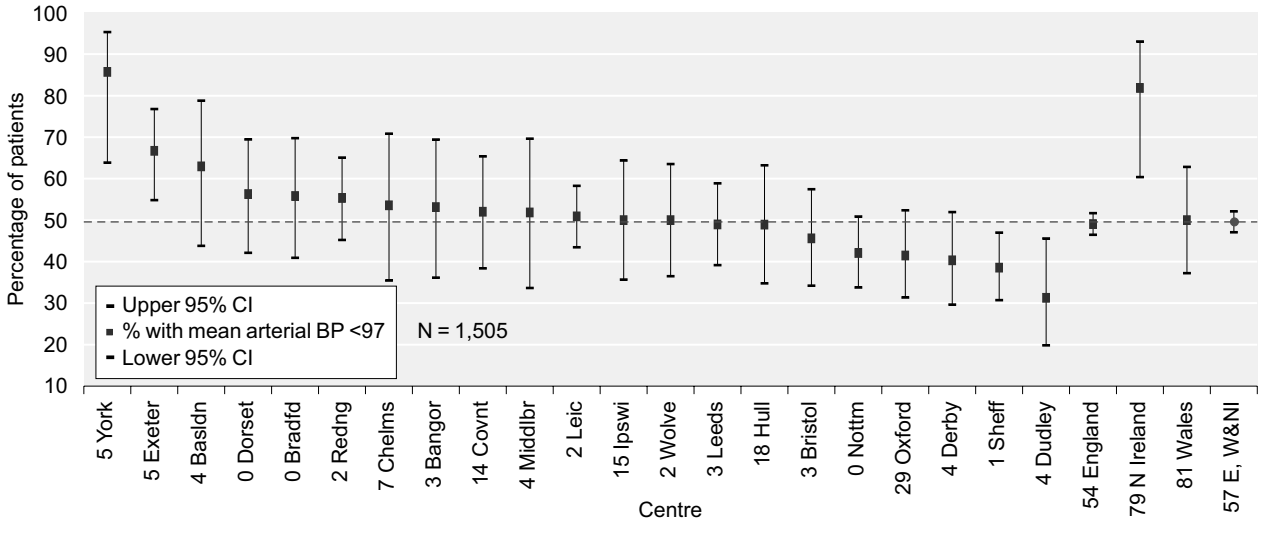

Figure 10.27: Percentage of patients with MAP <97 mmHg: PD

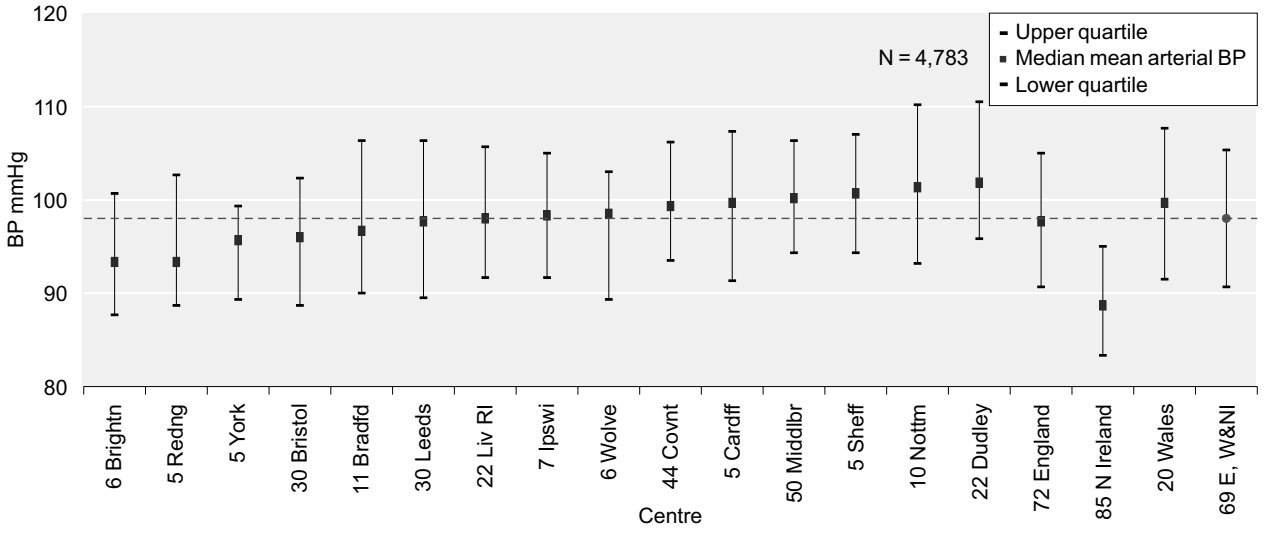

Figure 10.28: Median MAP: Tx

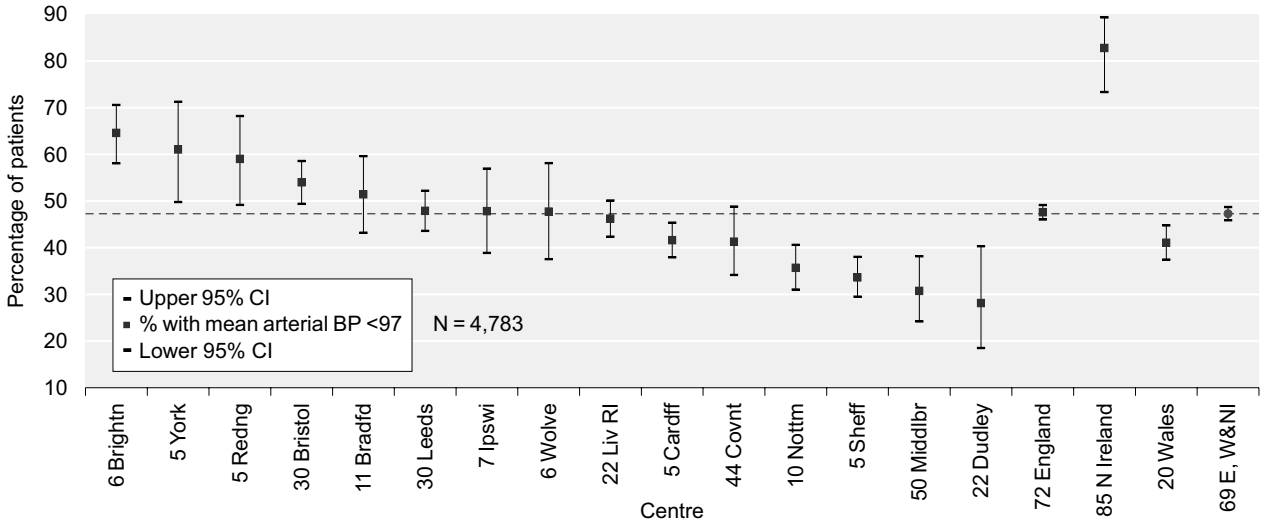

Figure 10.29: Percentage of patients with MAP <97 mmHg: Tx

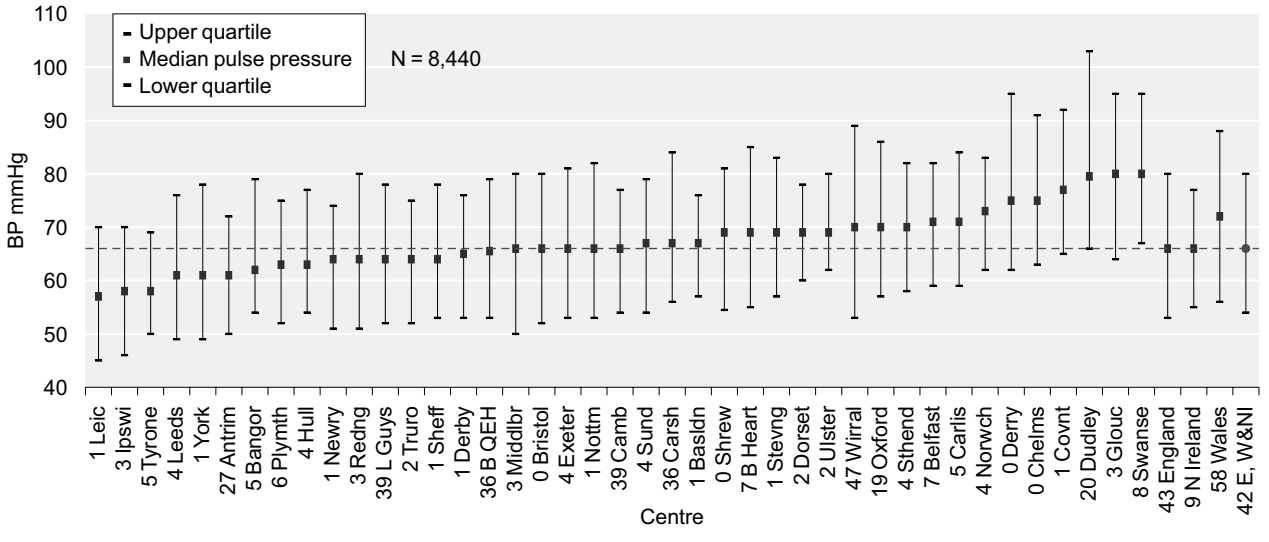

Figure 10.30: Median PP: pre-HD

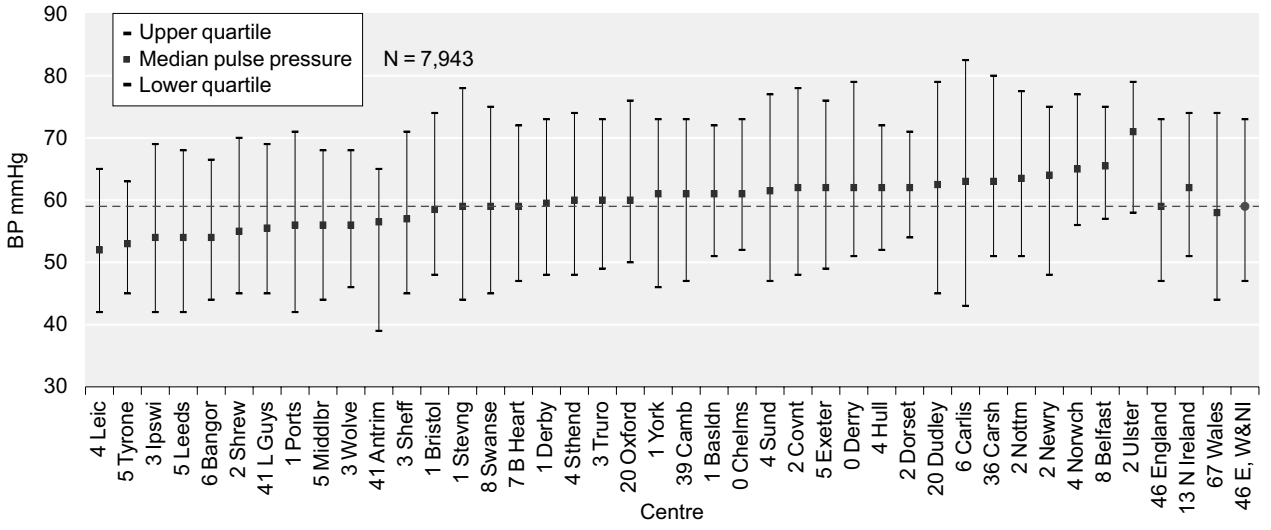

Figure 10.31: Median PP: post-HD

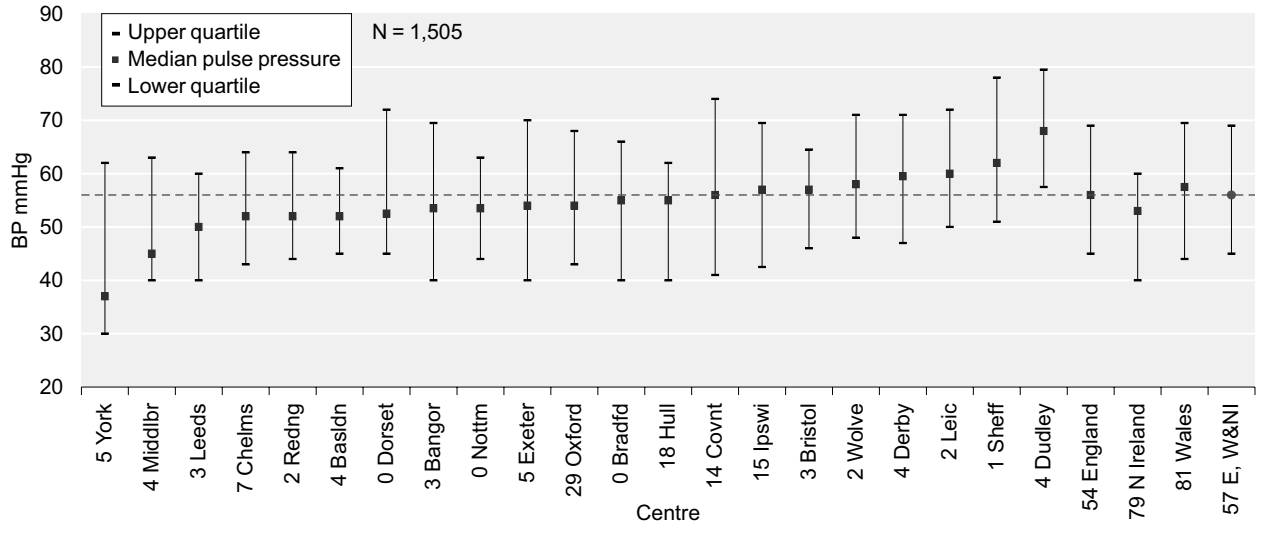

Figure 10.32: Median PP: PD

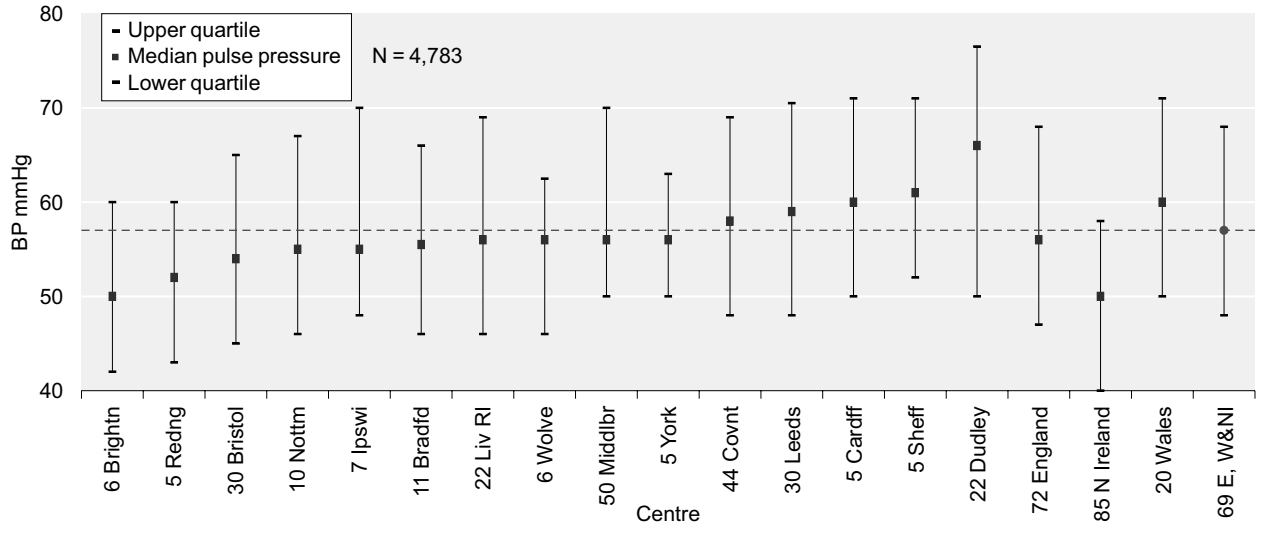

Figure 10.33: Median PP: Tx

pulse pressure for pre-HD, post-HD, PD and transplant was 66, 59, 56 and 57 mmHg respectively. A high SBP accounts for the wider PP in pre-HD readings.

Blood pressure by primary diagnosis

Figures 10.34 to 10.41 show the variation in blood pressure control by primary diagnosis for all treatment modalities (post-HD data is shown). The prevalence of hypertension varied with the underlying renal condition and was highest in vascular disorders (diabetes, renovascular disease or hypertension), lower in glomerulonephritis and lowest in tubular disorders. Blood pressure control was significantly better on HD for all diagnostic groups. Post-HD, 43% of patients with vascular disease, 49% with glomerulonephritis and 51–54% with tubular disorders achieved the standard. Poor blood pressure control was due to a high SBP.

