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The Renal Association

UK Renal Registry

The Ninth Annual Report

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Chapter 1: Summary of Findings in the 2006 UK Renal Registry Report

In 2005, the acceptance rate for RRT in adults in the UK was 108 pmp and this was derived from 100% complete data returns for the UK. From 2001–2005 there has been an 7.3% rise in the acceptance numbers in those 42 renal units with full reporting throughout that period.

The median age of patients starting RRT in England has increased from 63.8 years in 1998 to 65.2 years in 2005. Patients starting on PD were on average 9 years younger than those on HD and had fewer co-morbidities present. HD was the first modality of RRT in 76% of patients, PD in 21% and pre-emptive transplant in 3%.

Patients starting RRT without any co-morbidity present had a lower estimated eGFR (eGFR) than those with co-morbid conditions. 12% of patients starting RRT had a previous MI and 31% of those starting RRT aged over 65 years had IHD. Patients with a previous MI or CABG, started RRT with slightly higher mean haemoglobin than those without co-morbid conditions or other co-morbid conditions. Estimated GFR at the start of RRT appears to be higher in older than younger patients. Mean eGFR of all patients starting RRT rose from 6 in 1997 to above 7.5 in 2003, since when it has remained stable. In 2005, the mean percentage of patients referred late (<90 days before dialysis initiation) was 30% (centre range 13–48%). This was similar to the value in 2000.

From the date of first RRT, the 1 year survival of all patients (unadjusted for age) is 79%. From the 90th day of RRT (to allow comparison with other countries' 1 year survival), the 1 year survival is 83%. The age adjusted (60 years) survival for the 1 year after 90 day period is 86%. There is 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 (including deaths within the first 90 days) rates are 58%, 53%, 44%, 28%, 20% and 12% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and 75+ years.

The 'vintage effect' of increasing hazard of death with length of time on RRT, prominent in data from the US, is only noted in older age groups (65–75 and 75+ years) at 5–6 years after starting RRT.

In the multivariate survival analysis of incident patients, the presence of ischaemic/neuropathic ulcers was the predictor of worst survival, followed by malignancy, previous MI and age per 10 year increment.

There were 41,776 adult patients alive on RRT in the UK at the end of 2005, a prevalence for adults of 694 pmp. Addition of the 748 children under age 18 on RRT gives a total prevalence of 706 pmp. The annual increase in prevalence in the 38 renal units participating in the Registry since 2000 was 5.0%. The median age of prevalent patients on RRT was 56.6 years, that of patients on HD 64.5 years, PD 59.2 years and transplanted patients 49.7 years.

The median vintage of the whole RRT population was 5.1 years: that of transplanted patients was 9.8 years, HD patients 2.8 years and PD patients 2.1 years.

There is no significant differences in survival of prevalent patients between centres. The one-year survival of prevalent dialysis patients increased significantly from 1998 to 2004 in England (83.3% to 87.1% $p = 0.0001$ for linear trend), Scotland (84.0% to 87.0% $p = 0.023$ for linear trend), and Wales (83.4% to 86.1% $p = 0.027$ for linear trend).

In the 2006 vascular access survey, 51% of all patients commenced renal replacement therapy using definitive access. Of patients commencing on HD, 37% commenced with definitive access (31% in the 2005 survey). 4% of patients currently on HD were in-patients. 30% of staphylococcal line infections were MRSA, which was similar to the 2005 survey.

At 6 months after starting RRT, 76% of live patients were using definitive access (defined as the use of peritoneal dialysis, transplant, AVF or AVG) and at 12 months 80%. Of HD patients starting RRT in April 2005, 65% started using venous catheters, at 6 months this had fallen to 35% and at 12 months 30%. The use of non-tunnelled lines was below 1% by 6 months.

The median Hb on HD is 11.8 g/dl with 86% of patients having a Hb >10.0 g/dl. The median Hb on PD in the UK is 12.0 g/dl with 90% of patients having a Hb >10.0 g/dl. In the UK, 49% of patients on PD and 48% of patients on HD have a Hb between 10.5–12.5 g/dl. The median ferritin in HD patients in the UK is 413 μg/L and 256 μg/L in PD.

In the UK there is a continuing year-on-year trend of improvement in serum phosphate control in dialysis patients. The RA target (<1.8 mmol/L) was achieved in 71% of PD and 63% of HD patients. 76% percent of UK dialysis patients achieved a corrected calcium concentration within the RA target range and there was a continuing trend of year-on-year improvement. Nearly two-thirds (69%) of patients achieve a calcium × phosphate product within the KDOQI guidelines. There is large variation in the ability of renal centres to achieve the UK Renal Association target for plasma PTH (median 63%, range 47 to 92% compliance with the standard).

The % of HD patients achieving the combined BP standard (<140/90 pre-dialysis) average 43% and post-dialysis (<130/80) average 48%. On average, 27% of PD patients achieve the standard of <130/80 and 26% of renal transplant patients. Over the last 8 years there has been no significant change in systolic or diastolic BP achievement.

The total number of patients active on the transplant waiting list (adult and paediatric) on 31/12/2005 was 5,736, an 8% increase from the previous year. On 31/12/2005 46% of prevalent adult RRT patients in the UK, had a functioning renal transplant which equated to 19,074 patients. During 2005, the death rate in prevalent transplant patients was 2.7/100 patient years. An additional 3.1% of all prevalent transplants failed with patients returning to dialysis. 11.4% of incident transplants in 2005 were to patients with diabetes.

Transplant function analysed by CKD stage 1–2 (eGFR <60), 3 (eGFR 30–59), 4 (eGFR 15–29) and 5 (eGFR <15), shows that these categories account for 24%, 59%, 15% and 2.5% of patients respectively. The median Hb in prevalent transplant recipients was 12.9 g/dl, with 10% of patients having a Hb <10 g/dl. Hb values fall with decreasing eGFR such that of the 2.5% of transplant patients with eGFR <15 ml/min, 27% had a Hb <10 g/dl and 51% <11 g/dl. Control of iPTH was poor in transplant recipients in CKD stages 4 and 5, with 22% and 50% respectively having a PTH >32 pmol/L. Patients with failing transplants are less likely to achieve RA targets of key biochemical variables when compared to patients on dialysis.

For paediatric patients at one year from starting RRT, 49% are on PD, 10% on HD and 41% have a transplant. Short stature is a major problem in paediatric ERF patients with 29% of transplant patients and 41% of dialysis patients below the 2nd percentile for height. Only 6.5% of transplant patients and 15.5% of dialysis patients are receiving rhGH. 14% of paediatric transplant patients and 30% of paediatric dialysis patients have a haemoglobin below 10.5 g/dl.

Chapter 2: Introduction to the 2006 UK Renal Registry Report

David Ansell, Es Will and Charlie Tomson

The UK Renal Registry is part of the UK Renal Association and provides independent audit and analysis of renal replacement therapy (RRT) in the UK. The Registry is funded directly by participating renal units through an annual fee per patient registered.

The Registry is now collecting data on incidence and prevalence from 100% of UK renal units, with the 5 remaining non-linked sites in England providing summary data.

Maintaining and enhancing Registry functionality will be an important touchstone for the Connecting for Health initiative. Collaboration with other formal agencies also promises an exciting prospect for future development. After a long proving period, the means, methods and roles have come together to complete an effective adjunct to clinical activity, planning, research and the performance of the renal community.

Quality Improvement

Provision of evidence of important variations in the outcomes of RRT is not, by itself, sufficient to result in reduction of variation. For this reason, the variations that the Registry reports between renal units around the UK remain, at least for some markers, remarkably stable over time. It is easy for clinicians in 'under-performing' units to ignore the analyses – arguing, for instance, that case mix explains the variation ("my patients are different"), or differences in funding, or differences in infrastructure – or just that the data are wrong. The first challenge therefore, is to persuade clinicians to accept that the data reflect real differences. Over time, the Registry Reports have gained increasing acceptance, and many now believe that the differences are real, and susceptible to improvement within existing funding. In this sense, the Registry Reports provide the 'tension for change'. The second challenge is to discover the reasons – the differences in practice patterns, treatment strategies, funding arrangements and policies that cause the variations – while acknowledging that different strategies may work in different units, depending on staffing, geography and culture. The third challenge is to reduce variation and to improve the overall standard of care provided to patients on RRT throughout the UK.

These are new challenges for the UK Renal Registry. The science of quality improvement incorporates evidence-based medicine, but also involves understanding of the sociology and psychology of change. The Registry is launching a year-long web-based collaborative quality improvement project at the forthcoming meeting of the multidisciplinary British Renal Society (BRS) in June 2007, in collaboration with the NHS Institute for Innovation and Improvement. The design of this project draws on the Institute for Healthcare Improvement's collaboratives. This will focus on two topic areas, control of serum phosphate and correction of renal anaemia. Renal units have been invited to send multidisciplinary teams working in each of these areas to the BRS meeting. The meeting will comprise a 'crash course' in how to achieve quality improvement in the NHS, followed by sessions devoted to 'change packages' developed in each clinical area by a faculty drawn from renal units whose performance against Renal Association standards in each clinical area has been consistently high. Teams will then be expected to test implementation of new systems of care, protocols and treatment algorithms and to share their experience on a password-protected area in a new website, www.nhs.uk/collaborate, designed to promote such interactions.

With the presentation of these Registry analyses to the renal community, the challenge to UK nephrology remains, to find effective and creative ways of using the analyses to understand and reduce variations in clinical

practice. The necessary formal structures are now in place to allow full value to be derived from the opportunities provided by the Registry data. The Registry is committed to developing added value to the collected data through novel means of presentation and analysis. This commitment has gained increasing acceptance and recognition. With external pressures for increasing diversity of renal provision in England, a more formal role for the Registry within NHS structures appears likely to help monitor this new service provision.

Geographical areas covered by the UK Renal Registry

The full participating centres are shown in Table 2.1.

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

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

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

Cambridge are in the process of changing their renal IT system to in-house software; Derby are in the process of changing their renal IT system to Vitaldata; Wirral are developing in-house software; Wrexham are in the process of changing their renal IT system to Renalplus.

Table 2.1: Centres in the 2006 Registry Report

	Hospital	Estimated population (Millions)
England & Wales		**46.55**
Bangor	Ysbyty Gwynedd	0.18
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
Cardiff	University of Wales Hospital	1.30
Carlisle	Cumberland Infirmary	0.36
Carshalton	St Helier Hospital	1.80
Chelmsford	Broomfield Hospital	0.50
Clwyd	Ysbyty Clwyd	0.15
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	Ipswich Hospital	0.33
Leeds	St James's Hospital & Leeds General Infirmary	2.20
Leicester	Leicester General Hospital	1.80
Liverpool	Royal Infirmary	1.35
London	St Barts & The Royal London	1.79
London	Guys & St Thomas' Hospital	1.70

Table 2.1: (continued)

	Hospital	Estimated population (Millions)
London	Hammersmith & Charing Cross Hospitals	1.30
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
Swansea	Morriston Hospital	0.70
Truro	Royal Cornwall Hospital	0.36
Wirral	Arrowe Park Hospital	0.53
Wolverhampton	New Cross Hospital	0.49
Wrexham	Maelor General Hospital	0.32
York	York District Hospital	0.39
Northern Ireland		**1.69**
Antrim	Antrim Hospital	
Belfast	Belfast City 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	Glasgow Royal Infirmary & Stobhill General Hospital	
Glasgow	Western Infirmary	
Kilmarnock	Crosshouse Hospital	
Inverness	Raigmore Hospital	

*Renal unit included in the report for the first time.

Future coverage by the Registry

From the analyses presented here, it can be seen that the report on the 2005 data covers over 90% of the UK with further centres joining with data for 2006. With the recommendation in the Renal National Service Framework (NSF) that all renal units should participate in audit through the Registry, all renal units in England, Wales and Northern Ireland have invested in the IT technology and local support

Table 2.2: Progress in centres not included in this report

	Hospital (Indicates IT system used by hospital)	Estimated population (millions)
(a) Centres submitting data for 2006		
Stoke	North Staffs (Cybernius system)	0.70
Manchester	Royal Infirmary (CCL clinical vision)	2.51
(b) Centres hoping to submit data for 2007		
Canterbury	Kent & Canterbury – Renalplus	0.91
London	St George's (CCL clinical vision)	
London	St Mary's Paddington (Proton)	0.81

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.

There are 3 new renal units that already have been/or are in the process of being set up:

1. Aintree (previously a satellite of the Liverpool renal unit) will be submitting data via Liverpool.
2. Cheshire (previously a satellite of the Wirral renal unit) will be submitting data via Liverpool.
3. Colchester.

Centres submitting 2006 and 2007 data

The renal units shown in Table 2.2 plan to have their IT systems setup and running in time to submit 2006 data. By the end of 2007 all adult renal units will have Registry compatible renal IT systems.

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
Dorset	100.0	100.0	100.0	98.0	99.5	England
Nottingham	99.3	100.0	98.6	98.6	99.1	England
Ulster	100.0	100.0	90.0	100.0	97.5	NI
Swansea	99.0	99.0	93.8	95.9	96.9	Wales
Bradford	93.8	95.4	100.0	95.4	96.2	England
Gloucester	100.0	95.2	91.9	96.8	96.0	England
Tyrone	100.0	91.7	91.7	100.0	95.8	NI
York	97.7	93.0	90.7	90.7	93.0	England
Wolverhampton	100.0	100.0	97.8	69.6	91.8	England
Basildon	93.3	90.0	90.0	93.3	91.7	England
Newry	100.0	92.9	32.1	100.0	81.2	NI
Portsmouth	96.1	94.1	91.5	28.8	77.6	England
Belfast	100.0	73.2	37.2	99.3	77.4	NI
Antrim	97.6	100.0	9.5	100.0	76.8	NI
Bangor	68.4	97.4	89.5	47.4	75.7	Wales
Sheffield	75.9	100.0	97.4	28.5	75.5	England

Table 2.3: (continued)

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Co-morbidity	Average completeness	Country
Leicester	93.3	83.9	58.9	61.2	74.3	England
Newcastle	96.8	98.9	97.8	2.2	73.9	England
L Hammersmith & CX	100.0	93.9	0.0	100.0	73.5	England
L Kings	85.1	98.6	9.9	98.6	73.0	England
Middlesbrough	98.6	98.7	90.5	0.0	71.9	England
Ipswich	81.7	98.3	94.9	8.3	70.8	England
Bristol	86.3	76.6	60.0	57.1	70.0	England
Truro	43.8	81.3	65.6	84.4	68.7	England
L St Barts	95.0	100.0	0.0	79.4	68.6	England
Carlisle	100.0	100.0	0.0	70.0	67.5	England
Sunderland	89.7	100.0	0.0	75.9	66.4	England
Stevenage	100.0	100.0	59.6	1.0	65.2	England
Chelmsford	12.5	100.0	47.5	100.0	65.0	England
Leeds	45.1	61.6	88.3	59.1	63.5	England
Norwich	24.0	99.2	27.3	100.0	62.6	England
Derby	62.0	97.2	1.4	84.5	61.3	England
Cambridge	77.7	100.0	60.2	0.0	59.5	England
Manchester West	93.8	100.0	0.0	24.0	54.5	England
Liverpool	70.7	98.8	0.0	41.5	52.7	England
Hull	7.9	99.2	1.6	95.2	51.0	England
Dudley	100.0	100.0	0.0	0.0	50.0	England
Redding	100.0	100.0	0.0	0.0	50.0	England
Southend	57.1	85.7	0.0	57.1	50.0	England
Shrewsbury	97.7	100.0	0.0	0.0	49.4	England
Birm Heartlands	97.6	99.2	0.0	0.8	49.4	England
Oxford	84.6	95.5	1.3	14.7	49.0	England
Birm QEH	97.9	82.5	0.0	0.0	45.1	England
Preston	83.1	96.6	0.0	0.0	44.9	England
Coventry	75.3	100.0	0.0	0.0	43.8	England
Wirral	72.7	100.0	0.0	0.0	43.2	England
L Guys	56.8	100.0	0.0	2.7	39.9	England
Exeter	17.1	60.4	45.0	25.2	36.9	England
Plymouth	36.8	100.0	0.0	0.0	34.2	England
Cardiff	15.2	93.8	0.6	20.2	32.5	Wales
Clwyd	11.1	100.0	0.0	0.0	27.8	Wales
Brighton	22.2	88.0	0.0	0.0	27.5	England
Carshalton	30.6	75.6	0.6	3.3	27.5	England
L Royal Free	94.0	0.8	0.0	0.0	23.7	England
Wrexham	11.6	51.2	0.0	0.0	15.7	Wales
Scotland						
Aberdeen	1.6	3.2				Scotland
Airdrie	92.3	84.6				Scotland
Dumfries & Galloway	0.0	66.7				Scotland
Dundee	94.7	94.7				Scotland
Dunfermline	4.5	72.7				Scotland
Edinburgh	1.0	77.2				Scotland
Glasgow RI	1.6	86.3				Scotland
Glasgow WI	2.0	83.8				Scotland
Inverness	0.0	95.4				Scotland
Kilmarnock	0.0	64.3				Scotland

Software and links to the Registry

It is apparent that there are now 13 systems in use by renal units, 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 unit 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

In the UK in 2005 there were 768 patients under 18 years old who were on renal replacement therapy. As most of the 13 UK paediatric renal units are small, the British Association of Paediatric Nephrology (BAPN) was able to set up its own database to register data on a partially manual basis. As in previous years, this report includes separate analyses from these data (Chapters 13, 14, 15). In order to integrate them with the adult Registry and also benefit from funded resources for data management, the BAPN has asked the adult Registry to develop the means to collect the paediatric data electronically. This process of integration of paediatric data is proceeding slowly.

Links with other organisations

The UK Renal Registry has been active in supporting the Renal Association Standards Sub-committee in the production of the Standards document. It now participates in the Renal Association Clinical Affairs Board to support activity in all clinical areas and in informing new standards.

Close collaboration has developed with UK Transplant (UKT), in conjunction with the British Transplantation Society, to produce analyses utilising the coverage of both the UKT 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.

Support has been given to the Department of Health (DH) in acquiring the basic data necessary for the future planning of renal services. The Registry participated in providing data to formulate the advice to ministers in the Renal NSF. It is also working with the DH Data Standards Board developing a Renal Dataset for the national IT spine. The Registry is part of the Kidney Alliance. A collaboration between the Renal Association and the Registry, the British Renal Society, the British Transplantation Society, the National Kidney Federation and others, was selected and funded by the Heath Care Commission to write the scope for audit of implementation of the Renal National Service Framework and of renal care in the UK.

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 units 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 units, 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.

The Registry is exploring ways of linking the dataset collected direct from renal unit IT

systems with NHS data items such as the Hospital Episode Statistics database, now held by the Secondary User Service. Development of such linkages, using NHS number as a unique identifier, will require approval under Section 60 of the Health and Social Care Act. This would allow the Registry to incorporate analyses, for instance, of hospitalisation rates or of co-morbidity derived from hospital discharge codes.

The UK Registry 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 UK Renal Registry. 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.

The Registry has links with the new Swiss Renal Registry and while this is in the process of being established; Dr Dorothea Nitsch has been seconded to work in the UK and collaborates closely with the UK Registry. Collaborative work is also being undertaken with the Australian and Canadian renal registries.

Dr Simon Watson has obtained a one year consultant level fellowship grant from the NHS Institute for Innovation and Improvement. He will be collaborating with the UK Renal Registry and leading the quality improvement initiative.

Commissioning of renal services and PCTs

A specialist renal commissioner representative (Jenny Scott) has joined the Registry Committee to inform on the support provided by the Registry in assisting Specialist commissioning consortia and individual Primary Care Trusts with appropriate data and analyses. An executive summary of this Report will be prepared for Commissioners.

Contact has also been made with the East Midlands Public Health Observatory, which the Department of Health has identified to be the lead PHO for renal services in England.

The Registry has reported some demographic analyses based on Local Authority and also PCT areas. Only some of the boundaries of the PCTs and Local Authorities in England are similar. The Office for National Statistics is in the process of re-aligning the PCT boundaries with those of Local Authorities and hopes to complete this process in 2007.

The Registry and clinical governance

There has been debate within the Renal Association Trustee and Executive Committees, the Clinical Affairs Board, the Registry Board and Committee, about the Registry's responsibilities under the principles of clinical governance, particularly if an individual renal unit appears to be under-performing on one or more key measures of clinical activity.

The Registry Report is sent to the Chief Executives of all Trusts in which a renal unit 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 unit 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 unit.

If the findings and analyses are robust and concern appears warranted, the Registry Chairman will notify the President of the Renal Association, who will write to explain matters to the Clinical Director or Specialty Lead of the relevant unit, 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

There has been pressure for the Renal Registry to cease the anonymous reporting of results and analyses and to identify the individual renal centres. The removal of anonymity aids the development of comparative audit and may assist learning from best practice, as well as allowing public accountability. In 2002, anonymity was removed from all the adult data except for the survival figures in individual renal units.

In the event, progress has been slow in improving the co-morbidity and ethnicity returns essential to allowing a meaningful comparison of patient survival between renal units that is corrected for case mix. Following discussion with the Renal Clinical Directors Forum there was overwhelming support for removing anonymity even if co-morbidity returns remain poor. This year, for the first time, patient survival in the named centres is reported.

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 units 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 second annual report on progress by the Registry towards anonymisation has been submitted to the PIAG and the third review is due in March 2007.

Support for renal services in Connecting for Health – the National Programme for IT

Many renal units are concerned about support for existing IT systems under the National IT Programme. In addition, there is also concern about retaining existing functionality in any new IT system. Support for the National Renal Dataset and existing renal systems has been included in the Output Based Specification (OBS) contract for renal services and the full text is provided in Appendix F in the 2005 Report. Section 167 within the contract deals with provision of IT for renal services and has been signed by all the regionally based Local Service Providers (LSPs) as a component of the National IT Programme.

As mentioned earlier, the Registry has worked with the DH, Connecting for Health, the NHS Information Centre and BT (who provide the national spine), in the specification of the National Renal Dataset that all LSP systems will be required to support. This dataset has now been finalised and submitted to the Information Standards Board for approval.

Support for renal systems managers and informatics staffs

In 2005, 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. In 2006, a renal IS meeting was run by Connecting for Health and the Registry is planning a follow on meeting for September 2007.

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 χ^2 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 units 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 units 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 12). 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 Uday Udayaraj started work at the Registry in February 2006 and Dr Daniel Ford has recently been appointed to the 3rd registrar position. 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.

Dr Fergus Caskey organised a secondment in Berlin with the German Renal Registry and undertook a detailed comparative analysis between the UK and Germany on the factors underlying the large differences in incidence of renal replacement therapy in the two countries[10].

New data collection and analysis

The survey on vascular access

Last year provided the first report of detailed UK national data on vascular access provision. The 6 month and 1 year follow up results from this patient cohort are reported in Chapter 5.

The repeat 2006 vascular access survey is also reported in this chapter.

The report has been invaluable in establishing a base line 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 units, with some units managing to start 95% of renal replacement therapy patients with definitive access and others less than 50%.

The Renal Association would like to thank everyone involved in the collection of these data and appreciate the effort required to supply it.

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 and a summary of these data have been included in this report.

Chronic kidney disease

In 2005, the Registry published a national survey of CKD patients under the care of nephrologists which has been published in the Quarterly Journal of Medicine. There is considerable interest in collecting further data on cohorts of renal patients with chronic kidney disease not receiving RRT, many renal units already hold such data in their systems. The Clinical Directors Forum have indicated they would like the Registry to collect data on all CKD stage 5 patients not on RRT and ways to implement this are being investigated.

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. *Nephrology, Dialysis, Transplantation* 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 International* 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.
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

The 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 seen on the Registry website – www.renalreg.org.

Chapter 3: New Adult Patients Starting Renal Replacement Therapy in the UK in 2005

Ken Farrington, Raman Rao, Julie Gilg, David Ansell and Terry Feest

Summary

- In 2005, the acceptance rate for RRT in adults in the UK was 108 pmp. This was derived from complete data for adults in the UK, as data were obtained separately from the 5 English renal units not currently returning to the Registry. In addition, 87 children started RRT (see Chapter 13) giving a total incidence of 110 pmp.

- From 2001–2005 there has been an 7.3% rise in the acceptance numbers in those 42 renal units with full reporting throughout that period.

- In the UK, for adults in 2005, the crude acceptance rates in Local Authorities (LA) varied from 0 (in two very small LA areas in Scotland and Northern Ireland) to 271 pmp; the standardised rate ratios for acceptance varied from 0 to 2.76. Excluding the two areas with null returns, 20 areas had significantly low ratios, all of them in England. Thirty had significantly high ratios, seven in Northern Ireland, four in Scotland, three in Wales and seven in London.

- Over the period 2001–2005, 25 areas had a significantly low standardised acceptance rate; 24 in England and one in Scotland. All except one of these had ethnic minority populations of less than 10%. Thirty-seven had high standardised acceptance rates, seven in Scotland where ethnicity data were not available, 14 from areas with ethnic minority populations in excess of 10%, and 12 were in Wales or the Southwest of England.

- The median age of patients starting renal replacement therapy in England has increased from 63.8 years in 1998 to 65.2 years in 2005. The median age of incident non White patients is significantly lower at 56.8 years.

- In England the acceptance rate is highest in the 75–79 age band at 408 pmp, as in Scotland at 580 pmp; in Wales the peak is in the 80–84 age band at 525 pmp, as in Northern Ireland with a rate of 825 pmp.

- Diabetic renal disease (20%) remains the most common specific primary renal disease. There was a significant positive correlation between the percentage of incident RRT patients with diabetic renal disease and the percentage of non Whites in the incident cohort.

- Haemodialysis was the first modality of RRT in 76% of patients, peritoneal dialysis in 21% and pre-emptive transplant in 3%. In 1998 the proportion whose first modality was haemodialysis was 58% and this continues to increase.

- By day 90, 8% had died, a further 1% had stopped treatment or been transferred out leaving 91% of the original cohort on RRT. Of these, 71% were on haemodialysis, 26% on peritoneal dialysis and 3% had received a transplant.

- Data on first referral to a nephrologist were available from 22 centres for the period 2000–2005 (for a total of 5,611 patients and 59 centre-years).

- In 2005, the mean percentage of patients referred late (<90 days before dialysis initiation) was 30% (centre range 13–48%). This was similar to the value in 2000.

- Patients referred late were older, a higher proportion of them were male, a lower proportion non White, and a lower proportion with no recorded co-morbidity. Patients with polycystic kidney disease and diabetic nephropathy tended to be referred early compared to the whole incident cohort and those with uncertain aetiology and no recorded diagnosis referred late.

- Estimated GFR (eGFR) at the start of RRT appears to be higher in older than younger patients. eGFR is significantly lower in those referred late compared with those referred earlier and this is especially marked in the older patients.

- The geometric mean eGFR of all patients starting RRT rose from 6 in 1997 to above 7.5 in 2003, since when it has remained stable.

Introduction

The acceptance data presented were from the whole UK. In 2005, the UK Renal Registry received complete returns from all 5 renal units in Wales, all 5 renal units in Northern Ireland and 90% of the renal units in England. Data from all 10 renal units in Scotland were obtained from the Scottish Renal Registry. In addition summary data were obtained separately from the 5 remaining English renal units not currently returning to the Registry, to enable accurate calculation of acceptance rates and initial modality used.

Extrapolation from Registry data to derive other information relating to the whole UK was still necessary and these results must still be viewed with a little caution, although estimates become more reliable 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 renal units) 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 comparisons between renal units and between local areas fully covered by the Renal Registry, the data from the Registry are fully valid. Data on children and young adults can be found in Chapter 13.

Adult patients accepted for renal replacement therapy in the UK, 2005

Overall take-on rate

In 2005 there were 6,485 adult patients who started RRT in the whole UK. This equates to acceptance rates of 108 pmp for adults (Table 3.1) and 110 pmp including children. This represents an overall increase in the past 2 years. The adult acceptance rate in England was 104 pmp. Acceptance rates in Wales, Scotland and Northern Ireland were all higher than this, at 129, 122 and 140 pmp respectively (Figure 3.1). There continues to be very marked gender differences in take-on rate, the annual acceptance was 137 (95% CI 132–141) pmp in males and 81 (95% CI 77–84) pmp in females.

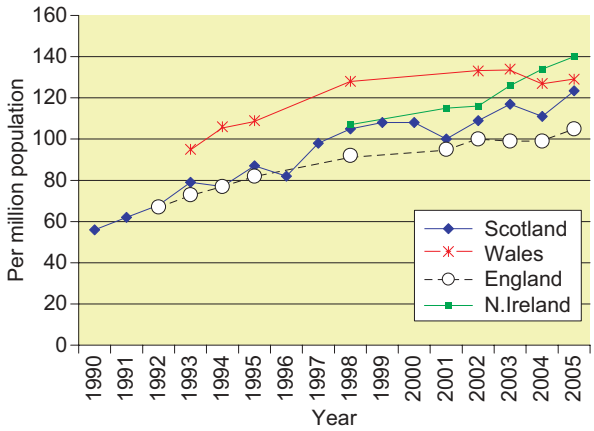

Figure 3.1: Incident rates in the countries of the UK; 1990–2005

Table 3.1: Number of new adult patients accepted in the UK in 2005

	England	Wales	Scotland	N. Ireland	UK
Centres contributing to RR (65)	4,598	383	624	242	**5,847**
All UK centres (65 + 5 = 70)	**5,236**	383	624	242	**6,485**
*Total estimated population mid 2005 (millions)	50.4	3.0	5.1	1.7	**60.2**
Acceptance rate (pmp)	104	129	122	140	**108**
(95% CI)	(101–107)	(116–142)	(113–132)	(123–158)	**(105–111)**

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

Local changes in acceptance rate

Acceptance rates of individual units

The number of patients accepted by each renal unit is shown in Table 3.2. There is variation in time trends between renal units, which may reflect chance fluctuation, completeness of reporting, changing incidence of ERF, changes in referral patterns or catchment populations and areas and the introduction of conservative care teams.

The percentage change over the period 2001–2005 is shown for those 42 renal units, which had full reporting during that period and for the same data on a national level. Overall there has been an 7.3% rise in the acceptance numbers. There are wide variations between different renal units, the more extreme ones are related to changes in catchment populations, eg an increase of 70% since 2001 (Hull), a decrease of 25.8% (Liverpool). The Northamptonshire region has moved from the Oxford renal unit catchment to that of the Leicester renal unit. The increase seen in the national figures is similar to that reported for the period 2000–2004 in last year's report. Acceptance rates of individual renal units have not been calculated, as their catchment populations are not precisely defined.

Table 3.2: Number of new patients accepted by individual renal units reporting to the UK Renal Registry 2000–2005

Country	Centre	Year						% change since 2001
		2000	2001	2002	2003	2004	2005	
England	Barts					187	180	
	Basildon				53	46	30	
	Bradford		61	62	75	62	65	+6.6
	Brighton					119	108	
	Bristol	148	151	127	163	166	175	+15.9
	Cambridge		93	77	98	109	103	+10.8
	Carlisle	28	29	27	31	29	30	+3.4
	Carshalton	123	124	182	205	180	180	+45.2
	Chelmsford					55	40	
	Coventry	89	105	97	79	79	85	−19.0
	Derby	54	59		61	65	71	+20.3
	Dorset				71	62	51	
	Dudley	40	35	25	42	55	38	+8.6
	Exeter	71	98	82	99	113	111	+13.3
	Gloucester	47	50	55	53	54	62	+24.0
	Guys	126	115	146	100	104	111	−3.5
	H&CX			180	153	195	147	
	Heartlands	86	85	61	105	103	115	+35.2
	Hull	82	74	106	80	108	126	+70.3
	Ipswich			44	39	43	60	
	Kent						*104*	
	Kings			117	108	110	133	
	Leeds	163	166	151	190	182	164	−1.2
	Leicester	179	187	152	171	165	224	+19.8
	Liverpool		221	153	114	135	164	−25.8
	London St Georges						*90*	
	London St Mary's						*176*	
	Manchester RI & East						*181*	
	ManWst				142	110	109	
	Middlesbrough	86	82	111	104	102	74	−9.8
	Newcastle			109	106	106	93	
	Norwich					98	121	
	Nottingham	114	120	87	116	108	147	+22.5

Table 3.2: (continued)

Country	Centre	Year						% change since 2001
		2000	2001	2002	2003	2004	2005	
	Oxford	159	172	171	186	170	156	−9.3
	Plymouth	59	64	79	67	62	57	−10.9
	Portsmouth		144	146	143	120	153	+6.3
	Preston	117	136	113	99	81	118	−13.2
	QEH					202	194	
	Reading	52	68	44	73	71	75	+10.3
	Royal Free						126	
	Sheffield	137	155	157	162	170	158	+1.9
	Shrewsbury					55	43	
	Southend	40	37	34	42	41	35	−5.4
	Stevenage	134	129	100	123	85	86	−33.3
	Stoke						*87*	
	Sunderland	50	41	58	57	52	58	+41.5
	Truro		41	62	53	67	32	−22.0
	Wirral			43	53	68	55	
	Wolverhampton	80	78	101	89	103	92	+17.9
	York	41	37	63	58	49	43	+16.2
Wales	Bangor			29	33	36	38	
	Cardiff	139	155	181	166	186	178	+14.8
	Clwyd			20	12	14	27	
	Swansea	92	114	114	130	93	97	−14.9
	Wrexham	53	35	42	33	29	43	+22.9
Scotland	Aberdeen	57	44	61	52	68	63	+43.2
	Airdrie	57	58	60	52	51	38	−34.5
	Dumfries	20	23	21	21	16	18	−21.7
	Dundee	48	50	68	61	63	75	+50.0
	Dunfermline	46	37	28	26	29	44	+18.9
	Edinburgh	101	59	81	89	98	101	+71.2
	Glasgow RI	75	76	73	97	81	101	+32.9
	Glasgow WI	76	102	100	124	102	99	−2.9
	Inverness	29	29	29	35	34	43	+48.3
	Kilmarnock	38	27	32	40	24	42	+55.6
N Ireland	Antrim						42	
	Belfast						138	
	Newry						28	
	Tyrone						24	
	Ulster						10	
England		**2,305**	**2,957**	**3,322**	**3,763**	**4,446**	**5,236**	
Wales		**284**	**304**	**386**	**374**	**358**	**383**	
Scotland		**547**	**505**	**553**	**597**	**566**	**624**	
N Ireland							**242**	
UK		**3,136**	**3,766**	**4,261**	**4,734**	**5,370**	**6,485**	
Including only units reporting continuously 2001–2005								
England			**2,898**	**2,829**	**2,977**	**2,925**	**3,037**	**+4.8**
Wales			**304**	**337**	**329**	**308**	**318**	**+4.6**
Scotland			**505**	**553**	**597**	**566**	**624**	**+25.5**
Total			**3,707**	**3,719**	**3,903**	**3,799**	**3,979**	**+7.3**

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

Geographical variation in 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 social and demographic factors including age, gender, social deprivation and ethnicity, so comparison of crude acceptance rates by geographical area alone 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 2002 report. The population used for standardisation is the sum of all Local Authority areas for which the Registry had full coverage in 2005.