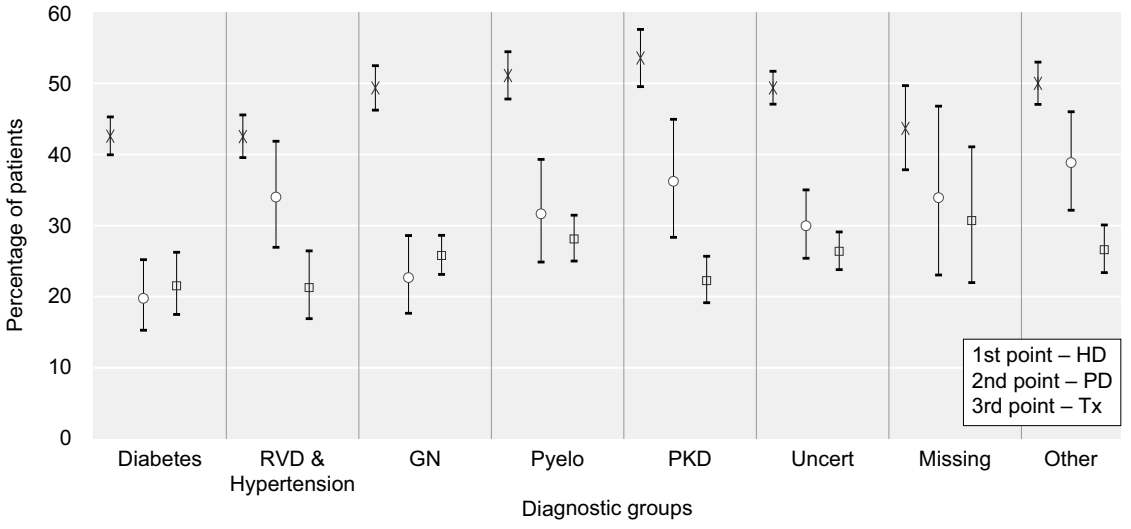

Figure 10.34: Percentage of patients with BP in standards by primary diagnosis

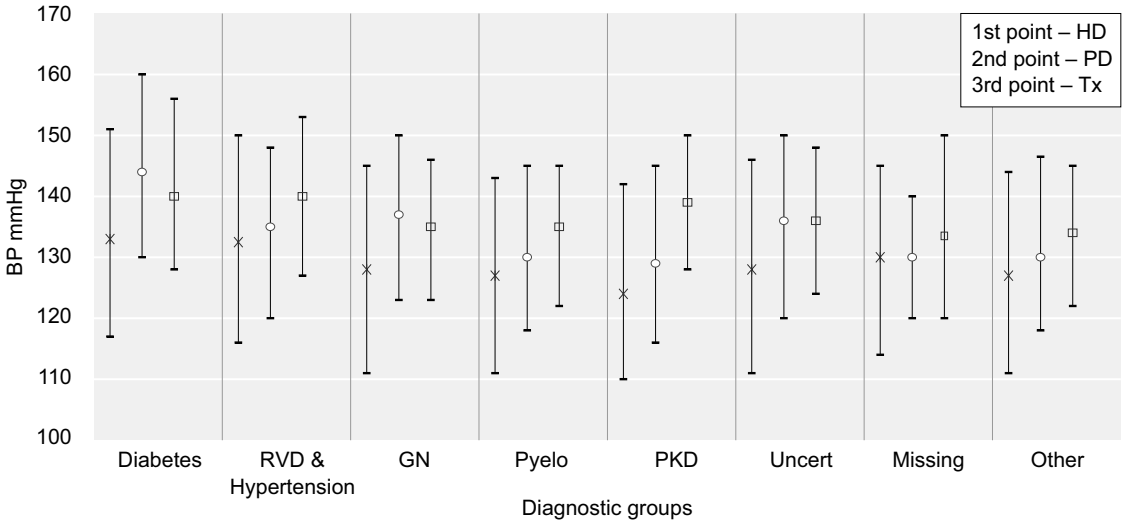

Figure 10.35: Median SBP by primary diagnosis

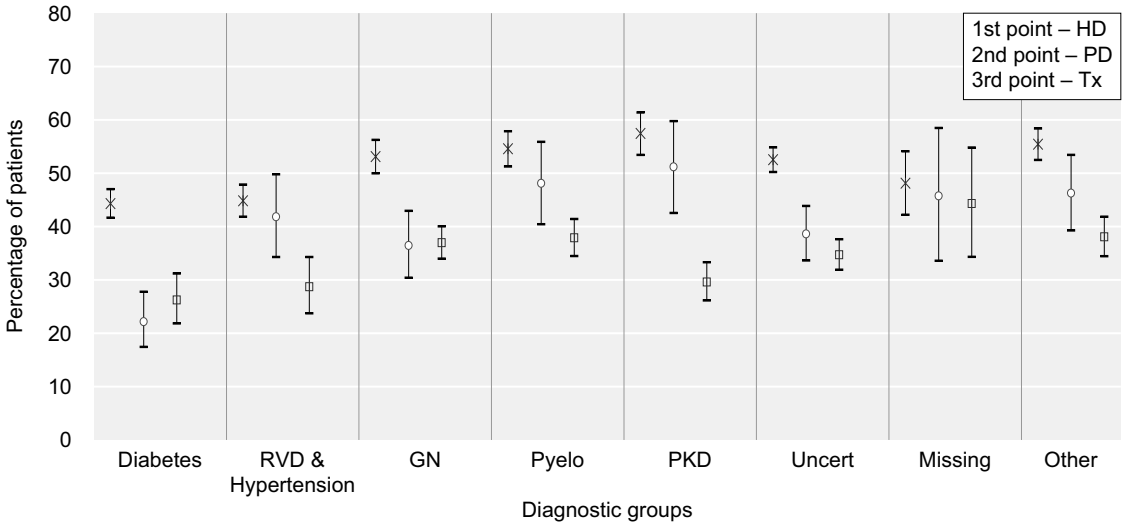

Figure 10.36: Percentage of patients with SBP in standards by primary diagnosis

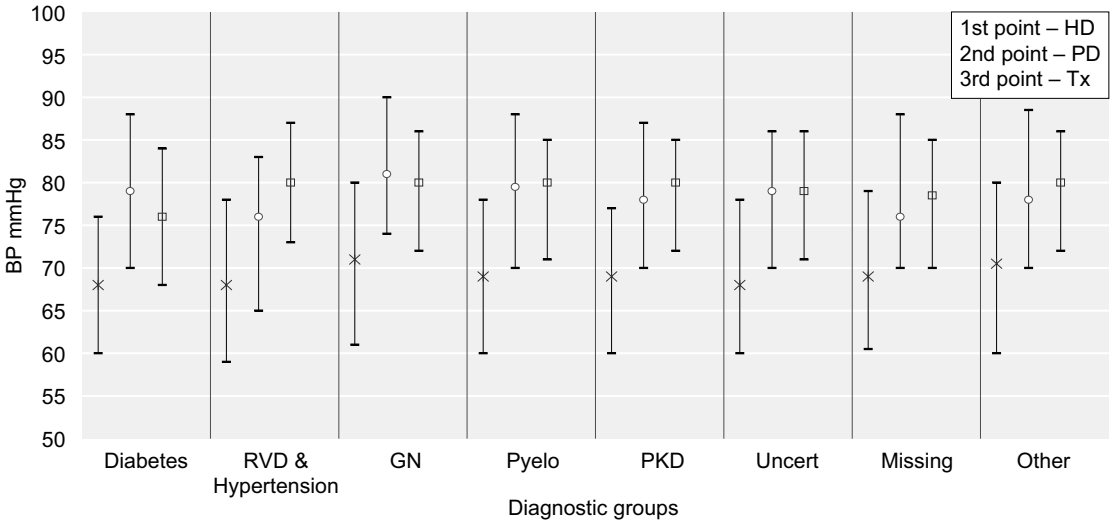

Figure 10.37: Median DBP by primary diagnosis

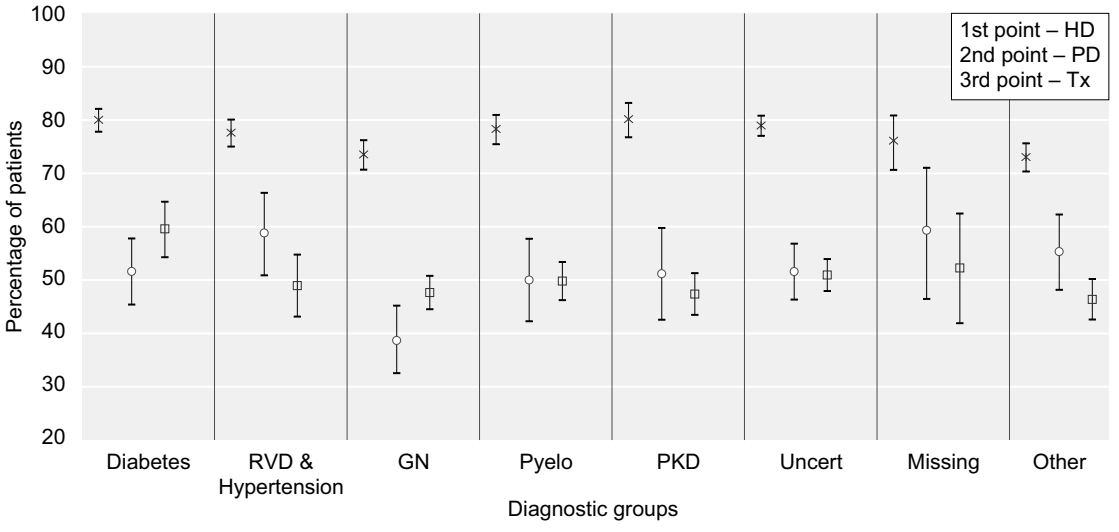

Figure 10.38: Percentage of patients with DBP in standards by primary diagnosis

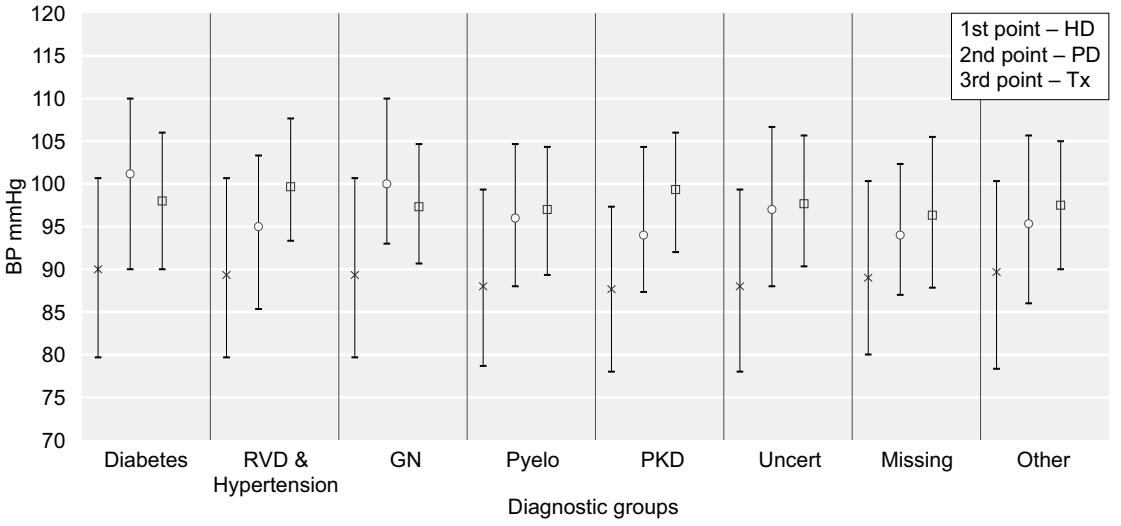

Figure 10.39: Median MAP by primary diagnosis

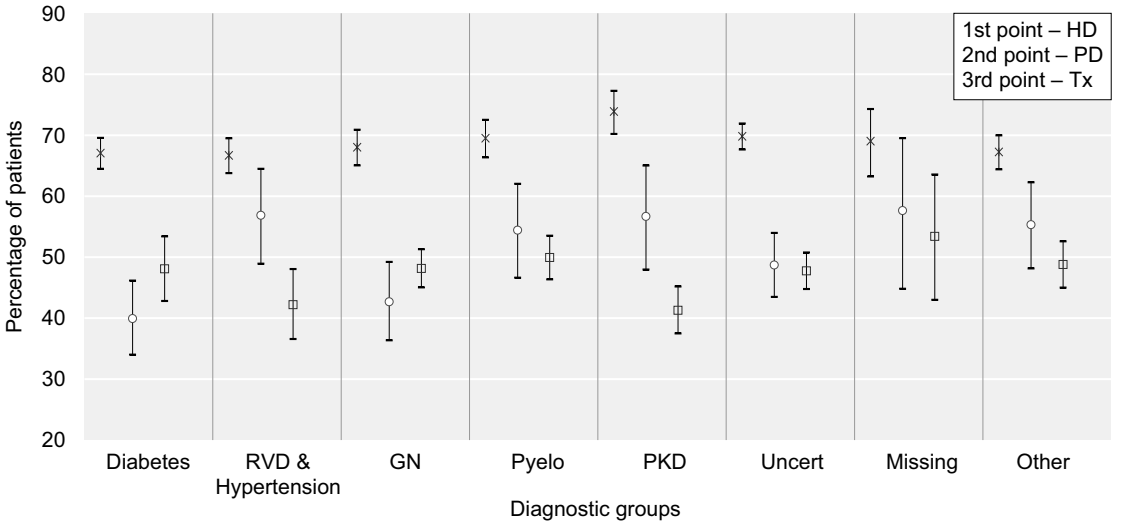

Figure 10.40: Percentage of patients with MAP in standards by primary diagnosis

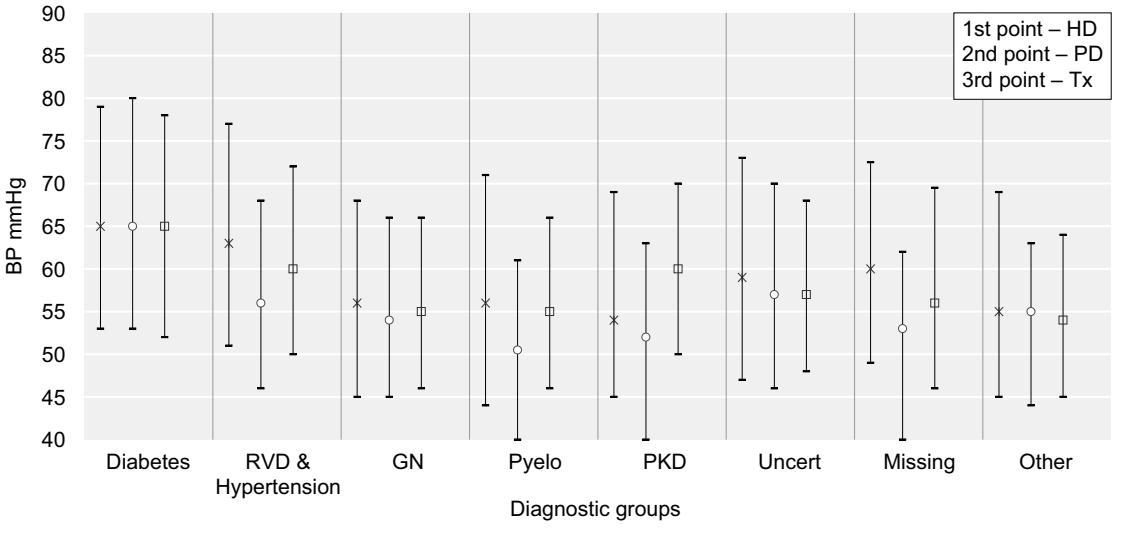

Figure 10.41: Median PP by primary diagnosis

Future directions

Publication of observational data has failed to improve blood pressure control over the last nine years. This is distinct from other areas such as anaemia and dialysis adequacy where significant improvements have been made. The UKRR now needs co-morbidity data for every patient on its database to address important clinical questions. Adjusting for co-morbidity is essential to show whether good blood pressure control improves cardiovascular outcomes and survival on RRT. The UKRR also intends to collect a number of data items from each HD session. These will include pre- and post-dialysis blood pressure and episodes of symptomatic intradialytic hypotension. These data will clarify whether blood pressure variation through the dialysis week has more prognostic value than the random readings currently collected by the UKRR.

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Chapter 11: Measures of Care in Adult Renal Transplant Recipients in the UK

Rommel Ravanan, Udaya Udayaraj, Retha Steenkamp, David Ansell and Charlie Tomson

Summary

- The total number of adult and paediatric patients active on the renal transplant waiting list on 31/12/2006 was 6,220, an 8% increase from the previous year.
- During 2006, heart beating deceased donor numbers decreased by 1% compared to 2005. In comparison, non-heart beating deceased donors and living kidney donors increased by 25% and 24% respectively. The proportion of renal transplants performed from deceased heart beating donors fell from 60% in 2005 to 55% in 2006.
- The number of combined kidney and pancreas transplants has doubled since 2004.
- On 31/12/2006, 46% of prevalent adult patients on renal replacement therapy (RRT) in the UK, had a functioning renal transplant which equated to 20,262 patients. During 2006, the death rate in prevalent transplant patients was 2.4 per 100 patient years. An additional 3.2% of all prevalent transplants failed with patients returning to dialysis.
- There was wide variation in prevalence per million population (pmp) of transplanted patients resident in each Local Authority area across the UK.
- There were wide and unexplained variations between centres in the percentage of prevalent dialysis patients on the renal transplant waiting list and also the time taken to listing incident patients.
- Results from the joint Renal Association/British Transplantation Society survey highlight centre differences in resource allocation and clinical practices governing access to renal transplantation in both transplant and non-transplanting renal centres.
- In 2006, 12.5% of incident transplants were performed in patients with diabetes, similar to 2005.
- The median eGFR in patients with a functioning kidney transplant was 46 ml/min/1.73 m^2, with 17% of prevalent transplant recipients having an eGFR <30. The median eGFR 12 months after transplantation for patients transplanted in 2001–2005 inclusive was 49 ml/min/1.73 m^2.
- The median Hb in prevalent transplant recipients was 12.8 g/dl, with 4% of patients having a Hb <10 g/dl. The median Hb, 12 months after transplantation for incident patients (2000–2005) was 13.0 g/dl.
- The median systolic and diastolic BP in prevalent transplant patients was 136 mmHg and 80 mmHg respectively; only 25% had a systolic BP <130 mmHg and a diastolic BP <80 mmHg.
- Transplant function analysed by CKD stage 1–2T (eGFR ⩾60), 3T (eGFR 30–59), 4T (eGFR 15–29) and 5T (eGFR <15), showed that these categories account for 24%, 59%, 15% and 2% of prevalent transplant patients respectively. Clinical and biochemical variables deteriorate with declining eGFR and patients with CKD stages 4T or 5T were less likely to achieve RA standards compared to prevalent patients on dialysis.

Introduction

This chapter is a result of independent work performed by NHS Blood & Transplant (NHS BT, formerly UK Transplant), the UK Renal Registry (UKRR) and joint analyses between the two organisations. The UKRR holds information on key clinical and biochemical variables for renal transplant recipients and NHS

Table 11.1: Kidney and kidney plus other organ transplants in the UK, 1 Jan 2004–31 Dec 2006

Organ	2004	2005	2006	% change 2005–2006
Heart beating donor kidney[a]	1,211	997	990	−1
Non-heart beating kidney	147	200	250	25
Living donor kidney	463	543	671	24
Kidney and liver	15	11	17	55
Kidney and heart	0	2	1	
Kidney and pancreas[b]	69	102	138	35
Total kidney transplants	**1,905**	**1,855**	**2,067**	**11**

[a] Includes en bloc kidney transplants (three in 2004, five in 2005, five in 2006) and double kidney transplants (five in 2004, six in 2005, eleven in 2006).
[b] Includes combined non-heart beating k/p/single lung transplant (one in 2006).

BT holds information on details of the episode of transplantation. This continues to be a fruitful and mutually beneficial relationship, as it results in a comprehensive database of renal transplant recipients in the UK. This has allowed comparison of key outcome variables between centres and provided insight into the processes involved in the care of renal transplant patients.

Overview

In December 2006, there were 19 adult renal transplant centres in England, 1 in Northern Ireland, 2 in Scotland and 1 in Wales.

Comprehensive information from the year 1995 to present date, concerning the number of patients on the transplant waiting list, the number of transplants performed, the number of heart beating, non-heart beating and living donors, patient and graft survival are available on the NHS BT website (www.uktransplant.org/ukt/statistics).

As of 31 December 2006, 6,220 patients (including adult and paediatric) were active on the renal or renal plus other solid organ waiting list, an increase of 10.5% when compared with 2005. Absolute numbers of live donor and non-heart beating donor transplants continued to increase and in 2006 formed 32% and 12% of all kidney transplants respectively (Table 11.1) which compared with 29% and 10% in 2005. There has been a further fall in heart beating donor numbers. Compared to 2004, there was a 100% increase in the number of combined kidney and pancreas transplants performed in 2006.

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 11.2). These graft survival rates included grafts with primary non-function (which is excluded in some countries).

Data from the UKRR showed that 3.2% of patients with a functioning transplant on 1/1/2006 returned to dialysis after their transplants failed in 2006. This has remained almost unchanged since 2000.

Using data from the UKRR, the death rate in the prevalent transplant cohort was 2.3 per 100 patient years (95% CI 2.1–2.6) when censoring at return to dialysis and 2.5 per 100 patient years (95% CI 2.3–2.8) including those who restarted dialysis.

Table 11.2: 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	91	98	75	84	95	100		
Birmingham	93	95	84	88	93	100	91	95
Bristol	94	94	89	89	97	99	93	100
Cambridge	92	95	79	85	96	99	92	99
Cardiff	90	96	84	90	92	99	85	94
Coventry	95	96	88	89	97	100	89	90
Edinburgh	91	98	81	89	97	98	85	92
Glasgow	91	95	79	88	97	98	86	96
Guy's	92	96	83	88	97	100	95	96
Leeds	92	96	77	82	97	98	92	93
Leicester	90	93	78	86	97	96	85	93
Liverpool	90	98	79	88	90	95	87	97
Manchester	93	96	78	87	96	100	79	93
Newcastle	91	95	82	79	96	99	92	92
Nottingham	86	93	81	87	94	100	90	99
Oxford	94	95	85	84	96	99	90	96
Plymouth	90	94	71	85	75	93		
Portsmouth	89	96	80	85	94	95	89	94
Royal Free	89	95	78	89	90	100	81	100
Royal London	93	95	84	83	93	98	85	93
Sheffield	90	98	81	88	90	100	87	94
St George's	94	97	87	87	91	99	87	93
WLRTC*	95	96	85	86	94	98	91	98
All centres	**92**	**96**	**81**	**86**	**95**	**99**	**88**	**95**

* WLRTC – West London Renal Transplant Centre.
Cohorts for survival rate estimation: 1 year survival 1 Jan 2001–31 Dec 2005; 5 year survival 1 Jan 1997–31 Dec 2001. First grafts only (re-grafts excluded for patient survival estimation). Estimates not provided where number of transplants <15.
[a] Information courtesy of NHS BT. Number of transplants/patients and 95% CI for each estimate; statistical methodology for computing risk adjusted estimates can be obtained from the NHS BT website.

Post transplant follow up

Sixty seven centres sent data electronically to the UKRR and provided data on demographic, laboratory and blood pressure data for renal transplant patients during 2006. The remaining 5 UK centres (Kent & Canterbury, Manchester RI, Stoke, Colchester and London St George's) are not yet linked electronically but have supplied summary statistics. Due to differences in the timing of repatriation of patients after transplantation from the transplanting centre to the host/non-transplanting renal centre, caution needs to be exercised when comparing results between centres. The number of prevalent patients on renal replacement therapy (RRT) in each renal centre and the proportion of transplant patients are shown in Table 11.3.

On 31/12/2006, 46% of UK RRT patients had a functioning renal transplant, compared to 46% in 2005 and 45% in 2004. This compares to 49% in 1997 and reflects growth in number of patients on dialysis rather than in decreasing transplant numbers or poorer patient survival post transplantation.