Methods

Standardised acceptance rate ratios were calculated as detailed in web Appendix D (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), 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.

Results

Local Authority acceptance rates

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 Primary Care Trusts or Local Authorities have wide confidence intervals for any observed frequency. 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 109 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 17 to 200 per million population per year, whilst for a population of 1 million, the limits are from 88 to 129 per million population per year.

In the UK, for adults in 2005, the crude acceptance rates in Local Authorities varied from 0 (in two very small Local Authority areas; in Scotland [Eilean Siar – population 26,502] and Northern Ireland [Moyle – population 15,932]) to 271 pmp. There were also wide variations in the standardised rate ratios for acceptance (0–2.76). Excluding the two null returns, 20 areas had significantly low ratios, all of them in England. Four of these had ratios <0.5: Salford (0.35), Darlington (0.37), Isle of Wight (0.46) and Poole (0.47). Thirty had significantly high ratios: 7 in Northern Ireland, 4 in Scotland, 3 in Wales and 7 in London. Nine had ratios of 2.0 or more. Six of these were in Northern Ireland (Antrim [2.58], Armagh [2.00], Carrickfergus [2.73], Castlereigh [2.50], Coleraine [2.66] and Cookstown [2.76]) one in Scotland (Dundee City [2.20]) and the others in London (Newham [2.10] and Greenwich [2.11]).

In Table 3.3 the trends over the 5 years 2001–2005 are shown, illustrating the wide variations in annual standardised acceptance ratios in areas with small populations, especially those with habitually low take-on rates.

Also depicted in Table 3.3 are the standardised acceptance ratios derived from combined 2001–2005 data. Only data from areas with 3 or more years' data are included in the following analysis. This excludes data from Northern

Table 3.3: Crude adult annual acceptance rates and standardised rate ratios 2001–2005

Areas with significantly low acceptance ratios over 5 years are italicised in greyed areas, those with significantly high ratios are bold in greyed areas.

O/E = Standardised acceptance rate ratio.

% non White = sum of % South Asian and African–Caribbean from 2001 Census.

UK Area	LA name	Tot pop	2001 O/E	2002 O/E	2003 O/E	2004 O/E	2005 O/E	pmp	2001–2005 O/E	LCL	UCL	pmp	% non White
North East	Darlington	97,838	0.74	0.91	0.96	0.77	0.37	41	0.74	0.54	1.02	78	2.1
	Durham	***493,469***	***0.56***	***1.04***	***0.81***	***0.88***	***0.83***	***93***	***0.83***	***0.72***	***0.95***	***87***	***1.0***
	Hartlepool	88,610	1.07	0.57	1.30	0.99	0.62	68	0.91	0.67	1.23	93	1.2
	Middlesbrough	134,855	1.09	1.13	1.14	1.00	1.02	104	1.07	0.85	1.36	102	6.3
	Redcar & Cleveland	139,132	0.80	1.83	1.07	1.07	0.76	86	1.10	0.89	1.37	116	1.1
	Stockton-on-Tees	178,408	0.86	1.06	0.89	1.07	0.75	78	0.92	0.74	1.15	91	2.8
	Gateshead	191,151		1.27	0.96	0.92	0.69	78	0.95	0.76	1.19	103	1.6
	Newcastle upon Tyne	259,536		0.98	0.89	1.09	0.96	100	0.98	0.81	1.19	97	6.9
	North Tyneside	191,658		0.95	0.76	0.91	0.59	68	0.80	0.63	1.01	87	1.9
	Northumberland	***307,190***		***0.76***	***0.98***	***0.87***	***0.52***	***62***	***0.78***	***0.65***	***0.95***	***88***	***1.0***
	South Tyneside	152,785		0.88	0.66	0.97	0.86	98	0.84	0.65	1.09	92	2.7
	Sunderland	280,807	0.80	0.99	1.29	0.60	0.77	82	0.89	0.75	1.06	89	1.9
North West	Cheshire												1.6
	Halton	**118,209**	**1.64**	**0.84**	**1.23**	**1.51**	**1.35**	**135**	**1.32**	**1.05**	**1.65**	**124**	**1.2**
	Knowsley	150,459	0.75	0.94	1.30	0.97	0.92	93	0.98	0.78	1.24	93	1.6
	Liverpool	**439,471**	**1.94**	**0.96**	**0.74**	**1.05**	**1.20**	**123**	**1.17**	**1.03**	**1.32**	**112**	**5.7**
	Sefton	***282,958***	***0.98***	***1.00***	***0.70***	***0.51***	***0.91***	***106***	***0.81***	***0.68***	***0.97***	***89***	***1.6***
	St. Helens	176,843	1.20	0.98	0.55	0.50	1.15	124	0.87	0.70	1.09	88	1.2
	Warrington	191,080	0.81	1.06	0.63	0.95	0.76	79	0.84	0.67	1.05	82	2.1
	Wirral	312,293	0.55	0.81	1.00	1.18	1.09	125	0.94	0.80	1.10	100	1.7
	Blackburn with Darwen	137,470	0.89	1.37	1.29	0.98	1.39	131	1.19	0.94	1.50	105	22.1
	Blackpool	***142,283***	***0.80***	***1.09***	***0.37***	***0.31***	***0.64***	***77***	***0.63***	***0.48***	***0.83***	***72***	***1.6***
	Cumbria	***487,607***	***0.87***	***0.76***	***0.76***	***0.62***	***0.86***	***103***	***0.78***	***0.68***	***0.89***	***86***	***0.7***
	Lancashire	***1,134,975***	***0.95***	***0.64***	***0.59***	***0.61***	***0.61***	***67***	***0.67***	***0.61***	***0.74***	***70***	***5.3***
	Bolton	261,037			0.96	0.74	0.74	77	0.81	0.64	1.04	82	11.0
	Bury	***180,607***			***0.56***	***0.62***	***0.75***	***78***	***0.64***	***0.46***	***0.89***	***65***	***6.1***
	Manchester												19.0
	Oldham	***217,276***			***0.72***	***0.67***	***0.59***	***60***	***0.66***	***0.49***	***0.89***	***64***	***13.9***
	Rochdale	205,357			1.01	0.82	0.53	54	0.78	0.59	1.04	76	11.4
	Salford	***216,105***			***1.22***	***0.50***	***0.35***	***37***	***0.69***	***0.51***	***0.92***	***71***	***3.9***
	Stockport												4.3
	Tameside												5.4
	Trafford												8.4
	Wigan	301,415			0.89	0.86	1.01	106	0.92	0.75	1.14	94	1.3
Yorkshire and the Humber	East Riding of Yorkshire	314,113	0.85	0.91	1.06	0.75	1.14	137	0.95	0.81	1.10	106	1.2
	Kingston upon Hull	243,588	0.97	1.07	0.96	1.27	1.24	127	1.10	0.93	1.31	106	2.3
	North East Lincolnshire	157,981	0.27	1.15	0.67	1.10	1.22	133	0.89	0.71	1.13	91	1.4
	North Lincolnshire	152,848	0.80	0.95	0.66	1.28	0.98	111	0.94	0.75	1.17	99	2.5
	North Yorkshire	569,660	0.86	1.23	1.02	1.08	0.91	107	1.02	0.91	1.14	112	1.1
	York	181,096	0.86	1.44	1.62	0.95	0.90	99	1.15	0.95	1.39	119	2.2
	Barnsley	218,063	0.77	1.10	0.74	0.92	0.71	78	0.85	0.69	1.03	87	0.9
	Doncaster	286,865	0.94	0.94	0.96	0.90	0.69	77	0.88	0.74	1.05	91	2.3
	Rotherham	**248,175**	**1.67**	**0.86**	**0.98**	**1.18**	**1.23**	**133**	**1.18**	**1.00**	**1.39**	**119**	**3.1**
	Sheffield	513,234	1.00	0.98	0.97	1.16	1.03	111	1.03	0.91	1.16	104	8.8
	Bradford	**467,664**	**1.60**	**1.32**	**1.52**	**1.31**	**1.32**	**130**	**1.41**	**1.26**	**1.58**	**130**	**21.7**
	Calderdale	192,405	1.18	0.65	1.33	0.88	0.78	83	0.96	0.78	1.18	96	7.0
	Kirklees	388,567	0.98	1.23	1.26	1.30	0.78	80	1.11	0.97	1.27	106	14.4
	Leeds	715,403	1.08	0.87	1.03	1.00	1.19	123	1.04	0.94	1.15	100	8.2
	Wakefield	***315,172***	***0.81***	***0.85***	***0.87***	***1.06***	***0.62***	***67***	***0.84***	***0.71***	***0.99***	***84***	***2.3***

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	pmp	2001–2005 O/E	LCL	UCL	pmp	% non White
East Midlands	**Leicester**	**279,920**	**1.27**	**1.57**	**1.67**	**1.41**	**1.41**	**132**	**1.47**	**1.27**	**1.70**	**129**	**36.1**
	Leicestershire	***609,578***	***1.22***	***0.84***	***0.81***	***0.74***	***0.82***	***90***	***0.88***	***0.78***	***0.99***	***91***	***5.3***
	Northamptonshire	***629,676***	***0.97***	***0.97***	***0.76***	***0.71***	***0.89***	***92***	***0.86***	***0.76***	***0.97***	***83***	***4.9***
	Rutland	34,563	0.58	0.28	1.60	0.27	0.76	87	0.71	0.41	1.22	75	1.9
	Derby	221,709			0.97	1.03	1.27	135	1.09	0.87	1.37	113	12.6
	Derbyshire	***734,585***	***0.90***	***0.45***	***0.83***	***0.71***	***0.69***	***79***	***0.71***	***0.64***	***0.80***	***76***	***1.5***
	Lincolnshire	***646,644***	***0.69***	***0.63***	***0.62***	***0.78***	***1.08***	***131***	***0.77***	***0.68***	***0.86***	***87***	***1.3***
	Nottingham	266,988	1.73	0.69	0.88	1.10	1.31	127	1.14	0.96	1.34	103	15.1
	Nottinghamshire	748,508	0.93	0.84	1.05	0.95	1.23	138	1.01	0.91	1.11	106	2.6
West Midlands	Birmingham	977,085				1.70	1.66	163	1.68	1.51	1.88	160	29.6
	Dudley	***305,153***	***0.60***	***0.61***	***0.82***	***1.16***	***0.96***	***108***	***0.84***	***0.71***	***0.99***	***88***	***6.3***
	Sandwell	282,904				1.83	1.41	152	1.62	1.32	1.98	170	20.3
	Solihull	**199,515**	**1.28**	**0.69**	**1.54**	**1.36**	**1.24**	**140**	**1.22**	**1.03**	**1.46**	**129**	**5.4**
	Walsall	**253,498**	**1.21**	**1.36**	**1.21**	**1.60**	**1.12**	**122**	**1.30**	**1.12**	**1.51**	**133**	**13.6**
	Wolverhampton	**236,582**	**1.24**	**1.70**	**1.65**	**1.54**	**1.58**	**173**	**1.55**	**1.34**	**1.79**	**159**	**22.2**
	Coventry	**300,849**	**1.68**	**1.50**	**1.25**	**0.85**	**0.90**	**93**	**1.22**	**1.06**	**1.42**	**118**	**16.0**
	Herefordshire, County of	174,871				1.03	0.79	97	0.91	0.66	1.25	109	0.9
	Warwickshire	505,858	1.10	1.00	0.76	0.88	0.99	111	0.94	0.83	1.07	98	4.4
	Worcestershire	542,105				0.95	0.79	89	0.86	0.71	1.05	95	2.5
	Shropshire	283,173				1.16	0.89	106	1.03	0.81	1.30	118	1.2
	Staffordshire												2.4
	Stoke-on-Trent												5.2
	Telford & Wrekin	158,325				1.38	0.85	82	1.11	0.79	1.56	104	5.2
East of England	Bedfordshire	381,572	0.91	0.99	0.93	0.86	0.74	76	0.88	0.76	1.03	85	6.7
	Hertfordshire	***1,033,978***	***0.88***	***0.58***	***0.64***	***0.55***	***0.62***	***65***	***0.65***	***0.58***	***0.73***	***64***	***6.3***
	Luton	**184,373**	**1.48**	**0.91**	**1.84**	**0.75**	**1.65**	**152**	**1.33**	**1.10**	**1.61**	**115**	**28.1**
	Essex	1,310,837				1.01	0.74	83	0.87	0.77	0.99	95	2.9
	Southend-on-Sea	160,259	0.95	1.26	1.31	0.97	1.09	125	1.12	0.92	1.37	120	4.2
	Thurrock	143,128				1.52	1.15	112	1.33	0.96	1.84	126	4.7
	Cambridgeshire	552,659	0.93	0.69	0.85	1.00	1.01	107	0.90	0.79	1.02	88	4.1
	Norfolk	796,728				1.01	1.17	146	1.09	0.95	1.25	132	1.5
	Peterborough	156,061	1.03	1.20	1.20	1.01	1.15	115	1.12	0.90	1.39	105	10.3
	Suffolk	668,555				0.93	1.09	129	1.01	0.87	1.19	116	2.8
London	Barnet	314,561					0.61	60	0.61	0.39	0.96	60	26.0
	Camden	198,020					0.87	76	0.87	0.52	1.44	76	26.8
	Enfield	273,559					1.05	102	1.05	0.72	1.52	102	22.9
	Haringey	216,505					1.40	115	1.40	0.95	2.07	115	34.4
	Islington	175,797					1.66	142	1.66	1.12	2.46	142	24.6
	Barking & Dagenham	163,942				1.06	0.63	61	0.84	0.57	1.23	79	14.8
	City of London												15.4
	Hackney	202,824				1.65	1.62	128	1.63	1.24	2.15	126	40.6
	Havering												4.8
	Newham	243,889				1.94	2.10	160	2.02	1.61	2.54	150	60.6
	Redbridge	238,634				1.39	1.06	105	1.22	0.94	1.58	117	36.5
	Tower Hamlets	196,105				1.25	1.44	112	1.35	0.99	1.83	102	48.6
	Waltham Forest												35.5
	Brent												54.7
	Ealing	**300,948**		**1.78**	**1.52**	**1.81**	**1.28**	**116**	**1.59**	**1.37**	**1.85**	**138**	**41.3**
	Hammersmith & Fulham	**165,244**		**1.86**	**1.88**	**1.77**	**0.98**	**85**	**1.61**	**1.31**	**1.99**	**133**	**22.2**
	Harrow												41.2
	Hillingdon	243,006				1.37	0.96	95	1.16	0.89	1.51	111	20.9
	Hounslow	212,342				2.20	1.46	132	1.82	1.43	2.31	160	35.1
	Kensington & Chelsea												21.4
	Westminster												26.8

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	pmp	2001–2005 O/E	LCL	UCL	pmp	% non White
London	Bexley	218,307	0.84	1.28	0.99	0.77	0.94	101	0.96	0.79	1.17	96	8.6
	Bromley	295,532	0.64	0.95	0.93	0.94	0.86	95	0.87	0.73	1.03	89	8.4
	Greenwich	**214,404**		**1.51**	**1.37**	**0.58**	**2.11**	**196**	**1.40**	**1.16**	**1.69**	**124**	**22.9**
	Lambeth	**266,169**	**0.74**	**1.65**	**1.35**	**1.43**	**1.58**	**128**	**1.36**	**1.15**	**1.61**	**103**	**37.6**
	Lewisham	**248,923**	**0.96**	**1.86**	**1.02**	**1.82**	**1.68**	**145**	**1.48**	**1.26**	**1.73**	**119**	**34.1**
	Southwark	**244,866**		**1.67**	**1.51**	**1.33**	**1.84**	**155**	**1.59**	**1.34**	**1.90**	**128**	**37.0**
	Croydon	**330,588**	**0.76**	**1.54**	**1.29**	**1.20**	**1.64**	**157**	**1.30**	**1.13**	**1.49**	**116**	**29.8**
	Kingston upon Thames												15.5
	Merton												25.0
	Richmond upon Thames												9.0
	Sutton												10.8
	Wandsworth												22.0
South East	***Hampshire***	***1,240,102***	***0.68***	***0.74***	***0.74***	***0.61***	***0.70***	***77***	***0.70***	***0.63***	***0.76***	***72***	***2.2***
	Isle of Wight	***132,731***	***0.67***	***0.70***	***0.67***	***0.67***	***0.46***	***60***	***0.63***	***0.48***	***0.83***	***77***	***1.3***
	Portsmouth	***186,700***	***1.16***	***0.70***	***0.88***	***0.61***	***0.63***	***64***	***0.79***	***0.62***	***1.00***	***75***	***5.3***
	Southampton	***217,444***	***0.70***	***0.83***	***0.82***	***0.59***	***0.70***	***69***	***0.73***	***0.58***	***0.91***	***67***	***7.6***
	Kent												3.1
	Medway												5.4
	Brighton & Hove	247,817				0.97	0.73	77	0.84	0.63	1.14	87	5.7
	East Sussex	492,326				1.11	0.68	87	0.89	0.74	1.07	112	2.3
	Surrey	1,059,017				0.78	0.61	67	0.69	0.59	0.81	74	5.0
	West Sussex	753,612				0.60	0.78	94	0.69	0.58	0.83	82	3.4
	Bracknell Forest	109,616				1.29	0.82	73	1.05	0.68	1.63	91	4.9
	Buckinghamshire	***479,026***	***1.01***	***0.70***	***0.71***	***0.77***	***0.64***	***67***	***0.76***	***0.66***	***0.88***	***75***	***7.9***
	Milton Keynes	207,057	0.76	1.04	1.37	1.22	0.88	77	1.06	0.86	1.30	87	9.3
	Oxfordshire	605,489	1.05	0.91	1.14	0.78	0.91	94	0.96	0.85	1.07	92	4.9
	Reading	143,096	1.04	0.84	1.34	1.04	1.06	98	1.06	0.84	1.35	92	13.2
	Slough	**119,064**	**1.39**	**1.24**	**1.66**	**2.07**	**1.96**	**176**	**1.68**	**1.35**	**2.08**	**141**	**36.3**
	West Berkshire	144,485	1.02	0.68	0.93	1.30	1.16	118	1.02	0.81	1.29	97	2.6
	Windsor & Maidenhead												7.6
	Wokingham	150,231	1.10	0.53	1.14	1.08	0.96	93	0.97	0.76	1.23	88	6.1
South West	Bath & NE Somerset	169,040	0.66	0.63	0.70	1.31	0.93	106	0.85	0.68	1.06	91	2.8
	Bristol, City of	**380,616**	**1.59**	**1.01**	**1.34**	**1.26**	**1.20**	**121**	**1.28**	**1.12**	**1.45**	**120**	**8.2**
	Gloucestershire	***564,559***	***0.88***	***0.84***	***0.85***	***0.87***	***0.89***	***101***	***0.87***	***0.77***	***0.98***	***92***	***2.8***
	North Somerset	188,564	1.11	0.92	1.38	1.24	1.13	138	1.16	0.97	1.38	132	1.4
	South Gloucestershire	245,641	0.98	1.29	1.06	1.02	1.32	138	1.14	0.96	1.34	112	2.4
	Swindon	180,051	0.63	1.04	0.98	1.28	0.66	67	0.92	0.74	1.15	87	4.8
	Wiltshire	***432,972***	***0.74***	***0.51***	***0.63***	***0.57***	***0.83***	***92***	***0.66***	***0.56***	***0.77***	***68***	***1.6***
	Bournemouth	163,444				0.59	0.76	92	0.68	0.46	1.00	80	3.3
	Dorset	390,980				0.74	0.59	79	0.66	0.52	0.84	87	1.3
	Poole	138,288				0.87	0.47	58	0.67	0.44	1.01	80	1.8
	Somerset	***498,095***	***0.83***	***0.92***	***0.82***	***0.91***	***0.66***	***80***	***0.82***	***0.73***	***0.94***	***93***	***1.2***
	Cornwall & Isles of Scilly	**501,267**	**1.05**	**1.55**	**1.26**	**1.39**	**0.72**	**90**	**1.18**	**1.07**	**1.32**	**139**	**1.0**
	Devon	704,491	0.88	0.83	0.89	1.08	1.07	135	0.95	0.86	1.05	112	1.1
	Plymouth	**240,722**	**1.53**	**1.47**	**1.39**	**1.03**	**1.01**	**108**	**1.27**	**1.09**	**1.49**	**127**	**1.6**
	Torbay	129,706	1.17	0.46	1.13	1.32	1.01	131	1.02	0.82	1.27	123	1.2
Wales	**Cardiff**	**305,353**	**1.07**	**1.69**	**1.56**	**1.36**	**1.32**	**131**	**1.40**	**1.22**	**1.61**	**130**	**8.4**
	Merthyr Tydfil	**55,979**	**0.76**	**1.82**	**1.72**	**2.26**	**1.65**	**179**	**1.65**	**1.24**	**2.20**	**168**	**1.0**
	Rhondda, Cynon, Taff	**231,947**	**1.14**	**1.53**	**1.08**	**1.63**	**1.31**	**142**	**1.34**	**1.14**	**1.56**	**136**	**1.2**
	The Vale of Glamorgan	119,292	0.87	1.16	1.02	1.27	0.75	84	1.01	0.79	1.29	106	2.2
	Carmarthenshire	172,842	1.09	1.05	1.44	1.15	1.04	127	1.16	0.96	1.39	132	0.9
	Ceredigion	74,941	1.42	1.24	0.59	0.94	0.78	93	0.98	0.72	1.33	109	1.4
	Pembrokeshire	114,131	1.24	0.87	1.21	0.76	1.08	131	1.03	0.81	1.31	117	0.9
	Powys	126,353	0.73	0.69	0.26	0.86	1.32	166	0.78	0.60	1.01	92	0.9

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	pmp	2001–2005 O/E	LCL	UCL	pmp	% non White
Wales	Blaenau Gwent	70,064	1.33	1.27	0.13	1.08	1.28	143	1.01	0.73	1.40	106	0.8
	Caerphilly	**169,519**	**0.96**	**1.47**	**1.05**	**1.05**	**1.56**	**165**	**1.22**	**1.01**	**1.48**	**122**	**0.9**
	Monmouthshire	84,885	1.95	1.21	0.73	1.26	0.99	118	1.21	0.93	1.57	134	1.1
	Newport	137,012	1.25	1.05	1.43	0.93	1.02	109	1.14	0.91	1.42	114	4.8
	Torfaen	90,949	1.36	1.42	1.14	0.83	0.89	99	1.12	0.86	1.47	117	0.9
	Bridgend	**128,645**	**1.21**	**1.16**	**1.68**	**1.40**	**1.12**	**124**	**1.31**	**1.07**	**1.62**	**137**	**1.4**
	Neath Port Talbot	**134,468**	**1.32**	**1.40**	**1.54**	**1.34**	**0.89**	**104**	**1.29**	**1.06**	**1.58**	**141**	**1.1**
	Swansea	**223,300**	**2.05**	**1.45**	**1.74**	**1.18**	**1.08**	**125**	**1.49**	**1.29**	**1.72**	**161**	**2.2**
	Conwy	109,596		1.23	0.51	1.10	0.69	91	0.88	0.66	1.16	109	1.1
	Denbighshire	93,065	0.31	0.68	0.37	1.02	1.94	236	0.89	0.67	1.18	101	1.2
	Flintshire	**148,594**		**1.32**	**1.19**	**1.13**	**1.39**	**148**	**1.26**	**1.00**	**1.57**	**128**	**0.8**
	Gwynedd	**116,843**		**1.68**	**1.52**	**1.22**	**1.52**	**180**	**1.48**	**1.19**	**1.85**	**167**	**1.2**
	Isle of Anglesey	66,829		0.96	1.30	1.17	1.86	224	1.33	0.98	1.81	153	0.7
	Wrexham	128,476	1.15	1.03	1.27	0.83	1.43	156	1.15	0.91	1.44	117	1.1
Scotland	Aberdeen City	212,125	0.83	1.15	0.99	1.62	1.13	118	1.15	0.96	1.37	112	
	Aberdeenshire	226,871	1.01	1.11	0.70	0.88	1.05	110	0.95	0.79	1.15	93	
	Angus	**108,400**	**1.55**	**2.18**	**0.91**	**1.33**	**1.10**	**129**	**1.40**	**1.13**	**1.74**	**153**	
	Argyll & Bute	91,306	0.95	0.71	1.35	0.97	0.83	99	0.96	0.73	1.27	107	
	Scottish Borders	106,764	0.36	0.94	0.73	1.39	0.77	94	0.84	0.64	1.11	96	
	Clackmannanshire	48,077	0.91	1.10	1.46	1.05	1.19	125	1.15	0.79	1.67	112	
	West Dunbartonshire	93,378	1.74	0.56	0.63	1.38	0.40	43	0.93	0.69	1.25	92	
	Dumfries & Galloway	**147,765**	**1.52**	**1.34**	**1.33**	**1.04**	**1.16**	**142**	**1.27**	**1.05**	**1.54**	**146**	
	Dundee City	**145,663**	**1.41**	**1.42**	**1.79**	**1.36**	**2.20**	**247**	**1.65**	**1.38**	**1.96**	**173**	
	East Ayrshire	120,235	1.31	0.75	1.19	0.56	1.21	133	1.00	0.78	1.29	103	
	East Dunbartonshire	108,243	0.68	0.75	1.33	0.71	0.68	74	0.83	0.62	1.11	85	
	East Lothian	90,088	0.91	0.98	0.31	0.83	1.08	122	0.82	0.60	1.12	87	
	East Renfrewshire	89,311	0.60	0.46	0.98	0.77	1.05	112	0.78	0.56	1.09	78	
	Edinburgh, City of	448,624	0.87	0.81	1.03	1.07	1.01	105	0.96	0.84	1.10	93	
	Falkirk	145,191	1.03	0.57	0.67	0.68	1.15	124	0.82	0.64	1.06	83	
	Fife	349,429	1.20	1.10	0.90	1.02	1.46	160	1.14	0.99	1.31	117	
	Glasgow City	**577,869**	**1.18**	**1.25**	**1.68**	**1.37**	**1.23**	**126**	**1.34**	**1.21**	**1.49**	**129**	
	Highland	**208,914**	**1.36**	**1.26**	**1.45**	**1.38**	**1.77**	**201**	**1.45**	**1.24**	**1.69**	**154**	
	Inverclyde	**84,203**	**1.61**	**2.14**	**1.13**	**1.02**	**0.97**	**107**	**1.36**	**1.05**	**1.76**	**140**	
	Midlothian	80,941	0.80	1.02	1.70	1.71	1.04	111	1.26	0.96	1.66	126	
	Moray	86,940	0.72	0.92	1.31	1.10	1.36	150	1.09	0.83	1.45	113	
	North Ayrshire	135,817	0.46	1.34	1.20	1.06	1.21	133	1.06	0.85	1.33	109	
	North Lanarkshire	321,067	1.38	1.22	1.28	0.97	0.83	84	1.13	0.97	1.31	107	
	Orkney Islands	19,245	1.04	1.50	1.90	0.48	1.81	208	1.35	0.80	2.28	145	
	Perth & Kinross	134,949	0.79	1.24	1.24	1.31	0.87	104	1.09	0.88	1.36	123	
	Renfrewshire	**172,867**	**1.05**	**1.79**	**1.13**	**1.14**	**1.24**	**133**	**1.27**	**1.05**	**1.53**	**127**	
	Shetland Islands	21,988	0.00	0.00	0.46	1.40	0.44	45	0.47	0.20	1.14	45	
	South Ayrshire	112,097	0.85	0.65	1.16	0.54	0.96	116	0.84	0.64	1.09	95	
	South Lanarkshire	302,216	1.36	1.24	0.91	0.98	0.87	93	1.06	0.91	1.24	106	
	Stirling	***86,212***	***0.75***	***0.72***	***0.68***	***0.68***	***0.32***	***35***	***0.62***	***0.43***	***0.91***	***63***	
	West Lothian	158,714	0.54	0.96	0.56	0.71	1.21	113	0.80	0.62	1.04	71	
	Eilean Siar	26,502	0.35	0.68	0.97	1.29	0.00	0	0.66	0.35	1.22	75	
N Ireland	Antrim	48,366					2.58	227	2.58	1.43	4.66	227	
	Ards	73,244					1.33	137	1.33	0.72	2.48	137	
	Armagh	54,262					2.00	184	2.00	1.08	3.73	184	
	Ballymena	58,610					1.50	154	1.50	0.78	2.89	154	
	Ballymoney	26,895					1.90	186	1.90	0.79	4.57	186	
	Banbridge	41,389					1.03	97	1.03	0.39	2.74	97	
	Belfast	277,391					1.31	130	1.31	0.95	1.82	130	
	Carrickfergus	37,658					2.73	266	2.73	1.47	5.08	266	

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	pmp	2001–2005 O/E	LCL	UCL	pmp	% non White
N Ireland	Castlereagh	66,488					2.50	271	2.50	1.58	3.97	271	
	Coleraine	56,314					2.66	266	2.66	1.60	4.41	266	
	Cookstown	32,581					2.76	246	2.76	1.38	5.53	246	
	Craigavon	80,671					1.72	161	1.72	1.00	2.96	161	
	Derry	105,066					1.30	105	1.30	0.72	2.35	105	
	Down	63,828					1.85	172	1.85	1.02	3.34	172	
	Dungannon	47,735					1.14	105	1.14	0.48	2.75	105	
	Fermanagh	57,527					1.06	104	1.06	0.48	2.36	104	
	Larne	30,833					0.93	97	0.93	0.30	2.89	97	
	Limavady	32,422					1.48	123	1.48	0.56	3.95	123	
	Lisburn	108,694					1.52	138	1.52	0.92	2.52	138	
	Magherafelt	39,778					1.43	126	1.43	0.59	3.43	126	
	Moyle	15,932					0.00	0	0.00			0	
	Newry & Mourne	87,058					0.91	80	0.91	0.43	1.91	80	
	Newtownabbey	79,996					1.12	113	1.12	0.58	2.15	113	
	North Down	76,323					1.33	144	1.33	0.73	2.39	144	
	Omagh	47,953					0.71	63	0.71	0.23	2.20	63	
	Strabane	38,246					0.58	52	0.58	0.15	2.34	52	

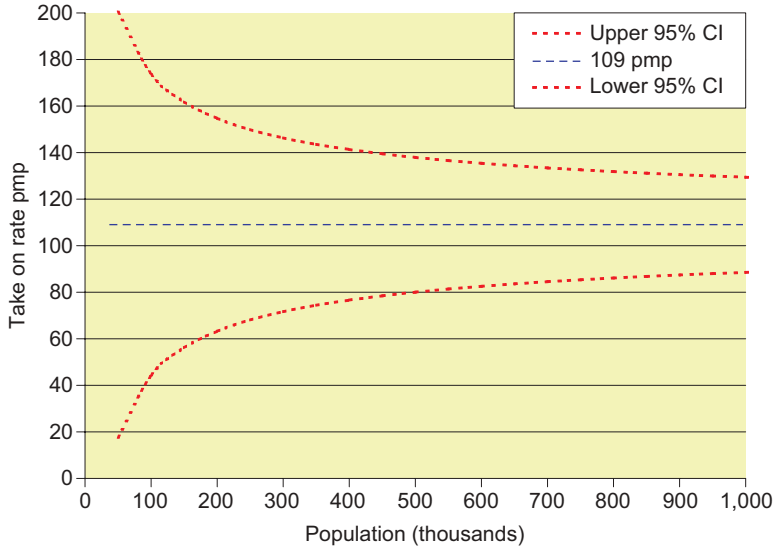

Figure 3.2: 95% confidence limits for take on rate of 109 pmp for population size 50,000–1 million

Ireland because data were only available for one year. Twenty-five areas had a significantly low take on rate (shaded and italicised in Table 3.3), 24 in England. All of these had ethnic minority populations of less than 10% (except Oldham, 13.9%). Nine areas had a standardised acceptance ratio less than 0.7 (excluding two Scottish areas with very small numbers). These were Isle of Wight, Blackpool, Stirling, Hertfordshire, Wiltshire, Lancashire, Bury, Salford and Oldham. Thirty-seven had significantly high standardised acceptance ratios (shaded and bold in Table 3.3). Seven of these were in Scotland and ethnicity data were not available, and 14 had ethnic minority populations of greater than 10%. Of the remaining 16, 12 were in Wales or the Southwest of England.

In Figure 3.3 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

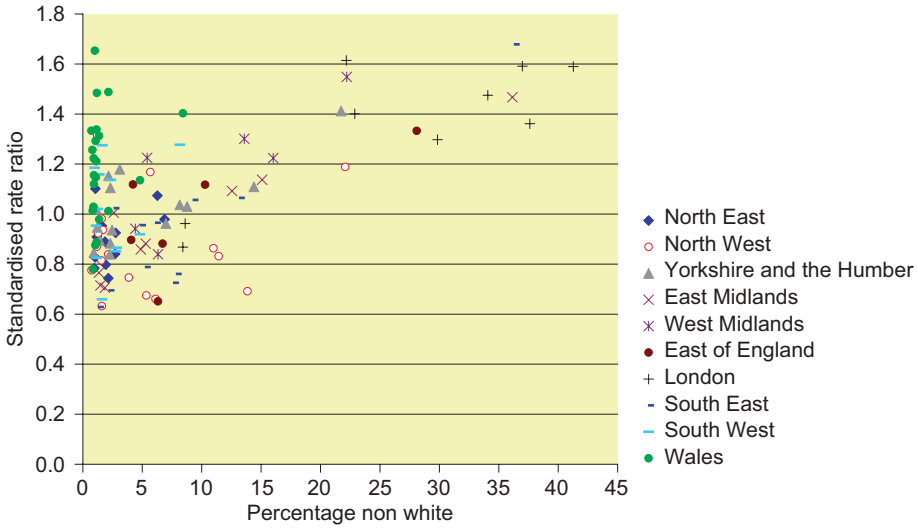

Figure 3.3: Relationship between ethnic mix and acceptance ratio

population (and/or a socially deprived population, as shown in previous reports) have high standardised acceptance rate ratios; although some areas with a very low ethnic minority population also have high standardised acceptance rate ratios. These age standardised rates (Table 3.3) are all relative to an overall acceptance rate which still needs to be adjusted for social deprivation and ethnicity so that the population RRT requirement can be calculated.

Ethnicity

Only 30 of the 65 renal units which submitted returns (46%) provided 90% or more complete ethnicity data (Table 3.4 includes only centres with 50% or more returns). Nevertheless, this is an improvement on previous years. The percentage of renal units providing ethnicity data less than 50% complete also improved (ie decreased) to 31% (20 units). This degree of incompleteness still makes analysis of ethnicity data unreliable.

Within the renal units with over 90% returns there is a huge variation in the percentages of new patients from the ethnic minorities ranging from 0% (Belfast, Antrim, Newry, Tyrone, Ulster, York, Gloucester, Carlisle, Airdrie) to over 40% (Royal Free, Bradford, Hammersmith and Charing Cross and Barts/Royal London). The latter renal units all include areas with high standardised acceptance rates.

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

			Percentage in each ethnic group				
	Centre	**Completion %**	**White**	**Black**	**Asian**	**Chinese**	**Other**
England	Gloucester	100	100				
	Carlisle	100	100				
	Dorset	100	98				2
	Dudley	100	92	5	3		
	Stevenage	100	81	2	16	1	
	Wolverhampton	100	78	5	15	1	
	Reading	100	76	7	15	1	1
	H&CX	100	43	11	25		21
	Nottingham	99	93	3	4		
	Middlesbrough	99	96		4		
	QEH	98	70	8	17	1	3
	York	98	100				
	Shrewsbury	98	95		5		
	Heartlands	98	73	6	20		2
	Newcastle	97	96		3		1
	Portsmouth	96	95	1	1	1	1
	Barts	95	40	16	29		15
	Royal Free	94	60	21	12	1	6
	ManWst	94	81	1	16	1	2
	Bradford	94	59	2	39		
	Basildon	93	96		4		
	Leicester	93	86	3	11		1
	Sunderland	90	96	2	2		
	Bristol	86	93	4	2	1	
	Kings	85	58	32	9	1	
	Oxford	85	87	5	6	1	2
	Preston	83	90		10		
	Ipswich	82	96	2	2		
	Cambridge	78	93	1	1	1	4
	Sheffield	76	90	1	6	1	3
	Coventry	75	81	5	13	2	
	Wirral	73	95	3			2.5
	Liverpool	71	94		3	3	1
	Derby	62	100				
	Southend	57	95	5.0			
	Guys	57	59	38	2	2	
N Ireland	Belfast	100	100				
	Newry	100	100				
	Tyrone	100	100				
	Ulster	100	100				
	Antrim	98	100				
Scotland	Dundee	95	99			1	
	Airdrie	92	100				
Wales	Swansea	99	97	2	1		
	Bangor	68	100				
England		**77**	**81**	**6**	**10**	**1**	**3**
N Ireland		**100**	**100**				
Scotland		**18**	**99**			**1**	
Wales		**41**	**98**	**1**	**1**		
UK		**69**	**83**	**5**	**9**	**1**	**2**

Details of centres with less than 50% returns are not shown.

Age

The median ages of patients starting renal replacement therapy are 65.2 years in England, 68.3 years in Northern Ireland, 65.4 years in Scotland, 67.5 years in Wales and 65.5 years for the whole UK (Table 3.5). Within the UK, there was a small increase in the median age of patients starting RRT from 63.9 years in 1998 to a plateau of 65.5 years in 2002.

In England the acceptance rate is highest in the 75–79 age band at 408 pmp, as in Scotland at 580 pmp; in Wales the peak is in the 80–84 age band at 525 pmp, as in Northern Ireland with a rate of 825 pmp (Table 3.6).

The median age of incident UK non white patients in 2005 was considerably lower, at 56.8 years, than that of whole incident cohort ($p < 0.001$; Wilcoxon test). This probably reflects the lower median age of the ethnic minority populations compared with the White population.

There remain large variations by centre in median age of new patients (Figure 3.4), the maximum (Tyrone) and the minimum (Barts and the London) are separated by over 2 decades. There are many possible reasons for these differences relating to local population demographics and the proportion of ethnic minorities in the catchment area. There may be differences in the prevalence, nature and management of renal disease and in approaches to conservative management.

Table 3.6: Acceptance rate pmp by age band and country

	Pmp			
Age	**England**	**Wales**	**Scotland**	**N Ireland**
16–19	13	7	12	10
20–24	32	24	54	46
25–29	38	30	38	35
30–34	42	55	60	39
35–39	61	57	74	85
40–44	83	113	82	111
45–49	97	103	113	146
50–54	98	130	91	173
55–59	148	204	215	169
60–64	214	242	222	258
65–74	329	447	374	520
75–79	408	501	580	773
80–84	345	525	419	825
85–89	162	282	253	496
90+	62	103	69	418

Table 3.5: Median age of patients starting renal replacement therapy 1998–2005

	Year							
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Country	**Median age**							
England	63.8	63.6	64.0	64.7	65.4	64.6	64.8	65.2
N Ireland	n/a	n/a	n/a	n/a	n/a	n/a	n/a	68.3
Scotland	64.4	66.0	64.8	66.6	65.3	66.6	65.4	65.4
Wales	63.6	64.3	66.6	65.4	66.8	66.4	68.7	67.5
UK	63.9	64.2	64.4	65.0	65.5	65.0	65.2	65.5

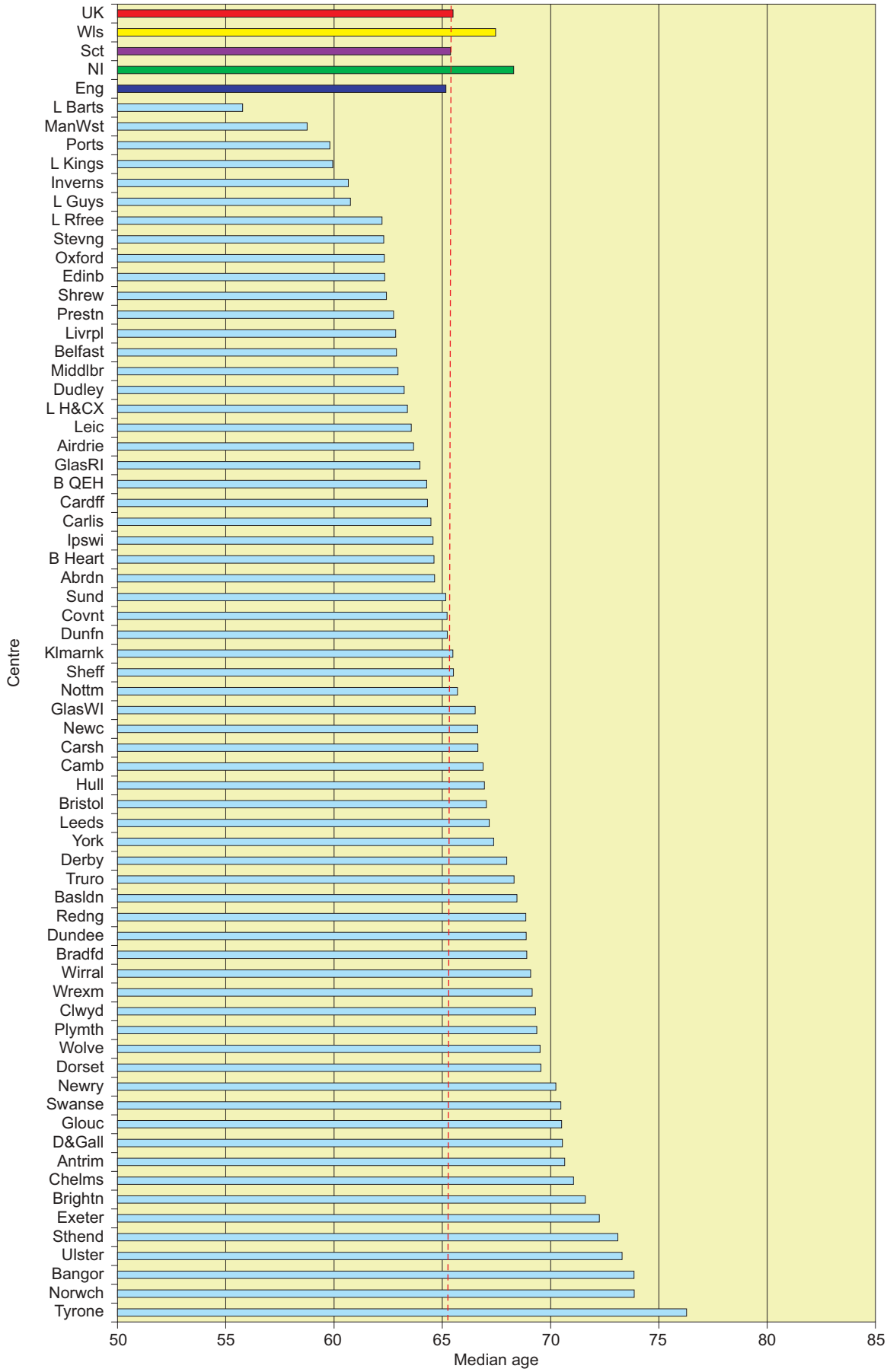

Figure 3.4: Median age of new patients in each centre in 2005

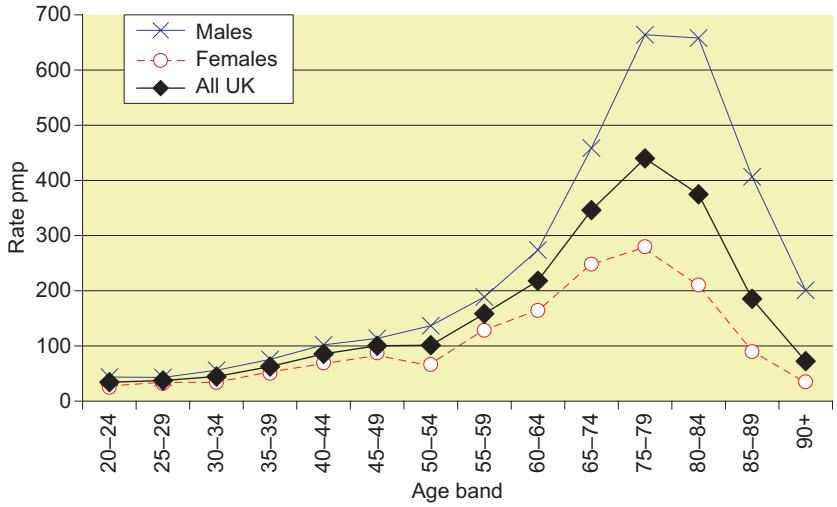

Figure 3.5: Incident rates by age and gender

Gender

As in previous years there was an excess of males starting RRT in all age groups (Figure 3.5). The ratio of males to females is fairly constant until the age of 75, but males are increasingly represented in the very old (Figure 3.6).

The mean UK male to female ratio in the 2005 incident cohort is 1.6:1. All reporting centres except Gloucester, Dumfries and Galloway, and Dunfermline report an excess of males in the 2005 incident cohort (Figure 3.7). The renal unit male to female ratio varies from 0.94 (Gloucester) to 6.5 (Carlisle). These high ratios are likely to be an effect of small numbers. All 5 renal units with a male to female ratio >2.5 in 2005 had a total take on number of 35 or less in that year.

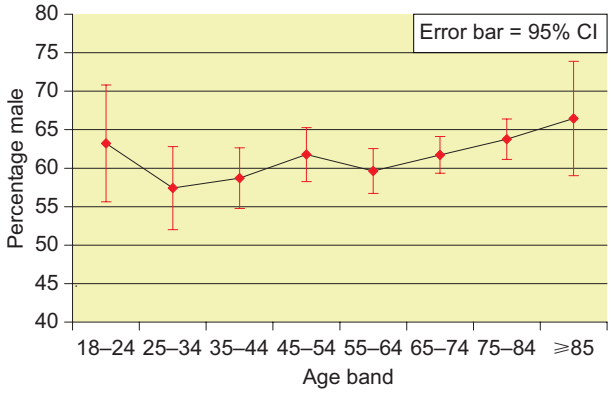

Figure 3.6: Percentage total starting RRT who are male, by age band

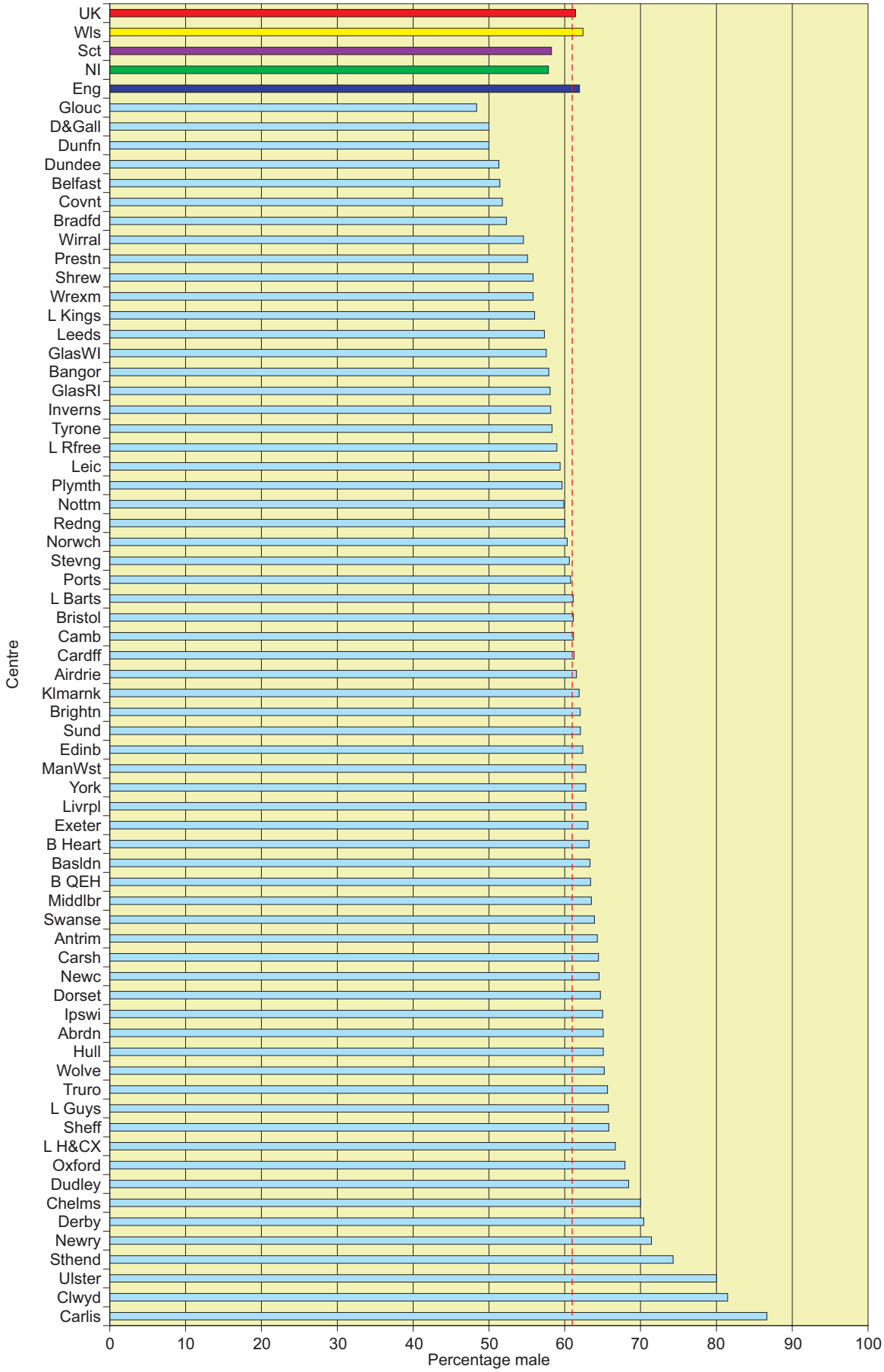

Figure 3.7: Percentage of new patients who are male in renal units reporting to UKRR in 2005

Primary renal diagnosis

The distribution of new patients by age, gender and cause of ERF is shown in Tables 3.7 and 3.8. For most types of kidney disease the male to female ratio is >1.5:1, as expected. The exception is adult polycystic kidney disease (APKD) for which the ratio approaches 1, as in the 2004 report. This would be expected from the mode of inheritance. Patients with APKD are relatively young when they develop ERF; approximately 4 times as many commence RRT in the under 65 cohort than the older cohort. This contrasts with renal vascular disease which is over 5 times more common in the older cohort. The gender imbalance may relate in part to the presence of factors, such as hypertension, atheroma and renal vascular disease, which are more common in males, and more common at increasing age. These factors may influence the rate of progression of renal failure.

The proportion of null returns for primary renal diagnosis has increased from a UK mean of 9.2% in 2004 to 12.0% in 2005. There is considerable national variation from 8.9% in Wales, through 10.1% in England, 16.9% in Northern Ireland, to 25% in Scotland. There is also very marked variation between centres (Table 3.8).

As in previous cohorts the diagnosis of aetiology uncertain/glomerulonephritis unproven is the most common and in patients over the age of 65 accounts for approximately 30% of all diagnoses. Some centre variation with respect to this diagnosis is likely to reflect the lack of clear definition of certain diagnostic categories eg hypertensive disease and renal vascular disease; some may result from differences between centres in the degree of certainty required to record other diagnoses. In keeping with this there are significant negative correlations between the frequency of the aetiology uncertain diagnosis and those of diabetes, glomerulonephritis, pyelonephritis and renal vascular disease.

Diabetic renal disease remains the most common specific primary renal diagnosis in the UK, at about 20%. Diabetic kidney disease generally follows the pattern of population distribution of ethnic minorities, but is also related to social deprivation. In the 33 centres with greater than 70% ethnicity returns, and excluding 4 centres who classified 60% or more of their patients as having an uncertain diagnosis, there was a significant correlation between the percentage of incident RRT patients with diabetic renal disease and the percentage non Whites in the incident cohort ($r = 0.60$, $p < 0.001$). Five of the 8 centres (62.5%) with 20% or more non Whites in their incident cohort had a mean incidence of diabetic renal disease in that cohort of greater than 25%, compared with only 1 of 25 (4%) centres with less non Whites ($p = 0.001$: Fisher's exact test).

Table 3.7: Percentage distribution of primary renal diagnosis by age, and gender ratio, in 2005 incident cohort

	UK <65		UK ⩾65		UK all		
Diagnosis		***Excluding not sent***		***Excluding not sent***		***Excluding not sent***	**M:F**
Aetiology unc./GN NP*	19.5	*21.8*	29.6	*34.0*	24.7	*28.0*	1.6
Glomerulonephritis	12.5	*14.0*	5.7	*6.6*	9.0	*10.3*	1.9
Pyelonephritis	8.2	*9.2*	6.3	*7.2*	7.2	*8.2*	1.7
Diabetes	19.7	*22.1*	15.3	*17.6*	17.5	*19.8*	1.6
Reno-vascular disease	2.0	*2.2*	11.1	*12.8*	6.7	*7.6*	1.8
Hypertension	4.0	*4.5*	4.4	*5.0*	4.2	*4.8*	2.4
Polycystic kidney	8.5	*9.5*	2.4	*2.8*	5.4	*6.1*	1.1
Other	14.8	*16.6*	12.1	*13.9*	13.4	*15.2*	1.4
Not sent	10.8	–	13.1	–	12.0	–	1.6
No of patients	2,897	*2,584*	3,034	*2,638*	5,931	*5,222*	

*GN NP, glomerulonephritis not proven.

Table 3.8: Percentage distribution of primary renal diagnosis by centre in 2005 incident cohort

Country	Treatment centre	*Not sent*	Aetiology unc./GN not proven	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Reno-vascular disease
England	Barts	***0.0***	14.4	31.1	12.8	7.8	16.1	6.7	8.3	2.8
	Basildon	***10.0***	22.2	18.5	0.0	0.0	25.9	11.1	11.1	11.1
	Bradford	***4.6***	16.1	24.2	8.1	11.3	16.1	4.8	9.7	9.7
	Brighton	***12.0***	30.5	16.8	5.3	3.2	13.7	6.3	13.7	10.5
	Bristol	***23.4***	20.9	23.1	17.2	3.7	16.4	6.0	8.2	4.5
	Cambridge	***0.0***	65.1	2.9	7.8	1.0	10.7	6.8	3.9	1.9
	Carlisle	***0.0***	0.0	20.0	33.3	3.3	20.0	13.3	0.0	10.0
	Carshalton	***24.4***	20.6	22.1	9.6	7.4	19.1	4.4	12.5	4.4
	Chelmsford	***0.0***	32.5	15.0	7.5	5.0	10.0	7.5	12.5	10.0
	Coventry	***0.0***	12.9	22.4	14.1	3.5	12.9	5.9	20.0	8.2
	Derby	***2.8***	18.8	30.4	5.8	0.0	18.8	7.3	7.3	11.6
	Dorset	***0.0***	19.6	15.7	13.7	5.9	21.6	5.9	5.9	11.8
	Dudley	***0.0***	29.0	31.6	7.9	2.6	2.6	15.8	5.3	5.3
	Exeter	***39.6***								
	Gloucester	***4.8***	25.4	13.6	13.6	0.0	23.7	6.8	10.2	6.8
	Guys	***0.0***	16.2	28.8	6.3	9.0	18.0	7.2	6.3	8.1
	H&CX	***6.1***	15.9	34.1	8.7	10.9	20.3	1.5	8.0	0.7
	Heartlands	***0.8***	29.8	33.1	6.5	2.4	9.7	8.1	6.5	4.0
	Hull	***0.8***	24.8	17.6	9.6	7.2	12.0	7.2	13.6	8.0
	Ipswich	***1.7***	61.0	10.2	10.2	0.0	10.2	3.4	5.1	0.0
	Kings	***1.4***	25.2	23.0	10.8	7.9	14.4	6.5	7.9	4.3
	Leeds	***38.4***								
	Leicester	***16.1***	29.3	18.6	12.2	3.7	9.6	6.9	10.6	9.0
	Liverpool	***1.2***	60.5	13.0	3.1	6.2	9.3	2.5	3.7	1.9
	ManWst	***0.0***	83.7	3.1	4.7	0.0	3.1	1.6	1.6	2.3
	Middlesbrough	***1.4***	32.9	21.9	9.6	12.3	12.3	2.7	5.5	2.7
	Newcastle	***1.1***	21.7	12.0	10.9	6.5	27.2	9.8	6.5	5.4
	Norwich	***0.8***	39.2	10.8	13.3	2.5	10.8	4.2	11.7	7.5
	Nottingham	***0.0***	27.2	23.8	6.1	5.4	23.1	5.4	4.1	4.8
	Oxford	***4.5***	22.8	24.2	12.1	2.7	15.4	6.7	8.7	7.4
	Plymouth	***0.0***	12.3	15.8	17.5	3.5	19.3	5.3	10.5	15.8
	Portsmouth	***5.9***	15.3	13.2	13.9	5.6	25.0	10.4	9.7	6.9
	Preston	***3.4***	15.8	21.1	14.0	7.9	14.0	8.8	13.2	5.3
	QEH	***17.5***	12.5	23.1	15.0	1.9	23.1	8.8	4.4	11.3
	Reading	***0.0***	20.0	28.0	4.0	4.0	22.7	4.0	10.7	6.7
	Royal Free	***99.3***								
	Sheffield	***0.0***	39.9	17.1	9.5	2.5	12.7	3.8	7.6	7.0
	Shrewsbury	***0.0***	18.6	20.9	20.9	7.0	27.9	0.0	2.3	2.3
	Southend	***14.3***	33.3	16.7	0.0	0.0	20.0	3.3	6.7	20.0
	Stevenage	***0.0***	59.6	5.1	5.1	1.0	16.2	5.1	5.1	3.0
	Sunderland	***0.0***	5.2	13.8	12.1	41.4	12.1	6.9	8.6	0.0
	Truro	***18.8***	23.1	7.7	15.4	0.0	19.2	7.7	7.7	19.2
	Wirral	***0.0***	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wolverhampton	***0.0***	18.5	26.1	8.7	4.4	13.0	5.4	7.6	16.3
	York	***7.0***	20.0	12.5	17.5	2.5	25.0	0.0	2.5	20.0

Table 3.8: (continued)

Country	Treatment centre	*Not sent*	Aetiology unc./GN not proven	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Reno-vascular disease
N Ireland	Antrim	***0.0***	21.4	23.8	11.9	4.8	11.9	4.8	7.1	14.3
	Belfast	***26.8***								
	Newry	***7.1***	11.5	23.1	7.7	0.0	11.5	7.7	3.9	34.6
	Tyrone	***8.3***	4.6	22.7	4.6	9.1	9.1	4.6	9.1	36.4
	Ulster	***0.0***	0.0	0.0	0.0	20.0	40.0	0.0	10.0	30.0
Scotland	Aberdeen	***96.8***								
	Airdrie	***15.4***	9.1	24.2	15.2	9.1	15.2	6.1	15.2	6.1
	Dumfries	***33.3***								
	Dundee	***5.3***	8.3	23.6	4.2	4.2	13.9	1.4	8.3	36.1
	Dunfermline	***27.3***								
	Edinburgh	***22.8***	14.1	12.8	21.8	3.9	14.1	14.1	10.3	9.0
	Glasgow RI	***13.7***	30.8	19.6	11.2	0.0	15.9	5.6	8.4	8.4
	Glasgow WI	***16.2***	27.7	20.5	6.0	3.6	16.9	6.0	7.2	12.1
	Inverness	***4.7***	4.9	22.0	22.0	4.9	4.9	19.5	14.6	7.3
	Kilmarnock	***35.7***								
Wales	Bangor	***2.6***	32.4	27.0	13.5	13.5	10.8	0.0	2.7	0.0
	Cardiff	***6.2***	34.7	24.0	12.0	2.4	12.6	7.2	3.0	4.2
	Clwyd	***0.0***	55.6	37.0	0.0	0.0	0.0	7.4	0.0	0.0
	Swansea	***1.0***	21.9	19.8	11.5	3.1	15.6	3.1	10.4	14.6
	Wrexham	***48.8***								
England		***10.1***	29.1	19.5	10.1	5.1	15.6	5.9	8.1	6.6
N Ireland		***16.9***	16.4	18.4	10.0	3.0	15.9	7.5	12.4	16.4
Scotland		***25.0***	19.9	20.3	11.3	3.7	14.0	8.2	9.7	12.9
Wales		***8.9***	32.4	24.1	11.2	3.4	12.0	5.4	4.9	6.6
Total		***12.0***	**28.0**	**19.8**	**10.3**	**4.8**	**15.2**	**6.1**	**8.2**	**7.6**

For those centres with a high percentage of missing primary diagnoses, the percentage in the other diagnostic categories has not been calculated. The percentage by each category has been calculated after excluding those patients with a missing diagnosis.

First established treatment modality

In the UK in 2005 haemodialysis was the first modality of RRT in 75.5% of patients, peritoneal dialysis in 21.4% and pre-emptive transplant in 3.1% (defined as first treatment recorded irrespective of any later change). This represents little change from the figures recorded in the 2004 report but a significant change from 1998 when the very first treatment modality was haemodialysis in 57.7%. Many patients, especially those referred late to renal units, undergo a brief period of haemodialysis before being established on peritoneal dialysis. As an indication of the elective treatment modality, the established modality at 90 days is more representative. By day 90 of treatment, 8.4% had died, a further 1.2% had stopped treatment or been transferred out, leaving 90.4% of the original cohort on RRT. Of these remaining patients 70.6% were on HD, 26.2% on PD and 3.2% had received a transplant (Figure 3.8).

In Table 3.9 these variables are represented as a percentage of the whole 2005 cohort, showing for the whole UK, 63.8% on HD, 23.7% on PD and 2.9% with a transplant. The percentage of the incident cohort which had died by day 90 varied considerably between individual renal units (0 to 35%). Small numbers are the likeliest explanation for these differences. Both of the two renal units with zero death rate and six of the seven units with a death rate above 15% took on less than 45 patients during the year. In addition the median age of incident patients was greater than 68 years in six of the seven with the higher death rate.

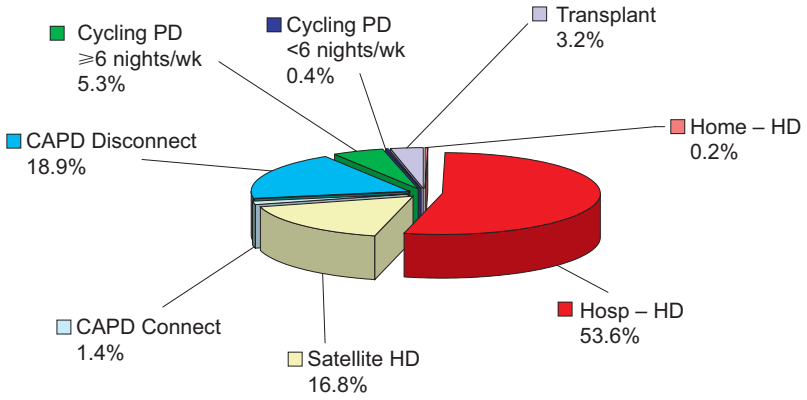

Figure 3.8: RRT modality at 90 days in the 2005 cohort

Table 3.9: Treatment modality at day 90

		Percentage of patients on each modality					
Country	**Centre**	**HD**	**PD**	**Tx**	**Transferred**	**Stopped treatment**	**Died**
England	Barts	59.0	36.4	1.7	0.6	0.0	2.3
	Basildon	50.0	27.5	2.5	0.0	5.0	15.0
	Bradford	72.1	16.4	0.0	1.6	0.0	9.8
	Brighton	66.7	25.2	0.0	0.0	0.0	8.1
	Bristol	63.0	16.7	4.3	0.0	3.7	12.4
	Cambridge	69.6	19.0	8.9	0.0	0.0	2.5
	Carlisle	80.0	20.0	0.0	0.0	0.0	0.0
	Carshalton	66.7	21.0	2.2	1.1	0.5	8.6
	Chelmsford	69.2	18.0	0.0	0.0	0.0	12.8
	Coventry	61.0	25.6	6.1	1.2	1.2	4.9
	Derby	58.2	37.3	0.0	0.0	0.0	4.5
	Dorset	35.4	58.3	0.0	0.0	0.0	6.3
	Dudley	46.3	41.5	0.0	0.0	0.0	12.2
	Exeter	54.7	32.5	0.9	0.0	0.0	12.0
	Gloucester	63.5	25.4	1.6	0.0	1.6	7.9
	Guys	74.8	12.2	9.4	0.0	0.0	3.7
	H&CX	75.3	15.4	1.2	2.5	0.0	5.6
	Heartlands	72.4	13.8	0.0	0.0	0.8	13.0
	Hull	63.9	21.3	0.0	1.6	0.8	12.3
	Ipswich	41.2	45.6	0.0	4.4	0.0	8.8
	Kings	67.3	23.4	4.7	0.9	0.0	3.7
	Leeds	70.7	14.7	1.3	1.3	0.0	11.5
	Leicester	55.7	28.1	8.9	0.0	0.0	7.4
	Liverpool	66.9	18.3	3.5	0.7	2.1	8.5
	ManWst	55.9	35.1	4.5	0.0	0.0	4.5
	Middlesbrough	77.9	5.8	0.0	1.2	0.0	15.1
	Newcastle	62.9	15.7	13.5	0.0	1.1	6.7
	Norwich	70.5	17.2	0.0	0.0	0.0	12.3
	Nottingham	58.7	26.8	1.5	0.0	0.7	12.3
	Oxford	52.4	28.6	10.7	2.4	0.0	6.0
	Plymouth	68.4	14.0	5.3	0.0	0.0	12.3
	Portsmouth	54.7	30.9	6.5	0.0	0.0	7.9
	Preston	49.1	44.4	0.9	0.0	0.9	4.6
	QEH	66.7	26.3	2.0	0.0	0.0	5.1

Table 3.9: (continued)

		Percentage of patients on each modality					
Country	**Centre**	**HD**	**PD**	**Tx**	**Transferred**	**Stopped treatment**	**Died**
England	Reading	50.0	40.3	0.0	4.2	0.0	5.6
	Royal Free	62.5	27.1	7.3	1.0	0.0	2.1
	Sheffield	64.4	23.0	1.7	0.6	0.0	10.3
	Shrewsbury	53.3	37.8	0.0	0.0	2.2	6.7
	Southend	63.3	20.0	0.0	0.0	0.0	16.7
	Stevenage	79.4	15.9	0.0	1.6	0.0	3.2
	Sunderland	84.1	4.6	2.3	0.0	0.0	9.1
	Truro	75.0	19.4	0.0	0.0	0.0	5.6
	Wirral	76.8	16.1	0.0	0.0	0.0	7.1
	Wolverhampton	74.4	15.9	0.0	0.0	1.2	8.5
	York	66.0	26.4	0.0	0.0	0.0	7.6
N Ireland	Antrim	75.8	24.2	0.0	0.0	0.0	0.0
	Belfast	61.1	17.6	0.9	0.0	7.4	13.0
	Newry	69.6	26.1	0.0	0.0	0.0	4.4
	Tyrone	64.7	0.0	0.0	0.0	0.0	35.3
	Ulster	83.3	16.7	0.0	0.0	0.0	0.0
Scotland	Aberdeen	65.0	25.0	1.7	0.0	0.0	8.3
	Airdrie	79.1	18.6	0.0	0.0	0.0	2.3
	Dumfries	52.9	23.5	0.0	0.0	5.9	17.7
	Dundee	50.0	32.9	1.4	0.0	1.4	14.3
	Dunfermline	60.0	30.0	0.0	0.0	0.0	10.0
	Edinburgh	67.9	17.9	6.3	0.9	0.9	6.3
	Glasgow RI	76.8	11.1	0.0	0.0	0.0	12.1
	Glasgow WI	64.8	24.8	1.9	0.0	0.0	8.6
	Inverness	50.0	44.1	0.0	0.0	0.0	5.9
	Kilmarnock	62.2	32.4	0.0	0.0	0.0	5.4
Wales	Bangor	58.1	22.6	0.0	0.0	0.0	19.4
	Cardiff	67.6	17.3	6.4	0.0	0.0	8.7
	Clwyd	73.9	17.4	0.0	0.0	0.0	8.7
	Swansea	64.1	19.6	2.2	0.0	0.0	14.1
	Wrexham	44.7	23.7	7.9	5.3	0.0	18.4
England		**63.5**	**24.3**	**3.1**	**0.7**	**0.5**	**8.0**
N Ireland		**65.8**	**18.2**	**0.5**	**0.0**	**4.3**	**11.2**
Scotland		**65.0**	**23.7**	**1.8**	**0.2**	**0.5**	**8.9**
Wales		**63.9**	**19.1**	**4.5**	**0.6**	**0.0**	**12.0**
UK		**63.8**	**23.7**	**2.9**	**0.6**	**0.6**	**8.4**

There were major differences between individual renal units in the percentage of new patients established on HD at 90 days (range 38–100%, Figure 3.9). Only 2 renal units had less than 50% on HD, whilst 19 had 80% or more. A significantly higher proportion ($p < 0.0001$) of incident dialysis patients over the age of 65 (82.0%) were on HD at 90 days compared with their younger counterparts (63.7%) (Table 3.10). This translates to the proportion of patients on PD being twice as high in patients aged <65 years as the proportion in older patients (36.3% vs 18.0%). This trend appears to be increasing. These overall differences were reflected in the vast majority of renal units though in 5 the proportions were reversed and PD was more popular in the elderly (Dorset, Ulster, Clwyd, Inverness, and Southend). The male:female ratio in patients on HD was 1.70 compared with a ratio of 1.57 for patients on PD.