Table 11.3: Distribution of prevalent patients on RRT by centre and modality on 31/12/2006[a]

Centre	Total	% HD	% PD	% Transplant
B Heart	578	64	7	29
B QEH	1,557	48	9	44
Basldn	186	70	15	15
Bradfd	365	43	12	44
Brightn	659	48	15	37
Bristol	1,203	38	7	55
Camb	906	36	7	57
Carlis	188	46	6	47
Carsh	1,102	46	11	43
Chelms	155	66	21	13
Chestr	43	100	0	0
Colchester	84	100	0	0
Covnt	675	43	10	47
Derby	301	68	26	5
Dorset	396	37	14	49
Dudley	263	49	20	31
Exeter	630	45	13	42
Glouc	319	53	12	35
Hull	610	50	10	39
Ipswi	283	36	20	44
Kent & Canterbury	546	47	18	34
L Barts	1,416	38	17	46
L Guys	1,315	35	5	60
L Kings	669	48	12	41
L RFree	1,383	42	10	49
L St George's	595	33	7	59
L West	2,156	50	4	46
Leeds	1,380	37	8	55
Leic	1,500	41	13	45
Liv Ain	99	100	0	0
Liv RI	1,338	31	7	62
Man RI	1,504	24	10	66
ManWst	718	42	19	39
Middlbr	640	41	5	53
Newc	905	27	7	66
Norwch	437	55	12	32
Nottm	923	37	15	47
Oxford	1,250	30	10	60
Plymth	412	35	10	54
Ports	1,143	33	9	58
Prestn	832	43	11	46
Redng	530	41	16	43
Sheff	1,232	47	12	41
Shrew	259	53	19	28
Stevng	606	57	8	35
Sthend	184	67	9	24
Stoke	588	42	17	40
Sund	271	56	6	38
Truro	291	54	13	33
Wirral	163	79	21	0
Wolve	451	65	14	21
York	223	50	12	38
England	**36,462**	**43**	**11**	**47**

Table 11.3: (continued)

Centre	Total	% HD	% PD	% Transplant
Bangor	103	66	34	0
Cardff	1,333	34	11	55
Clwyd	80	81	10	9
Swanse	503	54	17	29
Wrexm	132	70	28	2
Wales	**2,151**	**44**	**15**	**41**
Abrdn	434	47	7	46
Airdrie	233	66	11	23
D&Gall	77	73	16	12
Dundee	365	41	13	46
Dunfn	156	63	17	19
Edinb	701	37	12	52
Glasgw	1,553	38	7	56
Inverns	200	39	21	40
Klmarnk	215	63	21	16
Scotland	**3,934**	**44**	**11**	**46**
Antrim	200	65	13	23
Belfast	751	36	8	55
Derry	34	91	0	9
Newry	148	56	11	32
Tyrone	160	58	4	38
Ulster	61	92	3	5
N Ireland	**1,354**	**49**	**8**	**43**
England	**36,462**	**43**	**11**	**47**
Wales	**2,151**	**44**	**15**	**41**
Scotland	**3,934**	**44**	**11**	**46**
N Ireland	**1,354**	**49**	**8**	**43**
UK	**43,901**	**43**	**11**	**46**

[a] Includes five centres which were not electronically linked but provided summary statistics. L West includes Hammersmith & Charing Cross and additional summary data for St Mary's transplant patients.

Demographic variables

Age and gender

There has been no significant change in the gender ratio of incident and prevalent transplant patients between 2001 and 2006 (Table 11.4, Figure 11.1). This ratio was similar to that found in patients starting RRT and indicated there was no gender bias in patient selection for transplantation. The median age of patients receiving a transplant and those surviving with a transplant has been slowly rising.

Centre and Local Authority prevalence of renal transplant patients

In 2006, the number of prevalent transplant patients in the UK increased to more than 20,000 compared to approximately 19,000 patients in 2005. Table 11.5 describes the prevalence of renal transplant recipients amongst the countries that make up the UK. The number of prevalent transplant recipients under follow up in each UK renal centre are shown in Table 11.6. Table 11.7 describes the prevalence per million population (pmp) in each Local Authority (LA) in the country.

The LA prevalence data was derived from the patient postcode which was validated against the full address using QAS software (www.qas.co.uk). LA boundaries and population numbers were obtained from the UK 2001 census and the methodology is described elsewhere[1].

The above data demonstrated that like all other modalities, the prevalent transplant population was increasing in most centres and LAs.

Table 11.4: Median age and gender ratio of incident and prevalent transplant patients for centres returning data electronically to the Registry

	Incident transplants			Prevalent transplants[a]		
Year	Number	Median age	M:F ratio	Number	Median age	M:F ratio
2001	972	44.5	1.7	10,179	48.7	1.6
2002	1,042	46.9	1.5	11,798	49.4	1.6
2003	1,171	45.3	1.5	12,848	49.5	1.6
2004	1,363	45.5	1.7	15,048	49.6	1.6
2005	1,471	45.4	1.4	16,894	49.7	1.6
2006	1,698	45.4	1.6	17,985	49.9	1.6

[a] As on 31st December for given year.

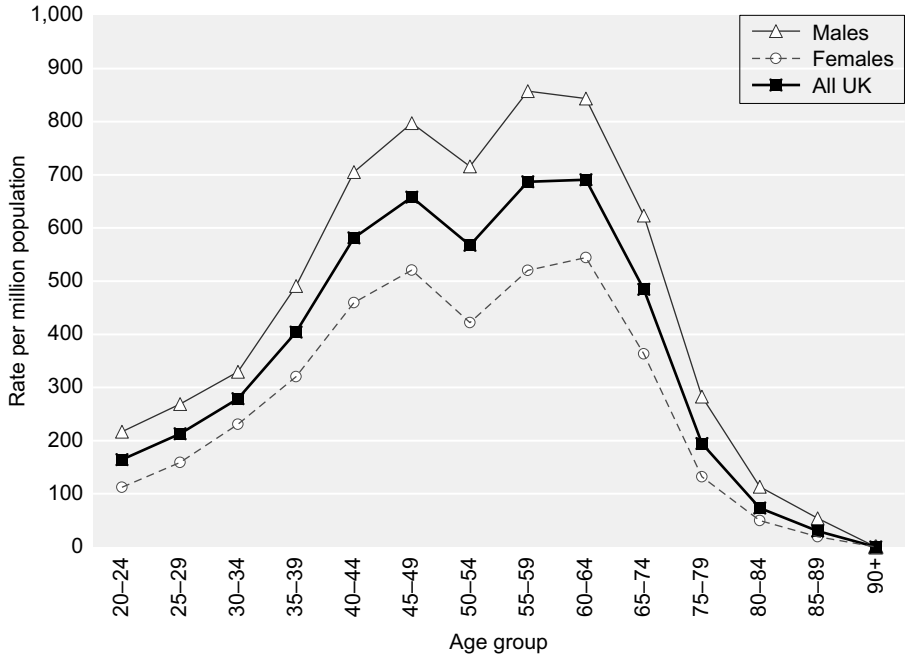

Figure 11.1: Transplant prevalence rate (pmp) by age and gender on 31/12/06

Whilst local policies that affect the relative number of patients followed up in transplant and non-transplanting centres might explain the differences in numbers between centres, it is uncertain as to why such wide differences existed between LAs. Further work is necessary to demonstrate if differences between LAs in incidence of patients on RRT, number of live kidney donor (LKD) transplants performed in the local transplanting centre, access to cadaveric transplantation waiting list were factors that influenced the number of prevalent transplant patients in each LA. The LAs with some of the highest acceptance rates of RRT in the UK

Table 11.5: Prevalence of transplants in adults in the UK on 31/12/2006

	England	Wales	Scotland	N Ireland	UK
Centres contributing to UKRR (67)	14,718	891	1,799	577	17,985
All UK centres (67 + 5[a] = 72)	16,995	891	1,799	577	20,262
Total population, mid-2006 estimates from ONS[b] (millions)	50.8	3.0	5.1	1.7	60.6
Prevalence pmp transplant[a]	335	300	352	331	334

[a] Includes data from five centres which are not electronically linked but provide summary statistics.
[b] ONS – Office of National Statistics, UK.

Table 11.6: Number of prevalent transplant patients by renal centre on 31/12/2006*

Dialysis centres	Number of patients	Transplant centres	Number of patients
Abrdn	200	B QEH	681
Airdrie	54	Belfast	416
Antrim	46	Bristol	665
B Heart	167	Camb	513
Bangor	0	Cardff	735
Basldn	28	Covnt	314
Bradfd	162	Edinb	361
Brightn	243	Glasgw	862
Carlis	89	L Barts	651
Carsh	469	L Guys	789
Chelms	20	L RFree	677
Chestr	0	L St George's	352
Clwyd	7	L West	1,002
Colchester	0	Leeds	765
D&Gall	9	Leic	679
Derby	16	Liv RI	830
Derry	3	Man RI	1,000
Dorset	194	Newc	595
Dudley	82	Nottm	437
Dundee	169	Oxford	755
Dunfn	30	Plymth	224
Exeter	264	Ports	662
Glouc	113	Sheff	504
Hull	239		
Inverns	80		
Ipswi	125		
Kent & Canterbury	186		
Klmarnk	34		
Liv Ain	0		
L Kings	274		
Man Wst	280		
Middlbr	340		
Newry	48		
Norwch	142		
Prestn	381		
Redng	230		
Shrew	73		
Stevng	213		
Stoke	238		
Sthend	44		
Sund	102		
Swanse	146		
Truro	96		
Tyrone	61		
Ulster	3	**England**	**17,084**
Wirral	0	**N Ireland**	**577**
Wolve	94	**Scotland**	**1,799**
Wrexm	3	**Wales**	**891**
York	85	**UK**	**20,351**

* Includes data from five centres which were not electronically linked but provided summary statistics.

Table 11.7: The prevalence per million population of patients with a renal transplant by UK Local Authorities on 31 December 2004–2006

UK Area	Region	Local Authority	Population covered*	Rate pmp 2004	Rate pmp 2005	Rate pmp 2006
North East	County Durham & Tees Valley	Darlington	97,838	307	317	317
		Durham	493,469	357	377	381
		Hartlepool	88,610	406	395	429
		Middlesbrough	134,855	400	408	408
		Redcar & Cleveland	139,132	446	446	460
		Stockton-on-Tees	178,408	319	336	381
	Northumberland, Tyne & Wear	Gateshead	191,151	387	429	398
		Newcastle upon Tyne	259,536	331	362	385
		North Tyneside	191,658	412	449	438
		Northumberland	307,190	378	384	378
		South Tyneside	152,785	340	360	380
		Sunderland	280,807	388	370	377
North West	Cheshire & Merseyside	Cheshire				
		Halton	118,209	271	288	296
		Knowsley	150,459	312	299	299
		Liverpool	439,471	289	309	309
		Sefton	282,958	254	262	276
		St. Helens	176,843	221	237	243
		Warrington	191,080	272	267	309
		Wirral	312,293	295	301	320
	Cumbria & Lancashire	Blackburn with Darwen	137,470	189	182	204
		Blackpool	142,283	239	232	246
		Cumbria	487,607	277	277	304
		Lancashire	1,134,975	266	255	283
	Greater Manchester	Bolton	261,037	180	222	238
		Bury	180,607	61	100	100
		Manchester				
		Oldham	217,276	110	110	143
		Rochdale	205,357	83	112	131
		Salford	216,105	148	171	176
		Stockport				
		Tameside				
		Trafford				
		Wigan	301,415	149	173	216
Yorkshire & Humber	N&E Yorkshire & N Lincolnshire	East Riding of Yorkshire	314,113	242	264	271
		Kingston upon Hull, City of	243,588	267	283	320
		North East Lincolnshire	157,981	247	241	272
		North Lincolnshire	152,848	249	262	288
		North Yorkshire	569,660	276	290	314
		York	181,096	271	298	353
	South Yorkshire	Barnsley	218,063	349	339	367
		Doncaster	286,865	272	279	317
		Rotherham	248,175	282	262	290
		Sheffield	513,234	247	261	283
	West Yorkshire	Bradford	467,664	342	370	374
		Calderdale	192,405	395	421	426
		Kirklees	388,567	381	419	448
		Leeds	715,403	292	301	333
		Wakefield	315,172	282	308	314

Table 11.7: (continued)

UK Area	Region	Local Authority	Population covered*	Rate pmp 2004	Rate pmp 2005	Rate pmp 2006
East Midlands	Leicestershire, Northamptonshire & Rutland	Leicester	279,920	432	454	489
		Leicestershire	609,578	325	349	359
		Northamptonshire	629,676	195	302	310
		Rutland	34,563	434	463	434
	Trent	Derby	221,709	198	226	257
		Derbyshire	734,585	212	225	241
		Lincolnshire	646,644	289	297	298
		Nottingham	266,988	266	273	270
		Nottinghamshire	748,508	277	285	297
West Midlands	Birmingham & the Black Country	Birmingham	977,085	320	331	351
		Dudley	305,153	246	239	246
		Sandwell	282,904	318	343	346
		Solihull	199,515	216	241	276
		Walsall	253,498	280	292	304
		Wolverhampton	236,582	254	258	254
	Coventry, Warwickshire, Herefordshire & Worcestershire	Coventry	300,849	316	339	352
		Herefordshire, County of	174,871	263	274	286
		Warwickshire	505,858	356	352	366
		Worcestershire	542,105	225	251	258
	Shropshire & Staffordshire	Shropshire	283,173	208	237	240
		Staffordshire				
		Stoke-on-Trent				
		Telford & Wrekin	158,325	126	139	177
East of England	Bedfordshire & Hertfordshire	Bedfordshire	381,572	246	286	309
		Hertfordshire	1,033,978	145	231	248
		Luton	184,373	233	325	380
	Essex	Essex	1,310,837	222	256	278
		Southend-on-Sea	160,259	156	218	231
		Thurrock	143,128	196	252	245
	Norfolk, Suffolk & Cambridgeshire	Cambridgeshire	552,659	248	282	300
		Norfolk	796,728	223	235	267
		Peterborough	156,061	218	224	269
		Suffolk	668,555	226	233	265
London	North Central London	Barnet	314,561		324	347
		Camden	198,020		278	323
		Enfield	273,559		380	413
		Haringey	216,505		319	365
		Islington	175,797		336	370
	North East London	Barking & Dagenham	163,942	244	274	281
		City of London	7,183			0
		Hackney	202,824	227	296	286
		Havering				
		Newham	243,889	221	250	271
		Redbridge	238,634	281	314	356
		Tower Hamlets	196,105	194	240	280
		Waltham Forest	218,341			339
	North West London	Brent	263,463			175
		Ealing	300,948	272	292	352
		Hammersmith & Fulham	165,244	236	242	266

Table 11.7: (continued)

UK Area	Region	Local Authority	Population covered*	Rate pmp 2004	Rate pmp 2005	Rate pmp 2006
London	North West London	Harrow				
		Hillingdon	243,006	193	263	300
		Hounslow	212,342	226	264	344
		Kensington & Chelsea				
		Westminster				
	South East London	Bexley	218,307	376	399	403
		Bromley	295,532	308	342	369
		Greenwich	214,404	219	261	294
		Lambeth	266,169	222	233	240
		Lewisham	248,923	374	382	414
		Southwark	244,866	433	461	478
	South West London	Croydon	330,588	221	242	290
		Kingston upon Thames				
		Merton				
		Richmond upon Thames				
		Sutton				
		Wandsworth				
South East	Hampshire & I of Wight	Hampshire	1,240,102	297	298	326
		Isle of Wight	132,731	301	294	286
		Portsmouth	186,700	370	354	370
		Southampton	217,444	317	340	363
	Kent & Medway	Kent				
		Medway				
	Surrey & Sussex	Brighton & Hove	247,817	218	230	270
		East Sussex	492,326	240	244	238
		Surrey	1,059,017	239	253	303
		West Sussex	753,612	245	261	281
	Thames Valley	Bracknell Forest	109,616	292	265	265
		Buckinghamshire	479,026	330	347	403
		Milton Keynes	207,057	280	304	338
		Oxfordshire	605,489	370	385	419
		Reading	143,096	349	217	231
		Slough	119,064	336	353	386
		West Berkshire	144,485	353	318	318
		Windsor & Maidenhead				
		Wokingham	150,231	260	266	293
South West	Avon, Gloucestershire & Wiltshire	Bath & NE East Somerset	169,040	248	272	284
		Bristol, City of	380,616	410	415	431
		Gloucestershire	564,559	315	342	351
		North Somerset	188,564	430	414	414
		South Gloucestershire	245,641	387	403	411
		Swindon	180,051	300	317	317
		Wiltshire	432,972	254	273	293
	Dorset & Somerset	Bournemouth	163,444	269	263	269
		Dorset	390,980	309	330	343
		Poole	138,288	289	340	369
		Somerset	498,095	305	333	341
	South West Peninsula	Cornwall & I of Scilly	501,267	289	327	347
		Devon	704,491	277	285	309
		Plymouth	240,722	361	415	440
		Torbay	129,706	285	316	347

Table 11.7: (continued)

UK Area	Region	Local Authority	Population covered*	Rate pmp 2004	Rate pmp 2005	Rate pmp 2006
Wales	Bro Taf	Cardiff	305,353	383	413	442
		Merthyr Tydfil	55,979	482	518	536
		Rhondda, Cynon, Taff	231,947	401	444	491
		Vale of Glamorgan	119,292	360	344	352
	Dyfed Powys	Carmarthenshire	172,842	336	364	388
		Ceredigion	74,941	360	320	320
		Pembrokeshire	114,131	289	333	307
		Powys	126,353	230	222	269
	Gwent	Blaenau Gwent	70,064	400	385	400
		Caerphilly	169,519	354	366	383
		Monmouthshire	84,885	495	530	530
		Newport	137,012	387	358	336
		Torfaen	90,949	451	451	462
	Morgannwg	Bridgend	128,645	381	412	420
		Neath Port Talbot	134,468	320	364	439
		Swansea	223,300	381	416	425
	North Wales	Conwy	109,596	319	319	319
		Denbighshire	93,065	269	322	312
		Flintshire	148,594	289	316	330
		Gwynedd	116,843	265	308	291
		Isle of Anglesey	66,829	209	209	224
		Wrexham	128,476	311	319	366
Scotland		Aberdeen City	212,125	311	311	325
		Aberdeenshire	226,871	304	322	335
		Angus	108,400	517	526	535
		Argyll & Bute	91,306	252	252	340
		Scottish Borders	106,764	244	272	262
		Clackmannanshire	48,077	250	270	291
		West Dunbartonshire	93,378	257	257	268
		Dumfries & Galloway	147,765	305	311	318
		Dundee City	145,663	384	391	433
		East Ayrshire	120,235	250	241	258
		East Dunbartonshire	108,243	406	416	425
		East Lothian	90,088	344	322	300
		East Renfrewshire	89,311	381	392	414
		Edinburgh, City of	448,624	294	323	308
		Falkirk	145,191	317	331	303
		Fife	349,429	266	289	306
		Glasgow City	577,869	386	408	417
		Highland	208,914	278	306	330
		Inverclyde	84,203	321	368	344
		Midlothian	80,941	297	309	321
		Moray	86,940	322	403	426
		North Ayrshire	135,817	346	398	427
		North Lanarkshire	321,067	327	349	352
		Orkney Islands	19,245	520	572	572
		Perth & Kinross	134,949	319	333	333
		Renfrewshire	172,867	347	370	399
		Shetland Islands	21,988	318	273	273

Table 11.7: (continued)

UK Area	Region	Local Authority	Population covered*	Rate pmp 2004	Rate pmp 2005	Rate pmp 2006
Scotland		South Ayrshire	112,097	339	339	357
		South Lanarkshire	302,216	377	384	390
		Stirling	86,212	255	255	244
		West Lothian	158,714	347	372	334
		Eilean Siar	26,502	189	226	226
Northern Ireland		Antrim	48,366		331	414
		Ards	73,244		341	341
		Armagh	54,262		350	387
		Ballymena	58,610		239	273
		Ballymoney	26,895		223	297
		Banbridge	41,389		314	362
		Belfast	277,391		314	332
		Carrickfergus	37,658		505	505
		Castlereagh	66,488		391	466
		Coleraine	56,314		213	195
		Cookstown	32,581		92	123
		Craigavon	80,671		310	310
		Derry	105,066		314	352
		Down	63,828		235	266
		Dungannon	47,735		230	209
		Fermanagh	57,527		174	226
		Larne	30,833		616	551
		Limavady	32,422		339	308
		Lisburn	108,694		386	432
		Magherafelt	39,778		402	402
		Moyle	15,932		314	377
		Newry & Mourne	87,058		414	391
		Newtownabbey	79,996		288	363
		North Down	76,323		341	328
		Omagh	47,953		250	313
		Strabane	38,246		261	340

* Population numbers obtained from UK census 2001.
Estimates are not provided for a given year for LA centres that were not electronically linked to UKRR.

(Chapter 3, Table 3.3) did not have similarly high rates of transplant prevalence and this is likely to reflect the ethnic minority mix of these areas (with higher acceptance rates in Asians and African Caribbeans, lower donor rates and difficult matching of tissue types).