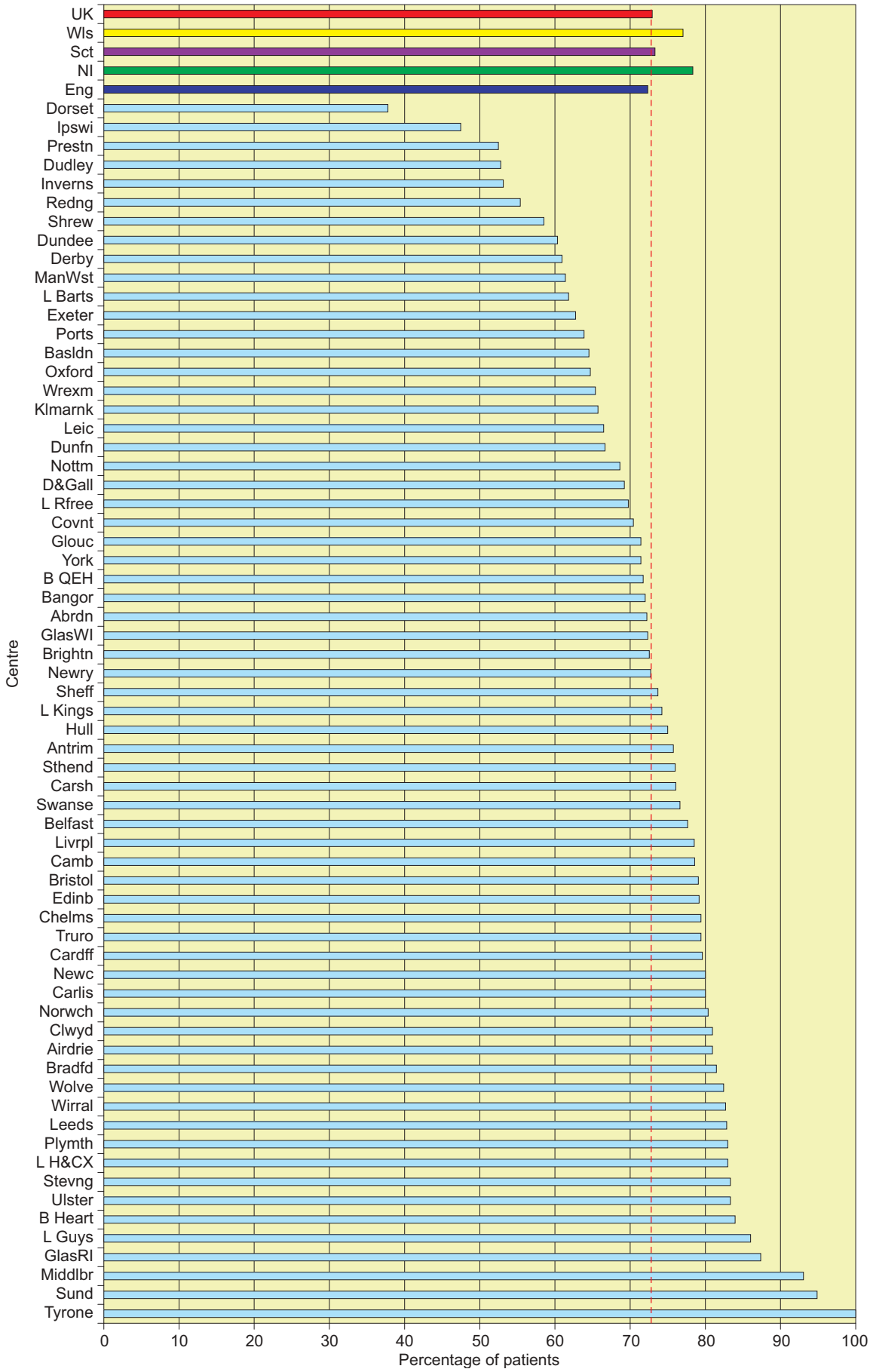

Figure 3.9: Percentage of incident dialysis patients in each centre on HD on day 90

Table 3.10: Take on figures for new patients on dialysis by modality and age

	Aged <65 (%)		Aged >65 (%)			Aged <65 (%)		Aged >65 (%)	
Treatment centre	**HD**	**PD**	**HD**	**PD**	**Treatment centre**	**HD**	**PD**	**HD**	**PD**
Aberdeen	56.7	43.3	91.7	8.3	H&CX	73.8	26.3	94.0	6.0
Airdrie	70.8	29.2	94.4	5.6	Kings	66.0	34.0	84.1	15.9
Antrim	58.3	41.7	85.7	14.3	Royal Free	58.7	41.3	82.5	17.5
Heartlands	78.4	21.6	89.1	10.9	Leeds	69.5	30.5	93.3	6.7
QEH	65.6	34.4	78.4	21.6	Leicester	65.1	34.9	67.9	32.1
Bangor	50.0	50.0	82.4	17.6	Liverpool	74.3	25.7	84.3	15.7
Basildon	53.3	46.7	75.0	25.0	ManWst	57.1	42.9	66.7	33.3
Belfast	75.5	24.5	80.6	19.4	Middlesbrough	90.5	9.5	96.7	3.3
Bradford	70.0	30.0	88.2	11.8	Newcastle	77.1	22.9	82.9	17.1
Brighton	59.5	40.5	80.0	20.0	Newry	40.0	60.0	100.0	
Bristol	68.2	31.8	90.5	9.5	Norwich	67.5	32.5	88.1	11.9
Cambridge	76.5	23.5	80.6	19.4	Nottingham	54.2	45.8	83.1	16.9
Cardiff	70.1	29.9	87.5	12.5	Oxford	51.4	48.6	78.8	21.2
Carlisle	69.2	30.8	91.7	8.3	Plymouth	78.3	21.7	87.5	12.5
Carshalton	68.6	31.4	84.4	15.6	Portsmouth	58.8	41.2	70.6	29.4
Chelmsford	66.7	33.3	86.4	13.6	Preston	43.3	56.7	65.9	34.1
Clwyd	85.7	14.3	78.6	21.4	Reading	51.9	48.1	57.9	42.1
Coventry	61.8	38.2	78.4	21.6	Sheffield	61.6	38.4	84.8	15.2
Dumfries	60.0	40.0	75.0	25.0	Shrewsbury	43.5	56.5	77.8	22.2
Derby	50.0	50.0	71.9	28.1	Stevenage	75.0	25.0	92.9	7.1
Dorset	50.0	50.0	29.6	70.4	Southend	77.8	22.2	75.0	25.0
Dudley	44.0	56.0	72.7	27.3	Sunderland	90.9	9.1	100.0	
Dundee	47.8	52.2	68.6	31.4	Swansea	64.5	35.5	84.8	15.2
Dunfermline	55.0	45.0	81.3	18.8	Truro	73.3	26.7	84.2	15.8
Edinburgh	67.4	32.6	90.0	10.0	Tyrone	100.0		100.0	
Exeter	44.4	55.6	77.2	22.8	Ulster	100.0		80.0	20.0
Glasgow RI	80.5	19.5	93.5	6.5	Wirral	72.2	27.8	88.2	11.8
Glasgow WI	47.7	52.3	94.0	6.0	Wolverhampton	75.8	24.2	87.8	12.2
Gloucester	54.2	45.8	84.4	15.6	Wrexham	33.3	66.7	82.4	17.6
Hull	59.1	40.9	86.7	13.3	York	59.1	40.9	81.5	18.5
Inverness	56.3	43.8	50.0	50.0	**England**	**63.9**	**36.1**	**80.9**	**19.1**
Ipswich	36.4	63.6	61.5	38.5	**N Ireland**	**68.5**	**31.5**	**86.9**	**13.1**
Kilmarnock	35.3	64.7	94.4	5.6	**Scotland**	**59.8**	**40.2**	**86.1**	**13.9**
Barts	60.2	39.8	65.4	34.6	**Wales**	**65.6**	**34.4**	**85.1**	**14.9**
Guys	81.6	18.4	90.9	9.1	**UK**	**63.7**	**36.3**	**82.0**	**18.0**

Survival of incident patients

This analysis is to be found in Chapter 12.

Late referral of incident patients

Methodology

Data were included from all incident patients in the years 2000–2005 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 is only available for a handful of people.
3. The small number of patients who recovered sufficient renal function to allow discontinuation of dialysis.

Referral time was calculated as the number of days between the date of first being seen by a nephrologist and the date of RRT initiation. A small proportion of data (1.8%) was excluded

Table 3.11: Percentage completeness of data from the centres and years included in the data set

	Year					
Centre	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Bangor					97.2	89.5
Basildon				96.2	95.7	90.0
Bradford					95.2	100.0
Bristol	95.2	90.1				
Dorset				98.6	100.0	100.0
Exeter		78.6	77.8			
Gloucester						91.9
Ipswich			86.4			94.9
Leeds				76.1	87.7	88.3
Leicester		89.7	87.4	92.9	92.0	
Middlesbrough		84.1	91.0	92.3	87.3	90.5
Nottingham	98.2	99.2	93.8	99.1	98.1	98.6
Portsmouth		97.8	95.0	95.0	93.2	91.5
Preston		83.2				
Sheffield	94.8	95.4	97.4	98.1	98.2	97.4
Stevenage				95.9	86.9	
Swansea						93.8
Truro				75.5		
Tyrone						91.7
Ulster						90.0
Wolverhampton				79.3	99.0	97.8
York			87.3	82.8	93.6	

because of actual or potential inconsistencies. Only data from those centres/years with 75% or more completeness were used. Centre/years where 10% or more of the referral times were zero were excluded. After these exclusions, data on 5,611 patients were available for analysis. Referral times of 90 days or more were defined as early referrals. Referral times of less than 90 days were defined as late referrals. 29 people were calculated to have negative referral times (−1 to −14 days). These were attributed as zero. After the exclusions outlined, the data available for analysis are detailed in Table 3.11, which shows the percentage completeness of data from the centres and years included in the data set.

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 2000–2005 is shown in Table 3.12. The range in 2005 was 13–48%. The mean annual incidence of late referral in 2005 was 29.8%, which was similar to the value in 2000.

Time referred before dialysis initiation in the 2005 incident cohort

Just over half the patients (52.6%) had been referred over a year before they needed to start dialysis. There were 10.3% of patients referred within 6–12 months, 7.3% within 3–6 months and 29.8% within 3 months.

Age and late referral

Patients who were referred late (<90 days before dialysis initiation) were significantly older than patients referred earlier (median age 67.7 vs 64.3 years: $p < 0.001$). Furthermore the median duration of pre-dialysis care diminished progressively with increasing age beyond the 45–54 age group (Figure 3.10).

Table 3.12: Percentage of patients referred to a nephrologist less than 90 days before dialysis initiation

	Year					
Centre	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Bangor					34.3	41.2
Basildon				39.2	36.4	18.5
Bradford					16.9	32.3
Bristol	30.4	25.7				
Dorset				23.2	19.4	37.3
Exeter		32.5	17.5			
Gloucester						21.1
Ipswich			39.5			48.2
Leeds				36.4	28.7	32.6
Leicester		21.1	28.8	19.1	22.0	
Middlesbrough		17.4	32.7	26.0	31.5	13.4
Nottingham	39.3	31.6	38.2	28.8	33.3	31.3
Portsmouth		42.6	33.6	24.6	30.9	26.4
Preston		20.2				
Sheffield	21.1	25.5	20.8	27.2	20.2	20.7
Stevenage				30.5	19.2	
Swansea						44.0
Truro				15.0		
Tyrone						22.7
Ulster						33.3
Wolverhampton				24.6	30.7	29.9
York			21.8	22.9	27.3	
Total	**29.9**	**27.3**	**28.6**	**26.9**	**26.4**	**29.8**

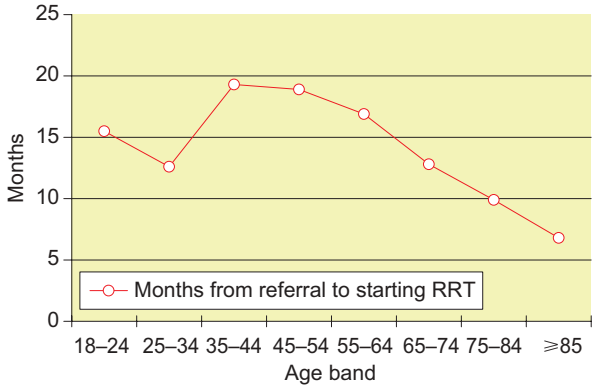

Figure 3.10: Duration of pre-dialysis care by age

Gender and late referral

There was a borderline significant difference in the male:female ratio in those referred late (<90 days) and those referred earlier (1.79 vs 1.59: $p = 0.047$), with late referral more common in males.

Ethnicity, social deprivation and late referral

Patients from the Chinese ethnic minority were excluded from this analysis as the numbers with referral data were too small ($n = 17$). Thirty patients with an ethnic background of 'other' were also excluded. The proportion of non Whites (South Asian and Black) referred late (<90 days) was significantly lower than in Whites (21.7% vs 27.7%: $p = 0.012$), implying that late referral may be less common in non Whites. This will be partly due to the high incidence of diabetes in non Whites (which tends to be referred earlier) and the Whites being an older group. Advancing age is also associated with late referral.

Importantly in the UK, there was no relationship between social deprivation and referral pattern.

Table 3.13: Early and late referral by primary renal diagnosis

	Early referral		Late referral	
Diagnosis	**N**	**%**	**N**	**%**
Diabetes	174	84.1	33	15.9
Glomerulonephritis	78	75.0	26	25.0
Pyelonephritis	66	77.6	19	22.4
Polycystic kidney disease	47	88.7	6	11.3
Reno-vascular disease	108	70.1	46	29.9
Other	101	52.6	91	47.4
Aetiology unc/GN NP*	180	66.4	91	33.6
Not sent	49	62.8	29	37.2

*GN NP – glomerulonephritis not proven.

Primary renal disease and late referral in 2005 incident cohort

Late referral (<3 months) differs significantly between primary renal diagnoses (Table 3.13, 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 with a diagnosis of 'other identified category' or 'not sent' appear to have higher rates of late referral, those with diabetes and polycystic disease have lower rates.

Modality and late referral

Referral pattern had a marked effect on initial modality choice. The proportion of patients whose initial modality was PD was significantly less in the late referral group in comparison to the group referred earlier (13.2% vs 31.8%: $p < 0.0001$). By 90 days after dialysis initiation the difference was partially redressed, though the proportion on PD was still significantly lower after late referral (22.1 vs 34.7%: $p < 0.0001$).

Co-morbidity and late referral

Significantly fewer patients who had been referred late (<90 days) were assessed as having no co-morbidity compared to the group referred earlier (39.5% vs 44.5%: $p = 0.0046$). In terms of specific co-morbidities, peripheral vascular disease was significantly less common in the group referred late. On the other hand, liver disease and malignancy were significantly more common in those referred late, perhaps because of the potential for rapid decompensation in these conditions (Table 3.14).

Haemoglobin and late referral

Patients referred late had a significantly lower haemoglobin level at dialysis initiation than patients referred earlier (9.4 g/dl vs 10.3 g/dl: $p < 0.001$), presumably because of inadequate pre-dialysis care, and the lack of opportunity to optimise anaemia management.

Table 3.14: Frequency 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
Ischaemic heart disease	21.9	24.4	0.0955
Peripheral vascular disease	11.3	14.1	0.019
Cerebrovascular disease	10.7	11.0	0.82
Diabetes (not a cause of ERF)	7.1	7.6	0.63
COPD*	7.8	6.6	0.19
Liver disease	3.3	1.8	0.0067
Malignancy	19.0	9.6	<0.0001
Smoking	20.1	17.9	0.11

*COPD – chronic obstructive pulmonary disease.

Renal function at the time of starting RRT

Using the abbreviated 4 variable MDRD calculation, the eGFR of patients starting RRT was calculated. Data from patients with no available 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. Data from one centre (Hammersmith and Charing Cross) were excluded from analysis because of errors in the data extraction process of this item. The log of the eGFR was taken to normalise the data, and a two sample t-test was used to compare the means of the log(eGFR) of those patients with early referral against those with late referral (<3 months).

eGFR and late referral

Estimated GFR was slightly lower in patients referred late compared to earlier referrals (7.34 vs 7.58 ml/min/1.73 m^2: $p = 0.045$). In those over the age of 65 at the time of dialysis initiation the difference was more pronounced (7.41 vs 7.99 ml/min/1.73 m^2: $p = 0.0003$). In whites only, the difference between late and earlier referrals remained significant but there was little difference in Asians or in Blacks. There were no significant differences in eGFR between those referred late and those referred earlier when stratified by gender, Townsend score or primary renal disease, except that eGFR was significantly lower in patients with renal disease of uncertain aetiology who had been referred late rather than early (6.86 vs 7.40 ml/min/1.73 m^2: $p = 0.02$). When stratifying by co-morbidity there were no significant differences in eGFR between the referral groups except that amongst smokers eGFR was significantly lower in those who had been referred late rather than early (7.27 vs 7.95 ml/min/1.73 m^2: $p = 0.03$).

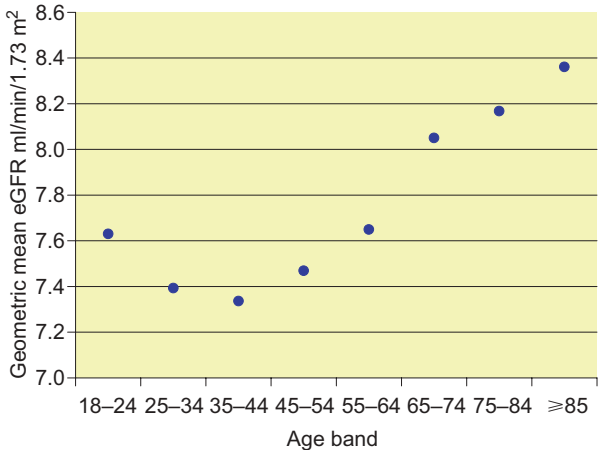

Figure 3.11: Geometric mean eGFR at start of RRT by age band

p value from an ANOVA to test for differences between these age groups is <0.0001

Table 3.15: Median eGFR at start of RRT in the UK, 2000–2005

Year	N	Median eGFR
2000	1,804	7.12
2001	2,285	7.24
2002	2,271	7.39
2003	2,527	7.80
2004	2,714	7.79
2005	2,861	7.85

eGFR and age

Older patient groups appear to have a higher geometric mean eGFR at start of dialysis than younger groups (Figure 3.11).

Changes over time in eGFR at start of RRT

Analysis of serial data shows a small rise in median eGFR prior to start of RRT in the period 2000–2003 which now appears to have reached a plateau for the last 3 years (Table 3.15).

There appears to have been a small increase in eGFR at start of RRT between 1997 and 2003, since when it has remained stable (Figure 3.12). There is no consistent difference between dialysis modalities in eGFR at start of RRT (Figure 3.12).

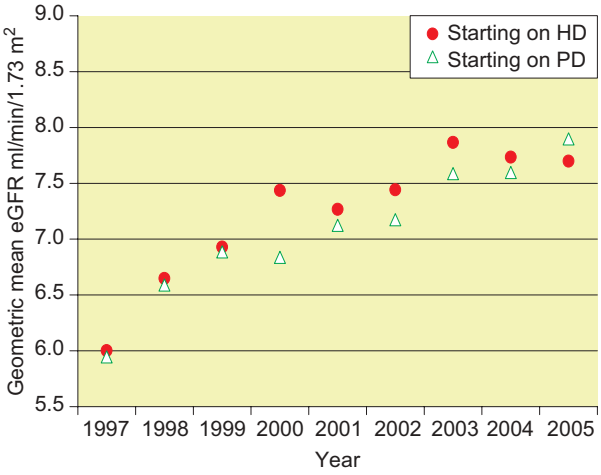

Figure 3.12: Change in eGFR on starting RRT 1997–2005; PD and HD

Chapter 4: All Patients Receiving Renal Replacement Therapy in the United Kingdom in 2005

Ken Farrington, Raman Rao, Retha Steenkamp, David Ansell and Terry Feest

Summary

- Summary data are provided for the whole UK.
- There were 41,776 adult patients alive on RRT in the UK at the end of 2005, a prevalence for adults of 694 pmp. Addition of the 748 children under age 18 on RRT gives a total prevalence of 706 pmp.
- The more detailed analysis includes data on 37,534 patients from 65 of the 70 units which returned detailed data to the Registry: all in Northern Ireland, Scotland, and Wales, and 45 of the 50 units in England.
- The annual increase in prevalence in the 38 renal units participating in the Registry since 2000 was 5.0%.
- There is substantial variation in the crude Local Authority area prevalence from 299 pmp to 1,275 pmp.
- In general, areas with large ethnic minority populations had high standardised prevalence ratios (SPR). Nevertheless several Local Authority areas in South Wales (Methyr Tydfil, Swansea, and Rhondda/Cynon/Taff) had a higher SPR than would be predicted from the local ethnic mix. Another group in North West England (Bury, Rochdale, Oldham and Salford), had a lower SPR than expected from the local ethnic mix.
- The median age of prevalent patients on RRT was 56.6 years, that of patients on HD 64.5 years, PD 59.2 years and transplanted patients 49.7 years.
- The median vintage of the whole RRT population was 5.1 years: that of transplanted patients was 9.8 years, HD patients 2.8 years and PD patients 2.1 years.
- The maximal prevalence rate (SPR) occurred in men (2,270 pmp) in the 75–79 year age band and women (1,144 pmp) in the 65–74 year age band.
- Of RRT patients in the UK, 45% had a transplant, 41.7% were on centre-based haemodialysis and 12% on peritoneal dialysis. The proportion of patients on home haemodialysis remained very small (1.2%) in spite of the recent NICE guidelines.
- The haemodialysis population is continuing to expand, mainly through growth in the proportion of patients undergoing dialysis in satellite units. The peritoneal dialysis population is continuing to contract in spite of the small but progressive rise in automated PD.
- The most common identifiable diagnosis in those under 65 was glomerulonephritis (18.0%) and in those over 65 it was diabetes (13.4%).
- One year survival rates of prevalent patients in the different centres contributing to the UK Renal Registry are presented. The centres agreed to remove anonymity.
- There is no evidence of any significant differences in survival of prevalent patients between UK centres.
- The one-year survival of prevalent dialysis patients increased significantly from 1998 to 2004 in England (83.3% to 87.1% $p = 0.0001$ for linear trend), Scotland (84.0% to 87.0% $p = 0.023$ for linear trend) and Wales (83.4% to 86.1% $p = 0.027$ for linear trend). The test for non-linearity in this trend (indicating that there has been a large increase which is now tailing off) was significant for England and Wales.

Introduction

The prevalence data presented are from the whole UK. In 2005, the UK Renal Registry received complete returns from all 5 units in Wales, all 5 units in Northern Ireland and 90% of the units in England. Data from all 10 units in Scotland were obtained from the Scottish Renal Registry. In addition summary data were obtained separately from the 5 remaining English units not currently returning to the Registry, to enable accurate calculation of prevalence and modality used.

Extrapolation from Registry data to derive other information relating to the whole UK was still necessary and these results must still be viewed with a little caution, although estimates become more reliable 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 (LA) areas whose population was thought to be fully covered by participating units) 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 comparisons between renal units and between local areas fully covered by the Renal Registry, the data from the Registry are fully valid. Data on children and young adults can be found in Chapter 13.

All adult patients receiving Renal Replacement Therapy in the UK, 31/12/2005

There were 41,776 adult patients receiving RRT in the UK at the end of 2005, giving a total population prevalence for adults of 694 pmp (Table 4.1). Addition of the 748 children under age 18 on RRT (Chapter 13) gives a total prevalence of 706 pmp.

In those renal units continuously reporting for the last 6 years there was an average rise in prevalence from year to year of between 4.2% and 6.5%.

Table 4.1: Prevalence of renal replacement therapy in adults in the UK, 31/12/2005

	England	Wales	Scotland	N. Ireland	UK
Centres contributing to RR (65)	30,343	2,075	3,810	1,306	37,534
All UK centres (65 + 5 = 70)	34,585	2,075	3,810	1,306	**41,776**
Total population from mid-2005 estimates from ONS web site (millions)	50.4	3.0	5.1	1.7	60.2
Prevalence pmp	686	701	748	757	694
Confidence intervals	679–693	671–732	724–772	716–798	687–700

Prevalent patients by renal unit on 31/12/2005

For 2005, detailed data on prevalent patients were returned from 45 of the 50 renal units in England, all 5 units in Wales, all 5 units in Northern Ireland and all 10 units in Scotland, a total of 37,534 patients. The number of prevalent patients in each renal unit and the distribution of their treatment modalities are shown in Table 4.2.

There is a wide variation in the number of prevalent patients in each unit and in the distribution of these patients in the different treatment modality categories. This is due to many factors including geography, local population density, age distribution, ethnic composition and social deprivation index of that population. Local facilities and preferences also play a role in determining the modality distribution. Some of these will be discussed later in the chapter. However another major factor is whether or

Table 4.2: Distribution of prevalent patients and modalities 31/12/2005

	Unit	HD	PD	Dialysis	Transplant	RRT
England	B Heart	334	43	377	164	541
	B QEH*	716	143	859	659	1,518
	Basldn	112	31	143	26	169
	Bradfd	168	44	212	155	367
	Brightn	297	90	387	231	618
	Bristol*	434	71	505	660	1,165
	Camb*	286	79	365	454	819
	Carlis	78	21	99	86	185
	Carsh	478	170	648	354	1,002
	Chelms	88	37	125	9	134
	Covnt*	277	65	342	296	638
	Derby	201	71	272	5	277
	Dorset	125	74	199	182	381
	Dudley	119	54	173	85	258
	Exeter	243	94	337	246	583
	Glouc	144	37	181	101	282
	Hull	298	68	366	222	588
	Ipswi	110	68	178	111	289
	Kent & Canterbury	*194*	*191*	*385*	*184*	*569*
	*L St George's**	*187*	*50*	*237*	*307*	*544*
	L Barts*	497	219	716	621	1,337
	L Guys*	404	87	491	734	1,225
	L H&CX	574	147	721	416	1,137
	L Kings	294	79	373	263	636
	L RFree*	550	149	699	647	1,346
	*L St Mary's**	*613*	*0*	*613*	*536*	*1,149*
	Leeds*	472	128	600	741	1,341
	Leic*	543	227	770	660	1,430
	Livrpl*	456	91	547	814	1,361
	ManWst	237	141	378	253	631
	*Man RI**	*333*	*167*	*500*	*920*	*1,420*
	Middlbr	237	23	260	313	573
	Newc*	232	47	279	588	867
	Norwch	232	49	281	128	409
	Nottm*	323	143	466	428	894
	Oxford*	389	119	508	688	1,196
	Plymth*	122	38	160	209	369
	Ports*	342	104	446	639	1,085

Table 4.2: (continued)

	Unit	HD	PD	Dialysis	Transplant	RRT
England	Prestn	333	112	445	327	772
	Redng	185	105	290	119	409
	Sheff*	549	158	707	459	1,166
	Shrew	124	51	175	61	236
	Stevng	318	53	371	196	567
	Sthend	119	21	140	41	181
	Stoke	*233*	*99*	*332*	*228*	*560*
	Sund	153	15	168	110	278
	Truro	141	40	181	88	269
	Wirral	161	31	192	–	192
	Wolve	290	57	347	93	440
	York	93	26	119	63	182
Wales	Bangor	73	27	100	1	101
	Cardff*	417	137	554	718	1,272
	Clwyd	64	12	76	7	83
	Swanse	267	79	346	127	473
	Wrexm	102	44	146	–	146
Scotland	Abrdn	179	48	227	190	417
	Airdrie	145	26	171	–	171
	D&Gall	49	13	62	7	69
	Dundee	148	50	198	161	359
	Dunfn	97	26	123	27	150
	Edinb*	237	61	298	372	670
	GlasRI	321	25	346	4	350
	GlasWI*	262	79	341	902	1,243
	Inverns	86	41	127	73	200
	Klmarnk	104	51	155	26	181
Northern Ireland	Antrim	106	21	127	62	189
	Belfast*	315	68	383	366	749
	Newry	90	15	105	50	155
	Tyrone	104	6	110	59	169
	Ulster	41	1	42	2	44
	Eng	**14,438**	**4,227**	**18,665**	**15,920**	**34,585**
	NI	**656**	**111**	**767**	**539**	**1,306**
	Sct	**1,628**	**420**	**2,048**	**1,762**	**3,810**
	Wls	**923**	**299**	**1,222**	**853**	**2,075**
	UK	**17,645**	**5,057**	**22,702**	**19,074**	**41,776**

Units in italics provided summary data only.
* – transplant centres. Those prefixed with "L" are London units.
The numbers of patients calculated for each country quoted above (by adding the patient numbers in each renal unit) differ marginally from those quoted elsewhere when patients are allocated to areas by their individual post codes, as some units treat patients from across national boundaries.

not the renal unit is also a transplant centre. The 23 renal units which are also transplant centres tend to have a higher proportion of transplant patients under follow up compared with the other 42 units, but are also the larger dialysis units. The transplant/dialysis ratio is markedly higher in transplant centres than in other renal units (1.17 vs 0.46: $p < 0.001$). The wide variability of this ratio both in transplanting (0.58–2.65) and non-transplanting (0.01–1.2) renal units suggests considerable variation in policies for follow up of transplanted patients; some transplant centres continue to follow up the patients they transplant for other renal units, others transfer them back to their parent unit but at variable times post transplant and

some renal units do not follow up any transplant patients.

Changes in prevalence 2000–2005

The total number of prevalent patients in all 65 centres contributing to the Registry in 2005 is 41,776. The increase from 2004 to 2005 in the 59 centres with data in both years was 4.6%, which is entirely consistent with 2000–2005 analysis. For individual centres, the changes in total numbers are shown in Table 4.3. There were wide variations between centres with respect to change in prevalent patient numbers between 2004 and 2005, ranging from an 18.6% increase (Clwyd) to a 5.5% decrease (Airdrie).

In some units (Wrexham, Hammersmith and Charing Cross, Leicester and Oxford) changes in the prevalent population are partly due to changes in catchment areas. This explanation is confirmed by the fact that the prevalence changes for the local authority areas served by these units have been consistent with national trends.

The growth in prevalent patient numbers in the UK since 1982 is shown in Figure 4.1.

The total percentage increase in number of prevalent patients in the 38 renal units who have returned data continuously from 2000 to 2005 was 27.8%. The rate of increase was similar in England (27.6%), Scotland (28.6%) and Wales (27.9%) and fairly uniform over the time span, varying between 4.2 and 6.5% per year (Table 4.4).