Commissioners of renal services need to take such data into consideration when planning for allocation of resources to deliver an equitable and comprehensive renal transplant service across the UK. Local surgical, medical, transplant coordinators and specialist nursing requirements will vary in order to reflect these complex variations in underlying service requirements to match the local need.

Access to renal transplantation

A number of patient and centre specific factors are likely to influence access to renal transplantation. This makes it difficult to consider prescribing a 'standard' for proportion of patients that should ideally be waitlisted for transplantation in a given centre. However, as discussed in the previous section there were unexplained differences in transplant patient prevalence across

the UK. As a consequence, the UKRR, in conjunction with data supplied by NHS BT, undertook an analysis to analyse differences in the proportion of patients waitlisted for transplantation between UK renal centres.

Methods

Centre specific data were analysed in two formats.

1. Prevalent patients: The number of prevalent patients on dialysis on 31/12/06 at a given centre were used as the denominator. The number of patients active on the transplant waiting list for kidney or kidney plus another organ on 31/12/06 for that centre was taken as the numerator, to calculate percentage active on the waiting list. Using a point prevalence analysis, has some potential disadvantages. Firstly, short-term fluctuations in both numerator and denominator within a centre might lead to inaccuracy in estimation of the overall proportion listed. Secondly, selective enrichment over time of the prevalent dialysis population with patients who are unsuitable for transplantation and hence unlisted patients, could lead to a lower proportion listed. Thirdly, centres with active LKD transplant programs may have smaller proportions contributing to the numerator, particularly if the centre operates a policy of not entering potential LKD recipients onto the NHS BT waiting list.
2. Incident patients: To counter some of the potential criticism of using a prevalent patient analysis, the listing practices amongst the incident RRT patients in each centre were analysed. The number of incident RRT patients between 01/01/2003 and 31/12/2004 from each centre contributing data to the UKRR were used as the denominator. The number of patients from each centre who were active on the transplant list for kidney or kidney plus other organ within two years of commencement of RRT were used as the numerator. Patients with diabetic nephropathy as the cause of established renal failure (ERF) may require more intensive investigations to establish fitness prior to wait listing and consequently result in delayed listing. Therefore, for each centre, the proportion of patients with a primary renal diagnosis of diabetic nephropathy was also ascertained to see if this influenced the numerator value for the centre.

For both prevalent and incident patient analyses, patients were designated according to the referring renal centre and not by the local renal transplant centre. Information on start date of dialysis was obtained from the UKRR and date of first activation on the kidney transplant waiting list was supplied by NHS BT. Since the number of patients aged >65 years contributed to only a minority of those waitlisted but accounted for over 50% of those starting RRT, the results presented are only for patients aged <65 years. Accurate attribution of patients undergoing pre-emptive LKD transplantation to their parent dialysis centre was not always possible. It requires the centre to include a 'transfer out pre-emptive transplant' in their RRT timeline.

Therefore, it was not possible to analyse whether such patients, who may not have been waitlisted prior to transplantation, impacted on the final analyses. Instead, the LKD transplants pmp in each transplant centre were used as a surrogate marker for living kidney donor transplant activity.

Results

Figure 11.2 shows the percentage of prevalent patients aged <65 on the active waiting list and Figure 11.3 shows the same data in a funnel plot. The solid lines in the funnel plot show 2 s.ds (95% CI) where 3/60 centres may fall outside these limits (above or below) and the dotted lines show 3 s.ds (99.9% CI) where no centre would be expected by chance to fall outside these limits. Figure 11.3 indicates 2 transplanting centres (Liverpool and London Guy's) and 4 referring renal centres (Wrexham, Clwyd, Bangor and Sunderland) as 'outliers' with a percentage of patients outside the lower 99.9% CI compared to the rest of the UK. Interestingly 3 of the outlying referring centres (Wrexham, Clwyd and Bangor) all refer partly or completely to one transplanting centre (Liverpool). Liverpool Aintree was also outside the lower 2 s.d. limit.

Liverpool have indicated that this may partly be a consequence of using point prevalence analysis as indicated by the numbers of patients on the active waiting list at this centre are continuing to increase by 70 per year from 2005–2007.

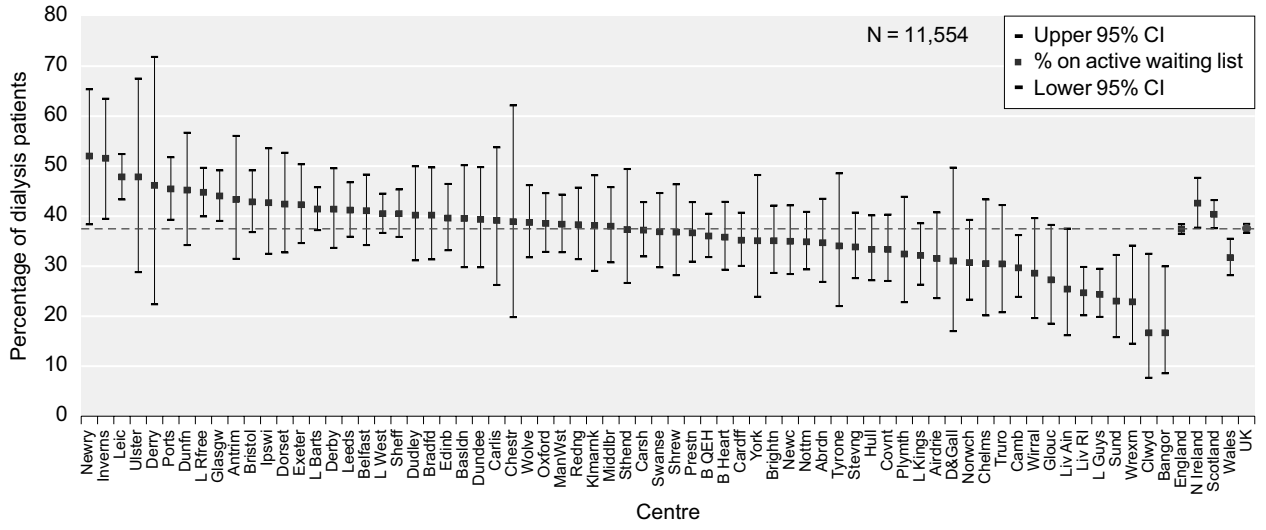

Figure 11.2: Percentage of prevalent dialysis patients aged <65 years active on transplant waiting list on 31/12/06

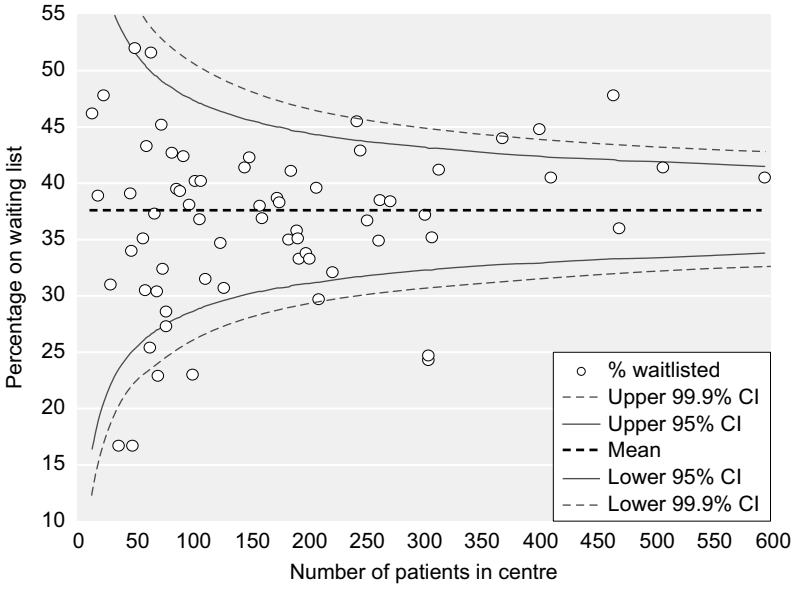

Figure 11.3: Funnel plot of the percentage of prevalent dialysis patients aged under 65 on the active transplant waiting list on 31/12/2006

London Guy's have indicated that their low listing rate may be due to their very active LKD transplant program. Analysis in conjunction with NHS BT, has shown that Guys waitlist a lower proportion of their LKD patients at 27%, compared with a UK average of 65%. If the data were adjusted to reflect 65% of LKDs being listed, the data for Guys would still remain outside 3 s.ds.

Leicester and London Royal Free fell outside the upper 99% CI. Patients from the ethnic minorities (who are more difficult to match and have lower donor rates) contributed to a greater proportion of the prevalent pool in these two centres and consequently had a longer wait time on dialysis. This selectively increased the numerator. However, other centres with similar demographics did not have similar percentages of waitlisted patients suggesting factors other than just ethnicity may also be important.

The percentage of incident dialysis patients waitlisted for individual centres has not previously been analysed. This has been analysed as the percentage of incident patients waitlisted within 2 years of starting RRT (Figure 11.4). Figure 11.5 shows the same data in a funnel plot.

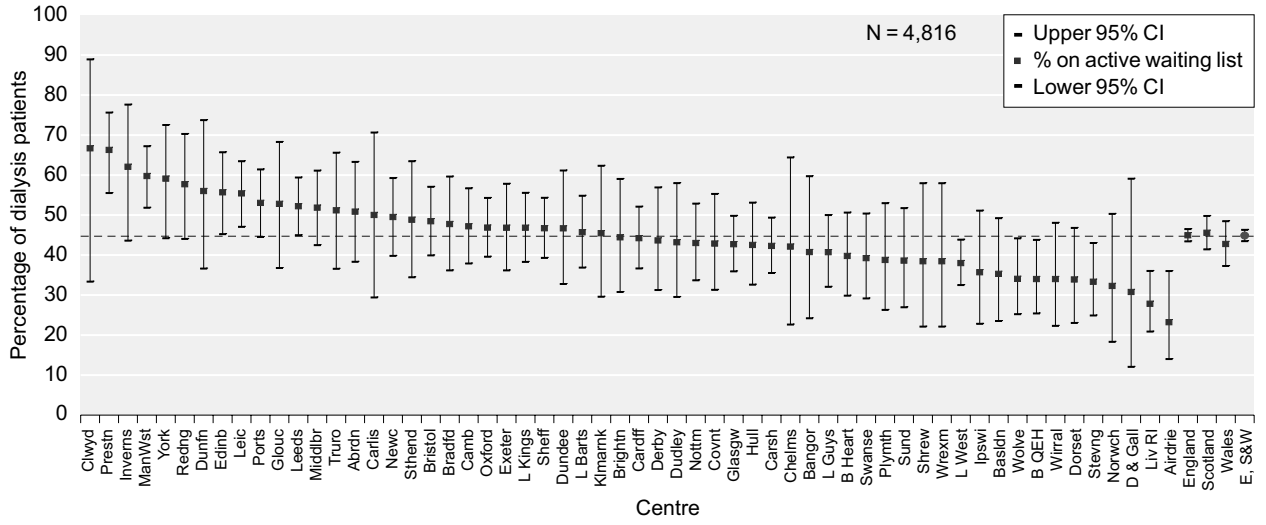

Figure 11.4: Percentage of incident patients 2003–2004, aged <65 years active on the transplant waiting list within 2 years of commencement of dialysis

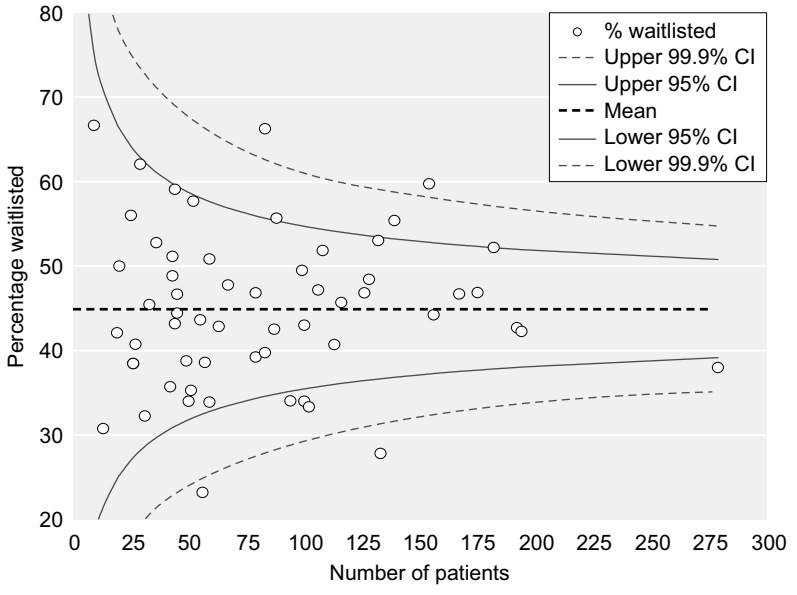

Figure 11.5: Funnel plot of the percentage of incident patients 2003–2004, aged <65 years active on the transplant waiting list within 2 years of commencement of dialysis

This indicates one transplanting centre (Liverpool) and one non transplanting renal centre (Airdrie) fell below the lower 99.9% CI. Several other centres fell below the lower 95% CI limits. It is not possible to state whether these data are due primarily to greater delay between start of RRT and wait listing, or to a genuine difference in selection policy for transplantation. In the absence of robust co-morbidity data from all the centres it is difficult to know whether a differential distribution of co-morbidity may explain some of these variances. Interestingly both centres (Manchester West, Preston) that fell outside the upper 95% CI with speedier listing are served by a single transplant centre.

Table 11.8 includes the prevalent and incident data reported in funnel plots (Figures 11.3 and 11.5) for individual transplanting centres and the referring centres. The table indicates wide variations between transplant centres as well as between some referring centres and their transplant centre. Despite the differences in the proportion of incident patients with a primary renal diagnosis of diabetic nephropathy between centres, there appeared to be no correlation

Table 11.8: Prevalent and incident patients wait listing data according to transplant centre (in bold) and its referring centres

	Prevalent dialysis population on 31/12/06 aged <65		Incident dialysis patients between 01/01/03–31/12/04 aged <65			LKD transplants pmp 01/04/03–31/03/04**
Centre name*	Number	% active on waiting list	Number	% with diabetes as primary renal diagnosis	% waitlisted within 2 years of starting RRT	
Birmingham QE	469	36	100	26.5	34	3.1
Birmingham H	190	35.8	83	43.2	39.8	
Wolverhampton	173	38.7	94	28	34	
Dudley	102	40.2	44	27.3	43.2	
Shrewsbury	106	36.8	26	11.5	38.5	
Bristol	245	42.9	128	27.4	48.4	17.8
Exeter	149	42.3	79	21.2	46.8	
Gloucester[a]	77	27.3	36	14.7	52.8	
Dorset[b]	92	42.4	59	27.3	33.9	
Cambridge	209	29.7	106	22.9	47.2	4.4
Stevenage	198	33.8	102	18.2	33.3	
Norwich	127	30.7	31	19.4	32.3	
Ipswich	82	42.7	42	17.1	35.7	
Cardiff	307	35.2	156	26.2	44.2	6.3
Swansea	160	36.9	79	23	39.2	
Coventry	192	33.3	63	22.2	42.9	22.2
Edinburgh	207	39.6	88	12.5	55.7	6.8
Aberdeen	124	34.7	59	35.6	50.8	6.4[c]
Dundee	89	39.3	45	31.1	46.7	
Inverness	64	51.6	29	25.9	62.1	
Dunfermline	73	45.2	25	28	56	
Glasgow	368	44	192	22.8	42.7	7.9
Dumfries	29	31	13	23.1	30.8	
Airdrie	111	31.5	56	27.3	23.2	
Kilmarnock	97	38.1	33	17.1	45.5	
Leeds	313	41.2	182	19.9	52.2	8.4
Bradford	107	40.2	67	27.7	47.8	
York	57	35.1	44	25.6	59.1	
Hull	201	33.3	87	24.1	42.5	
Leicester	464	47.8	139	27.3	55.4	12.7
Liverpool	304	24.7	133	14.3	27.8	4.6
Bangor	48	15.7	27	7.4	40.7	
Glan Clwyd	36	16.7	9	37.5	66.7	
Wrexham	70	22.9	26	52	38.5	
Aintree	63	25.4	1	0	0	
Wirral	77	28.6	50	0	34	
Chester	18	38.8	3	0	0	
Manchester RI						
Manchester W	271	38.4	154	10.4	59.7	
Preston	251	36.7	83	15.7	66.3	
Stoke						

Table 11.8: (continued)

Centre name*	Prevalent dialysis population on 31/12/06 aged <65		Incident dialysis patients between 01/01/03–31/12/04 aged <65			LKD transplants pmp 01/04/03–31/03/04**
	Number	% active on waiting list	Number	% with diabetes as primary renal diagnosis	% waitlisted within 2 years of starting RRT	
Newcastle	183	35	99	16.3	49.5	6.7
Sunderland	100	23	57	17.5	38.6	
Middlesbrough	158	38	108	17.9	51.9	
Carlisle	46	39.1	20	25	50	
Nottingham	261	34.9	100	27	43	9.4
Derby	145	41.4	55	33.3	43.6	
Oxford	262	38.5	175	28.7	46.9	5.3
Reading	175	38.3	52	19.2	57.7	
Plymouth	74	32.4	49	24.5	38.8	2.2
Truro	69	30.4	43	22.2	51.2	
Portsmouth	242	45.5	132	21.7	53	5.0
Sheffield	410	40.5	167	26.5	46.7	4.9
London Kings	221	32.1	126	27.3	46.8	
London Guys	304	24.3	113	24.8	40.7	
Kent & Canterbury						
London RFree	400	44.8				
London Barts	507	41.4	116	28.6	45.7	
Southend	67	37.3	43	41.9	48.8	
Basildon	86	39.5	51	31.4	35.3	
Chelmsford	59	30.5	19	47.1	42.1	
Colchester						
London West	595	40.5	279	32.9	38	
L St George's						
Carshalton	301	37.2	194	30.6	42.3	
Brighton	191	35.1	45	22.9	44.4	
Belfast	185	41.1				4.1
Derry	13	46.2				
Ulster	23	47.8				
Tyrone	47	34				
Newry	50	52				
Antrim	60	43				
Total	**11,554**	**37.6**	**2,129**	**24.3**	**43.8**	

* Referring centres assigned to the transplant centre that performs most of their transplants especially LKD transplantation. This allocation may not be accurate.
** Data from NHS BT website (annual activity data for 2003–2004).
[a] Gloucester patients are equally split for wait listing at Oxford and Bristol.
[b] Dorset contract for transplantation moved from Plymouth to Bristol in 04/05.
[c] Aberdeen used to undertake renal transplantation until 2004.
Centres in italics do not submit data to UKRR. Blank spaces indicate data un-available at UKRR or not accessible from NHS BT website.

between this factor and the percentage of patients activated onto the waiting list (Pearson correlation coefficient of -0.005, $p = 0.96$). Table 11.8 does not seem to suggest the number of LKD transplants performed by a transplant centre correlates with the number of prevalent (Pearson correlation coefficient of 0.16, $p = 0.56$) or incident patients (Pearson

correlation coefficient of 0.14, $p = 0.44$) accessing the waiting list. This suggests factors other than rate or volume of LKD transplantation influenced access to the waiting list in individual centres.

Entry onto the waiting list was dependent on referral for individual patients to be received by 'gate-keeping' clinicians/physicians/surgeons and the time taken to process such referrals followed by a decision to waitlist. Consequently inequity or delay in any step of this patient pathway may result in variations between centres. The above data might be useful for transplant centres and referring renal centres to design local patient pathways to ensure equitable and early access to the waiting list for the entire catchment population.

Currently NHS BT defines time on the waiting list as commencing from the date the patient was first listed for an organ on its database. Since current organ allocation rules favour 'longer waiters', time accrued on the waiting list increases the chances of an organ being allocated. Hence, the time taken to list a patient for renal transplantation may be used as a quality of care indicator for patients with ERF on dialysis, with better performing centres achieving earlier activation. Whilst a 'standard' for optimum or maximum time a patient may expect to elapse after commencing dialysis before being waitlisted is difficult to prescribe at an individual level, such analyses may open the debate for what the centre or national average should be. It is hoped to include median time to waitlist for individual centres in next year's report.

Results of the joint Renal Association – British Transplantation Society survey on access to transplantation

In 2007, the RA and BTS undertook a joint survey of transplant centres and referring renal centres across the UK to better understand resource allocation and clinical practices both pre and post-transplant, in individual centres. The questionnaire was designed by a joint working group on behalf of the RA and BTS and administered by Dr Kesh Baboolal (Consultant Nephrologist, Cardiff). The questionnaire was sent to both the lead nephrologist and lead transplant surgeon in each transplant centre and to the lead nephrologist in each non-transplanting renal centre. Responses were collated by Dr Baboolal and were analysed jointly with the UKRR.

Clinical practice data for individual centres was self reported by the lead clinician. Catchment population and transplant numbers pmp, including sub-types of transplants, number of waitlisted patients as of 31 March 2007 for each centre was obtained by accessing the NHS BT database: (http://www.NHSBTransplant.org.uk/NHSBT/statistics/transplant_activity_report/current_activity_reports/NHS BT/tx_activity_report_2007_uk_pp12–20.pdf).

The transplant activity quoted below includes kidney alone and kidney plus other organ transplants performed at any of the centres.

Despite the endorsement of both the RA and BTS disappointingly only 9 of the 23 adult renal transplant centres (39%) and 15 of the 47 (31%) referring renal centres responded to the survey. For purposes of this year's annual report, the results of the analyses from the survey have been restricted to variables surrounding access to transplantation. A more detailed publication of all aspects covered by the survey is expected later.

Table 11.9 suggests wide variability in dedicated sessional commitment to transplantation by both consultant nephrologists and transplant surgeons amongst transplant centres across the UK. There was also a very wide variation in number of transplants pmp and number of waitlisted patients pmp amongst transplant centres. Even after excluding Cambridge (which included liver transplant sessions) there was no relationship between the number of consultant surgical or nephrologist sessions dedicated to transplantation and total (cadaveric and LKD) transplant numbers. Whilst a number of factors including allocation rules and the proportion of patients from the ethnic minority on the waiting list may have influenced the number of cadaveric transplants performed by a centre, the numbers of LKD and non-heart beating donor transplants were likely to be more influenced by availability of local resources. Centre transplant activity seemed to be clustered into 3 groups (<30 pmp, 30–40 pmp, >40 pmp).

Table 11.9: Consultant and transplant co-ordinator resources compared with transplant activity at renal transplant centres

Centre	Catchment population (millions[a])	Consultant surgical PA[b] pmp	Consultant nephrologist PA pmp	LKD co-ordinators pmp	Number of transplants pmp[d]				No of dialysis patients active on tx waiting list pmp[e]
					Cadaveric	Live kidney donor	Non-heart beating	Total	
Cambridge	2.6	*9.6* [c]	n/a	0.6	23.0	10.2	21.1	54.3	94
Cardiff	2.2	9.0	3.1	0.4	21.4	10.0	7.0	38.4	102
Edinburgh	2.4	7.0	4.1	0.4	18.3	5.8	1.2	25.3	129
Leicester	2.1	11.4	5.7	0.4	9.2	14.7	0.0	23.9	157
Newcastle	2.8	3.5	3.5	0.3	12.8	9.0	16.0	37.8	83
Nottingham	1.6	11.2	1.5	0.6	14.2	8.7	0.0	22.9	134
Sheffield	1.8	5.0	3.8	0.5	16.0	8.0	0.0	24.0	116
St George's	3.5	n/a	n/a	1.4	14.2	10.0	2.2	26.4	76
Bristol	2.2	4.5	3.1	0.9	18.9	16.9	13.1	48.9	139

[a] Catchment population obtained from NHS BT website except for St George's which was reported by the clinical lead. This figure was used as the denominator to calculate the number of patients on waiting list data for the centre.
[b] Programmed activity/week dedicated to transplantation (a PA is equivalent to 4 hours of consultant time).
[c] Cambridge surgical data includes both liver and kidney transplants.
[d] Transplant numbers pmp for the financial year 2006–2007 for each centre obtained from NHS BT website.
[e] Number of patients active on 31 March 2007 for the centre used as the numerator.
n/a = data not available.

Clinics, referral and team organisation

All the transplant centres included transplantation as part of their pre-ERF education programme. All centres except Cardiff and Newcastle, had weekly dedicated transplant assessment clinics. At Cambridge, St George's and Sheffield these clinics were staffed by both consultant nephrologists and transplant surgeons, in Edinburgh and Leicester they were staffed only by nephrologists whilst in Nottingham and Bristol only by surgeons.

Referrals for transplant assessment were usually accepted from all members of the renal multi-disciplinary team. Bristol, Edinburgh, Nottingham and St George's had a written protocol for acceptance of patients onto the waiting list. All centres except Cambridge and Sheffield, had written protocols for cardiac investigations prior to wait listing.

All centres held at least monthly multi-disciplinary meetings to discuss patients before wait listing which was attended by the extended renal multi-disciplinary team including transplant co-ordinators and specialist nurses. No centre reported involvement by anaesthetists in these multi-disciplinary meetings.

Only Edinburgh and St George's undertook 'out-reach' transplant assessment clinics in the referring renal centres, while all other centres undertook pre-transplant assessment only at the transplant centre.

All transplant centres had dedicated LKD co-ordinators with St George's and Newcastle also having dedicated LKD co-ordinators at one or more of their referring renal centres.

With the exception of Edinburgh and Nottingham, donor work up was performed by nephrologists. All the transplant centres reported a belief that more LKD transplants could be performed in their centre, with major barriers to increasing transplant numbers identified as: availability of theatre time, support from Trust and commissioning groups, ABO blood group/HLA incompatibility and access to specialist services such as cardiology and radiology.

The turn around time from referral to surgery for potential LKD transplants varied from 2 months (St George's) to 12 months (Sheffield) with most centres taking between 4–6 months. Delay in medical investigations to confirm donor fitness and theatre availability were regarded as the primary reasons for time taken to complete LKD transplants.

In Cambridge, St George's and Edinburgh, live transplant operations were performed simultaneously whilst in the other centres a sequential operation took place. Laparoscopic nephrectomy was the predominant donor operation in all centres.

Analysis from non-transplanting centres

Table 11.10 indicated wide variability in consultant nephrologist time dedicated to transplantation in non-transplanting renal centres as well as the number of prevalent transplant patients cared for at the centre, with several centres not following transplant patients.

Only Salford and Carshalton reported having dedicated educational programmes for transplantation; other centres included this as part of their general pre-ERF counselling. Bangor, Carshalton and Chelmsford had a dedicated pre-transplant assessment clinic, usually manned by surgical and/or medical staff from the local transplant centre. In the remaining centres, patients travelled to the transplant centre to be assessed before being activated on the waiting list.

Approximately 50% of the centres who responded to the survey had a written protocol for referral and assessment prior to wait listing and/or for cardiac investigations. All centres except Birmingham Heartlands, Basildon, Derby, Chelmsford, Colchester and Manchester West held at least monthly multi-disciplinary meetings to discuss patients prior to wait listing usually in conjunction with clinical staff from the transplant centre. With the exceptions of Carshalton and London Kings, final assessments were performed at the transplant centre.

All centres except Liverpool Aintree and Dunfermline, had a named contact/link person between their centre and the transplant centre. Only Carshalton, Swansea, Liverpool-Aintree and Chelmsford undertook regular audits of patient referrals and acceptance onto the waiting list.

About half these centres had a dedicated LKD co-ordinator on-site and in most centres some of the donor medical work up was undertaken locally.

Dunfermline, Brighton, Colchester, Chelmsford and Derby estimated they were achieving maximum potential in LKD referrals. Amongst the other centres, the number of LKD co-ordinators, delays at the transplant centre, awareness amongst patients and families and support from Trusts and commissioners were identified as the major barriers to increasing LKD transplant activity. Average turn around time from referral

Table 11.10: Consultant resources in non-transplanting centres

Centre	Catchment population (millions)	Nephrologist PAs dedicated to Tx	Prevalent transplant patients in centre[a]
Bangor	0.18	1	0
B Heart	0.60	3	167
Basildn	0.50	1	28
Brightn	0.98	5	243
Carsh	1.80	4	469
Chelms	0.50	1	20
Colchester	n/a	0	0
Derby	0.48	0	16
Dunfn	n/a	1	30
Livrpl Ain	0.64	0	0
L Kings	1.01	1	274
Man Wst	0.94	2	280
Swansea	0.70	4	146
Tyrone	n/a	1	61
Wrexm	0.32	0	3

[a] Prevalent patient numbers as of 31/12/06.
n/a = data not available.

for donor assessment to surgery was 6 months in most centres and varied from 3 months at Carshalton to 18 months at Bangor.

Survey conclusions

The joint RA/BTS survey highlights wide variability in availability of resources as well as local clinical practices at both transplanting and non-transplanting renal centres. Some of the specific findings need to be interpreted with caution as less than 50% of transplanting centres and less than a third of the non-transplanting renal centres responded to the survey. It was also difficult to accurately quantify consultant time dedicated to transplantation at the individual centre level.

There was unexplained variability in access to renal transplantation across the UK. These results suggest there should be guidance on minimum workforce requirements to support an adequate and timely service, clinical practice structures/care bundles to enable equitable access to transplantation for the whole population.

There is a necessity for regular local and national audit in order to assess access to renal transplantation and this should form part of the core audit of administered clinical care to patients with ERF.

Primary renal diagnosis, ethnicity, co-morbidity and transplantation

There has been no change (Table 11.11) in the relative proportions of patients with the most common primary renal diagnoses except for patients with diabetes undergoing transplantation in 2006. As expected with the large increase (see Table 11.1) in simultaneous pancreas kidney transplantation, there has been an increase in the proportion of diabetics receiving a transplant, from 9.7% in 2003 to 12.5% in 2006.

Data on ethnic origin was retrieved from renal 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 Appendix J at www.renalreg.org. There has been an improvement in the reduction of patients with missing ethnicity information in the incident RRT population (Table 11.12). In the last 2 years,

Table 11.11: Primary renal diagnosis of renal transplant recipients

	New transplants by year					Established transplants on 01/01/06	
	2003	2004	2005	2006			
Primary diagnosis	%	%	%	%	Number	%	Number
Aetiology uncertain/GN[a] not biopsy proven	19.5	19.9	19.4	17.3	293	20.4	3,452
Diabetes	9.7	10.9	11.8	12.5	212	7.3	1,227
Glomerulonephritis	21.1	20.5	19.2	18.0	305	19.4	3,280
Polycystic kidney disease	14.1	13.0	11.8	12.3	209	11.7	1,979
Pyelonephritis	13.1	12.4	11.6	10.7	181	15.7	2,659
Reno-vascular disease	5.5	6.9	6.3	5.3	90	5.7	971
Other	15.0	14.5	13.2	13.8	235	15.0	2,539
Not available	2.0	1.9	6.7	10.2	173	4.7	787

[a] GN – glomerulonephritis.

Table 11.12: Ethnicity of patients who received a transplant in the years 2001–2006

Year	% White	% South Asian	% African Caribbean	% Others	% Unknown
2001	69.4	4.6	2.0	0.7	23.3
2002	72.5	6.7	4.4	1.4	15.0
2003	72.2	4.1	3.1	1.5	19.0
2004	70.1	6.6	4.0	2.0	17.2
2005	71.2	7.2	5.5	1.1	15.0
2006	68.0	7.6	6.1	2.5	15.8

Table 11.13: Comparison of co-morbidity in patients starting RRT during 2001–2006 who underwent transplantation with those who remained on dialysis or died

	Not transplanted		Transplanted		
Co-morbidity	**Number**	**%**	**Number**	**%**	**p value[a]**
Patients with co-morbidity data	9,259		1,552		
Without co-morbidity	3,751	40.5	1,162	74.9	<0.0001
Ischaemic heart disease	2,470	27.1	85	5.5	<0.0001
Peripheral vascular disease	1,306	14.2	35	2.3	<0.0001
Cerebrovascular disease	1,072	11.6	44	2.8	<0.0001
Diabetes (not cause of ERF)	800	8.9	36	2.3	<0.0001
COPD	726	8.0	27	1.8	<0.0001
Liver disease	240	2.6	10	0.6	<0.0001
Malignancy	1,229	13.3	35	2.3	<0.0001
Smoking	1,438	16.7	214	14.7	0.0603

[a] Chi square p value comparing proportion with co-morbidity between groups.

there may have been a slight rise in the proportion of patients from South Asian and African origins receiving a transplant and this may have been due to the new matching scheme for rare antigens. In the incident RRT cohort, 9.5% were from a South Asian background and 5.8% having an African Caribbean origin.

As expected, patients who received a renal transplant had no co-morbidity or fewer co-morbidities (co-morbidity listed at time of commencement of RRT) compared to incident dialysis patients who did not receive a transplant or who died during the same period remaining on dialysis (Table 11.13). The patients and centres included in this analysis are described in Chapter 5.

The prevalence of smoking was similar to that of the dialysis population. Multiple co-morbidities were likely to restrict access to transplant waiting list or to living kidney donor transplantation and this would explain the above differences. The prevalence of various co-morbidities amongst patients waitlisted for a deceased donor transplant within the first year of RRT compared to those not waitlisted in the first year have been reported in Chapter 5. If more centres consistently reported co-morbidity data to the UKRR it would be possible to establish if there are any inter-centre differences between patients with one or more co-morbidities achieving renal transplantation.

Post-transplant outcome

Sixty seven centres (47 England, 9 Scotland, 5 Wales and 6 Northern Ireland) submitted demographic and clinical data to the UKRR in 2006, the highest number since the inception of the Registry. However, there continued to be a huge variation in the extent of completeness of data (Table 11.14) reported by each centre. Better data returns are likely to facilitate more meaningful comparisons between centres as well as to identify why some centres may be significantly different in any outcome variable compared to the rest of the country. Until the data returns improve caution needs to be exercised when comparing performances between centres as unrecorded or unreported variables may be influencing outcome.

Methods

Prevalent patient data

The cohort comprised of patients transplanted before 30th September 2006. Biochemical and clinical variables derived from both transplanting and non-transplanting centres for patients with a functioning transplant were included in the analyses.

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.

Table 11.14: Percentage completeness by centre for prevalent patients on 31/12/2006[a]

	Ethnicity		eGFR[b]		Hb		BP	
Centre	**%**	**Total with data**	**%**	**Total with data**	**%**	**Total with data**	**%**	**Total with data**
Antrim	100.0	46	82.6	38	69.6	32	34.8	16
B Heart	100.0	165	83.6	138	82.4	136	1.2	2
B QEH	99.9	655	87.4	573	87.4	573	0.6	4
Basldn	96.4	27	100.0	28	100.0	28	7.1	2
Belfast	99.5	403	96.1	389	93.3	378	31.4	127
Bradfd	67.5	106	89.8	141	77.7	122	95.5	150
Brightn	42.0	100	97.1	231	97.1	231	95.8	228
Bristol	98.0	626	97.2	621	96.9	619	89.4	571
Camb	81.8	401	91.4	448	91.4	448	2.0	10
Cardff	40.4	288	97.2	693	97.2	693	96.5	688
Carlis	98.9	86	94.3	82	93.1	81	0.0	0
Carsh	92.1	417	89.9	407	88.7	402	0.4	2
Chelms	93.3	14	86.7	13	80.0	12	80.0	12
Clwyd	0.0	0	85.7	6	85.7	6	85.7	6
Covnt	87.9	268	85.3	260	84.9	259	78.7	240
Derby	100.0	15	6.7	1	26.7	4	6.7	1
Derry	100.0	3	66.7	2	0.0	0	0.0	0
Dorset	100.0	190	92.6	176	90.5	172	8.4	16
Dudley	100.0	82	98.8	81	97.6	80	84.2	69
Exeter	94.6	244	95.0	245	94.6	244	59.3	153
Glouc	100.0	107	98.1	105	98.1	105	5.6	6
Hull	86.9	206	91.1	216	91.1	216	0.8	2
Ipswi	100.0	124	95.2	118	95.2	118	97.6	121
L Barts	94.0	592	82.5	520	82.4	519	0.2	1
L Guys	87.6	666	96.1	730	96.3	732	0.4	3
L Kings	94.0	250	94.7	252	95.1	253	0.4	1
L RFree	92.4	599	82.9	537	82.7	536	0.2	1
L West	100.0	456	95.8	437	95.8	437	0.0	0
Leeds	72.4	535	95.0	702	92.0	680	73.1	540
Leic	89.8	598	91.0	606	90.1	600	57.7	384
Liv RI	93.6	761	92.1	749	91.9	747	88.4	719
ManWst	94.0	251	89.5	239	89.9	240	0.0	0
Middlbr	92.5	309	94.3	315	92.2	308	58.4	195
Newc	99.1	570	96.4	554	96.0	552	0.4	2
Newry	100.0	46	84.8	39	82.6	38	4.4	2
Norwch	85.0	119	95.0	133	95.0	133	1.4	2
Nottm	94.8	404	96.0	409	95.3	406	96.0	409
Oxford	38.2	287	96.6	725	96.0	724	13.9	106
Plymth	93.6	203	96.8	210	95.9	208	0.5	1
Ports	99.1	637	86.0	553	86.5	556	0.3	2
Prestn	91.9	331	85.3	307	80.0	288	0.0	0
Redng	100.0	230	98.1	225	98.1	225	98.1	225
Sheff	98.2	481	97.6	478	97.6	478	97.8	479
Shrew	100.0	70	100.0	70	100.0	70	15.7	11
Stevng	100.0	205	53.7	110	70.2	144	0.0	0
Sthend	81.4	35	90.7	39	90.7	39	0.0	0
Sund	96.1	98	98.0	100	98.0	100	1.0	1
Swanse	100.0	141	96.5	136	96.5	136	11.4	16
Truro	80.7	75	95.7	89	96.8	90	83.9	78

Table 11.14: (continued)

	Ethnicity		eGFR[b]		Hb		BP	
Centre	**%**	**Total with data**	**%**	**Total with data**	**%**	**Total with data**	**%**	**Total with data**
Tyrone	100.0	60	91.7	55	40.0	24	5.0	3
Ulster	100.0	3	100.0	3	100.0	3	33.3	1
Wolve	100.0	94	96.8	91	96.8	91	95.7	90
Wrexm	66.7	2	33.3	1	33.3	1	0.0	0
York	79.0	64	98.8	80	91.4	74	97.5	79
England	**88.7**	**12,753**	**91.6**	**13,144**	**91.1**	**13,076**	**33.7**	**4,918**
N Ireland	**99.6**	**561**	**93.4**	**526**	**84.4**	**475**	**26.5**	**149**
Wales	**49.9**	**431**	**96.8**	**836**	**96.8**	**836**	**82.2**	**710**
UK	**87.0**	**13,745**	**91.9**	**14,506**	**91.2**	**14,391**	**36.1**	**5,777**

[a] Scottish centres are not shown as they do not report biochemical data to the UKRR.
[b] Patients with missing ethnicity were classed as White for eGFR calculation.

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 exact date of transplant was not known were excluded from analyses. Eleven centres with <20 patients are not shown in the figures and tables and Scottish centres were excluded as they do not report biochemical data to the UKRR. Patients were considered as having a functioning transplant if 'transplant' was listed as the last mode of RRT in the last quarter of 2006. For laboratory results, the last value in quarter 3 or quarter 4 (last 6 months) of 2006 was used. For blood pressure recordings the latest value from 2006 was used.

Estimated glomerular filtration rate (eGFR)

For the purpose of eGFR calculation, the 4-variable MDRD formula[2] was used. Serum creatinine has not been standardised to that of the assay used at the MDRD laboratory, also the different creatinine assay methods in use in the UK have not specifically been taken into account. By May 2006, over 60% of UK laboratories had aligned their creatinine assays with that of the creatinine concentration obtained using the Beckman analyzer running a compensated kinetic Jaffe assay as used in the MDRD study. 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 have 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 eGFR calculation (few UK patients are of African Caribbean origin).

One year post transplant data

Time post transplantation may have a significant effect on key biochemical and clinical variables. This is likely to be independent of a centre's clinical practices. Therefore inter-centre comparisons of data on prevalent transplant patients is open to bias. To minimise such bias outcomes are additionally reported in patients one year post transplantation. It was presumed that patient selection policies and local clinical practices were more likely to be relevant in influencing outcomes 12 months post transplant and therefore comparison of outcomes between centres is more robust.

Patients who received a renal transplant between 01 January 2000 and 31 December 2005 were assigned according to the renal centre in which they were transplanted. Thus, Carlisle, Sunderland and Middlesbrough patients were transferred to Newcastle, Hull to Leeds, London Kings to London Guy's, Shrewsbury and Birmingham Heartlands to Birmingham QEH, Stevenage to Cambridge, Swansea to Cardiff, Truro to Plymouth and Bangor, Clwyd and Wrexham to Liverpool. Carshalton and Brighton were

transplanting centres until 2003 with all subsequent transplantation performed at London St George's. Therefore data from these two centres refer to patients transplanted in these centres until 2003. London Barts, Scottish and Northern Ireland centres were excluded as they did not submit biochemical data for the entire 5 year period. Patients who had died or experienced graft failure within 12 months post transplantation were excluded from analysis. Patients with more than one transplant between 2000–2005 were included as separate episodes provided each of the transplants functioned for at least a year.