Table 4.3: Number of patients on RRT in each participating centre 2003–2005

Centre	31/12/2003	31/12/2004	31/12/2005	% change 2004–2005
Abrdn	349	388	417	7.5
Airdrie	172	181	171	−5.5
Antrim			189	
B Heart	487	497	541	8.9
B QEH		1,420	1,518	6.9
Bangor	96	94	101	7.4
Basldn	164	161	169	5.0
Belfast			749	
Bradfd	309	326	367	12.6
Brightn		592	618	4.4
Bristol	1,051	1,093	1,165	6.6
Camb	722	767	819	6.8
Cardff	1,154	1,225	1,272	3.8
Carlis	170	181	185	2.2
Carsh	885	956	1,002	4.8
Chelms		138	134	−2.9
Clwyd	64	70	83	18.6
Covnt	576	604	638	5.6
D&Gall	79	61	69	13.1
Derby	260	276	277	0.4
Dorset	352	369	381	3.3
Dudley	242	255	258	1.2
Dundee	299	321	359	11.8
Dunfn	127	136	150	10.3
Edinb	616	649	670	3.2
Exeter	520	575	583	1.4
GlasRI	325	330	350	6.1
GlasWI	1,165	1,192	1,243	4.3
Glouc	244	260	282	8.5

Table 4.3: (continued)

Centre	31/12/2003	31/12/2004	31/12/2005	% change 2004–2005
Hull	514	553	588	6.3
Inverns	160	179	200	11.7
Ipswi	240	280	289	3.2
Klmarnk	167	159	181	13.8
L Barts		1,297	1,337	3.1
L Guys	1,183	1,216	1,225	0.7
L H&CX	1,090	1,145	1,143	−0.2
L Kings	575	598	636	6.4
L RFree			1,346	
Leeds	1,228	1,299	1,341	3.2
Leic	1,119	1,271	1,430	12.5
Livrpl	1,251	1,295	1,361	5.1
ManWst	532	564	631	11.9
Middlbr	549	577	573	−0.7
Newc	804	809	867	7.2
Newry			155	
Norwch		360	409	13.6
Nottm	808	832	894	7.5
Oxford	1,397	1,200	1,196	−0.3
Plymth	346	351	369	5.1
Ports	1,030	1,051	1,085	3.2
Prestn	733	770	772	0.3
Redng	227	376	409	8.8
Sheff	1,084	1,149	1,166	1.5
Shrew		226	236	4.4
Stevng	561	544	567	4.2
Sthend	166	180	181	0.6
Sund	237	268	278	3.7
Swanse	419	454	473	4.2
Truro	230	277	269	−2.9
Tyrone			169	
Ulster			44	
Wirral	157	185	192	3.8
Wolve	399	424	440	3.8
Wrexm	202	188	146	−22.3
York	185	169	182	7.7
Eng	**22,621**	**27,731**	**30,343**	**9.4**
NI			**1,306**	
Sct	**3,459**	**3,596**	**3,810**	**6.0**
Wls	**1,935**	**2,031**	**2,075**	**2.2**
Total	**28,015**	**33,358**	**37,534**	**12.5**

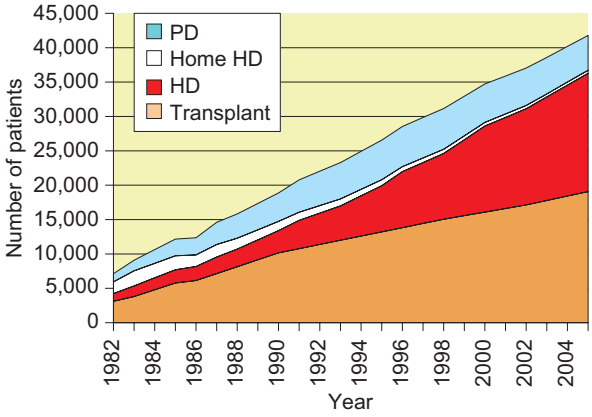

Figure 4.1: Growth in prevalent patients, by modality, 1982–2005

Table 4.4: Prevalent patient numbers in renal units reporting continuously 2000–2005

Centre	31/12/00	31/12/01	31/12/02	31/12/03	31/12/04	31/12/05	% change 2000–2005
Abrdn	311	327	354	349	388	417	34.1
Airdrie	104	148	171	172	181	171	64.4
B Heart	421	451	444	487	497	541	28.5
Bristol	911	950	992	1,051	1,093	1,165	27.9
Cardff	1,029	1,055	1,087	1,154	1,225	1,272	23.6
Carlis	156	159	161	170	181	185	18.6
Carsh	667	693	784	885	956	1,002	50.2
Covnt	513	545	564	576	604	638	24.4
D&Gall	55	72	73	79	61	69	25.5
Derby	124	162		260	276	277	123.4
Dudley	248	239	231	242	255	258	4.0
Dundee	238	248	288	299	321	359	50.8
Dunfn	90	112	119	127	136	150	66.7
Edinb	549	574	596	616	649	670	22.0
Exeter	416	446	508	520	575	583	40.1
GlasRI	332	320	321	325	330	350	5.4
GlasWI	1,048	1,090	1,110	1,165	1,192	1,243	18.6
Glouc	235	195	211	244	260	282	20.0
Hull	425	452	506	514	553	588	38.4
Inverns	96	124	147	160	179	200	108.3
Klmarnk	139	146	157	167	159	181	30.2
L Guys	1,124	1,144	1,180	1,183	1,216	1,225	9.0
Leeds	1,175	1,172	1,195	1,228	1,299	1,341	14.1
Leic	975	1,030	1,078	1,119	1,271	1,430	46.7
Middlbr	420	429	519	549	577	573	36.4
Nottm	761	818	788	808	832	894	17.5
Oxford	1,240	1,315	1,358	1,397	1,200	1,196	−3.5
Plymth	407	393	386	346	351	369	−9.3
Prestn	474	520	587	733	770	772	62.9
Redng	177	204	198	227	376	409	131.1
Sheff	863	941	1,020	1,084	1,149	1,166	35.1
Stevng	450	451	524	561	544	567	26.0
Sthend	141	143	149	166	180	181	28.4
Sund	227	217	235	237	268	278	22.5
Swanse	228	384	384	419	454	473	107.5

Table 4.4: (continued)

Centre	31/12/00	31/12/01	31/12/02	31/12/03	31/12/04	31/12/05	% change 2000–2005
Wolve	319	337	366	399	424	440	37.9
Wrexm	*222*	*203*	*202*	*202*	*188*	*146*	*−34.2*
York	97	130	160	185	169	182	87.6
Eng	**12,966**	**13,536**	**14,144**	**15,171**	**15,876**	**16,542**	**27.6**
Sct	**2,962**	**3,161**	**3,336**	**3,459**	**3,596**	**3,810**	**28.6**
Wls	**1,479**	**1,642**	**1,673**	**1,775**	**1,867**	**1,891**	**27.9**
Total	**17,407**	**18,339**	**19,153**	**20,405**	**21,339**	**22,243**	**27.8**

The figures for Leicester, Reading and Oxford are misleading as there has been a redistribution of catchment areas related to these units.

Local Authority prevalence

The prevalence of RRT and standardised prevalence ratios in those Local Authorities with complete coverage in 2005 are shown in Table 4.5.

Standardised prevalence ratios

Methods

The methods of calculating the standardised rate ratio are described in detail 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 and the data on the age and gender breakdown of the population of each Local Authority area obtained from the 2001 census data from the Office of National Statistics (ONS). These age and gender prevalences were then used to calculate the expected prevalence for each LA area. The age and gender standardised ratio is therefore equal to (observed prevalence)/(expected prevalence).

A ratio of 1 indicates that the LA area's prevalence was as 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 is 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 under one.

Prevalence estimates of RRT in relatively small populations such as those covered by individual Primary Care Trusts incur wide confidence intervals for any observed frequency. To enable assessment of whether an observed prevalence rate differs significantly from the national average, Figures 4.2 and 4.3 have been included. For any size of population (X axis), the upper and lower 95% confidence limits (dotted lines) around the national average prevalence can be read from the Y axis. Any observed prevalence for renal failure outside these limits is significantly different from the national average. Thus for a population of 50,000, an observed prevalence outside the limits of 470 to 930 pmp is significantly different, whilst for a population of 500,000 the limits are 625 to 770 pmp.

Results

There were substantial variations in the crude LA area prevalence from 299 (Bury) to 1,275 pmp (Carrickfergus). As discussed above, local authorities with small populations have wide confidence limits for standardised prevalence rate (SPR), such that the interpretation of an individual year may be difficult. Nevertheless the annual standardised prevalence rate is inherently more stable than the annual standardised acceptance.

Geographical considerations and ethnicity are the major factors underlying the variation in SPR. There were 33 local authority areas with a significantly low SPR, 123 with a normal SPR and 51 with a significantly high SPR. The geographical distribution of these is summarised in Table 4.6. The North West ($p < 0.0001$) and the South East of England ($p = 0.03$) had a significantly higher proportion of areas with a low SPR, whilst in London, Wales, Scotland and Northern Ireland, the proportion was

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

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 OE	2005 O/E	2005 LCL	2005 UCL	2005 pmp	ALL O/E	% non-White
NE England	Darlington	97,838	0.64	0.78	0.83	0.88	**0.89**	0.70	1.15	**623**	0.81	2.1
	Durham	493,469	0.49	0.84	0.83	0.89	**0.95**	0.85	1.06	**671**	0.80	1.0
	Hartlepool	88,610	0.73	0.81	0.88	0.97	**0.92**	0.71	1.20	**632**	0.86	1.2
	Middlesbrough	134,855	0.86	1.02	1.08	1.02	**1.01**	0.82	1.25	**653**	1.00	6.3
	Redcar/Cleveland	139,132	0.67	0.89	0.90	0.97	**0.97**	0.79	1.18	**683**	0.88	1.1
	Stockton	178,408	0.52	0.69	0.74	0.82	**0.87**	0.71	1.05	**583**	0.73	2.8
	Gateshead	191,151		0.94	0.92	0.94	**0.97**	0.82	1.15	**685**	0.94	1.6
	Newcastle	259,536		0.87	0.84	0.84	**0.93**	0.79	1.08	**605**	0.87	6.9
	N Tyneside	191,658		0.86	0.88	0.90	**0.97**	0.82	1.15	**694**	0.90	1.9
	Northumberland	307,190		0.80	0.82	0.87	**0.88**	0.77	1.01	**648**	0.84	1.0
	S Tyneside	152,785		0.73	0.77	0.83	**0.90**	0.74	1.10	**635**	0.81	2.7
	Sunderland	280,807	0.62	0.86	0.92	0.95	**0.96**	0.83	1.11	**652**	0.86	1.9
NW England	Cheshire											1.6
	Halton	118,209	0.67	0.72	0.87	0.94	**0.99**	0.80	1.24	**651**	0.84	1.2
	Knowsley	150,459	0.96	1.01	1.10	1.12	**1.12**	0.93	1.35	**724**	1.06	1.6
	Liverpool	439,471	0.98	0.99	1.01	1.06	**1.08**	0.97	1.21	**699**	1.02	5.7
	Sefton	*282,958*	*0.51*	*0.75*	*0.78*	*0.77*	**0.84**	*0.72*	*0.97*	**597**	*0.73*	*1.6*
	St. Helens	*176,843*	*0.60*	*0.73*	*0.73*	*0.72*	**0.80**	*0.66*	*0.98*	**554**	*0.72*	*1.2*
	Warrington	*191,080*	*0.59*	*0.69*	*0.80*	*0.84*	**0.82**	*0.68*	*0.99*	**555**	*0.75*	*2.1*
	Wirral	312,293	0.52	0.92	0.96	0.98	**1.00**	0.88	1.14	**704**	0.88	1.7
	Blackburn/Darwen	137,470	0.48	0.59	0.81	0.97	**1.08**	0.88	1.32	**655**	0.78	22.1
	Blackpool	*142,283*	*0.41*	*0.47*	*0.59*	*0.61*	**0.67**	*0.53*	*0.85*	**492**	*0.55*	*1.6*
	Cumbria	*487,607*	*0.58*	*0.62*	*0.68*	*0.71*	**0.75**	*0.67*	*0.85*	**552**	*0.67*	*0.7*
	Lancashire	*1,134,975*	*0.41*	*0.44*	*0.59*	*0.70*	**0.76**	*0.70*	*0.82*	**524**	*0.58*	*5.3*
	Bolton	*261,037*			*0.65*	*0.66*	**0.79**	*0.67*	*0.93*	**521**	*0.70*	*11.0*
	Bury	*180,607*			*0.29*	*0.35*	**0.45**	*0.34*	*0.58*	**299**	*0.36*	*6.1*
	Manchester											19.0
	Oldham	*217,276*			*0.43*	*0.47*	**0.49**	*0.39*	*0.62*	**318**	*0.46*	*13.9*
	Rochdale	*205,357*			*0.44*	*0.47*	**0.48**	*0.38*	*0.61*	**312**	*0.47*	*11.4*
	Salford	*216,105*			*0.60*	*0.56*	**0.61**	*0.50*	*0.75*	**407**	*0.59*	*3.9*
	Stockport											4.3
	Tameside											5.4
	Trafford											8.4
	Wigan	*301,415*			*0.53*	*0.59*	**0.65**	*0.55*	*0.77*	**445**	*0.59*	*1.3*
Yorkshire & Humber	*East Riding*	*314,113*	*0.65*	*0.72*	*0.76*	*0.79*	**0.85**	*0.74*	*0.98*	**630**	*0.76*	*1.2*
	Hull	243,588	0.87	0.90	0.90	0.99	**1.06**	0.91	1.23	**681**	0.94	2.3
	NE Lincolnshire	157,981	0.64	0.79	0.84	0.96	**1.02**	0.85	1.24	**696**	0.85	1.4
	N Lincolnshire	152,848	0.79	0.85	0.85	0.87	**0.86**	0.71	1.06	**615**	0.84	2.5
	N Yorkshire	*569,660*	*0.60*	*0.69*	*0.72*	*0.78*	**0.82**	*0.73*	*0.91*	**595**	*0.72*	*1.1*
	York	181,096	0.77	0.79	0.88	0.86	**0.89**	0.74	1.07	**613**	0.84	2.2
	Barnsley	218,063	0.91	1.01	1.07	1.14	**1.11**	0.95	1.29	**770**	1.05	0.9
	Doncaster	286,865	0.76	0.86	0.97	0.99	**0.98**	0.85	1.12	**676**	0.91	2.3
	Rotherham	**248,175**	**0.96**	**1.01**	**1.06**	**1.15**	**1.16**	**1.01**	**1.33**	**794**	**1.07**	**3.1**
	Sheffield	513,234	0.80	0.89	0.92	1.01	**1.04**	0.94	1.15	**696**	0.93	8.8
	Bradford	**467,664**	**0.96**	**1.06**	**1.17**	**1.23**	**1.31**	**1.19**	**1.45**	**823**	**1.15**	**21.7**
	Calderdale	192,405	0.84	0.91	1.01	1.05	**1.09**	0.92	1.29	**738**	0.98	7.0
	Kirklees	**388,567**	**0.92**	**1.00**	**1.09**	**1.13**	**1.17**	**1.05**	**1.31**	**767**	**1.06**	**14.4**
	Leeds	715,403	0.87	0.89	0.91	0.94	**1.02**	0.93	1.11	**661**	0.92	8.2
	Wakefield	315,172	0.76	0.76	0.78	0.82	**0.87**	0.75	1.00	**593**	0.80	2.3

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 OE	2005 O/E	2005 LCL	2005 UCL	pmp	ALL O/E	% non-White
East Midlands	**Leicester**	**279,920**	**1.45**	**1.57**	**1.63**	**1.71**	**1.80**	**1.60**	**2.01**	**1,075**	**1.63**	**36.1**
	Leicestershire	609,578	0.79	0.81	0.85	0.91	**0.93**	0.84	1.03	**650**	0.86	5.3
	Northamptonshire	629,676	0.79	0.82	0.83	0.69	**0.92**	0.83	1.01	**613**	0.81	4.9
	Rutland	34,563	0.61	0.69	0.81	0.85	**0.93**	0.62	1.40	**665**	0.78	1.9
	Derby	221,709			1.08	1.15	**1.16**	1.00	1.35	**767**	1.13	12.6
	Derbyshire	*734,585*	*0.64*	*0.54*	*0.76*	*0.77*	**0.80**	*0.73*	*0.88*	**570**	*0.70*	*1.5*
	Lincolnshire	*646,644*	*0.69*	*0.71*	*0.71*	*0.77*	**0.83**	*0.75*	*0.92*	**615**	*0.74*	*1.3*
	Nottingham	**266,988**	**1.30**	**1.19**	**1.17**	**1.21**	**1.25**	**1.09**	**1.43**	**760**	**1.22**	**15.1**
	Nottinghamshire	748,508	0.84	0.85	0.88	0.93	**0.99**	0.91	1.08	**703**	0.90	2.6
West Midlands	**Birmingham**	**977,085**				**1.55**	**1.67**	**1.57**	**1.77**	**1,023**	**1.61**	**29.6**
	Dudley	305,153	0.67	0.64	0.68	0.90	**0.94**	0.82	1.08	**665**	0.76	6.3
	Sandwell	**282,904**				**1.33**	**1.40**	**1.25**	**1.58**	**937**	**1.37**	**20.3**
	Solihull	199,515	0.66	0.64	0.75	0.95	**0.98**	0.83	1.16	**697**	0.80	5.4
	Walsall	**253,498**	**0.63**	**0.72**	**0.72**	**1.18**	**1.25**	**1.10**	**1.43**	**852**	**0.90**	**13.6**
	Wolverhampton	**236,582**	**0.98**	**1.01**	**1.11**	**1.26**	**1.33**	**1.16**	**1.52**	**896**	**1.14**	**22.2**
	Coventry	**300,849**	**1.12**	**1.13**	**1.20**	**1.20**	**1.20**	**1.05**	**1.36**	**768**	**1.17**	**16.0**
	Herefordshire	174,871				0.81	**0.87**	0.72	1.04	**646**	0.84	0.9
	Warwickshire	505,858	0.87	0.91	0.92	1.03	**1.08**	0.98	1.19	**765**	0.96	4.4
	Worcestershire	*542,105*				*0.80*	**0.86**	*0.77*	*0.96*	**612**	*0.83*	*2.5*
	Shropshire	283,173				0.80	**0.89**	0.77	1.03	**650**	0.85	1.2
	Staffordshire											2.4
	Stoke-on-Trent											5.2
	Telford/Wrekin	158,325				0.86	**0.85**	0.69	1.05	**543**	0.85	5.2
East of England	Bedfordshire	381,572	0.71	0.78	0.81	0.86	**0.90**	0.80	1.03	**605**	0.81	6.7
	Hertfordshire	*1,033,978*	*0.42*	*0.51*	*0.53*	*0.55*	**0.74**	*0.68*	*0.80*	**496**	*0.55*	*6.3*
	Luton	**184,373**	**0.89**	**0.95**	**1.06**	**1.09**	**1.29**	**1.10**	**1.52**	**781**	**1.06**	**28.1**
	Essex	*1,310,837*				*0.76*	**0.81**	*0.75*	*0.87*	**566**	*0.78*	*2.9*
	Southend	160,259	0.66	0.76	0.85	0.95	**1.01**	0.84	1.22	**705**	0.85	4.2
	Thurrock	143,128				0.86	**1.01**	0.82	1.24	**643**	0.93	4.7
	Cambridgeshire	552,659	0.64	0.73	0.76	0.82	**0.92**	0.83	1.02	**622**	0.77	4.1
	Norfolk	796,728				0.79	**0.85**	0.78	0.93	**639**	0.82	1.5
	Peterborough	156,061	0.62	0.75	0.86	0.95	**1.01**	0.84	1.23	**654**	0.84	10.3
	Suffolk	*668,555*				*0.70*	**0.75**	*0.68*	*0.84*	**541**	*0.73*	*2.8*
London	Barnet	314,561					**1.12**	0.98	1.27	**709**	1.12	26.0
	Camden	198,020					**1.08**	0.91	1.29	**641**	1.08	26.8
	Enfield	**273,559**					**1.49**	**1.32**	**1.68**	**943**	**1.49**	**22.9**
	Haringey	**216,505**					**1.68**	**1.46**	**1.92**	**956**	**1.68**	**34.4**
	Islington	**175,797**					**1.36**	**1.15**	**1.60**	**796**	**1.36**	**24.6**
	Barking/Dagenham	163,942				0.92	**1.02**	0.84	1.23	**622**	0.97	14.8
	City of London											15.4
	Hackney	**202,824**				**1.15**	**1.53**	**1.32**	**1.78**	**838**	**1.34**	**40.6**
	Havering											4.8
	Newham	**243,889**				**1.34**	**1.58**	**1.37**	**1.81**	**824**	**1.46**	**60.6**
	Redbridge	**238,634**				**1.12**	**1.31**	**1.14**	**1.50**	**834**	**1.21**	**36.5**
	Tower Hamlets	**196,105**				**1.16**	**1.28**	**1.07**	**1.51**	**668**	**1.22**	**48.6**
	Waltham Forest											35.5
	Brent											54.7
	Ealing	**300,948**		**1.29**	**1.31**	**1.41**	**1.49**	**1.32**	**1.68**	**907**	**1.37**	**41.3**
	H/smith/Fulham	**165,244**		**1.27**	**1.35**	**1.45**	**1.40**	**1.18**	**1.65**	**823**	**1.37**	**22.2**
	Harrow											41.2
	Hillingdon	243,006				0.85	**1.01**	0.86	1.18	**642**	0.93	20.9
	Hounslow	**212,342**				**1.60**	**1.63**	**1.42**	**1.86**	**984**	**1.61**	**35.1**
	Kensington/C/lsea											21.4

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 OE	2005 O/E	2005 LCL	2005 UCL	2005 pmp	ALL O/E	% non-White
London (continued)	Westminster											26.8
	Bexley	218,307	0.61	1.00	1.05	1.04	**1.09**	0.93	1.27	**733**	0.96	8.6
	Bromley	295,532	0.57	0.80	0.83	0.86	**0.92**	0.80	1.06	**636**	0.80	8.4
	Greenwich	214,404		0.90	0.91	0.87	**1.14**	0.97	1.33	**686**	0.96	22.9
	Lambeth	**266,169**	**0.72**	**1.17**	**1.23**	**1.31**	**1.39**	**1.21**	**1.59**	**778**	**1.16**	**37.6**
	Lewisham	**248,923**	**1.04**	**1.43**	**1.44**	**1.59**	**1.74**	**1.53**	**1.96**	**1,012**	**1.45**	**34.1**
	Southwark	**244,866**		**1.45**	**1.53**	**1.57**	**1.73**	**1.53**	**1.96**	**992**	**1.57**	**37.0**
	Croydon	**330,588**	**0.70**	**0.88**	**1.00**	**1.09**	**1.21**	**1.07**	**1.37**	**762**	**0.97**	**29.8**
	Kingston											15.5
	Merton											25.0
	Richmond											9.0
	Sutton											10.8
	Wandsworth											22.0
SE England	*Hampshire*	*1,240,102*	*0.62*	*0.64*	*0.69*	*0.72*	**0.75**	*0.69*	*0.81*	**522**	*0.68*	*2.2*
	Isle of Wight	*132,731*	*0.54*	*0.59*	*0.65*	*0.66*	**0.65**	*0.51*	*0.82*	**497**	*0.62*	*1.3*
	Portsmouth	186,700	0.98	1.01	1.03	1.06	**1.07**	0.90	1.28	**686**	1.03	5.3
	Southampton	217,444	0.71	0.76	0.80	0.85	**0.88**	0.73	1.05	**547**	0.80	7.6
	Kent											3.1
	Medway											5.4
	Brighton/Hove	*247,817*				*0.77*	**0.80**	*0.67*	*0.95*	**529**	*0.78*	*5.7*
	E Sussex	*492,326*				*0.79*	**0.81**	*0.72*	*0.90*	**607**	*0.80*	*2.3*
	Surrey	*1,059,017*				*0.71*	**0.76**	*0.70*	*0.83*	**533**	*0.74*	*5.0*
	W Sussex	*753,612*				*0.71*	**0.75**	*0.68*	*0.83*	**545**	*0.73*	*3.4*
	Bracknell Forest	109,616				0.85	**0.83**	0.64	1.08	**511**	0.84	4.9
	Buckinghamshire	479,026	0.79	0.85	0.88	0.91	**0.95**	0.85	1.06	**647**	0.88	7.9
	Milton Keynes	207,057	0.80	0.82	0.93	0.99	**1.04**	0.88	1.24	**633**	0.92	9.3
	Oxfordshire	605,489	0.90	0.92	1.00	1.02	**1.04**	0.94	1.14	**687**	0.98	4.9
	Reading	143,096	0.97	1.04	1.11	1.13	**1.08**	0.88	1.33	**657**	1.06	13.2
	Slough	**119,064**	**0.89**	**1.36**	**1.48**	**1.55**	**1.66**	**1.39**	**1.99**	**991**	**1.39**	**36.3**
	West Berkshire	144,485	0.77	0.75	0.82	0.95	**0.94**	0.77	1.16	**630**	0.85	2.6
	Windsor/Maidenhd											7.6
	Wokingham	150,231	0.71	0.72	0.80	0.85	**0.90**	0.73	1.11	**592**	0.80	6.1
SW England	Bath/NE Somerset	169,040	0.60	0.60	0.64	0.79	**0.88**	0.72	1.06	**615**	0.70	2.8
	Bristol	**380,616**	**1.11**	**1.17**	**1.25**	**1.28**	**1.33**	**1.19**	**1.48**	**846**	**1.23**	**8.2**
	Gloucestershire	564,559	0.69	0.74	0.79	0.85	**0.91**	0.82	1.01	**643**	0.80	2.8
	N Somerset	188,564	0.84	0.87	0.99	1.07	**1.06**	0.90	1.24	**785**	0.97	1.4
	S Gloucestershire	245,641	0.89	0.99	0.99	1.04	**1.09**	0.94	1.26	**741**	1.00	2.4
	Swindon	180,051	0.74	0.75	0.78	0.91	**0.90**	0.74	1.09	**589**	0.81	4.8
	Wiltshire	*432,972*	*0.61*	*0.62*	*0.63*	*0.63*	**0.71**	*0.62*	*0.81*	**494**	*0.64*	*1.6*
	Bournemouth	*163,444*				*0.73*	**0.69**	*0.55*	*0.86*	**489**	*0.71*	*3.3*
	Dorset	*390,980*				*0.77*	**0.82**	*0.72*	*0.93*	**642**	*0.79*	*1.3*
	Poole	*138,288*				*0.79*	**0.87**	*0.70*	*1.07*	**636**	*0.83*	*1.8*
	Somerset	*498,095*	*0.69*	*0.78*	*0.81*	*0.84*	**0.88**	*0.79*	*0.98*	**644**	*0.80*	*1.2*
	Cornwall/Scilly	*501,267*	*0.79*	*0.87*	*0.93*	*1.06*	**1.05**	*0.95*	*1.15*	**792**	*0.94*	*1.0*
	Devon	*704,491*	*0.66*	*0.72*	*0.76*	*0.82*	**0.85**	*0.77*	*0.93*	**639**	*0.76*	*1.1*
	Plymouth	240,722	1.02	1.02	1.03	1.00	**1.02**	0.87	1.18	**681**	1.02	1.6
	Torbay	129,706	0.75	0.77	0.81	0.97	**0.97**	0.80	1.19	**740**	0.86	1.2

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 OE	2005 O/E	2005 LCL	2005 UCL	pmp	ALL O/E	% non-White
Wales	**Cardiff**	**305,353**	**1.04**	**1.09**	**1.15**	**1.23**	**1.24**	**1.10**	**1.41**	**776**	**1.15**	**8.4**
	Merthyr Tydfil	**55,979**	**1.05**	**1.08**	**1.26**	**1.50**	**1.55**	**1.20**	**2.00**	**1,054**	**1.29**	**1.0**
	Rhondda/Cynon/Taff	**231,947**	**1.09**	**1.13**	**1.08**	**1.24**	**1.29**	**1.12**	**1.48**	**875**	**1.17**	**1.2**
	Vale of Glamorgan	119,292	0.82	0.87	0.93	1.06	**0.99**	0.80	1.23	**687**	0.93	2.2
	Carmarthenshire	172,842	0.93	0.89	0.99	1.05	**1.11**	0.94	1.30	**816**	0.99	0.9
	Ceredigion	74,941	0.66	0.77	0.76	0.88	**0.88**	0.67	1.17	**641**	0.79	1.4
	Pembrokeshire	114,131	0.72	0.65	0.79	0.82	**0.95**	0.76	1.18	**701**	0.79	0.9
	Powys	126,353	0.38	0.39	0.40	0.80	**0.91**	0.74	1.12	**689**	0.57	0.9
	Blaenau Gwent	70,064	1.03	1.14	1.07	1.07	**1.18**	0.91	1.53	**814**	1.10	0.8
	Caerphilly	169,519	0.94	1.04	1.01	1.05	**1.12**	0.94	1.33	**755**	1.03	0.9
	Monmouthshire	84,885	0.98	1.07	1.06	1.12	**1.20**	0.96	1.51	**884**	1.09	1.1
	Newport	137,012	0.94	1.02	1.15	1.16	**1.20**	0.99	1.44	**803**	1.09	4.8
	Torfaen	90,949	1.03	1.05	1.11	1.13	**1.16**	0.92	1.46	**803**	1.09	0.9
	Bridgend	128,645	0.84	0.88	0.99	1.08	**1.16**	0.96	1.40	**808**	0.99	1.4
	Neath/Port Talbot	134,468	0.96	0.89	1.04	1.12	**1.15**	0.95	1.38	**825**	1.03	1.1
	Swansea	**223,300**	**1.10**	**1.06**	**1.18**	**1.26**	**1.30**	**1.13**	**1.49**	**918**	**1.18**	**2.2**
	Conwy	109,596		0.79	0.83	0.87	**0.83**	0.66	1.06	**639**	0.83	1.1
	Denbighshire	93,065	0.34	0.75	0.82	0.88	**1.03**	0.81	1.30	**752**	0.77	1.2
	Flintshire	148,594		0.94	0.98	1.02	**1.06**	0.88	1.28	**727**	1.00	0.8
	Gwynedd	116,843		0.99	1.09	1.02	**1.05**	0.85	1.30	**753**	1.04	1.2
	Anglesey	66,829		0.75	0.85	0.87	**1.05**	0.80	1.38	**778**	0.88	0.7
	Wrexham	128,476	1.17	1.14	1.21	1.21	**1.21**	1.00	1.46	**833**	1.19	1.1
Scotland	**Aberdeen City**	**212,125**	**0.88**	**0.94**	**0.96**	**1.14**	**1.19**	**1.02**	**1.38**	**797**	**1.02**	
	Aberdeenshire	226,871	0.85	0.88	0.86	0.90	**0.99**	0.85	1.16	**683**	0.90	
	Angus	**108,400**	**0.88**	**1.13**	**1.05**	**1.19**	**1.24**	**1.02**	**1.51**	**904**	**1.10**	
	Argyll & Bute	91,306	0.84	0.83	0.84	0.89	**0.86**	0.66	1.11	**635**	0.85	
	Scottish Borders	106,764	0.60	0.69	0.67	0.75	**0.83**	0.65	1.06	**618**	0.71	
	Clackmannanshire	48,077	0.40	0.55	0.77	0.80	**0.92**	0.64	1.31	**624**	0.69	
	Dunbartonshire	93,378	0.87	0.84	0.78	0.82	**0.82**	0.63	1.08	**557**	0.83	
	Dumfries/Galloway	147,765	0.97	0.97	1.04	0.97	**1.05**	0.88	1.26	**792**	1.00	
	Dundee City	**145,663**	**0.97**	**1.07**	**1.18**	**1.24**	**1.40**	**1.19**	**1.66**	**968**	**1.17**	
	E Ayrshire	120,235	0.86	0.86	0.87	0.87	**0.99**	0.80	1.23	**690**	0.89	
	E Dunbartonshire	108,243	0.96	0.99	1.12	1.08	**1.06**	0.85	1.31	**739**	1.04	
	E Lothian	90,088	0.93	0.96	0.93	0.99	**0.97**	0.76	1.25	**688**	0.96	
	E Renfrewshire	89,311	0.86	0.85	0.93	0.96	**1.08**	0.85	1.37	**739**	0.94	
	Edinburgh	448,624	0.88	0.87	0.91	0.97	**0.99**	0.88	1.11	**653**	0.92	
	Falkirk	145,191	0.92	0.89	0.92	0.91	**1.00**	0.82	1.22	**689**	0.93	
	Fife	349,429	0.78	0.86	0.86	0.91	**1.01**	0.89	1.15	**701**	0.89	
	Glasgow	**577,869**	**1.16**	**1.21**	**1.26**	**1.26**	**1.31**	**1.20**	**1.43**	**857**	**1.24**	
	Highland	**208,914**	**0.78**	**0.89**	**0.97**	**1.09**	**1.25**	**1.09**	**1.45**	**905**	**1.00**	
	Inverclyde	**84,203**	**1.14**	**1.18**	**1.18**	**1.19**	**1.28**	**1.02**	**1.60**	**891**	**1.19**	
	Midlothian	80,941	0.88	0.90	1.01	1.11	**1.13**	0.88	1.45	**778**	1.01	
	Moray	86,940	0.86	0.91	0.89	0.96	**1.14**	0.90	1.44	**794**	0.95	
	N Ayrshire	**135,817**	**0.98**	**1.06**	**1.10**	**1.19**	**1.23**	**1.02**	**1.47**	**854**	**1.11**	
	N Lanarkshire	321,067	1.01	1.08	1.12	1.13	**1.13**	1.00	1.28	**748**	1.09	
	Orkney Isles	19,245	0.57	0.86	1.00	1.07	**1.22**	0.76	1.96	**883**	0.94	
	Perth/Kinross	134,949	0.75	0.84	0.93	0.98	**0.99**	0.81	1.21	**726**	0.90	
	Renfrewshire	172,867	0.91	1.04	1.07	1.10	**1.18**	1.00	1.39	**816**	1.06	
	Shetland Isles	21,988	0.61	0.61	0.61	0.74	**0.61**	0.32	1.17	**409**	0.64	
	S Ayrshire	112,097	0.83	0.85	0.96	0.90	**1.02**	0.82	1.26	**758**	0.91	
	S Lanarkshire	302,216	1.02	1.06	1.08	1.11	**1.08**	0.95	1.23	**741**	1.07	
	Stirling	86,212	0.76	0.76	0.80	0.80	**0.81**	0.61	1.08	**557**	0.79	
	West Lothian	158,714	0.95	0.96	0.99	0.98	**1.07**	0.88	1.29	**680**	0.99	
	Eilean Siar	*26,502*	*0.50*	*0.55*	*0.55*	*0.75*	**0.50**	*0.27*	*0.93*	**377**	*0.57*	

Table 4.5: (continued)

Region	Local Authority	Total Pop	2001 O/E	2002 O/E	2003 O/E	2004 OE	2005 O/E	2005 LCL	2005 UCL	2005 pmp	ALL O/E	% non-White
N Ireland	**Antrim**	**48,366**					**1.45**	**1.07**	**1.96**	**868**	**1.45**	
	Ards	**73,244**					**1.29**	**1.01**	**1.66**	**860**	**1.29**	
	Armagh	**54,262**					**1.47**	**1.11**	**1.95**	**885**	**1.47**	
	Ballymena	58,610					**1.17**	0.87	1.57	**768**	1.17	
	Ballymoney	26,895					**0.89**	0.54	1.47	**558**	0.89	
	Banbridge	41,389					**1.05**	0.72	1.54	**652**	1.05	
	Belfast	**277,391**					**1.17**	**1.02**	**1.34**	**721**	**1.17**	
	Carrickfergus	**37,658**					**2.00**	**1.51**	**2.66**	**1,275**	**2.00**	
	Castlereagh	**66,488**					**1.58**	**1.25**	**1.99**	**1,068**	**1.58**	
	Coleraine	56,314					**1.03**	0.74	1.42	**657**	1.03	
	Cookstown	32,581					**0.84**	0.51	1.37	**491**	0.84	
	Craigavon	**80,671**					**1.30**	**1.01**	**1.66**	**793**	**1.30**	
	Derry	**105,066**					**1.30**	**1.04**	**1.63**	**714**	**1.30**	
	Down	63,828					**1.18**	0.89	1.58	**721**	1.18	
	Dungannon	47,735					**0.85**	0.57	1.26	**503**	0.85	
	Fermanagh	57,527					**0.99**	0.72	1.38	**626**	0.99	
	Larne	**30,833**					**1.79**	**1.30**	**2.47**	**1,200**	**1.79**	
	Limavady	32,422					**1.03**	0.66	1.62	**586**	1.03	
	Lisburn	108,694					**1.22**	0.98	1.52	**736**	1.22	
	Magherafelt	**39,778**					**1.57**	**1.13**	**2.17**	**905**	**1.57**	
	Moyle	15,932					**0.87**	0.45	1.68	**565**	0.87	
	Newry/Mourne	**87,058**					**1.42**	**1.13**	**1.79**	**827**	**1.42**	
	Newtownabbey	79,996					**1.16**	0.90	1.49	**750**	1.16	
	North Down	76,323					**1.05**	0.81	1.37	**721**	1.05	
	Omagh	47,953					**1.36**	0.99	1.87	**792**	1.36	
	Strabane	38,246					**1.20**	0.82	1.75	**706**	1.20	
	England	42,396,371	0.47	0.57	0.63	0.88	**0.97**			**660**	0.87	
	Scotland	5,062,011										
	Wales	2,903,083	0.77	0.94	1.00	1.08	**1.13**			**791**	1.02	
	N Ireland	1,685,260					**1.24**			**765**		
	Total	**52,046,725**	**0.52**	**0.61**	**0.67**	**0.88**	**1.00**			**680**	**0.90**	

Areas with significantly high prevalence ratios in 2005 are shown highlighted and bold, those with significantly low prevalence ratios are highlighted and italic.
O/E = Standardised acceptance rate ratio.
% non White = sum of % South Asian and African–Caribbean from 2001 Census.