For each patient, the most recent laboratory or blood pressure for relative 4th/5th quarter (9–15 months) after renal transplantation was taken to be representative of the 'one year post transplant outcome'. For the purpose of eGFR calculation, if there was a valid serum creatinine but no ethnicity data available, patients were classed as White.

Post transplant eGFR in prevalent transplant recipients

Median eGFR in each centre and percentage of patients with eGFR $\geqslant 60$ or <30 ml/min/1.73 m^2 are shown in Figures 11.6 to 11.8. The median eGFR was 46.5, with 17% of prevalent transplant recipients having an eGFR <30 ml/min/1.73 m^2. Local repatriation policies on the

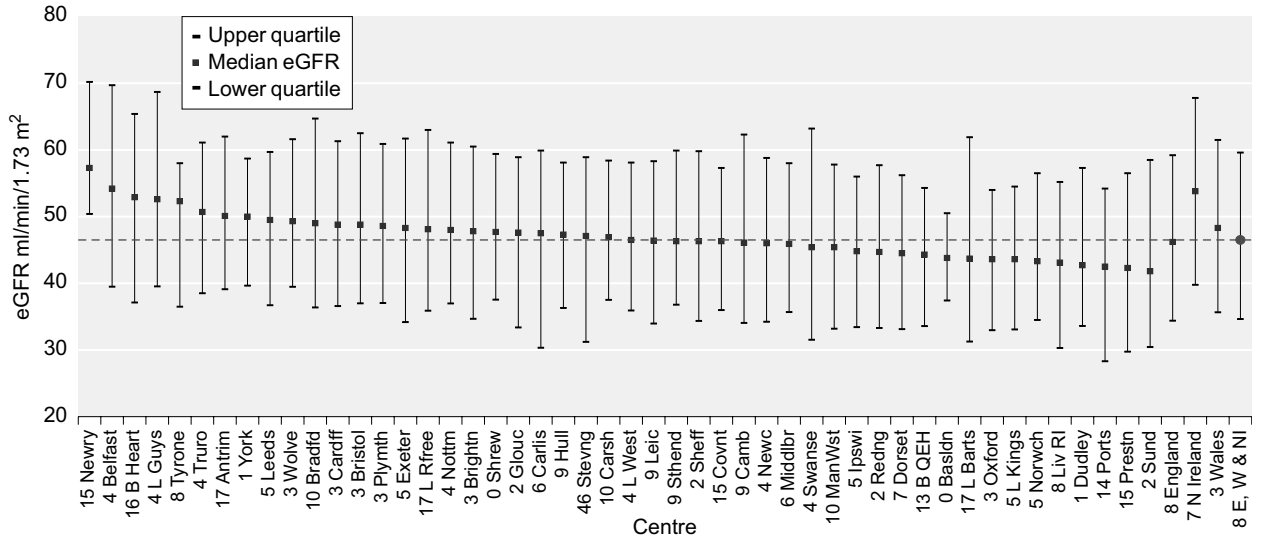

Figure 11.6: Median eGFR of prevalent transplant patients by centre on 31/12/2006

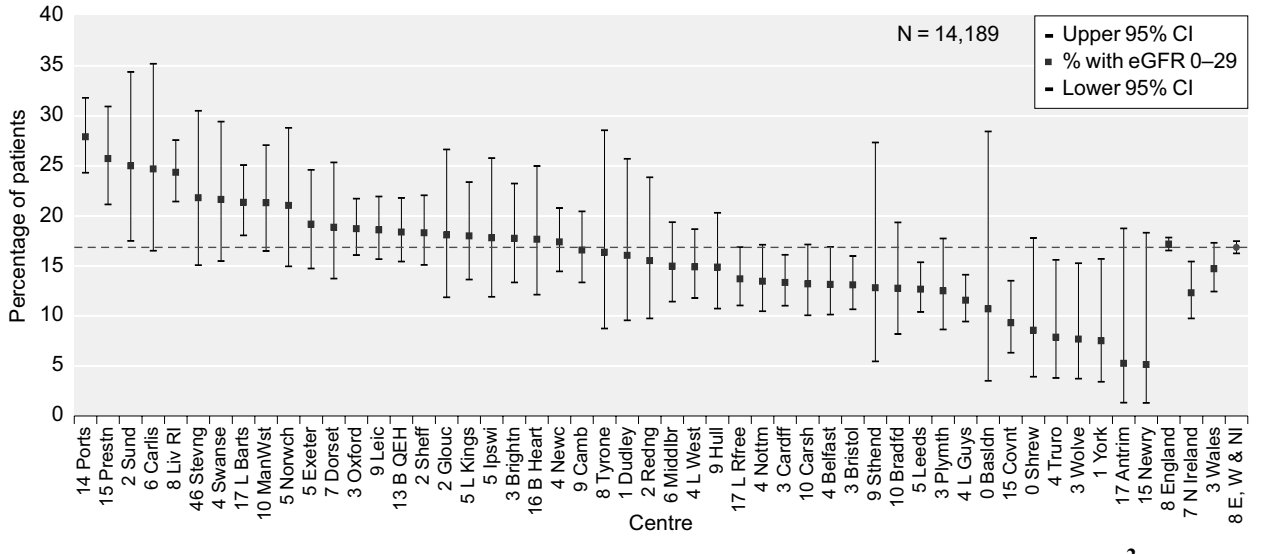

Figure 11.7: Percentage of prevalent transplant patients by centre with eGFR <30 ml/min/1.73 m^2 on 31/12/2006

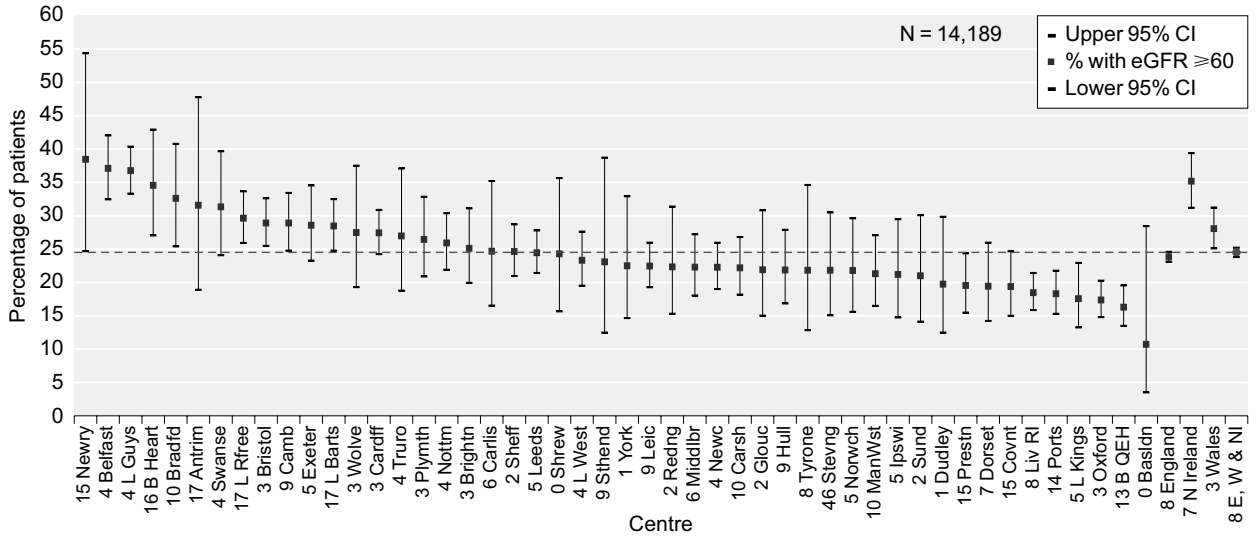

Figure 11.8: Percentage of prevalent transplant patients by centre with eGFR $\geqslant 60$ ml/min/1.73 m^2 on 31/12/2006

timing of transfer of patient care from transplant centres to the referring centres for those with a failing graft, might explain some of the differences but Figure 11.6, shows that both transplanting and non-transplant centres feature at both ends of the graph. The 4v MDRD equation is inaccurate in the estimation of GFR $\geqslant 60$ ml/min/1.73 m^2 and caution needs to be exercised whilst interpreting Figure 11.8. Centres with a high prevalence of patients with eGFR <30 ml/min/1.73 m^2 were likely to require significant resources in the management of complications related to declining renal function as well as ensuring safe transition to dialysis and/or re-transplantation.

eGFR in patients one year after transplantation

Renal function one year after transplantation may predict future graft performance. Figure 11.9 shows that median eGFR one-year post transplant for patients transplanted between 2000–2005, was 49 ml/min/1.73 m^2. All transplants (deceased and LKD) from each centre were included in this analysis.

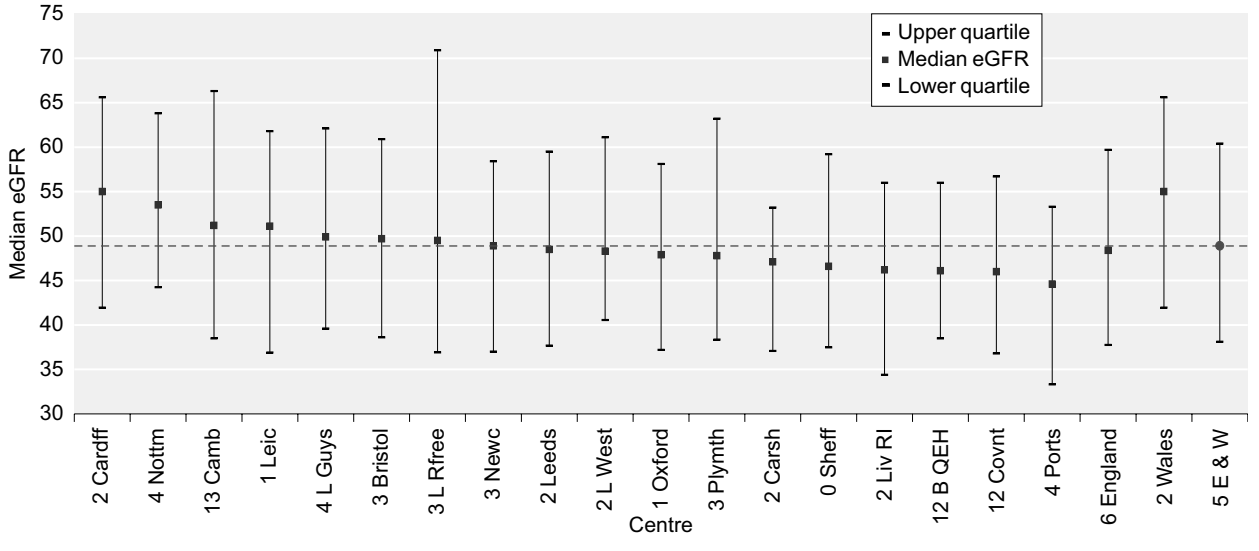

Figure 11.9: Median eGFR one year post transplant by transplant centre for patients transplanted between 2000–2005

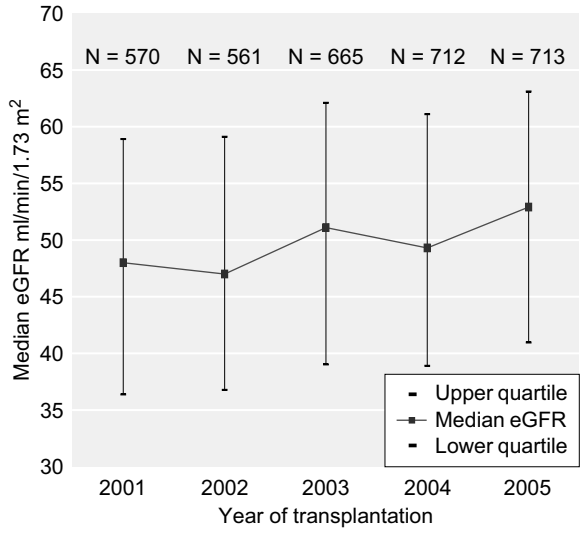

Figure 11.10: Median eGFR one year post transplant by year of transplantation 2000–2005

There was a significant difference in one year post transplant median eGFR between the years 2000 to 2005 (Kruskal–Wallis $p < 0.001$) (Figures 11.9 and 11.10). Linear regression analysis indicates a small upward trend in the one year post transplant median eGFR between 2001 and 2005 (Figure 11.9). This increase was approximately 1.1 ml/min/year ($p < 0.0001$), suggesting better graft function for patients transplanted more recently. Factors like newer immunosuppressive agents, increasing proportion of living kidney donor transplants etc may explain the improvement in eGFR over time. In subsequent Reports it is hoped to present this analysis separately for live and deceased donor kidney recipients, to study whether the changing donor demographics influence outcome over time.

Haemoglobin in prevalent transplant patients

The RA chronic kidney disease (CKD) guidelines recommend that all patients should have a haemoglobin above 10 g/dl.

A number of factors including; immunosuppressive medication, graft function, EPO use, IV/oral iron use in addition to centre practices/protocols for management of anaemia, will affect haemoglobin levels in transplant patients. Figure 11.11 shows the median Hb values from UK centres, whilst Figure 11.12 shows the percentage of transplant patients with Hb <10 g/dl by centre. In previous years, centres with <20 patients or <50% completeness of Hb data returns were excluded from these figures but are shown this year, however these data should be interpreted with caution.

The median Hb was 12.8 g/dl, with 4.2% of patients having a Hb <10 g/dl, both similar to last years results. Once again it is interesting to note that the five centres with the highest percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 (Figure 11.7) were not the same as the five centres with the highest percentage of patients with Hb <10 g/dl, suggesting centre practices outweigh any influence of low GFR contributing to anaemia.

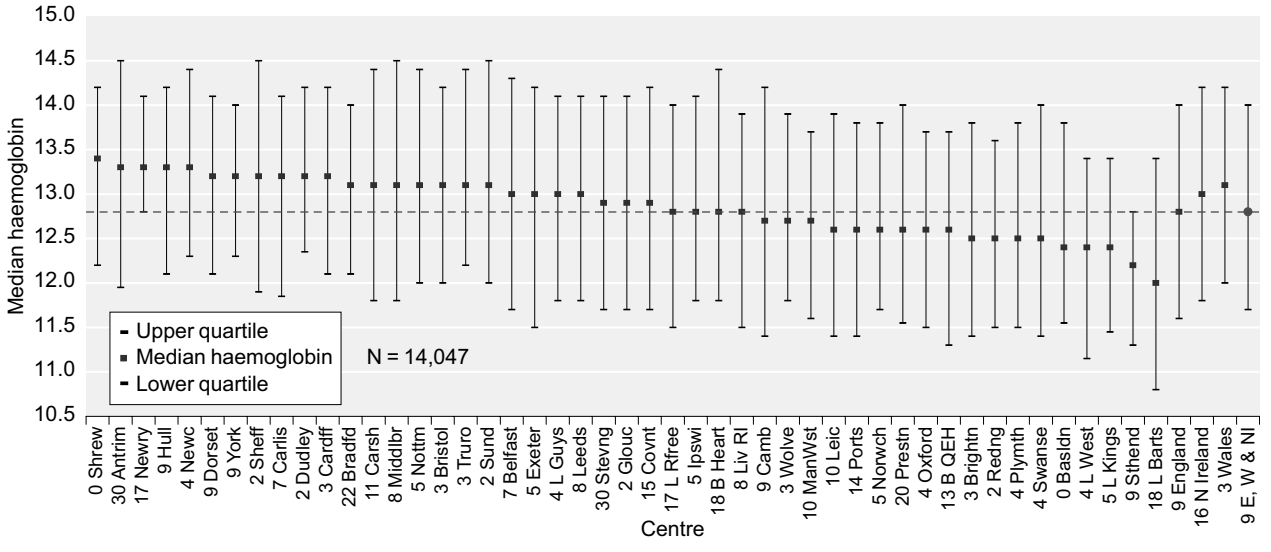

Figure 11.11: Median Hb (g/dl) for prevalent transplant patients by centre on 31/12/2006

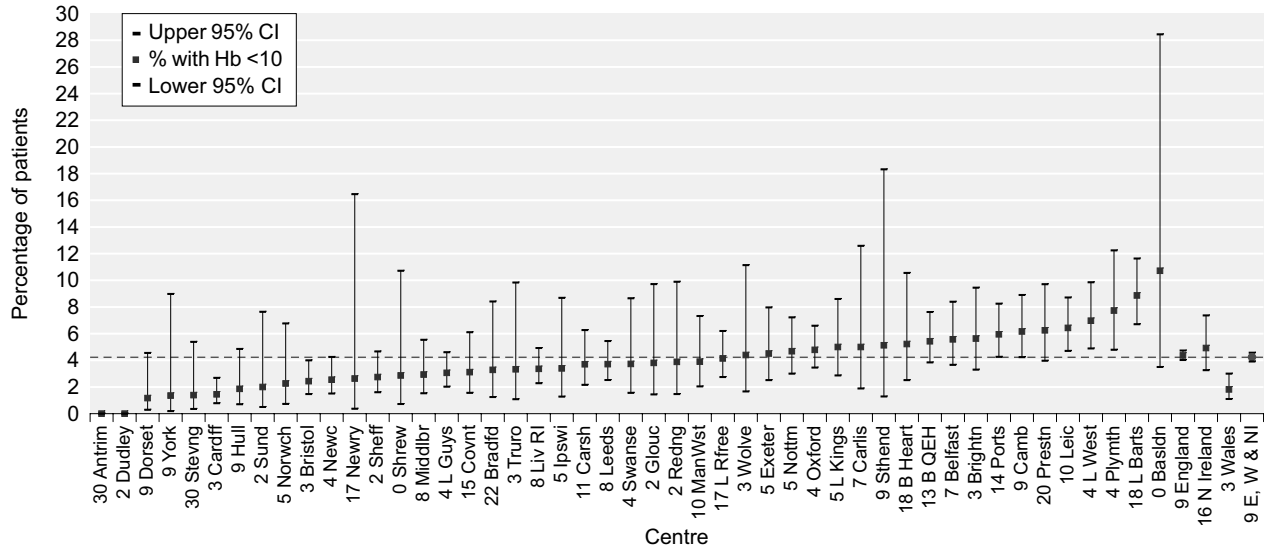

Figure 11.12: Percentage of prevalent transplant patients with Hb <10 g/dl by centre on 31/12/2006

Haemoglobin in patients one year after transplantation

There was no change in the median Hb of 13 g/dl at one year post transplantation compared to last year (Figure 11.13).

Blood pressure in prevalent transplant patients

In the absence of controlled trial data, opinion based recommendation from the 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.

Blood pressure data returns continued to be patchy with some centres providing information on the majority of patients, whilst others provided little if any. The data returns were reliant on nephrologists and surgeons entering these data into renal IT systems. It is hoped that the increasing availability of patients viewing their transplant clinic data using 'renalpatientview' will stimulate clinicians to enter this data.

Median systolic BP (Figure 11.14), median diastolic BP (Figure 11.15) and the percentage of patients who achieved RA standards (Figure 11.16) are shown. Only centres with >50% data returns are shown in these figures.

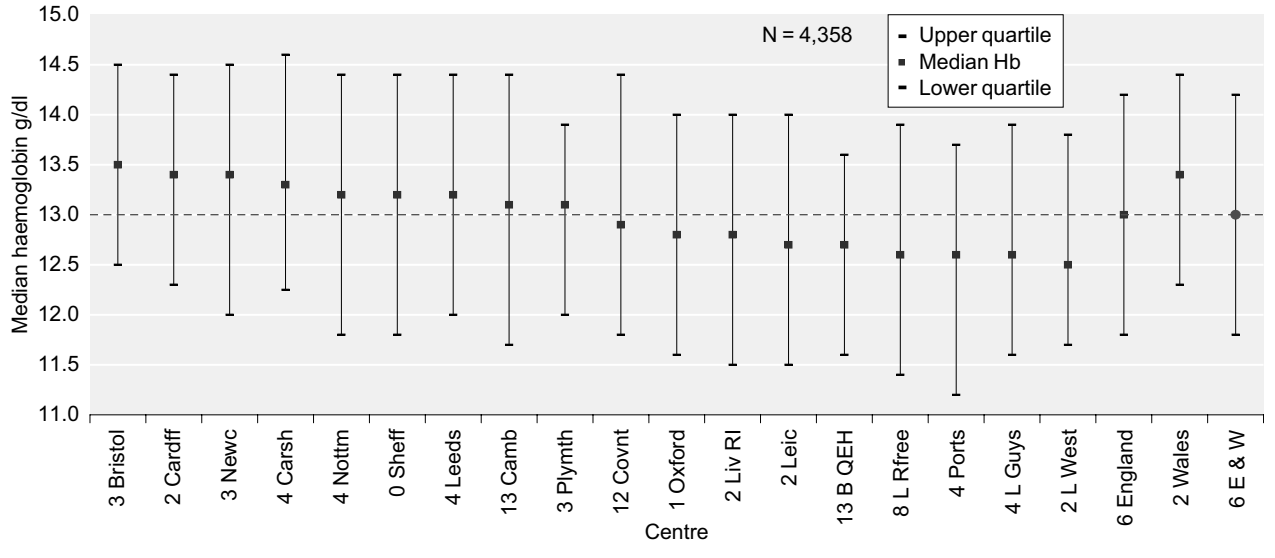

Figure 11.13: Median Hb one year post transplant by transplant centre for patients transplanted between 2000–2005

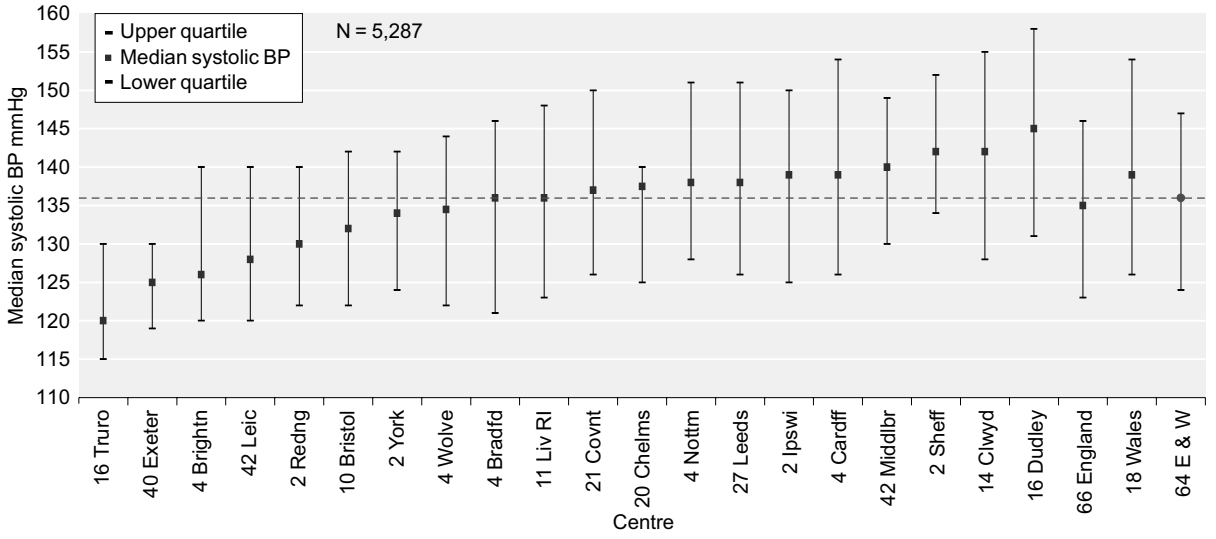

Figure 11.14: Median systolic BP mmHg in prevalent transplant patients by centre on 31/12/2006

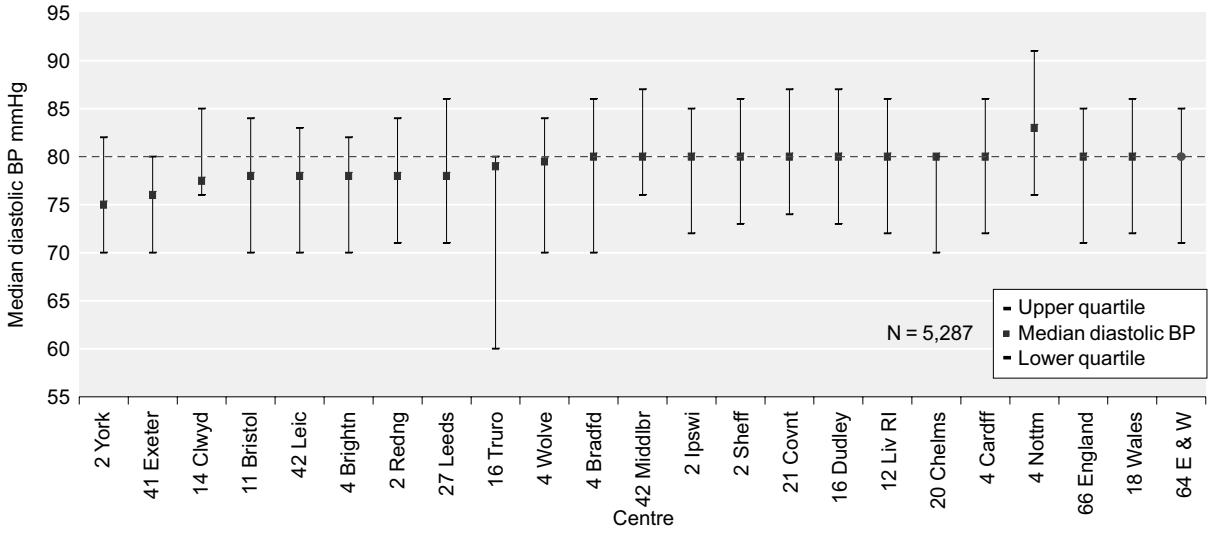

Figure 11.15: Median diastolic BP mmHg in prevalent transplant patients by centre on 31/12/2006

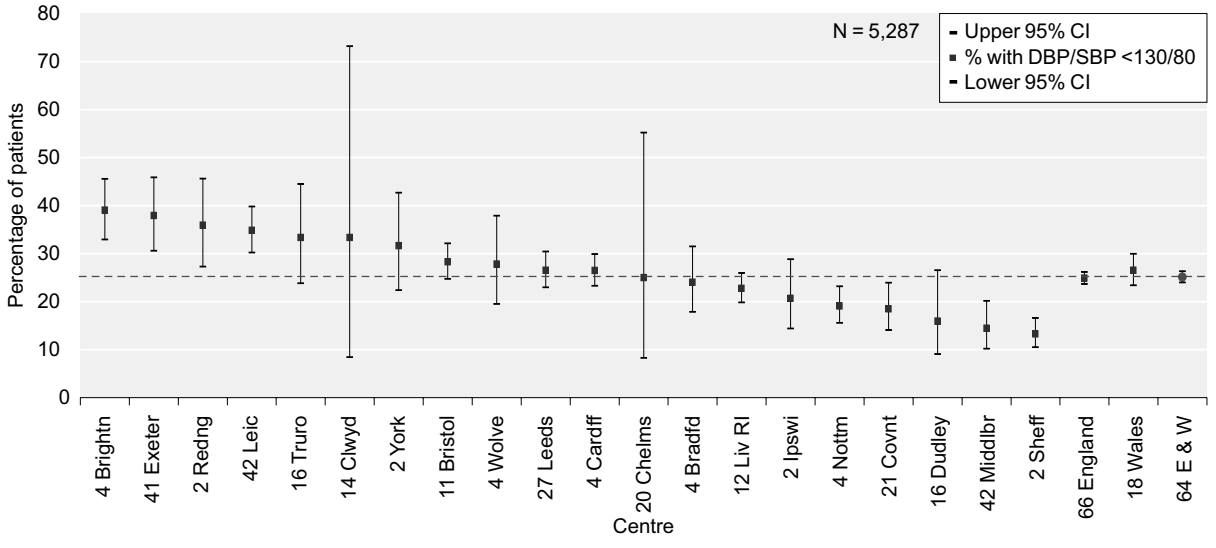

Figure 11.16: Percentage of prevalent transplant patients with SBP <130 mmHg and DBP <80 mmHg by centre on 31/12/2006

Blood pressure in patients one year after transplantation

Systolic and diastolic blood pressure at one year post transplantation is given in Figure 11.17 and Figure 11.18 respectively. Since only a few centres had substantially >50% data returns for this variable caution needs to be exercised when comparing centres.

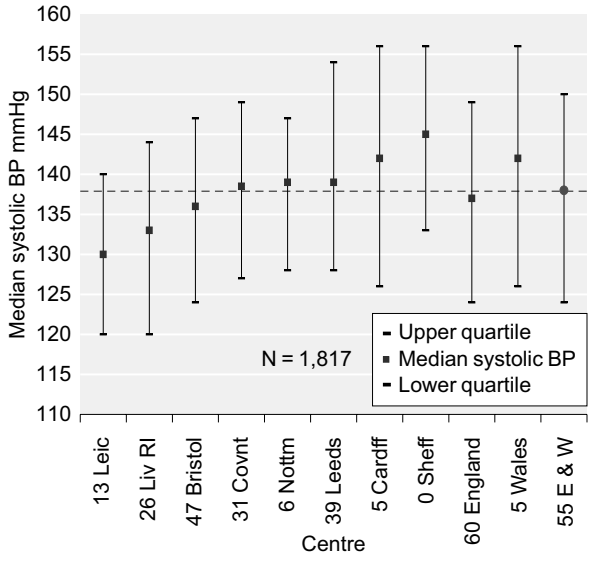

Figure 11.17: Median systolic BP mmHg one year post transplant by transplant centre for patients transplanted between 2000–2005

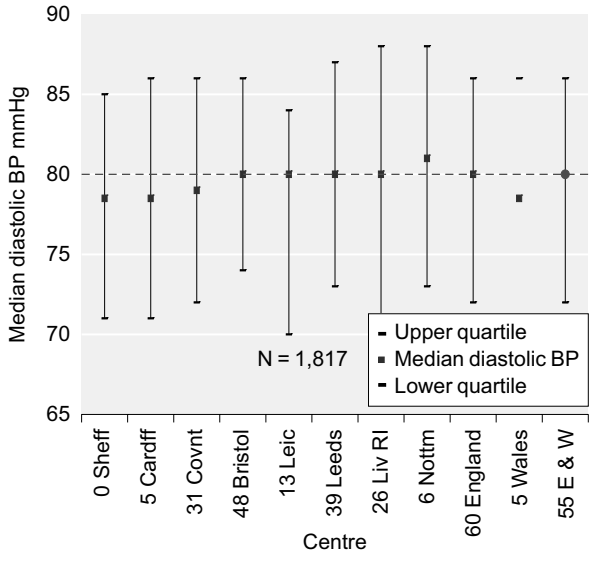

Figure 11.18: Median diastolic BP mmHg one year post transplant by transplant centre for patients transplanted between 2000–2005

Analysis of prevalent transplant patients by CKD stage

Patients were classified into different stages according to the CKD classification: Stage 1T – eGFR $\geqslant$90 ml/min/1.73 m^2; Stage 2T – eGFR 60–89 ml/min/1.73 m^2; Stage 3T – eGFR 30–59 ml/min/1.73 m^2; Stage 4T – eGFR 15–29 ml/min/1.73 m^2; Stage 5T – eGFR <15 ml/min/1.73 m^2. Using the KDIGO guidelines, RTR with eGFR $\geqslant$60 ml/min/1.73 m^2 were classified as CKD stage 1T–2T according to the level of GFR alone, which is in contrast to the KDOQI guidelines for native CKD, where markers of kidney damage (i.e. proteinuria, scarring) are also required. The UKRR does not collect data on proteinuria, allograft imaging or histology.

About 3% of prevalent transplant patients returned to dialysis in 2006 and this was similar to all previous years since 2000. Table 11.15 shows nearly 17% of the prevalent transplant population, or nearly 2,500 patients, had moderate to advanced renal impairment of eGFR <30 mls/min/1.73 m^2.

The table this year also includes the percentage in each group achieving the Standard in 2005 for comparison with the 2006 data. Similar to last year's analysis, the table demonstrates that patients with failing grafts do not achieve RA standards for key biochemical and clinical outcome variables with the same frequency as patients already on dialysis. In 2006, there might be a slight improvement in the percentage of patients in Stage 5T with PTH < 32 (54% v 50%) but this has been achieved with an increase in serum phosphate above 1.8 mmol/L (29% v 26%).

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 RRT.

Table 11.15: Analysis by CKD stage for prevalent transplant patients compared with prevalent dialysis patients

	Stage 1–2T (≥60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
No of patients	3,536	8,440	2,103	326	14,950
% of patients	24.6	58.6	14.6	2.3	
eGFR ml/min/1.73 m^2 [a]					
mean ± SD	73.8 ± 12.7	44.9 ± 8.3	23.9 ± 4.2	11.7 ± 2.6	
median	70.4	44.8	24.4	12.2	
Systolic BP mmHg					
mean ± SD	134.7 ± 17.6	137.2 ± 18.3	140.9 ± 20.8	140.9 ± 20.3	130.8 ± 24.8
% ≥130	60.4	65.4	72.6	70.3	49.6
Diastolic BP mmHg					
mean ± SD	78.3 ± 10.5	78.7 ± 10.8	79.0 ± 11.8	78.0 ± 11.6	70.6 ± 14.2
% ≥80	49.4	50.7	51.0	56.0	25.9
Cholesterol mmol/L					
mean ± SD in 2006	4.6 ± 1.0	4.6 ± 1.0	4.7 ± 1.1	4.7 ± 1.3	4.0 ± 1.4
% ≥5 in 2006	31.3	32.4	36.9	34.7	16.4
% ≥5 in 2005	35.8	38.4	40.5	35.3	18.4
Haemoglobin g/dl					
mean ± SD in 2006	13.7 ± 1.6	12.9 ± 1.6	11.7 ± 1.6	11.0 ± 1.7	11.8 ± 1.6
% <10 in 2006	1.3	2.9	11.2	25.1	12.4
% <10 in 2006	1.1	3.1	11.4	27.4	13.3
Ferritin µg/L					
Median in 2006	87.0	119.0	170.0	178.0	404.0
% ≤100 in 2006	54.4	43.8	28.8	25.9	6.0
% ≤100 in 2005	49.5	41.9	30.9	22.2	6.2
Phosphate mmol/L [b]					
mean ± SD in 2006	1.0 ± 0.2	1.0 ± 0.2	1.2 ± 0.3	1.6 ± 0.4	1.6 ± 0.4
% ≥1.8 in 2006	0.1	0.2	3.1	29.0	27.9
% ≥1.8 in 2005	0.1	0.3	3.0	26.0	30.0
Corrected calcium mmol/L					
mean ± SD in 2006	2.4 ± 0.1	2.4 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.4 ± 0.2
% >2.6 in 2006	7.0	7.9	5.7	7.3	9.1
% <2.1 in 2006	6.6	7.2	12.2	27.7	15.9
% >2.6 in 2005	9.5	9.8	5.9	7.2	10.5
% <2.1 in 2005	3.9	5.6	11.5	24.7	13.8
iPTH pmol/L					
Median in 2006	8.6	9.7	17.2	29.0	25.1
% ≥32 in 2006	4.0	6.8	23.4	46.4	40.9
% ≥32 in 2005	7.1	6.5	21.9	49.7	39.2
Albumin g/L [c]					
mean ± SD	42.5 ± 4.0	41.8 ± 3.9	40.1 ± 4.6	38.3 ± 5.1	37.8 ± 5.1
Bicarbonate mmol/L					
mean ± SD	25.7 ± 3.1	24.9 ± 3.4	22.9 ± 3.8	21.0 ± 4.4	23.7 ± 3.7

Data from last 2 quarters in 2006/and also where relevant data from 2005 used for this analysis.
For stage 5D, Incident dialysis patients in 2006 were excluded.
[a] Prevalent transplant patients with no ethnicity data were classed as White.
[b] Only PD patients included in stage 5D, n = 2,645.
[c] Only patients with BCG assay included: transplant patients n = 12,610, only HD patients included in stage 5D n = 9,489.

References

1. Appendix. *Nephrol Dial Transplant* 2007;22(Suppl 7): vii 194–vii 244.
2. Levey AS, Greene T, Kusek JW, Beck GJ. A simplified equation to predict glomerular filtration rate from serum creatinine (abstract). *J Am Soc Nephrol* 2000;11: A0828.

Chapter 12: Comparison of UK Registry Data with other National Renal Registries

Fergus Caskey, Anna Casula and David Ansell

Summary

- In 2006, the incidence of RRT in the United Kingdom was 113 per million of the population (pmp) using the day 0, 'first ever RRT' definition and including paediatric patients.
- This RRT incidence rate placed the UK 26th out of the 38 countries reporting to the USRDS in 2006. The overall incidence for the UK masked a higher incidence rate in Wales of 137 pmp, 20th of the 38 countries.
- The proportion of patients with diabetes as the cause of established renal failure was relatively low in the UK at 19%, compared to 45–60% in the United States, Malaysia and Jalisco (Mexico). Within the UK, Wales had the highest proportion of incident RRT patients with diabetes recorded as the cause of their renal disease at 26%.
- In 2006, the prevalence of RRT in the United Kingdom including paediatric patients was 733 pmp.
- Relative to the 39 other countries reporting prevalence data to the USRDS, the UK RRT prevalence rate was 23rd. Rates in Scotland and Northern Ireland were higher at 783 and 791 pmp respectively, but still considerably lower than in the United States, Taiwan and Japan where rates were 1,585–1,857 pmp.
- PD utilisation amongst prevalent dialysis patients varied around the world from 0% in Luxembourg to 83% in Hong Kong. Within the UK, rates of PD use varied from 14% in Northern Ireland to 25% in Wales. Home haemodialysis accounted for 2% of dialysis patients in the UK, but Australia and New Zealand achieved rates of 9% and 15%.
- The number of transplants performed each year was highest in the United States, France and Spain at 59–67 pmp. This compared with rates of 20 pmp in Northern Ireland, 22 pmp in Scotland, 28 pmp in Wales and 29 pmp in England. Conversely, the number of patients alive with a functioning renal transplant per million of the population was highest in Scotland and Northern Ireland.

Introduction

International renal registry comparisons form an important part of the quality control process of a registry by enabling benchmarking of activity and performance between countries. This year, for the first time, UK Renal Registry (UKRR) data for England, Wales and Northern Ireland appeared in the international comparison chapter of the United States Renal Data System (USRDS) annual data report (USRDS 2007). This followed an exercise, presented in the Ninth Annual Report of the UK Renal Registry, exploring various approaches that might be adopted to prepare and present the UK data[1].

This year's analysis presents the data on RRT epidemiology: RRT incidence, RRT prevalence, the proportion of incident patients with diabetes mellitus, the dialysis modality mix and the transplant rate – for the four countries constituting the United Kingdom alongside data submitted to and published by the USRDS.

Methods

Data on numbers of incident and prevalent RRT patients in England, Northern Ireland, Scotland and Wales for the year 2006 were extracted from the UKRR database and collated to meet the specifications on the USRDS international data collection form. In order to overcome the issue of cross boundary referral, the five dialysis centres not reporting to the UKRR in 2006 were contacted and the number

of incident and prevalent patients by RRT modality established. The resulting numerators for incidence and prevalence rates were therefore based on all incident and prevalent patients in England and Wales and the general population data for the denominator were based on the entire populations of the four countries (from the Office for National Statistics). The international data for comparison came from the USRDS annual data report 2007[2] and with one or two exceptions, related to the year 2005.

As discussed in last year's International Comparison chapter, a day 0 definition of RRT has been adopted for RRT incidence rates. It is important to note however, that in order to be consistent with the definitions used in the USRDS report, the definitions used for the RRT incidence and prevalence rates in this chapter differ slightly from those used elsewhere in the report:

1. The rates quoted include 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.
2. The definition used in this chapter is the first take-on ever for a given patient, so that a patient is only counted once. In the Incident chapter the definition is slightly different and some patients were counted more then once. For example, a patient can be taken-onto dialysis at some point in 2005, recover sufficient renal function to become dialysis-independent but then be taken back onto dialysis again the next year (by the International chapter definition he is counted only once in 2005, while in the Incident chapter he is counted both in 2005 and 2006).

Results

Incidence of RRT

In 2006, the incidence of RRT in the UK was 113 per million of the population (pmp) (Figure 12.1). This rate placed the UK 26th out of the 38 countries reporting incident data to the USRDS for 2005. However, the overall RRT incidence for the UK masked higher rates in Scotland, Northern Ireland and Wales (115, 116 and 137 pmp respectively, compared with 111 pmp in England).