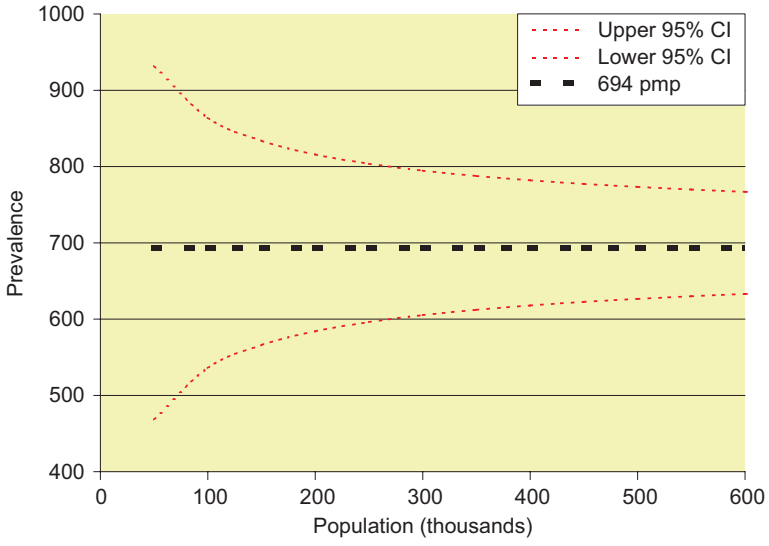

Figure 4.2: 95% confidence limits for prevalence of 694 pmp for population sizes 50,000–600,000

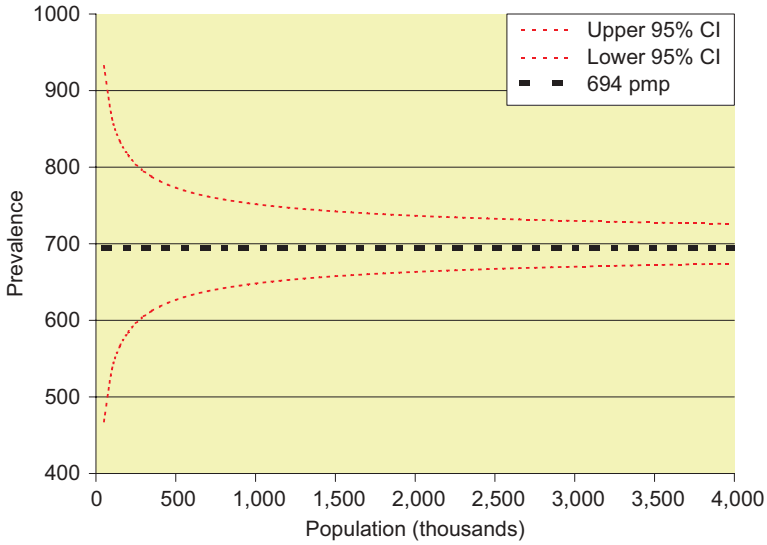

Figure 4.3: 95% confidence limits for prevalence of 694 pmp for population sizes 50,000–4 million

Table 4.6: Summary regional distribution of local authority areas with significantly low, normal, or significantly high values of SPR and mean % non-White

	Prevalence group				
Region	**Low**	**Normal**	**High**	**Total**	**Mean % Non-White**
North East England	0	12	0	12	2.5
North West England	12	5	0	17	5.4
Yorkshire & Humber	2	10	3	15	5.3
East Midlands	2	5	2	9	9.0
West Midlands	1	6	5	12	10.6
East of England	4	5	1	10	7.2
London	0	7	14	21	30.2
South East England	6	9	1	16	7.4
South West England	5	9	1	15	2.4
Wales	0	17	5	22	1.6
Scotland	1	23	8	32	n/a
Northern Ireland	0	15	11	26	n/a
All Regions	**33**	**123**	**51**	**207**	

significantly lower ($p = 0.03$ in all cases). Conversely, London ($p < 0.0001$) and Northern Ireland ($p = 0.048$) had a significantly higher proportion of areas with a high SPR, whilst in the North East ($p = 0.04$) and the North West of England ($p = 0.008$), the proportion was significantly lower. Although overall 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), in some areas such as South Wales, ethnicity does not seem to be a major factor.

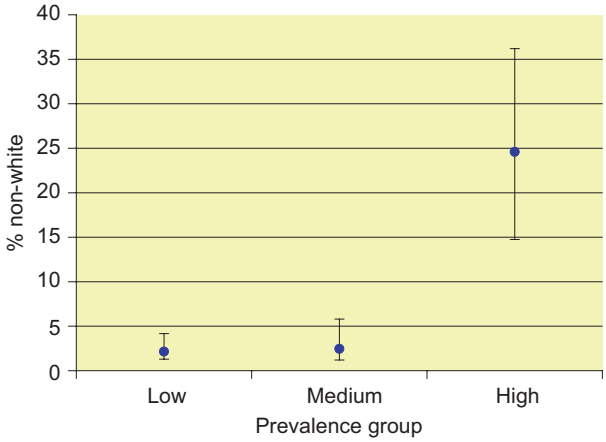

Figure 4.4: Percentage non-Whites in areas with significantly low, normal and significantly high SPR values (mean and quartiles)

The relationship between the ethnic composition of a LA area and its SPR is further demonstrated in Figure 4.5, which shows the

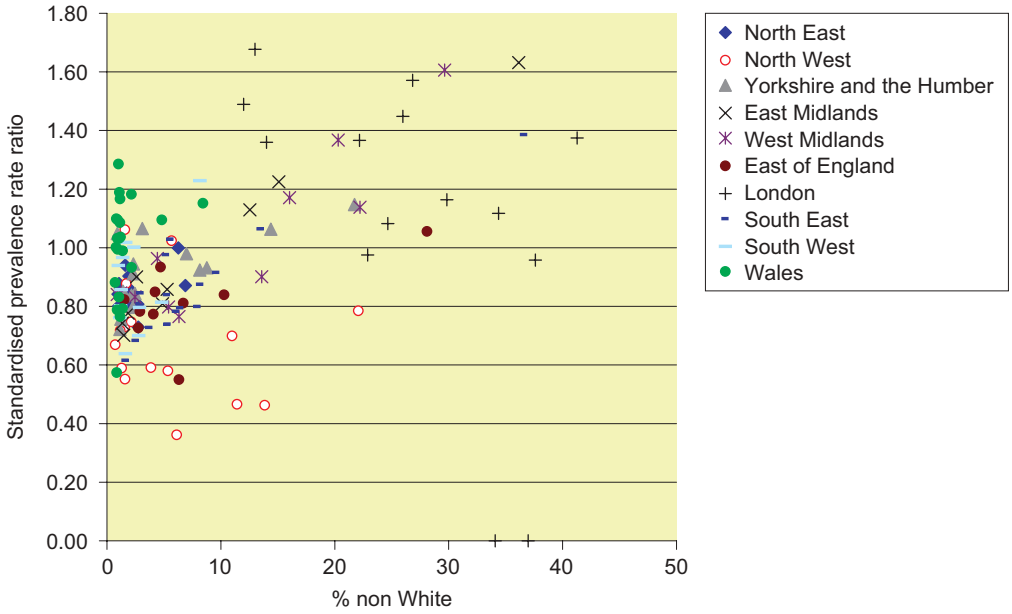

Figure 4.5: Plot of ethnicity and standardised prevalence ratio for all local authorities with available data

Data from outlying local authorities are plotted with reference to Table 4.5

relationship between ethnicity and SPR for all local authorities with available data. A small group of local authority areas in Wales have a higher SPR than might be predicted from the local ethnic mix. These are Methyr Tydfil, Swansea and Rhondda/Cynon/Taff. Another small group of local authority areas in the North West of England, have a lower SPR than might be expected by the local ethnic mix. These are Bury, Rochdale, Oldham and Salford. It is unlikely that social deprivation alone can account for these disparities. Further investigation would be of interest. Tower Hamlets appears to have an inappropriately low SPR for what is the second highest proportion of non-Whites in the Registry.

Vintage of prevalent patients

Table 4.7 shows the median vintage (years since starting renal replacement therapy) of prevalent RRT patients in 2005. Median vintage of the whole RRT population was 5.1 years. Patients with functioning transplants had survived a median 9.8 years on RRT whilst the median vintage of HD and PD patients was much less (2.8 and 2.1 years respectively). The dialysis population is of course much older and would be expected to have shorter survival. This is not a substantial change from the 2004 data.

Table 4.7: Median vintage of prevalent RRT patients on 31/12/05

Modality	N	Median time treated (years)
Haemodialysis	16,085	2.8
Peritoneal dialysis	4,550	2.1
Transplant	16,899	9.8
All RRT	37,534	5.1

Age of prevalent patients

The median age of prevalent patients on RRT was 56.6 years (Table 4.8). The age profile is markedly different in patients on dialysis than in transplanted patients. The median age of patients on HD (64.5 years) was higher than that of patients on PD (59.2 years) and substantially higher than that of transplanted patients (49.7 years). There were wide variations in median age between renal units for the whole RRT population (50.8 to 67.7 years). The major determinant of the median age of the prevalent RRT population is the ratio of the number of transplant and dialysis patients in that population ($r = -0.764$, $p < 0.0001$).

The differing age distributions of transplant and dialysis patients are well illustrated in Figure 4.6, the maximum prevalence of dialysis patients being almost 2 decades later than transplant patients. In patients under the age of 65 years, 56.3% of prevalent RRT patients had

Table 4.8: Median age by RRT modality

Centre	Median age on HD	Median age on PD	Median age on transplant	Median age for all
Abrdn	65.3	51.5	50.1	55.7
Airdrie	63.8	46.7	n/a	61.6
Antrim	68.3	60.8	46.8	59.8
B Heart	66.2	61.9	49.6	61.4
B QEH	64.0	56.2	48.6	55.6
Bangor	68.6	63.2	43.3	67.7
Basldn	63.6	61.0	50.2	61.0
Belfast	66.0	49.7	48.0	55.3
Bradfd	67.5	53.4	47.0	56.1
Brightn	67.5	62.2	52.0	61.1
Bristol	69.6	59.7	50.9	58.0
Camb	63.6	59.8	48.4	54.3
Cardff	65.2	59.3	49.6	55.7
Carlis	67.0	48.3	52.5	58.2
Carsh	63.4	55.2	51.5	57.9
Chelms	67.8	64.0	40.2	66.1
Clwyd	66.9	62.8	50.4	62.2
Covnt	63.9	60.1	47.5	55.1
D&Gall	67.9	67.5	44.2	66.8
Derby	65.7	63.6	38.8	64.7
Dorset	64.4	70.0	55.3	60.0
Dudley	62.0	60.0	55.5	58.7
Dundee	69.7	59.4	54.0	59.7
Dunfn	66.1	59.0	48.0	59.9
Edinb	62.6	55.2	51.0	54.9
Exeter	70.9	59.6	49.8	59.1
GlasRI	65.7	53.1	51.8	63.1
GlasWI	64.9	55.4	47.9	50.8
Glouc	70.7	60.7	52.4	63.0
Hull	65.8	53.2	49.9	57.2
Inverns	63.8	64.1	45.1	55.9
Ipswi	64.9	59.6	51.2	57.0
Klmarnk	66.9	54.9	47.1	59.0
L Barts	56.2	55.5	48.8	52.4
L Guys	62.4	59.8	48.8	52.1
L H&CX	62.9	56.1	53.1	58.3
L Kings	62.1	57.2	49.3	55.4
L RFree	61.4	59.2	47.9	53.9
Leeds	66.7	59.4	49.3	54.4
Leic	62.8	62.5	50.5	56.5
Livrpl	59.4	56.0	49.7	52.9
ManWst	58.6	55.5	46.4	52.6
Middlbr	63.7	52.3	50.1	55.6
Newc	62.2	56.3	51.6	54.5
Newry	67.7	56.3	53.4	62.2
Norwch	70.7	61.4	49.9	62.0
Nottm	65.8	58.0	47.5	55.1
Oxford	65.1	61.9	50.6	55.8
Plymth	68.9	62.1	49.6	58.7
Ports	63.9	59.2	50.0	55.3

Table 4.8: (continued)

Centre	Median age on HD	Median age on PD	Median age on transplant	Median age for all
Prestn	60.6	59.3	50.8	55.7
Redng	65.2	65.3	54.2	60.9
Sheff	62.6	61.3	49.2	57.0
Shrew	64.4	54.1	48.3	58.8
Stevng	64.5	60.1	51.6	58.9
Sthend	67.4	62.0	51.0	63.2
Sund	62.8	58.5	50.7	57.3
Swanse	67.0	63.9	53.6	62.2
Truro	72.9	61.6	54.5	64.7
Tyrone	65.7	58.2	46.9	59.3
Ulster	65.9	75.4	39.2	65.8
Wirral	65.8	62.8	–	65.7
Wolve	65.2	65.5	47.1	61.8
Wrexm	62.7	59.2	–	61.5
York	68.0	63.9	44.9	61.3
Eng	**64.2**	**59.4**	**49.9**	**56.6**
NI	**66.6**	**53.1**	**47.9**	**57.6**
Sct	**65.5**	**56.6**	**48.9**	**55.8**
Wls	**65.9**	**62.0**	**49.9**	**58.1**
UK	**64.5**	**59.2**	**49.7**	**56.6**

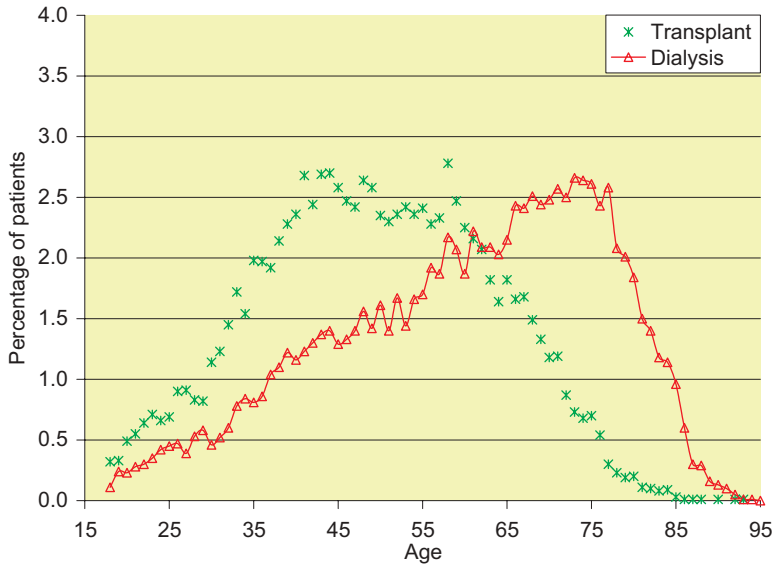

Figure 4.6: Age distribution of patients on RRT 31/12/2005

been transplanted with 43.7% on dialysis. The proportions were dramatically different in older patients, with 21.2% having been transplanted and 78.8% on dialysis.

Gender

In the UK there were more patients in the age range 55–65 years than in any other decade in both males and females (Figure 4.7). However the "corrected" peak prevalence, expressed as SPR calculated from local authority populations covered by the Registry using 2001 Census data, occurred in the age band 65–74 (1,565 pmp) overall, but was different in men (peak 75–79 year age band; 2,270 pmp) from women (peak 65–74 year age band; 1,144 pmp: Figure 4.8). Furthermore the male : female ratio of prevalence increased markedly with age from 1.48 in the 25–34 age band to 4.46 in those greater than 85 years.

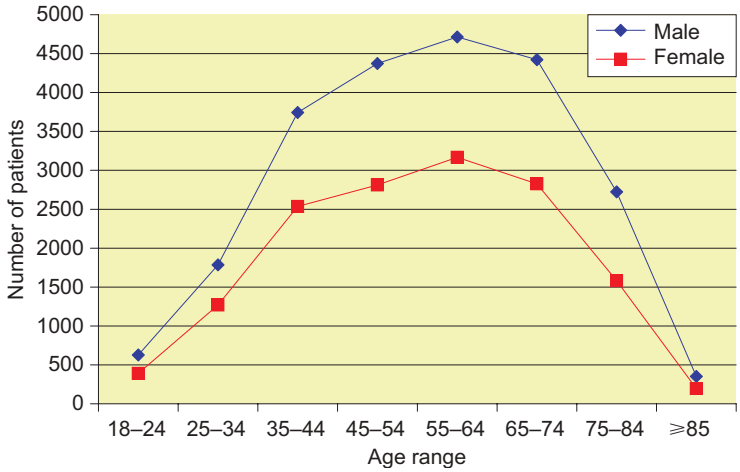

Figure 4.7: Age profile of prevalent adult patients by gender, 31/12/2005

Excludes data on those aged <18, reported in Chapter 13

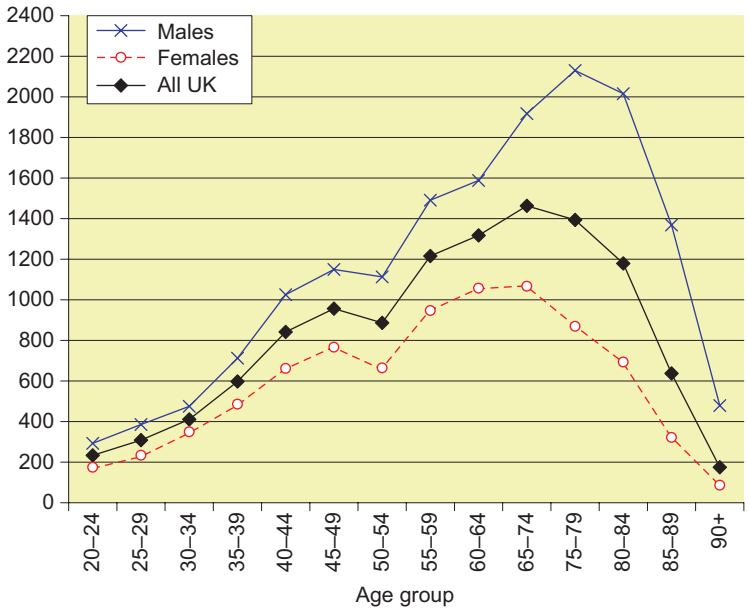

Figure 4.8: Crude prevalence rate of RRT patients per million population by age and gender on 31/12/05

Ethnicity

Thirty-six of the 65 centres submitting data to the Registry provided ethnicity data that were at least 90% complete. The data for centres with less than 50% returns for ethnicity are excluded from Table 4.9. Centres in Scotland are not required to report ethnicity to the Scottish Registry.

Table 4.9: Ethnicity of prevalent patients by centre 2005

Centre	% Complete	% White	% Black	% Asian	% Chinese	% Other
Ulster	100.0	100.0	0.0	0.0	0.0	0.0
Belfast	100.0	99.6	0.0	0.1	0.3	0.0
Glouc	100.0	98.9	1.1	0.0	0.0	0.0
Shrew	100.0	94.1	2.5	3.4	0.0	0.0
Dudley	100.0	89.5	2.3	7.8	0.4	0.0
Stevng	100.0	80.6	4.2	13.8	0.5	0.9
Redng	100.0	75.1	5.9	15.2	1.2	2.7
L H&CX	100.0	39.6	12.2	22.8	0.9	24.5
B QEH	99.8	69.2	9.5	19.5	0.9	0.9
Wolve	99.8	77.4	6.6	14.8	0.9	0.2
B Heart	99.4	69.5	7.1	21.2	0.6	1.7
Tyrone	99.4	100.0	0.0	0.0	0.0	0.0
Swanse	99.4	98.5	0.4	0.9	0.0	0.2
Newry	99.4	100.0	0.0	0.0	0.0	0.0
Newc	99.0	96.6	0.5	2.1	0.5	0.3
Ports	98.8	96.7	0.5	2.1	0.5	0.3
Dorset	98.7	96.5	0.3	0.5	1.3	1.3
Antrim	98.4	100.0	0.0	0.0	0.0	0.0
Carlis	98.4	99.5	0.0	0.5	0.0	0.0
Basldn	98.2	91.0	1.8	4.8	1.2	1.2
Nottm	97.7	89.0	4.7	5.6	0.0	0.7
Bristol	97.4	93.0	3.4	2.6	0.4	0.6
Ipswi	96.2	95.3	1.8	2.2	0.4	0.4
Sheff	95.5	92.8	1.7	3.8	0.7	1.0
L Barts	95.1	50.0	11.6	21.1	1.7	15.7
Dundee	95.0	99.1	0.0	0.3	0.3	0.3
Middlbr	94.1	96.1	0.0	3.2	0.7	0.0
Prestn	94.0	85.3	1.0	12.9	0.0	0.8
L Kings	93.7	58.6	27.5	12.2	1.7	0.0
ManWst	92.9	85.0	1.5	11.8	0.3	1.4
Sund	92.8	97.7	0.8	0.4	0.4	0.8
Leic	92.6	80.5	2.4	15.9	0.2	1.1
York	92.3	99.4	0.0	0.0	0.0	0.6
Livrpl	91.6	96.8	0.9	0.8	1.0	0.6
Bangor	90.1	98.9	1.1	0.0	0.0	0.0
Airdrie	90.1	99.4	0.0	0.6	0.0	0.0
Derby	88.8	90.2	2.0	5.3	0.8	1.6
Covnt	86.4	81.9	3.4	13.8	0.7	0.2
Plymth	84.8	95.8	2.2	0.3	1.0	0.6
Sthend	84.5	93.5	2.6	1.3	2.6	0.0
Camb	84.2	93.6	1.3	3.5	0.3	1.3
L Guys	83.3	72.6	22.7	3.4	1.2	0.0
L RFree	80.8	52.5	18.5	18.7	2.4	7.9
Abrdn	77.5	99.1	0.0	0.0	0.6	0.3
Bradfd	76.8	60.6	2.5	36.2	0.0	0.7
Wirral	71.9	96.4	1.4	0.0	0.0	2.2
Carsh	71.3	72.5	9.5	9.9	1.0	7.0
Leeds	69.4	83.0	3.8	12.6	0.0	0.6
Inverns	67.0	100.0	0.0	0.0	0.0	0.0
Exeter	66.4	98.4	0.8	0.3	0.3	0.3
Hull	62.4	98.1	0.3	0.3	0.5	0.8

Table 4.9: (continued)

Centre	% Complete	% White	% Black	% Asian	% Chinese	% Other
Truro	54.3	96.6	2.7	0.0	0.7	0.0
Oxford	47.8					
Dunfn	42.0					
Norwch	41.8					
Wrexm	38.4					
Chelms	36.6					
Cardff	32.5					
Brightn	31.9					
Clwyd	30.1					
D&Gall	14.5					
GlasWI	10.5					
GlasRI	9.4					
Edinb	9.0					
Klmarnk	3.3					
Eng	**86.2**	**80.9**	**5.9**	**9.6**	**0.7**	**2.9**
NI	**99.6**	**99.8**	**0.0**	**0.1**	**0.2**	**0.0**
Sct	**32.9**					
Wls	**50.9**	**97.5**	**0.9**	**1.2**	**0.2**	**0.2**
UK	**79.3**	**83.1**	**5.2**	**8.5**	**0.7**	**2.6**

Primary renal disease

In the previous two years' reports, the statement by the table indicating that diagnosis code GN histologically not examined (EDTA code 10) had been included in the 'Uncertain' group for analysis, was incorrect. Approximately 1,000 patients had been incorrectly allocated to the glomerulonephritis category. Table 4.10 this year, has now been corrected. The previous years data has also been retrospectively analysed to this grouping and the data this year shows no change and is consistent with the reports prior to 2004.

The most common specific diagnosis overall remains glomerulonephritis, in contrast to the pattern in incident patients in whom diabetes predominates. This reflects different survival and different ages of the patients with these diagnoses.

There are age-related differences. The prevalence of the aetiology uncertain/glomerulonephritis – not biopsy proven category is much greater in those aged over 65 years (27.7% vs 19.8%). In addition, diabetes (13.4%) (not glomerulonephritis (9.9%)) was the most common specific diagnosis in those over 65

Table 4.10: Primary renal disease in prevalent RRT patients by age and gender in 2005

Primary diagnosis	% all patients	Inter unit range %	% age <65	% age ⩾65	M : F ratio
Aetiology unc./glomer. NP*	22.3	0.52–81.25	19.8	27.7	1.6
Glomerulonephritis**	15.4	0.82–22.16	18.0	9.9	2.3
Pyelonephritis	12.5	0.52–19.31	14.3	8.8	1.1
Diabetes	12.1	0.30–23.58	11.5	13.4	1.6
Polycystic kidney	9.2	0.89–16.27	9.6	8.2	1.1
Hypertension	5.4	0.15–17.99	4.7	6.9	2.4
Renal vascular disease	3.7	0.52–17.42	1.3	8.8	1.9
Other	13.7	1.04–22.73	15.3	10.3	1.3
Not sent	5.7	0.08–95.77	5.5	6.0	1.5

*Glomerulonephritis not proven
**Glomerulonephritis biopsy proven

Table 4.11: Transplant : dialysis ratios by age and primary renal disease in the prevalent RRT population 31/12/2005

	Transplant : dialysis ratio	
Primary diagnosis	<65 years	⩾65 years
Diabetes	0.61	0.08
Glomerulonephritis	1.67	0.52
Hypertension	1.04	0.32
Diagnosis missing	0.99	0.18
Other	1.31	0.26
Polycystic kidney disease	1.54	0.94
Pyelonephritis	1.92	0.33
Renal vascular disease	0.52	0.07
Uncertain	1.31	0.24

years. The male:female ratio was significantly greater than unity for most primary renal diseases, but only marginally for polycystic kidney disease and pyelonephritis. The ratio for polycystic kidney disease is similar to that in incident patients and the possible underlying reasons were discussed in Chapter 3. The ratio for pyelonephritis is markedly different in prevalent (1.1) and incident patients (1.7). This is a consistent finding and may indicate poorer survival on RRT of males with this diagnosis.

The distribution of patients between the modalities is also heavily influenced by primary renal diagnosis (Table 4.11). Patients with pyelonephritis, polycystic kidney disease and glomerulonephritis are much more likely to have been transplanted than patients with diabetes and those with renal vascular disease. The differences are even more marked in patients over the age of 65.

Diabetes

The median age of all prevalent diabetic RRT patients (58.8 years) is slightly higher than that of non-diabetics (56.2 years), patients with Type 1 disease being considerably younger (52.8 years) than those with Type 2 disease (66.6 years) (Table 4.12). The RRT vintage of prevalent diabetics both Type 1 (3.3 years) and Type 2 (2.2 years) is significantly less than that of prevalent non-diabetics (5.8 years). Fewer prevalent diabetics than non-diabetics have transplants (26.9% vs 48.2%): 36.1% of patients with Type 1 disease and only 10.3% of those with Type 2 disease. The proportions are even lower in patients over the age of 65 (Table 4.13).

Table 4.12: Type of diabetes, median age, gender ratio and treatment modality in prevalent RRT patients 31/12/2005

	Type 1	Type 2	All diabetes	Non-diabetics
Number	2,924	1,629	4,553	30,830
M : F ratio	1.59	1.69	1.62	1.53
Median age on 31/12/05	52.8	66.6	58.8	56.2
Median age started ESRF	47.0	63.0	54.0	47.0
Median years on RRT	3.3	2.2	2.8	5.8
% HD	48.6	71.9	56.9	40.4
% PD	15.3	17.8	16.2	11.4
% transplant	36.1	10.3	26.9	48.2

Table 4.13: Age relationships by type of diabetes and modality in prevalent RRT patients 31/12/2005

	Age less than 65			Age 65 or over		
	Type 1	Type 2	Non-diabetics	Type 1	Type 2	Non-diabetics
Total no	2,231	702	21,080	693	927	9,748
% HD	39.8	63.1	30.2	77.1	78.5	62.5
% PD	15.6	20.9	10.5	14.1	15.4	13.5
% transplant	44.6	16.0	59.3	8.8	6.0	24.0

Modalities of treatment

The most common treatment modality is transplantation (45.0%), closely followed by the proportion on centre-based HD (41.7%) as shown in Figure 4.9. The proportion of patients on home HD remains very small (1.2% of RRT) in spite of the recent NICE guidelines.

Transplantation is the predominant treatment modality in patients less than 65 years old and haemodialysis in those 65 or older (Table 4.14). The proportions are similar in all of the UK countries except a small preference in favour of HD over PD in Northern Ireland, particularly in older patients.

Haemodialysis is increasingly prominent with increasing age at the expense of transplantation.

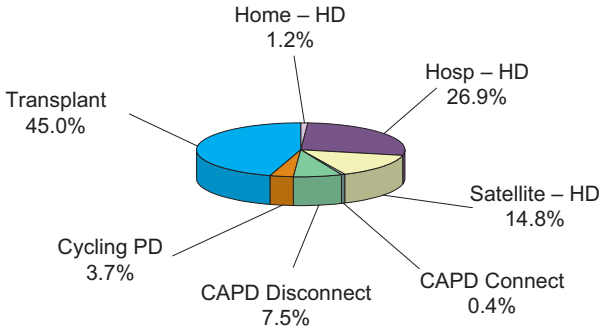

Figure 4.9: Treatment modality in prevalent RRT patients 2005

Note: In some centres local coding of RRT modality is such that the Registry could not differentiate between CAPD and cycling PD. In these centres all PD patients are included as CAPD disconnect. Thus the proportion of PD patients on cycling PD is a slight underestimate

The proportion of each age group treated by PD remains fairly stable across the whole age spectrum (Figure 4.10).

Table 4.14: Treatment modalities by age in UK countries in 2005

	<65 years			≥65 years		
	% HD	% PD	% Tx	% HD	% PD	% Tx
England	32.3	11.3	56.4	64.2	14.2	21.6
N Ireland	36.6	9.8	53.5	74.3	6.2	19.5
Scotland	30.8	11.4	57.8	68.5	10.3	21.2
Wales	33.0	13.2	53.8	65.7	16.6	17.6
UK	**32.3**	**11.4**	**56.3**	**65.1**	**13.7**	**21.2**

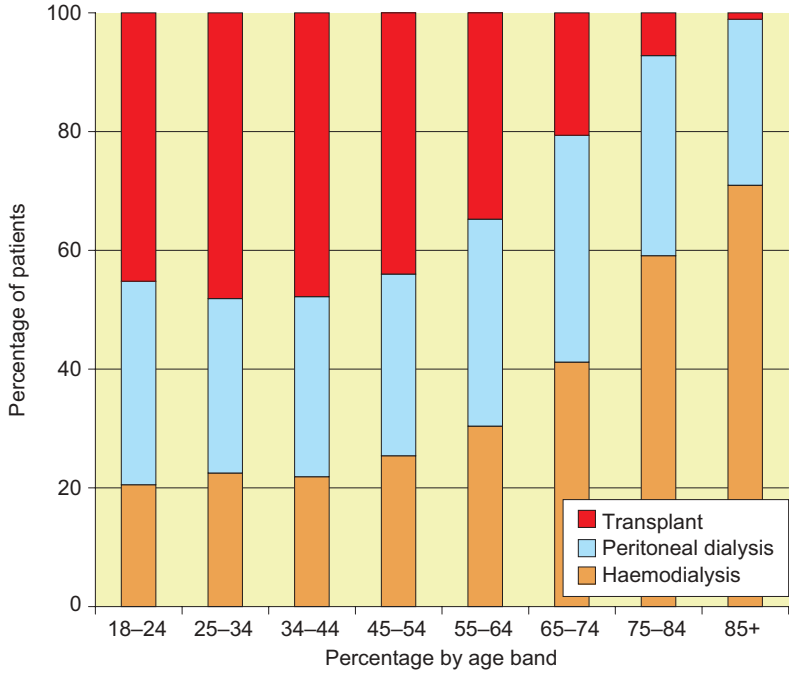

Figure 4.10: Treatment modality distribution by age in prevalent RRT patients in 2005

Haemodialysis

The proportion of dialysis patients on HD in the UK was 78% and higher in those over 65 years old than in younger patients (83% vs 74%). The proportions varied widely between renal units but the same pattern of age distribution was maintained in all but five units (Dorset, Ulster, Inverness, Dumfries & Galloway and Wolverhampton, Figure 4.11). A slightly larger percentage of the male dialysis population (78.7%) were on HD than of the female dialysis population (76.7%: $p < 0.001$).

The proportion receiving HD in satellite units varied. Twenty-nine units had no satellite haemodialysis whilst 12 units dialysed more than 50% of their haemodialysis patients in satellites (Figure 4.12). Satellite HD amounted to 34.5% of total HD activity. Twenty-one units had no home HD programme. In the 44 units which did offer home HD, the proportion of HD patients treated by this modality ranged from 0.6% to 11.1%. Overall only 2.7% were on home HD. Twelve units had home HD programmes amounting to more than 5% of total HD activity.

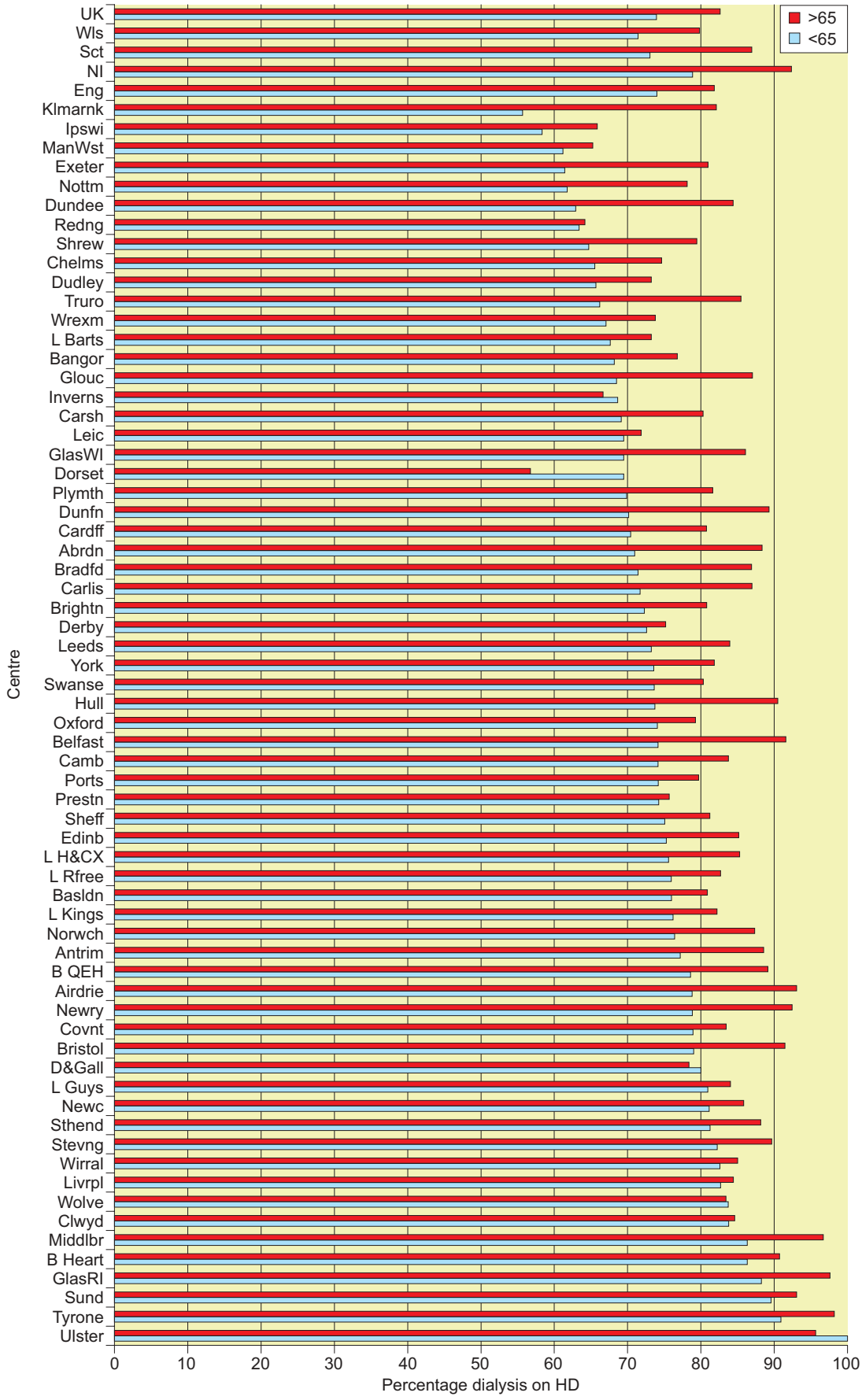

Figure 4.11: Proportion of older and younger prevalent dialysis patients on haemodialysis in each centre in 2005

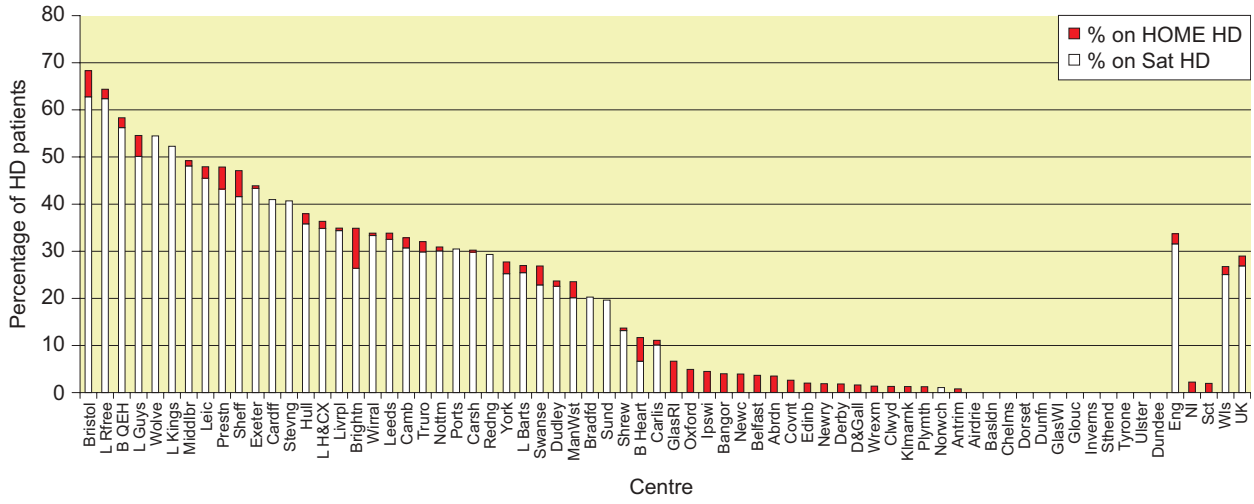

Figure 4.12: Percentage of prevalent HD patients treated at home and in satellite units in 2005

Peritoneal dialysis

The proportion of prevalent dialysis patients on PD varies widely ranging from 2.4% (one patient) in Ulster to 38.2% in Ipswich (Figure 4.13). Overall 23.3% of the female dialysis population were on PD compared with 21.2% of the male dialysis population ($p < 0.001$). The overall male to female ratio was 1.4 but there was marked variation between centres, the ratio varying from 0.6 to 5.0.

CAPD using disconnect systems remains the most common PD mode (62.0% of all patients on PD). The use of automated PD (APD) is continuing to increase and now comprises 32.2% of all PD treatments. However, the use of APD varies widely between units, ranging from 0–100% of all PD treatments (Figure 4.14). Treatment for 6 or more nights weekly is the norm, but many units use less frequent treatments on an occasional basis and one unit (Guys), exclusively. Use of connect systems remains very uncommon (3.6% of all treatments).

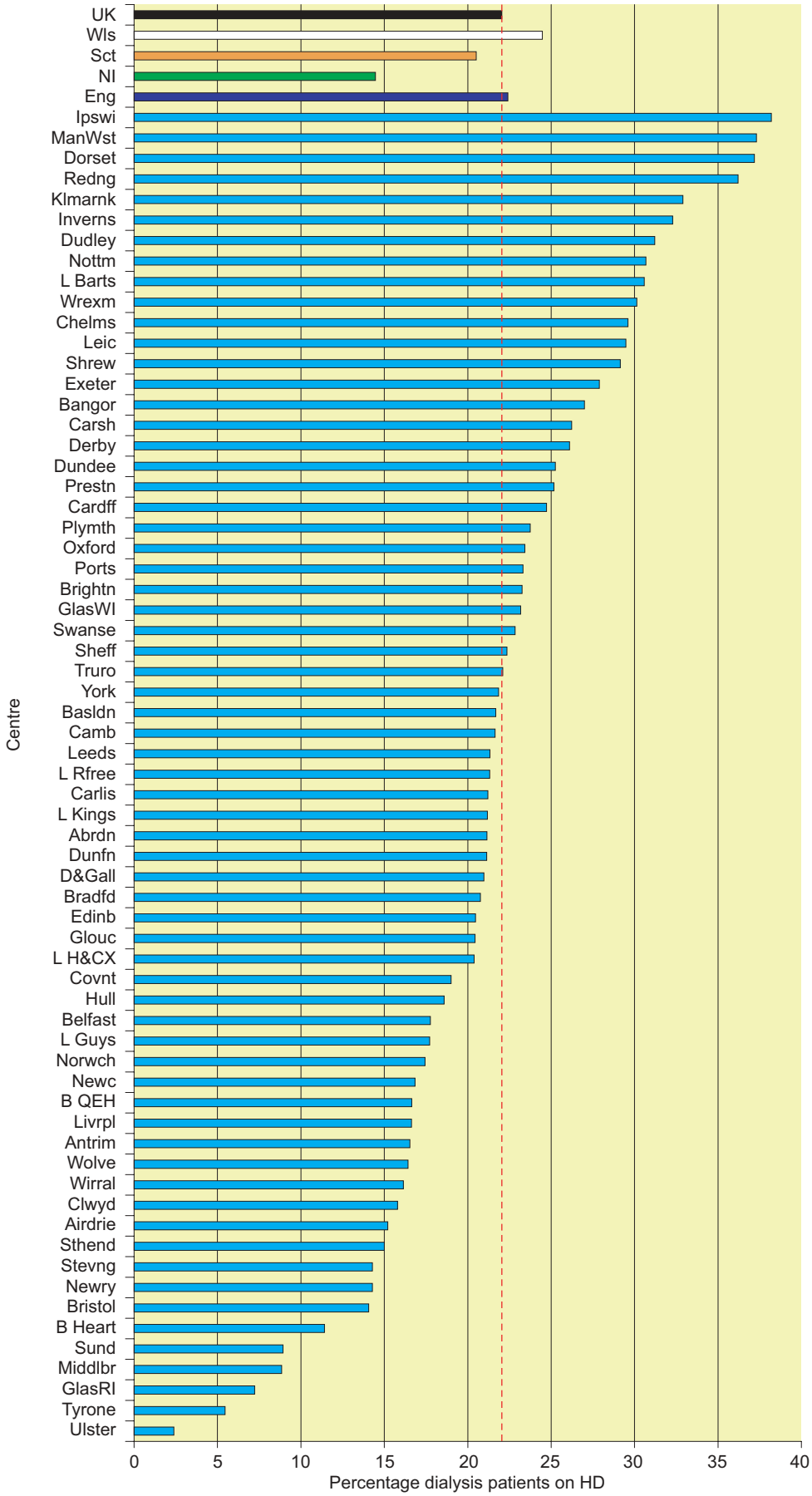

Figure 4.13: Proportion of prevalent dialysis patients on PD at each centre 2005

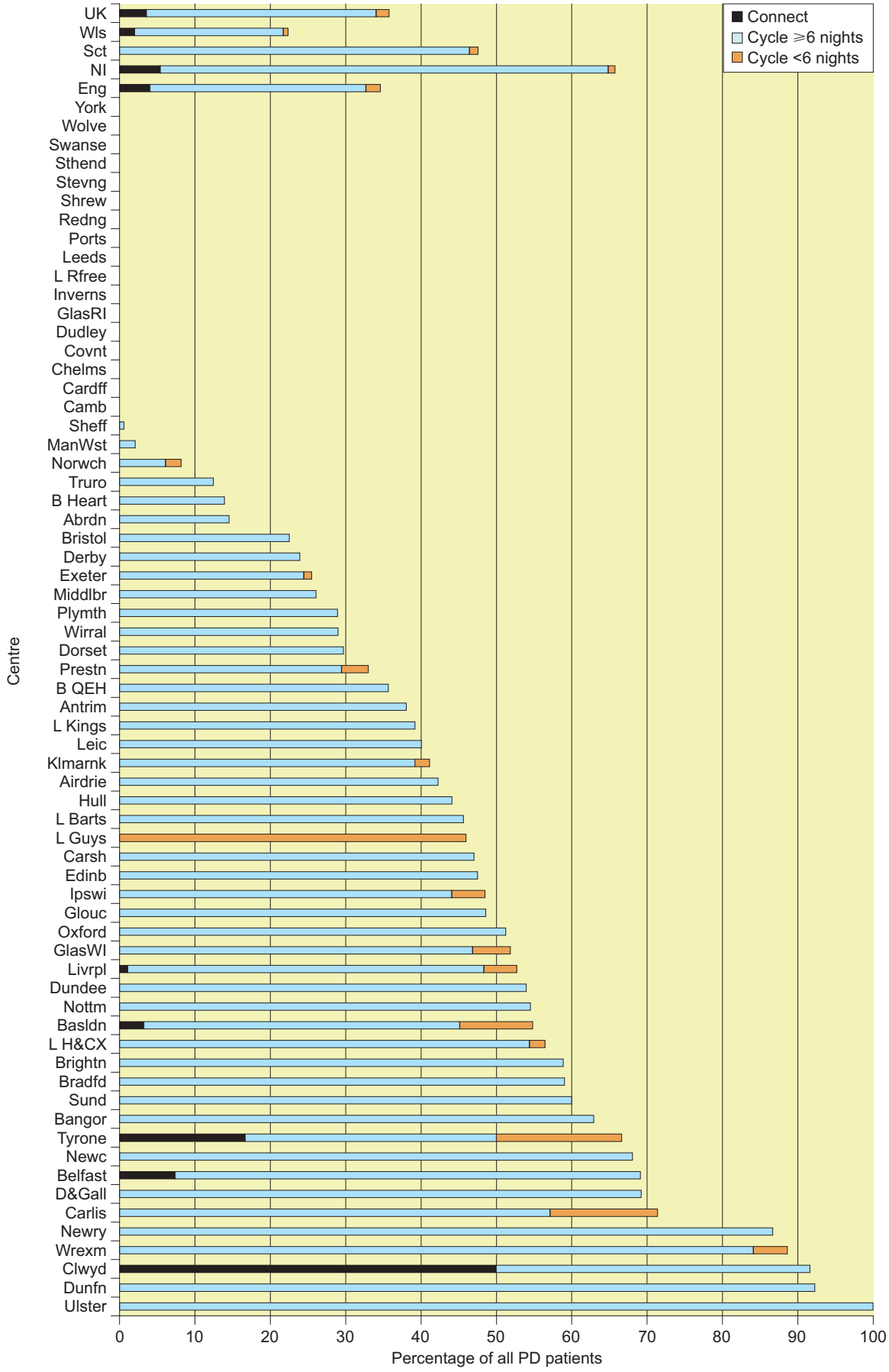

Figure 4.14: Use of connect and automated PD as a percentage of total PD in 2005

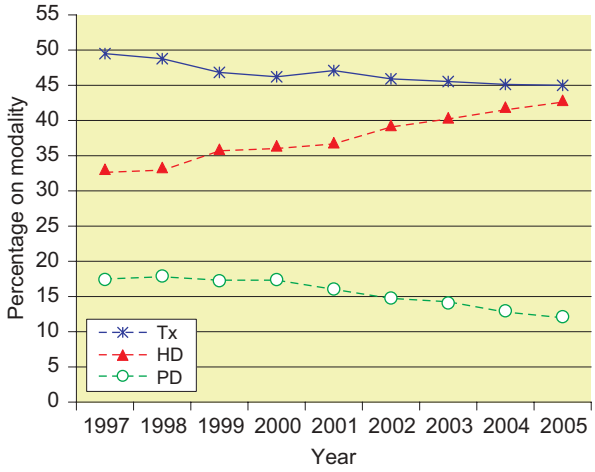

Figure 4.15: Modality changes in prevalent RRT patients 1997–2005, England and Wales

Change in treatment modality 1997–2005

The pattern of modality usage in prevalent RRT patients is still continuing to change (Figure 4.15). The proportion of RRT patients on haemodialysis continues to increase at the expense of a decreasing proportion of peritoneal dialysis and transplant patients. It should be noted though that the figures from each year are not strictly comparable since the number of units contributing to the Registry has increased successively.

Within the dialysis population, the proportion of patients undergoing haemodialysis in traditional hospital based units has reached a plateau, whilst the proportion dialysing in satellite units continues to grow. There is a progressive fall in the proportion on disconnect CAPD. The proportion on automated PD continues its slow rise. The use of 'standard' or 'connect' CAPD has virtually disappeared. In spite of NICE guidance, the proportion on home haemodialysis remains very low and static.

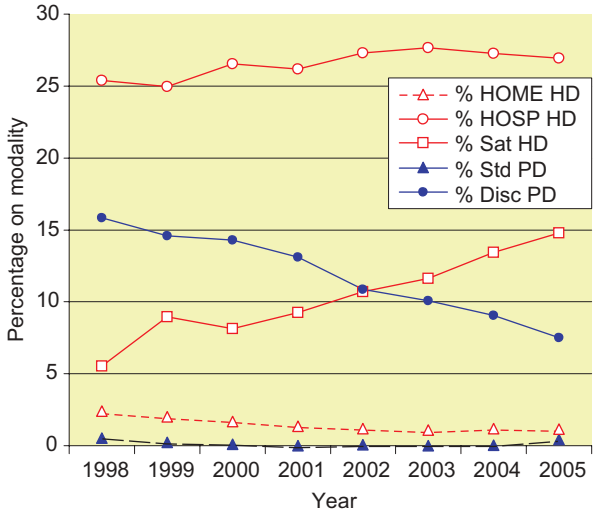

Figure 4.16: Proportion of prevalent patients on different modalities of RRT 1997–2005, England and Wales

The trends in change of proportions of patients on each modality of treatment since 1998 are shown in Figure 4.16.

Survival of patients established on RRT

This section analyses the one year survival rates in the different centres contributing to the UK Renal Registry. This year, with the agreement of all UK clinical directors, centre anonymity has been removed. These are raw data that require very cautious interpretation if legitimate centre comparisons are to be attempted. The Registry can adjust for the effects of the different age distributions of the patients in different centres, but lacks sufficient data from 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 is difficult to interpret any apparent difference in survival between centres.

All patients who had been established on RRT for at least 90 days on 1 January 2005 were included in this analysis. The patients in the transplant cohort have 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. It could induce differences between those renal units 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 units were compared with and without censoring at transplant. The results are shown in Table 4.15. 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 rest of this chapter.

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.

The one year death rate per 100 patient years is shown in Table 4.16 and one year survival of established prevalent RRT patients in Table 4.17.

In Figure 4.17 the survival of prevalent dialysis patients for each age band is shown.

Table 4.15: One year Kaplan-Meier 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	87.3	83.1	91.8	87.7	83.5	92.1
Airdrie	82.7	77.5	88.4	83.3	78.2	88.8
Antrim	84.1	78.6	89.9	84.7	79.4	90.3
B Heart	87.6	84.5	90.9	87.0	83.7	90.5
B QEH	88.9	86.9	91.0	88.3	86.2	90.5
Bangor	86.7	80.5	93.4	86.2	79.8	93.1
Basldn	90.3	85.5	95.2	90.9	86.3	95.7
Belfast	86.3	82.8	90.0	86.8	83.4	90.3
Bradfd	86.3	81.8	91.0	85.4	80.7	90.4
Brightn	84.4	81.0	87.8	83.8	80.4	87.4
Bristol	87.4	84.8	90.1	86.5	83.7	89.4
Camb	87.5	84.2	90.9	86.2	82.7	89.9
Cardff	84.4	81.5	87.4	82.8	79.7	86.0
Carlis	85.8	79.3	93.0	85.7	79.0	92.9
Carsh	86.6	84.0	89.3	86.4	83.7	89.2
Chelms	82.6	76.6	89.0	81.9	75.7	88.6
Clwyd	83.4	75.0	92.8	80.2	71.2	90.4
Covnt	89.5	86.4	92.7	88.9	85.7	92.3
D&Gall	91.0	84.9	97.5	91.5	85.7	97.7
Derby	88.1	84.5	91.9	87.4	83.5	91.4
Dorset	89.9	86.0	94.0	89.2	85.1	93.6
Dudley	86.3	81.3	91.7	85.3	80.0	91.1
Dundee	87.8	83.6	92.3	88.3	84.2	92.6
Dunfn	90.9	86.1	95.9	91.2	86.6	96.1
Edinb	86.1	82.2	90.1	86.6	82.8	90.5
Exeter	84.4	80.9	88.0	83.4	79.7	87.2
GlasRI	87.4	84.1	90.8	88.0	84.9	91.3
GlasWI	87.8	84.4	91.3	88.3	85.0	91.6
Glouc	88.4	84.1	93.0	88.3	84.0	92.9
Hull	84.5	80.9	88.4	83.8	80.0	87.8
Inverns	87.2	81.7	93.1	87.6	82.3	93.3

Table 4.15: (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
Ipswi	84.8	79.8	90.2	84.1	78.6	90.0
Klmarnk	84.7	79.0	90.8	85.2	79.7	91.1
L Barts	85.4	82.7	88.3	84.8	81.9	87.8
L Guys	89.5	86.8	92.2	89.1	86.3	91.9
L H&CX	87.2	84.8	89.6	86.5	84.1	89.1
L Kings	86.7	83.2	90.4	86.3	82.7	90.1
L RFree	90.1	87.9	92.4	90.0	87.8	92.4
Leeds	88.9	86.4	91.4	88.3	85.8	91.0
Leic	87.3	85.0	89.7	86.3	83.8	88.9
Livrpl	85.1	82.1	88.3	84.4	81.3	87.6
ManWst	83.5	79.7	87.6	82.9	78.9	87.1
Middlbr	85.9	82.0	90.0	85.1	81.0	89.4
Newc	87.3	83.5	91.2	86.1	82.1	90.3
Newry	85.7	79.5	92.4	86.1	80.1	92.6
Norwch	87.1	83.3	91.1	86.1	82.1	90.4
Nottm	85.3	82.1	88.5	84.5	81.2	87.9
Oxford	87.8	85.2	90.4	87.4	84.7	90.1
Plymth	87.3	82.7	92.2	86.3	81.4	91.5
Ports	86.2	83.0	89.5	85.4	82.1	88.9
Prestn	85.7	82.4	89.0	84.9	81.5	88.4
Redng	86.3	82.1	90.8	85.3	80.8	90.1
Sheff	87.0	84.5	89.5	86.6	84.1	89.2
Shrew	87.2	82.3	92.3	85.2	79.7	91.1
Stevng	88.8	86.2	91.6	88.5	85.8	91.3
Sthend	87.5	83.1	92.1	86.5	81.7	91.6
Sund	86.6	81.3	92.2	84.9	79.2	91.0
Swanse	89.7	86.7	92.7	89.2	86.1	92.4
Truro	85.7	81.5	90.1	85.6	81.4	90.1
Tyrone	88.7	83.3	94.4	89.1	83.9	94.6
Ulster	86.6	78.0	96.1	87.0	78.7	96.3
Wirral	89.0	84.6	93.5	88.3	83.8	93.1
Wolve	87.6	84.1	91.3	86.9	83.2	90.8
Wrexm	84.5	78.9	90.5	82.9	76.8	89.5
York	88.1	82.9	93.5	86.8	81.3	92.7
Eng	**87.1**	**86.5**	**87.7**	**86.5**	**85.9**	**87.1**
NI	**86.2**	**83.8**	**88.6**	**86.6**	**84.3**	**89.0**
Sct	**87.0**	**85.6**	**88.5**	**87.5**	**86.2**	**89.0**
Wls	**86.1**	**84.2**	**88.0**	**84.9**	**82.9**	**87.0**
UK	**87.0**	**86.5**	**87.5**	**86.5**	**85.9**	**87.1**

Table 4.16: One-year death rate per 100 patient years by country

	England	Wales	Scotland	N Ireland	UK
Death rate	17.7	20.7	18.2	19.7	18.0
95% CI	17.0–18.4	17.9–23.8	16.2–20.5	16.2–23.6	17.3–18.6

Table 4.17: 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 2005				
Censored at dialysis	14,512	384	97.3	97.0–97.5
Not censored at dialysis	14,526	417	97.1	96.8–97.3
Dialysis patients 2005				
All 2005	17,894	2,881	83.7	83.2–84.3
All 2005 adjusted age = 60	17,894	2,881	86.5	86.0–87.1
2 year survival – dialysis patients 2004				
All 1/1/2004 (2 year)	15,448	3,664	74.6	73.9–75.3
Dialysis patients 2005				
All age <65	9,399	887	90.4	89.8–91.0
All age 65+	8,495	1,994	76.4	75.5–77.3
Non-diabetic <55	4,558	251	94.4	93.7–95.0
Non-diabetic 55–64	2,704	312	88.3	87.1–89.5
Non-diabetic 65–74	3,458	658	80.8	79.5–82.2
Non-diabetic 75+	3,255	899	72.2	70.7–73.8
Non-diabetic <65	7,262	563	92.1	91.5–92.7
Diabetic <65	1,586	267	82.9	81.1–84.8
Non-diabetic 65+	6,713	1,557	76.7	75.7–77.7
Diabetic 65+	1,301	303	76.6	74.3–78.9

KM = Kaplan-Meier survival
Cohorts of patients alive 1/1/2005 unless indicated otherwise

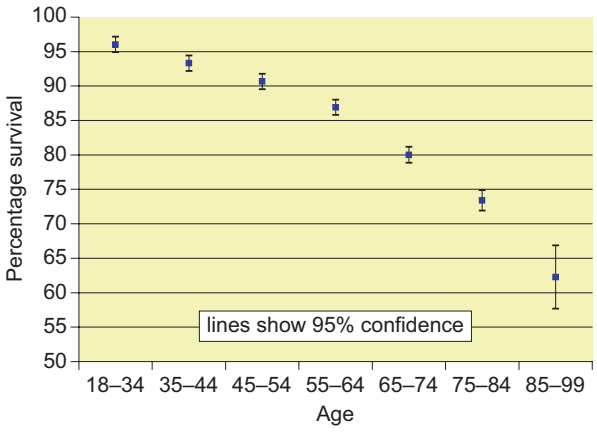

Figure 4.17: One year survival of prevalent dialysis patients in different age groups – 2005

One year survival of prevalent dialysis patients

The one year survival of dialysis patients in each centre is shown in Table 4.15 and is illustrated in Figures 4.18 and 4.19, dividing the data into those patients aged <65 years and those 65 years and over. Figures 4.20 and 4.21 show the data as a funnel plot, with the dotted line showing the 2 standard deviation limit (95% CI) and the solid line the limits for 3 standard deviations (99.9% CI). With over 60 units included it would be expected by chance that 3 units would fall outside the 95% (1 in 20) confidence intervals, which is in fact the case. These figures do not therefore provide support for significant differences between units.

After adjusting for the difference in median age of patients at each centre (Figure 4.22) there was no significant difference in survival between England, Scotland, Wales and Northern Ireland ($p = 0.40$). No centres had adjusted one year survival significantly below the national mean. This is consistent with a previous Registry neural network analysis of survival in UK prevalent patients which indicates that the difference in survival between centres is related to differences in patient characteristics, rather than a true centre effect[1].

One year survival of prevalent dialysis patients in England, Wales and Scotland from 1997–2005

The one-year survival of prevalent dialysis patients (Table 4.18, Figure 4.23) increased significantly from 1997 to 2005 in England

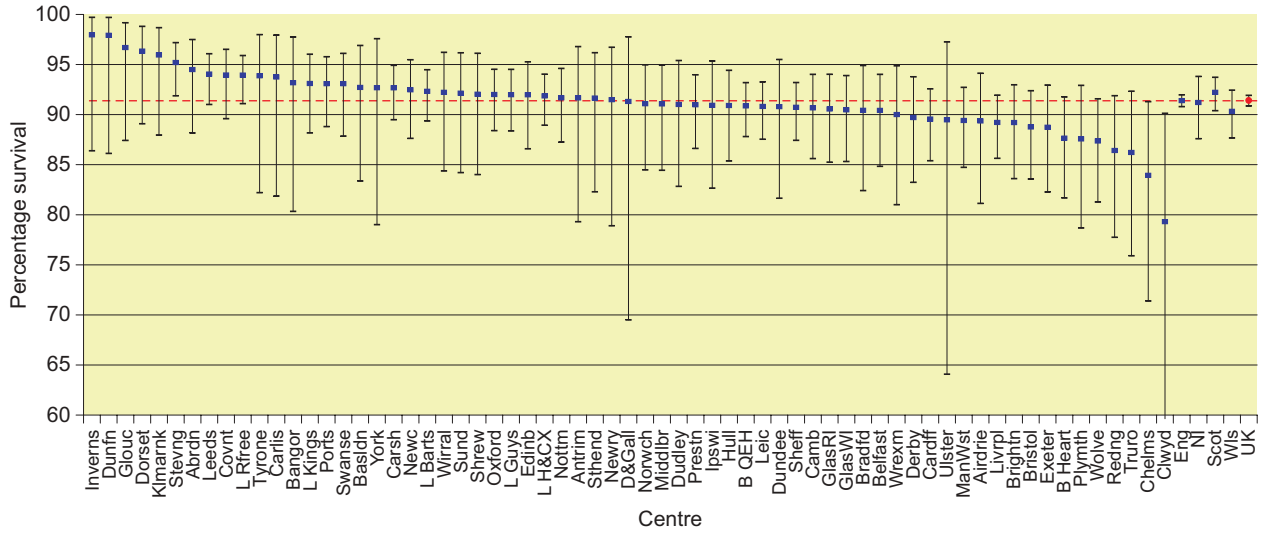

Figure 4.18: One year survival of prevalent dialysis patients aged under 65 in each centre

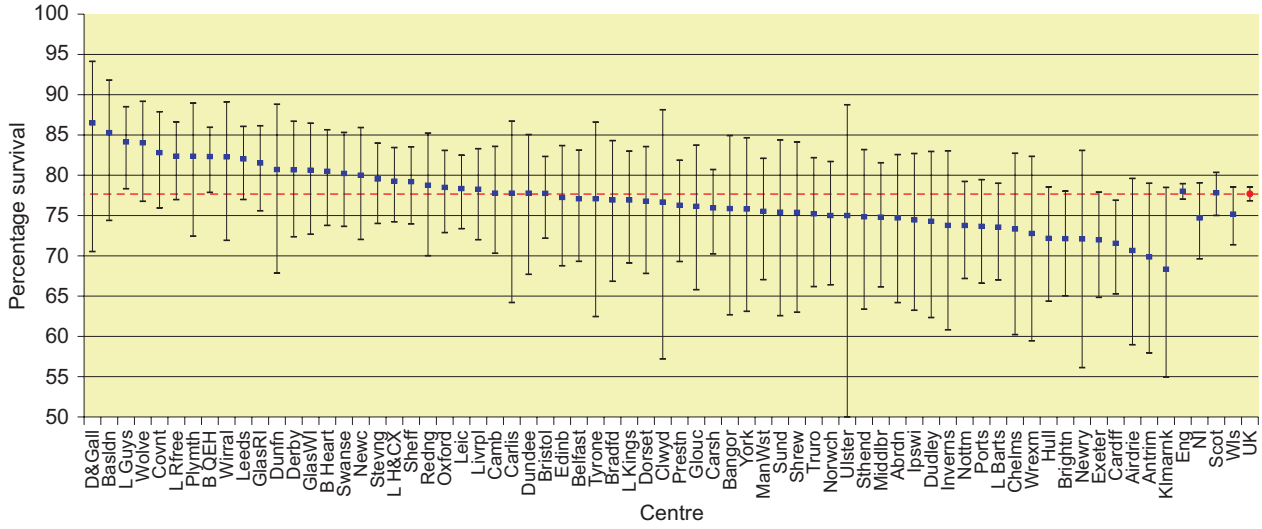

Figure 4.19: One year survival of prevalent dialysis patients aged 65 and over in each centre

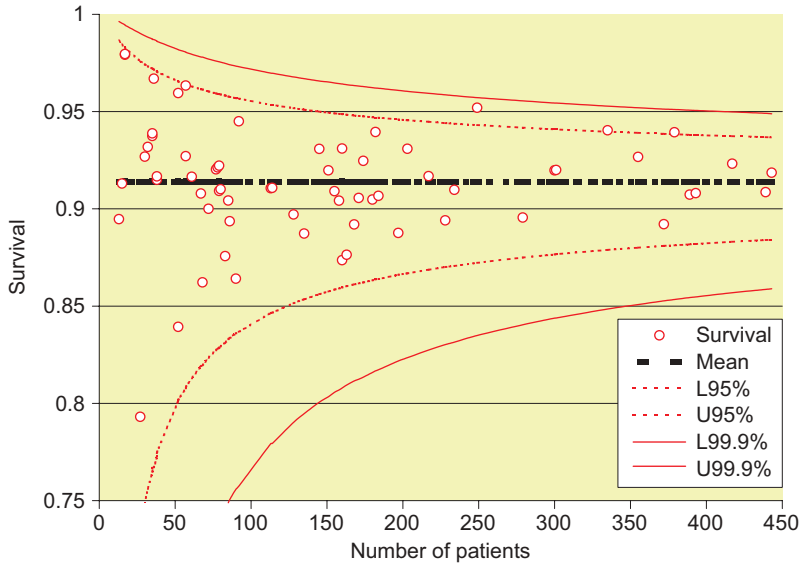

Figure 4.20: Funnel plot of 1 year survival of prevalent dialysis patients aged under 65 years

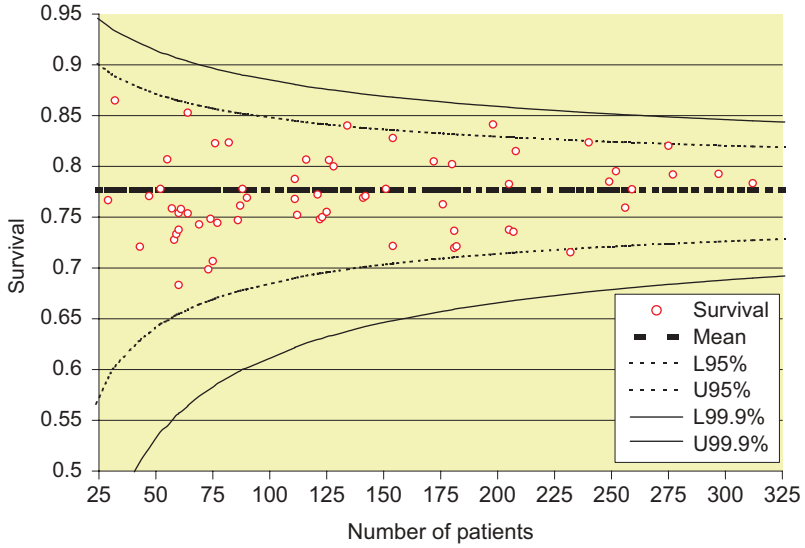

Figure 4.21: Funnel plot of 1 year survival of prevalent dialysis patients aged 65 and over