The percentage of incident RRT patients with diabetes recorded as the cause of the established renal failure was relatively low in the UK at 19%, compared with rates of over 40% in 7 of the 33 countries that were able to report this statistic (Figure 12.2). Within the UK, the percentage of incident patients with diabetes as the

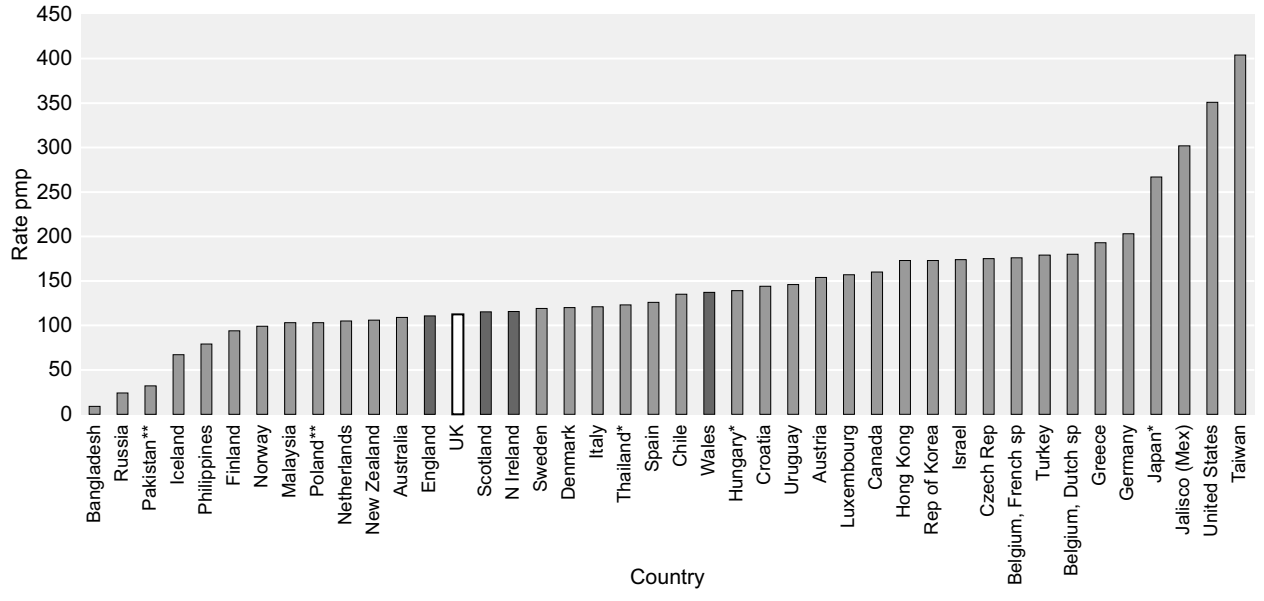

Figure 12.1: Incidence of RRT in different countries (pmp)

* 2004 data
** 2003 data

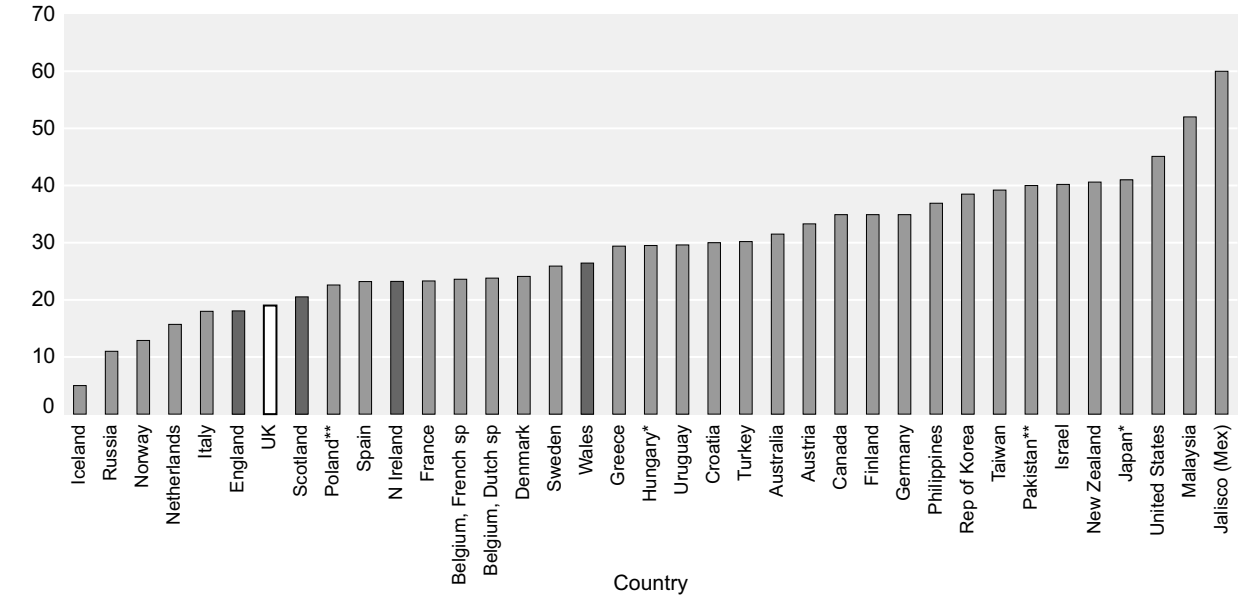

Figure 12.2: Percentage of incident RRT population with diabetes mellitus as cause of established renal failure

* 2004 data

** 2003 data

cause of established renal failure varied from 18% in England to 26% in Wales.

Prevalence of RRT

The RRT prevalence rate of 738 pmp in the UK was 23rd of the 39 other countries reporting prevalence data to the USRDS (Figure 12.3). Within the UK, rates were lowest in England at 731 pmp and highest in Northern Ireland at 791 pmp. The percentage of prevalent patients on peritoneal dialysis varied from 14% in Northern Ireland to 25% in Wales. Home haemodialysis use varied little within the UK at between 1.8–2.0% of the prevalent dialysis

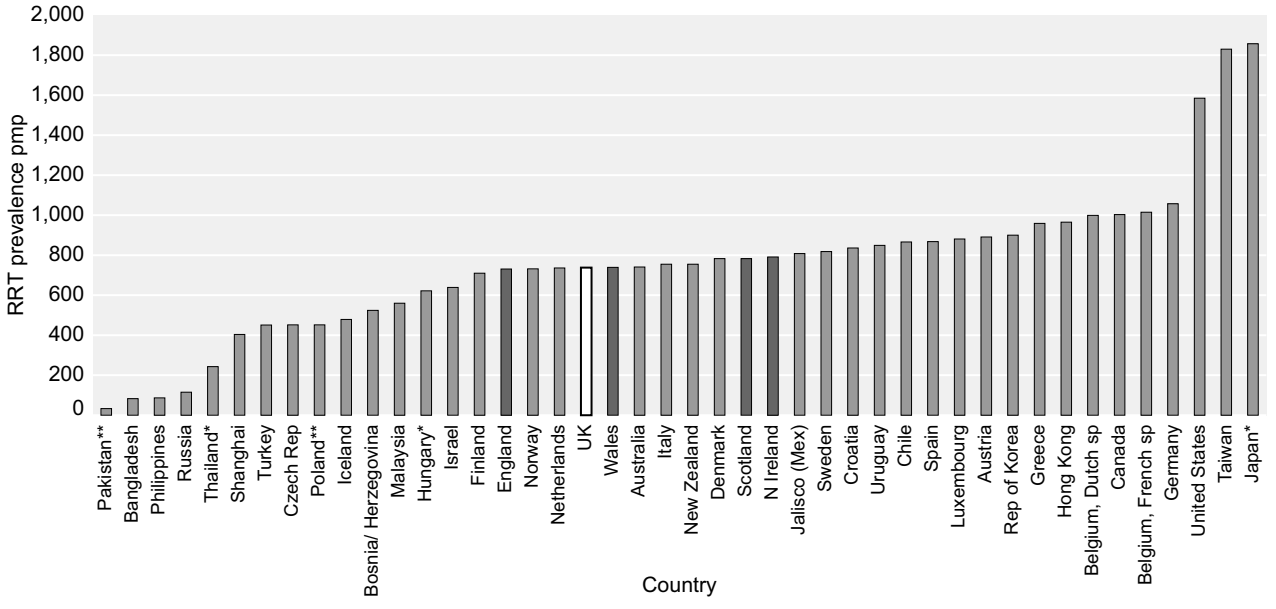

Figure 12.3: Prevalence of RRT by country (pmp)

* 2004 data

** 2003 data

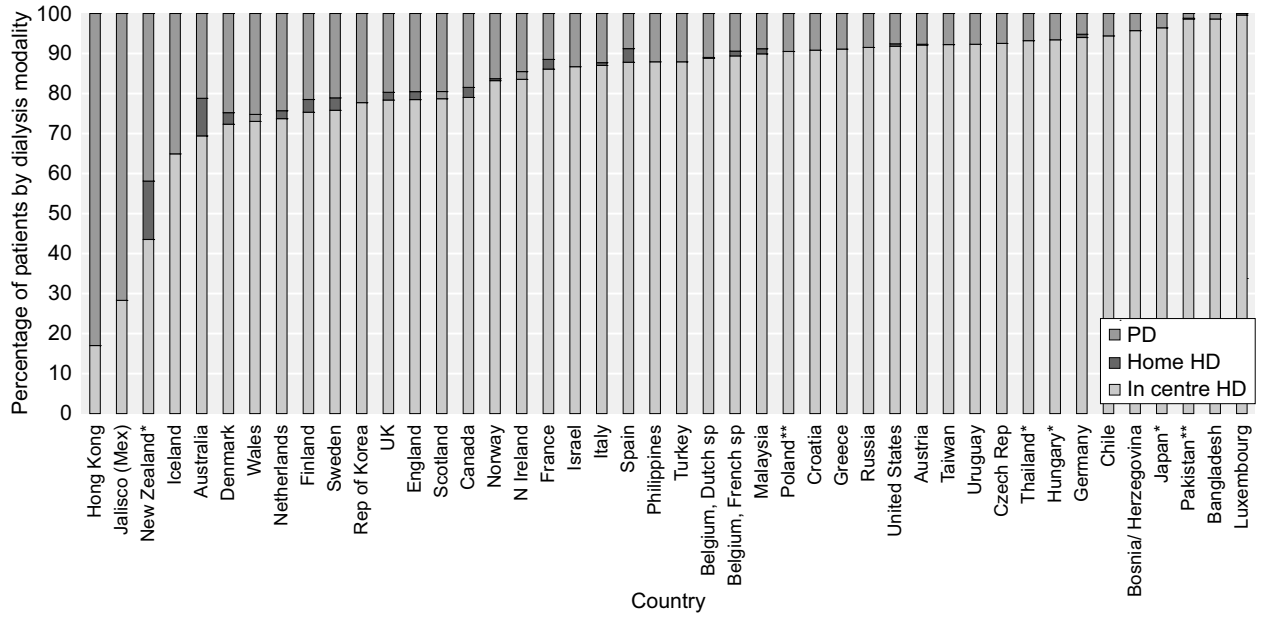

Figure 12.4: Percentage of prevalent dialysis population by dialysis modality

* 2004 data
** 2003 data

population; Australia and New Zealand however, achieved rates as high as 9–15% (Figure 12.4).

When considering the number of renal transplants pmp (deceased and live donor) performed in each country each year, the UK's rate of 28 pmp placed it 20th of 35 countries, considerably lower than Spain, Norway and the United States where rates varied between 59–67 pmp (Figure 12.5). In 2006, England had the highest transplantation rate of the four countries at 29 pmp compared with 28 pmp in Wales, 22 pmp in Scotland and 20 pmp in Northern

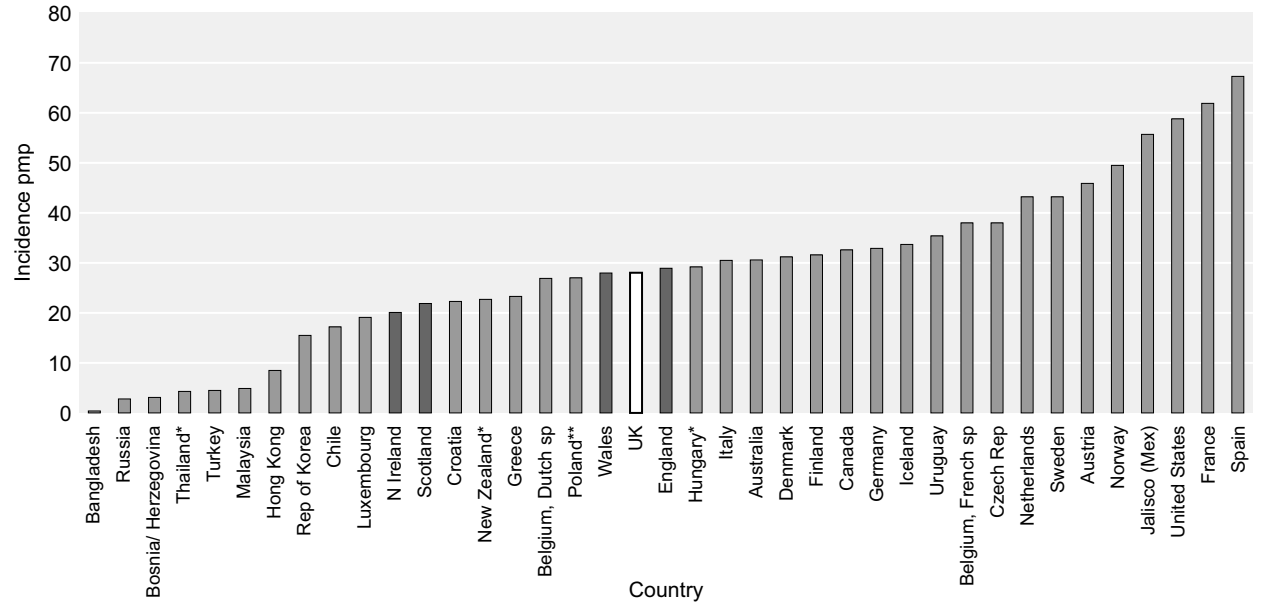

Figure 12.5: Renal transplant incidence rate by country (pmp)

* 2004 data
** 2003 data

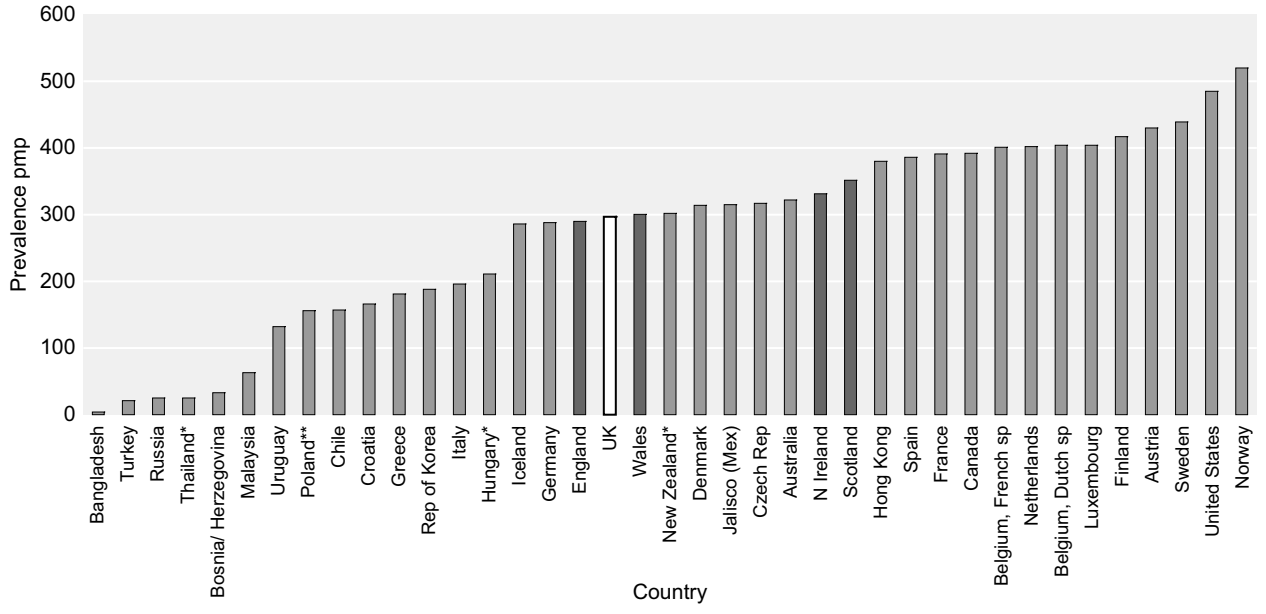

Figure 12.6: Renal transplant prevalence rate by country (pmp)

* 2004 data

** 2003 data

Ireland. The number of RRT patients with a functioning renal transplant per million of the population was lower in England than Wales, Northern Ireland or Scotland (Figure 12.6).

Discussion

The incidence of RRT in the UK continued to rise slowly, remaining on a par with rates in a number of demographically similar countries around the world, such as Australia, Norway, the Netherlands and New Zealand.

Home haemodialysis has been promoted by the National Institute for Health and Clinical Excellence[3], yet only 2% of the UK prevalent dialysis population were receiving this modality of treatment. While this rate was comparable to or higher than those observed in a number of other countries, rates of 9–15% have been achieved in Australia and New Zealand. Examination of the non-medical factors behind these markedly higher rates of home haemodialysis may inform future policy in the UK.

Renal transplantation rates in the UK remained relatively low by international standards. The transplantation rate should largely be determined by the organ donation rate in the country rather than the RRT prevalence rate (although as living kidney donation is increasingly adopted this statement becomes less true). France and Spain achieved renal transplantation rates more than twice as high as those achieved in the UK and while some of these differences had been identified previously, there remains potential for further study to better understand the differences in organisation and policy behind these variations in organ donation rate.

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3. National Institute for Clinical Excellence. Guidance for home versus hospital haemodialysis for patients with end-stage renal failure. Technology Appraisal Guidance – No. 48. September 2002, London.

Appendix A: The Renal Registry Statement of Purpose

This appendix is available on the web only and can be found at www.renalreg.org

Appendix B: Definitions, Statistical Methodology, Analysis Criteria

This appendix is available on the web only and can be found at www.renalreg.org

Appendix C: Renal Services Described for Non-physicians

This appendix is available on the web only and can be found at www.renalreg.org

Appendix D: Methodology of Standardised Acceptance Rates Calculation and Administrative Area Geography in the UK and the Analysis of Data by PCT Group for England

This appendix is available on the web only and can be found at www.renalreg.org

Appendix E: Data Tables

This appendix is available on the web only and can be found at www.renalreg.org

Appendix I: Renal Registry Dataset Specification

This appendix is available on the web only and can be found at www.renalreg.org

Appendix J: Ethnicity Grouping and Mapping of Read Codes

This appendix is available on the web only and can be found at www.renalreg.org

Appendix F: 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
FSGS	Focal segmental glomerulosclerosis
GFR	Glomerular filtration rate
GN	Glomerulonephritis
HA	Health Authority
HbA1c	Glycated Haemoglobin

HCFA	USA Health Care Finance Administration – now replaced by CMMS
HD	Haemodialysis
HDL	High-density lipoprotein
Hb	Haemoglobin
HLA	Human leucocyte antigen
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
MI	Myocardial infarction
MINAP	Myocardial infarction audit
MRSA	Methicillin resistant Staphylococcal aureus
NAS	National Analytical Society
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
UKRR	UK Renal Registry
UKT	UK Transplant
USRDS	United States Renal Data System
URR	Urea reduction ratio
WEQAS	Welsh External Quality Assurance Study
WTE	Whole time equivalent

Appendix G: Laboratory Conversion Factors

	Conversion factors from SI units
Albumin	$g/dl = g/L \times 0.1$
Aluminium	$\mu g/L = \mu mol/L \times 27.3$
Bicarbonate	$mg/dl = mmol/L \times 6.1$
Calcium	$mg/dl = mmol/L \times 4$
Calcium × phosphate	$mg^2/dl^2 = mmol^2/L^2 \times 12.4$
Cholesterol	$mg/dl = mmol/L \times 38.6$
Creatinine	$mg/dl = \mu mol/L \times 0.011$
Glucose	$mg/dl = mmol/L \times 18$
Haemoglobin	$Hct = g/dl \times 3.11$ (*NB this factor is variable*)
Phosphate	$mg/dl = mmol/L \times 3.1$
PTH	$ng/L = pmol/L \times 9.5$
Urea	$mg/dl = mmol/L \times 2.8$

Appendix H: 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	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
Chester	Countess of Chester Hospital	Chestr	England
Coventry	Walsgrave Hospital	Covnt	England
Derby	Derby City General Hospital	Derby	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
Leeds	St James's Hospital and Leeds General Infirmary	Leeds	England
Leicester	Leicester General Hospital	Leic	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	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	ManWst	England
Middlesbrough	James Cook University Hospital	Middlbr	England
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
Sunderland	Sunderland Royal Hospital	Sund	England
Truro	Royal Cornwall Hospital	Truro	England

City	Hospital	Abbreviation	Country
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