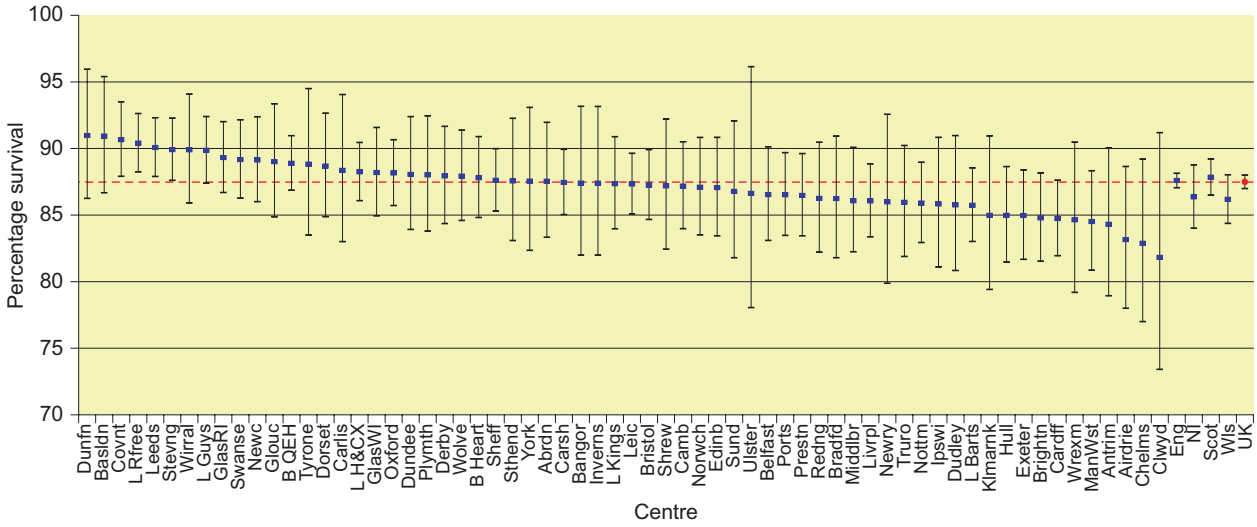

Figure 4.22: One year survival of prevalent dialysis patients in each centre adjusted to age 60

Table 4.18: Serial one year survival for dialysis patients in England, Wales and Scotland from 1997–2005 adjusted to age 60

	England		Wales		Scotland	
	1 year survival %	95% CI	1 year survival %	95% CI	1 year survival %	95% CI
1997	83.3	81.7–84.4	n/a	n/a	n/a	n/a
1998	84.2	83.0–85.5	n/a	n/a	84.0	81.9–86.1
1999	84.1	83.0–85.2	83.4	80.5–86.3	82.3	80.3–84.3
2000	85.3	84.4–86.3	85.4	82.9–88.0	83.4	81.6–85.3
2001	86.1	85.3–86.9	88.0	85.9–90.2	83.6	81.8–85.4
2002	87.5	86.8–88.1	87.4	85.5–89.3	85.0	83.3–86.7
2003	86.1	85.4–86.8	84.2	82.1–86.3	83.7	82.0–85.4
2004	87.4	86.8–88.0	87.8	86.0–89.5	86.1	84.5–87.6
2005	87.1	86.5–87.6	86.1	84.2–88.0	87.0	84.2–88.0

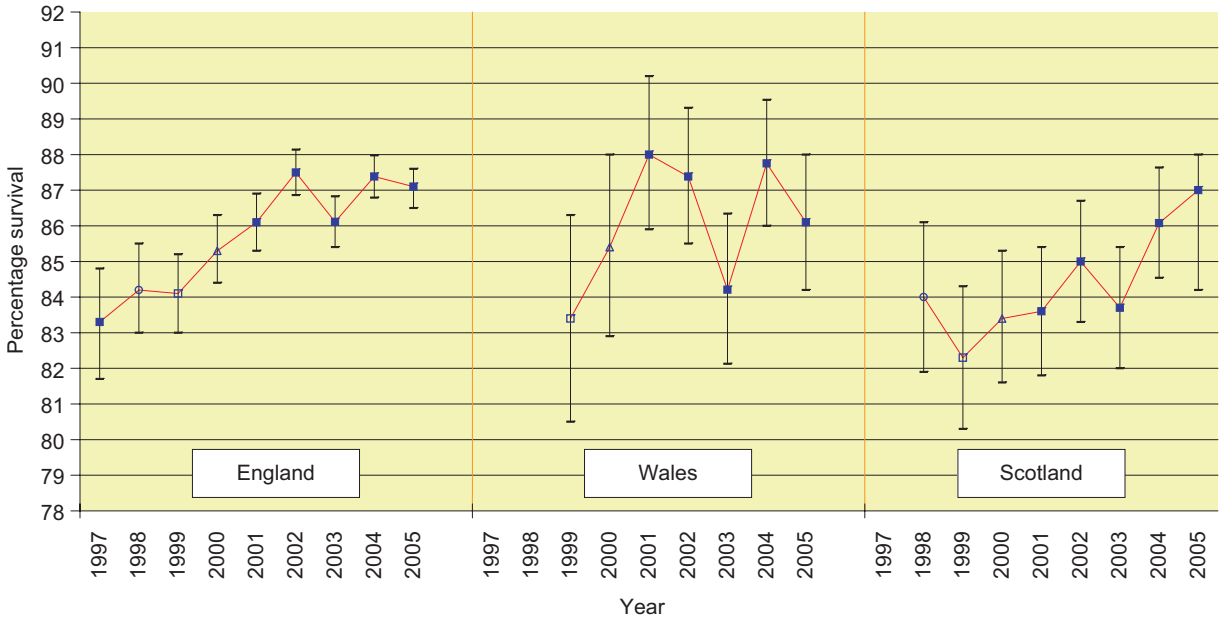

Figure 4.23: Serial one year survival for dialysis patients in the UK from 1997–2005

(83.3% to 87.1% p = 0.0001 for linear trend), Scotland 1998 to 2005 (84.0% to 87.0% p = 0.023 for linear trend) and Wales 1999 to 2005 (83.4% to 86.1% p = 0.027 for linear trend). The test for non-linearity in this trend (indicating that there has been a large increase which is now tailing off) was significant for England and Wales.

References

1. 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(3):743–8.

Chapter 5: The UK Vascular Access Survey – Follow-up Data and Repeat Survey

Richard Fluck, Raman Rao, Dirk van Schalkwyk, David Ansell and Terry Feest

Summary

- In the 2006 vascular access survey, 51% of all patients commenced renal replacement therapy using definitive access. Of patients commencing on HD, 37% commenced with definitive access (31% in the 2005 survey).
- Of those known to the renal units for a year or more, only half started HD with definitive access.
- 4% of patients currently receiving haemodialysis were in-patients.
- 30% of staphylococcal line infections were MRSA, which was similar to the 2005 survey.
- At 6 months after starting RRT, 76% of live patients were using definitive access (defined as the use of peritoneal dialysis, transplant, AVF or AVG) and at 12 months it was 80%.
- Of HD patients starting RRT in April 2005, 65% started using venous catheters, at 6 months this had fallen to 35% and at 12 months 30%. The use of non-tunnelled lines was below 1% by 6 months.
- The proportion on PD had fallen slightly at 12 months (from 20% to 16%) by which time 11% had received a transplant, 1% had recovered and 18% had died.
- Data returns for the 2006 survey were returned from 37/74 renal units compared with returns from 62 units in the 2005 survey.

Introduction

Vascular access remains a key component for the treatment of patients receiving haemodialysis with established renal failure. In the last Registry report, preliminary data from the National Survey were published[1]. This confirmed that for prevalent patients on established renal replacement therapy, vascular access provision across the country was variable. Only a minority of units reached recognised standards for the delivery of care. Vascular access is an important determinant of both morbidity and mortality in patients. Recent DOPPS data[2] suggest that much of the international difference in outcomes for patients on haemodialysis may be associated with vascular access provision. In the 2005 Registry report, it was confirmed that there was a high burden of morbidity in haemodialysis patients, as judged by in-patient bed requirements and *Staphylococcus aureus* infection and there was evidence of an association between the use of venous catheters and these morbidities.

Following the vascular access survey and the Registry report a number of initiatives have been launched. These include a working party from the Renal Association, the Vascular Society and the British Society of Interventional Radiologists which provided a report on the configuration and provision of services to provide and maintain vascular access in patients requiring haemodialysis[3]. Within England, the Department of Health has piloted and launched a supplementary renal dataset as a support to the Health Protection Agency MRSA reporting system (MESS).

This chapter reports on data related to the repeated 2006 survey and then analyses the follow-up data from the 2005 incident cohort and report information from the organisational section of the original survey.

Methods

Vascular Access Survey 2006

A further abbreviated survey set was requested for April 2006. This again required a manual

collection in paper form and requested data on *Staphylococcus aureus* bacteraemias during 2005 and information on the incident patients during April 2006.

Vascular Access Survey 2005 Follow up data and organisational data

As part of the 2005 Vascular Access Survey, units were requested to return follow up data on the incident cohort that was originally reported on. Units had returned data on patients commencing renal replacement therapy for established renal failure (ERF) in April 2005. As has been previously detailed[1] the purpose of this was to track the efficiency of the system and to understand the patient pathway. The initial report showed that only 45% of people commenced dialysis via definite access. Even for those patients known to a renal unit for over a year prior to the initiation of dialysis, 40% start dialysis using venous catheters. It was the intention to track the progress of patients through the pathway of access, to determine the responsiveness of the system of care. Data were requested on modality, access, transplant status and mortality at 6 months and 12 months after initiation of RRT. Data on several aspects of resources available for vascular access support were also collected.

Results

Vascular Access Survey 2006

Data returns

All renal units in the United Kingdom were circulated with a reduced survey in 2006. Of the 74 centres, 37 returned data (Table 5.1). Centre dialysis populations ranged from 88 to 720, median 203. The total number of prevalent dialysis patients was 9,495, 1,972 on peritoneal dialysis and 7,523 on haemodialysis on the day of census. Several large metropolitan areas were poorly represented – the two largest units, QE Birmingham and Barts & The Royal London were unable to return data. The results from this smaller sample were essentially the same as in the 2005 survey.

Morbidity data

Infection

Centres again provided information on the number of *Staphylococcus aureus* bacteraemic episodes diagnosed in the prevalent haemodialysis population during the calendar year 2005, and the number of those due to Methicillin resistant species. There were 590 episodes from 35 reporting centres: 179 (30%) were MRSA (29% in 2004). Rates by centre are summarised in Table 5.1. The median rate was 8.1 *Staph. Aureus* bacteraemias per 100 haemodialysis patients, with rates ranging from 1.9 to 18.2 episodes/100 patients. As all these *Staph. Aureus* infections will only be occurring in HD patients with lines, the true rate is 25 *Staph. Aureus* bacteraemias per 100 HD patients with a line.

Bed occupancy

On census day, the numbers of in-patient beds occupied by haemodialysis patients were collated. A total of 295 (3.9%) from 7,523 haemodialysis patients were in-patients and this compared with 5% in the 2005 survey.

Incident data

The 37 centres reported 236 incident patients during April 2006, range 0 to 17 (Table 5.1). About one third were female and 92% Caucasian. Unchanged from the 2005 survey, over half had been referred for access prior to renal replacement therapy and 11% (10% in 2005) were transplant listed prior to the initiation of RRT.

The survey demonstrated a similar pattern of modality and access at first renal replacement therapy to that shown in the 2005 survey: 1.3% received a pre-emptive transplant, 20% commenced on peritoneal dialysis and 78% started on haemodialysis. Of the 185 patients commencing on haemodialysis, only 37% did so with an arteriovenous fistula or graft (31% in the 2005 survey).

Modality data

As in 2005, nearly a third of incident patients present within 6 months of requiring renal

Table 5.1: Results of repeat vascular access survey 2006

	Prevalent patients									
Hospital name	**HD**	**PD**	**Total dialysis**	**Staph. Aureus**	**MRSA**	**In pts on renal beds**	**MRSA/SA**	**SA/100 pts**	**% HD in-patients**	**Incident patients**
Aberdeen Royal Infirmary	191	42	233	7	2	6	28.6	3.7	3.1	1
Addenbrookes Hospital	278	71	349	6	1	8	16.7	2.2	2.9	5
Antrim Hospital	122	36	158	3	2	8	66.7	2.5	6.6	1
Arrowe Park Hospital	172	31	203	16	5	10	31.3	9.3	5.8	4
Basildon Hospital	137	28	165	7	1	2	14.3	5.1	1.5	9
Broomfield Hospital	107	37	144	2	1	7	50.0	1.9	6.5	6
Crosshouse Hospital	109	44	153	14	5	3	35.7	12.8	2.8	3
Cumberland Infirmary	74	22	96	6	0	4	0.0	8.1	5.4	0
Daisy Hill Hospital	88	16	104	4	0	1	0.0	4.5	1.1	1
Derby City General Hospital	203	71	274	6	1	1	16.7	3.0	0.5	8
Freeman Hospital & Royal Victoria Infirmary	236	50	286	43	10	17	23.3	18.2	7.2	6
Gloucester Royal Hospital	141	35	176	11	1	7	9.1	7.8	5.0	3
Guy's and St Thomas's Hospital	439	77	516	28	11	13	39.3	6.4	3.0	11
Heartlands Hospital	339	44	383	12	4	10	33.3	3.5	2.9	10
Hull Royal Infirmary	288	67	355	38	19	9	50.0	13.2	3.1	8
Ipswich Hospital	103	64	167	4	1	4	25.0	3.9	3.9	6
James Cook University Hospital	242	30	272	21	11	14	52.4	8.7	5.8	8
King's College Hospital	312	79	391	36	9	23	25.0	11.5	7.4	5
Monklands Hospital	155	30	185	14	4	8	28.6	9.0	5.2	6
Morriston Hospital	282	72	354	43	9	8	20.9	15.2	2.8	13
New Cross Hospital	288	53	341	41	7		17.1	14.2		4
Ninewells Hospital	138	57	195	21	7	8	33.3	15.2	5.8	4
Northern General Hospital	563	157	720	56	15	19	26.8	9.9	3.4	16
Oxford Radcliffe Hospital	341	121	462	22	7	11	31.8	6.5	3.2	12
Queen Margaret's Hospital	100	28	128	11	3	10	27.3	11.0	10.0	1
Royal Berkshire Hospital	186	94	280	5	2	8	40.0	2.7	4.3	17
Royal Cornwall Hospital (Treliske)	146	37	183							5
Royal Devon and Exeter Hospital (Wonford)	252	100	352	18	6	5	33.3	7.1	2.0	7
Royal Infirmary of Edinburgh (New Royal)	238	61	299			10			4.2	4
Royal Preston Hospital	340	103	443	16	7	9	43.8	4.7	2.6	17
Royal Sussex County Hospital	306	90	396	27	8	16	29.6	8.8	5.2	10
Southend Hospital	125	21	146	18	1	3	5.6	14.4	2.4	9
Tyrone County Hospital	111	8	119	10	1	10	10.0	9.0	9.0	3
University Hospital Aintree	88	0	88	9	8	6	88.9	10.2	6.8	5
Wrexham Maelor Hospital	87	37	124	4	4	7	100.0	4.6	8.0	3
York District General Hospital	126	29	155	4	1	6	25.0	3.2	4.8	4
Ysbyty Gwynedd	70	30	100	7	5	4	71.4	10.0	5.7	1
Total	**7,523**	**1,972**	**9,495**	**590**	**179**	**295**	**30.3**	**7.8**	**3.9**	**236**

HD – number of prevalent haemodialysis patients
PD – number of prevalent peritoneal dialysis patients
Total dialysis – prevalent dialysis population
Staph. Aureus – number of *Staph. Aureus* associated bacteraemias during 2005 for haemodialysis patients
MRSA – Methicillin resistant *Staph. Aureus* associated bacteraemias during 2005 for haemodialysis patients
In pts on renal beds – number HD patients currently deemed to occupy a hospital bed on census day
MRSA/SA – MRSA % of overall *Staph. Aureus* number
SA/100 pts – *Staph. Aureus* bacteraemias per annum per 100 HD patients
% HD in-patients – % of overall HD population currently designated as in-patient
37 out of 74 units returned the data.

Table 5.2: Time from referral to renal services and 1st RRT by dialysis modality

Months	HD %	PD %	HD n	PD n	Total n
0–3	84.8	15.2	39	7	46
3–6	61.5	38.5	8	5	13
6–12	80.0	20.0	16	4	20
12 m+	75.0	25.0	93	31	124
Total	**76.8**	**23.2**	**156**	**47**	**203**

Table 5.3: Time since first contact and access type in HD patients

Months	AVF n	AVG n	Tunnelled line n	Non tunnelled n	Catheter %	Total n
0–3	1	0	16	22	97.4	39
3–6	3	0	2	3	62.5	8
6–12	5	0	7	4	68.8	16
12 m+	51	3	20	19	41.9	93
Total	**60**	**3**	**45**	**48**	**59.6**	**156**

support (Table 5.2). There was some difference in the modality selection when compared over presentation intervals. For 'late presenters', 15% used PD and for 'timely starters' 25% used PD (Table 5.2).

Overall 60% of haemodialysis starters used a venous catheter (Table 5.3). As in 2004, 'late presenters' were highly likely to start with a catheter, but a disappointingly high proportion of long-known patients were also subjected to venous lines.

Vascular Access Survey 2005 – follow-up data

Data returns

In the original survey, 62 units reported on a total of 457 incident patients. Three of those units did not have any new starters in April 2005. Complete 6 and 12 month follow up data were returned on 395 patients from 54 units. Five centres were unable to return follow-up data (Barts and the Royal London, Basildon, Kent and Canterbury, Norfolk, and the University Hospital of North Staffordshire). The follow up analysis reports on the 395 incident patients for whom complete data are available.

Table 5.4 lists the centres with the number of incident patients. Reported numbers ranged from 1 to 25, the largest centre being the Queen Elizabeth Hospital, Birmingham.

The full details of the incident patients are in the 2005 Registry Report. There was a male to female gender ratio of approximately 1.5:1 and 85% were Caucasian. Asian and Black ethnic origin accounted for 13%. These are in keeping with the dialysis population across England and Wales.

Access modality at start, 6 & 12 months post commencement of renal replacement therapy

Table 5.5 shows both frequency and percentage of patients as broken down by modality and access type. Twenty-six percent of patients commenced dialysis using either an arteriovenous fistula (AVF) or an arteriovenous graft (AVG). Forty-nine percent commenced using venous catheters, split approximately equally between tunnelled and non-tunnelled. Twenty percent of patients commenced on peritoneal dialysis and 4% were pre-emptively transplanted.

At 6 months, 76% of live patients were using definitive access (defined as the use of peritoneal dialysis, transplant, AVF or AVG) and at 12 months 80%. Of haemodialysis patients, 65% started using venous catheters, at 6 months this had fallen to 35% and at 12 months 30%. The use of non-tunnelled lines was below 1% by 6 months. The proportion on PD had fallen slightly at 12 months (from 20% to 16%) by which time 11% had received a transplant, 1% had recovered and 18% had died.

Table 5.4: Centres returning follow-up data, with number of incident patients in April 2005

Centre	Incident number	Centre	Incident number
Aberdeen Royal Infirmary	5	Northern General Hospital	18
Addenbrookes Hospital	7	Nottingham City Hospital	7
Arrowe Park Hospital	5	Oxford Radcliffe Hospital	12
Belfast City Hospital	9	Queen Elizabeth Hospital	25
Birmingham Children's Hospital	3	Queen Margaret's Hospital	5
Broomfield Hospital	3	Raigmore Hospital	1
Crosshouse Hospital	2	Royal Berkshire Hospital	12
Derby City General Hospital	10	Royal Cornwall Hospital (Treliske)	2
Derriford Hospital	3	Royal Infirmary of Edinburgh	10
Dumfries & Galloway Royal Inf	2	Royal Liverpool University Hosp	7
Freeman Hospital & Royal Vict	6	Royal Preston Hospital	12
Glasgow Royal Infirmary	7	Royal Sussex County Hospital	6
Gloucester Royal Hospital	4	Russells Hall Hospital	4
Guy's and St Thomas's Hospital	16	Southend Hospital	2
Heartlands Hospital	5	Southmead Hospital	12
Hope Hospital	11	St George's Hospital	9
Hull Royal Infirmary	16	St Helier Hospital	14
Ipswich Hospital	4	St James's University Hospital	12
James Cook University Hospital	9	St Luke's Hospital	2
King's College Hospital	6	Tyrone County Hospital	4
Leeds General Infirmary	14	University Hospital Aintree	5
Leicester General Hospital	13	Walsgrave Hospital	4
Lister Hospital	10	Western Infirmary Glasgow	8
Monklands Hospital	4	Wrexham Maelor Hospital	5
Morriston Hospital	7	York District General Hospital	2
New Cross Hospital	8	Ysbyty Glan Clwyd	3
Ninewells Hospital	2	Ysbyty Gwynedd	1

Table 5.5: Modality and access at start of RRT, and at 6 and 12 months

	At start		At 6 months		At 12 months	
Access and modality	**Frequency**	**Per cent**	**Frequency**	**Per cent**	**Frequency**	**Per cent**
Haemodialysis	**298**	**76**	**232**	**60**	**193**	**52**
AVF	98	25	145	38	132	36
AVG	6	2	6	2	4	1
Non-tunnelled line	103	26	3	1	3	1
Tunnelled line	91	23	78	20	54	15
PD	**79**	**20**	**78**	**20**	**58**	**16**
Transplanted	**16**	**4**	**24**	**6**	**40**	**11**
Recovered			8	2	5	1
Died			40	10	66	18
Transferred out					4	1
Unknown			3	1	2	1
Missing	2		10		27	
Total number	**395**		**395**		**395**	

Table 5.6 presents the data for haemodialysis patients alone broken down by access at start, at 6 months and 12 months post commencement of renal replacement therapy. As already reported only 35% of patients commenced haemodialysis using definitive access as defined by the use of an arterial venous fistula or arterial venous graft. Non-tunnelled access

Table 5.6: Haemodialysis patients' access at start, 6 and 12 months

	At start		At 6 months		At 12 months	
Access	**Frequency**	**Per cent**	**Frequency**	**Per cent**	**Frequency**	**Per cent**
AVF	98	33	145	62	132	69
AVG	6	2	6	3	4	2
Non tunnelled	103	35	3	1	3	2
Tunnelled	91	31	78	34	54	28
Total	**298**		**232**		**193**	

made up over a third of these patients at 35% and tunnelled access was used in 31%. At 6 months, 65% of haemodialysis patients were utilising arterial venous fistulas or grafts, the vast majority being fistulas. Non-tunnelled usage had fallen substantially but one third were still using tunnelled access. There was a small rise in the percentage using definitive access between 6 and 12 months reaching just over 70% and the percentage using tunnelled access had fallen to 28%. This is comparable with the overall prevalent level reported in last year's report for haemodialysis at 69% and would suggest that the steady state for the current system is reached in a year or less. Overall, definitive access in the incident group at one year (defined as the use of an AV fistula, AV graft or peritoneal dialysis) was achieved in 194 patients of a total of 251 (77%) patients still on dialytic therapies. This analysis of individual patient data is identical to the summarised prevalent cross sectional data reported for definitive access, with a rate of 77% across the United Kingdom. These data suggest that the sample incident cohort is therefore a useful representation of the overall picture across the United Kingdom.

Transplantation and transplant waiting list

At start, 5% of the patients had been transplanted and 7% were listed and active on transplant waiting lists. At 12 months, 15 patients were in work up, 40 had been transplanted and 48 were active on the waiting list, representing 39% of active patients. Of the overall incident cohort, 5% had been pre-emptively transplanted, another 1.5% were transplanted between 0–6 months and a further 4% transplanted between 6–12 months. These data are similar to the detailed joint analysis with UK Transplant presented in the 2005 report, suggesting that this small cohort is representative of the whole RRT population.

Patient pathway

These data demonstrate that the use of definitive access increases over time in the incident patient cohort. What is of interest is the relationship between starting access and access at a later time. This does provide a surrogate for systematic efficiency and the activity an individual is exposed to. The surveys sent out at 6 and 12 months allow the generation of a matrix of access and modality, comparing start with 6 or 12 months.

Table 5.7 summarises the data for patients at 6 months and Table 5.8 for 12 months. The left hand column (or y axis) indicates the type of dialysis at the start and the x axis or headers give the access at 6 months.

Around 10% of patients starting using venous catheters have converted to PD by 6 months with little change thereafter. There is a steady overall failure rate of AV fistulae with 8% of the original fistula cohort using venous catheters by one year.

There was a rapid move away from non-tunnelled access to tunnelled access. By 6 months, for non-tunnelled access, which made up 103 of the incident group, 34% were utilising tunnelled access, a quarter were now utilising AV fistulas. Nearly one in five (18%) were deceased and one was transplanted. There was a similar pattern for tunnelled access. Thirty four percent had been converted to an AV fistula, 10% were deceased and 34% were still utilising tunnelled access. Seven had been converted on to PD and 4 had recovered.

At 12 months there was a 12% mortality rate in the AVF group. For those initiated via

Table 5.7: Access and modality matrix at 6 months

		Access/modality at 6 months										
At start		**Miss**	**Died**	**AVF**	**AVG**	**Non tunnelled**	**Tunnel**	**PD**	**Recover**	**Unknown**	**Transplant**	**Total**
AVF	Frequency	1	4	81	2	0	4	2	0	0	4	**98**
	%	1	4	83	2	0	4	2	0	0	4	
AVG	Frequency	0	1	2	2	0	0	0	0	0	1	**6**
	%	0	17	33	33	0	0	0	0	0	17	
Non tunnelled	Frequency	3	18	26	0	3	35	13	4	0	1	**103**
	%	3	18	25	0	3	34	13	4	0	1	
Tunnelled	Frequency	1	10	31	2	0	34	7	4	1	1	**91**
	%	1	11	34	2	0	37	8	4	1	1	
PD	Frequency	5	7	3	0	0	5	56	0	0	3	**79**
	%	6	9	4	0	0	6	71	0	0	4	
Transplant	Frequency	0	0	0	0	0	0	0	0	2	14	**16**
	%	0	0	0	0	0	0	0	0	13	88	
Total	**Frequency**	**10**	**40**	**145**	**6**	**3**	**78**	**78**	**8**	**3**	**24**	**395**

Table 5.8: Access and modality matrix at 12 months

		Access/modality at 12 months											
At start		**Miss**	**Died**	**AVF**	**AVG**	**Non tunnelled**	**Tunnel**	**PD**	**Recover**	**Trans-ferred**	**Unknown**	**Transplant**	**Total**
AVF	Frequency	5	12	61	0	1	8	0	0	0	0	11	**98**
	%	5	12	62	0	1	8	0	0	0	0	11	
AVG	Frequency	1	1	1	1	1	0	0	0	0	0	1	**6**
	%	17	17	17	17	17	0	0	0	0	0	17	
Non tunnelled	Frequency	4	27	34	1	0	20	11	2	0	0	4	**103**
	%	4	26	33	1	0	19	11	2	0	0	4	
Tunnelled	Frequency	10	14	29	2	1	19	8	2	2	2	2	**91**
	%	11	15	32	2	1	21	9	2	2	2	2	
PD	Frequency	7	11	5	0	0	7	39	1	2	0	7	**79**
	%	9	14	6	0	0	9	49	1	3	0	9	
Transplant	Frequency	0	0	1	0	0	0	0	0	0	0	15	**16**
	%	0	0	6	0	0	0	0	0	0	0	94	
Total	**Frequency**	**27**	**66**	**132**	**4**	**3**	**54**	**58**	**5**	**4**	**2**	**40**	**395**

non-tunnelled access, one third were utilising an AV fistula but 20% were still using tunnelled access. For those who started using tunnelled catheters, 32% were utilizing an AV fistula, 15% were deceased and 21% still remained on tunnelled access.

For peritoneal dialysis, 79 patients started on this modality. Of those, 71% were still on PD at 6 months and 50% at 12 months – seven had been transplanted and 12 were on haemodialysis, 5 of whom had an AV fistula and 7 a catheter. The mortality rate at 1 year in this group was 14%.

These data are not individual patient's timelines but are only snapshot data at given moments; they do not give an idea of the frequency at which individual patients change between one form of modality or access to another over the 12 month period. Neither do they give an idea of how many failed access attempts there may have been in patients who continue to use venous catheters at 6 and 12 months. Nevertheless these are potentially important data. The apparent slow transition to definitive access and rates of access failure are likely to expose patients to longer periods with venous catheters. These in turn are likely to be

associated with complications and therefore could have detrimental consequences for an individual.

Mortality and incident access and modality

Tables 5.7 and 5.8 show differing mortality rates for patients started on different modalities and types of access. However the patients in each group are highly selected and are not matched for age, late referral, primary disease or co-morbidities. Thus, although patients starting RRT using venous catheters appear to have a poor prognosis, after adjusting for patient age, this was not statistically significant at 12 months. These are relatively small numbers and this may account for lack of statistical significance.

Organisational data

The organisational data set included information on both work force and activity. Units provided information on numbers of surgical personnel and surgical procedures, plus the number of non tunnelled lines placed in April 2005. In the survey data tunnelled line placement and radiological procedures were not collected. For comparison with the following information, the 2005 survey reported on 457 incident patients. That number is relevant in terms of reporting the number of procedures that were carried out within the centres providing data. Table 5.9 outlines the numerical information.

During the month of April, 751 surgical procedures were delivered by 167 consultants. Of those, 122 were vascular accredited and 73 were transplant accredited: a proportion are dual accredited. In addition, during the same month 482 non tunnelled lines were inserted. There was no correlation between the number of incident patients and the number of surgical procedures that were carried out nor was there any correlation between the prevalent definitive access rate and the capacity of units, judged by surgical numbers or activity. In retrospect, April may have been a poor month to choose as it contained both a long Bank Holiday and a long school holiday during which many staff take leave and may not have been representative of normal activity or capacity.

Table 5.9: Organisational information summary

	Total (median, min–max)
Incident patients	457 (7, 1–25)
Surgical procedures	751 (11, 0–64)
Surgeons (consultant)	167 (2, 0–7)
Vascular consultants	122 (2, 0–7)
Transplant consultants	73 (1, 0–5)
Non tunnelled lines	482 (7, 0–37)

Total number with median, minimum and maximum for incident patients (all reported in April 2005), surgical procedures, consultant numbers and the use of non tunnelled lines.

During April 2005, as many temporary lines were inserted as there were incident patients (482 vs 457). What was not requested was on whom procedures were carried out. It is therefore unclear whether the majority of work is performed in those patients who are incident, predialysis, access or modality failures.

Discussion

The 2006 survey reinforced many of the messages of the original survey. A third of patients arrive late, most of whom require venous catheters at the start of dialysis. Many patients, known well in advance to nephrology clinics, still commence on venous catheters. Few patients are transplant listed prior to renal support. For every 100 haemodialysis patients there will be 8 episodes of *Staph. Aureus* bacteraemia per year: these episodes are indicative of the potential scale of infection amongst the dialysis population. Infection and access issues are a major contributor to in-patient bed days – 1 in 25 haemodialysis patients are an in-patient at any one time.

Follow up of the incident data has demonstrated that many patients over a year achieve either definitive access or transplantation but the rate appears to be slow. There is no evidence that there are fast track processes for patients for whom dialysis commences with a venous catheter. Also, the data are too small in number to judge whether late or early presentation has any bearing upon the subsequent formation of a robust dialysis plan.

At 6 months and at 12 months, many patients are still utilising venous catheters. In some, this appears to be related to AVF failure, but many come from the cohort who commenced renal replacement therapy with a catheter. The current data collection does not allow one to assess the number of different access procedures an individual is exposed to in any time period. This may of course be relevant to outcome – a high number of access procedures may exhaust conventional access rapidly and increase morbidity and mortality. This terminal failure of access may not be apparent in a one year time frame, but clearly is relevant.

The difficulties units experienced in making paper returns of data and the subsequent poor returns, highlight the need to develop electronic patient databases to capture and enable retrieval and analysis of such data from units. It will clearly not be possible to sustain such surveys without this.

Progress has been made towards this goal of improved IT. During 2006–7, 8 renal units in England piloted a web-based system for collection of an extended dataset by the Health Protection Agency (HPA) on patients on RRT with MRSA. 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 units, to ensure that all patients on RRT developing MRSA bacteraemia can be accurately identified. This will supply more robust data on MRSA within renal centres and provide a lever to generate improvement in service. It is likely that this will also extend to *Clostridium difficile* in the future. The working party on vascular access brought together surgeons, radiologists and nephrologists to provide a template for a vascular access service with associated audit markers to drive improvement.

The Registry has contributed to the specification of the National Renal Dataset that all LSP systems will be required to support. This dataset includes a vascular access subset and has now been finalised and submitted to the Information Standards Board for approval. The DoH is expected to be providing some funding to pilot the additional data items in existing renal systems during 2007–8.

As had been noted in the previous report, for the individual patient the overall pathway towards established renal failure and the commencement of renal replacement therapy has several components. Late referral is certainly one aspect of that which affects a large number of patients. However, it is clear from the data that such patients do not rapidly move towards definitive access in a timely fashion. This suggests that an enhanced and rapid pathway for such late presenters is still not well established across the UK nephrological community. Given that about a third of patients are late presenters such systems should be developed as a matter of urgency.

Summary and recommendations

Key issues still remain.

Renal networks and commissioners must be involved in joining ownership of this important aspect of renal services. It is one of the key determinants of outcome of patients. The adoption of the audit standards from the working party and the Renal Association guidelines should form part of the feedback to commissioners.

It is hoped the continuing work on agreed definitions and data items for electronic collection will enable comparative performance to be assessed on a network by network basis and month upon month for individual centres.

Acknowledgments

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Chapter 6: Co-morbidities in UK Patients at the Start of Renal Replacement Therapy

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Summary

- Co-morbidity returns have continued to improve, albeit slowly, with centres running Mediqal software having the highest rates of completeness.
- Diabetes as a primary renal diagnosis accounted for 20% of those starting RRT, but a further 7% had diabetes present as a co-morbid condition. The incidence of smoking remained high at 17% of diabetic patients, which was similar to that found in non-diabetics.
- 12% of patients starting RRT had a previous myocardial infarction (MI) and 31% of those aged over 65 years starting RRT had ischaemic heart disease (IHD).
- Patients starting on PD were on average nine years younger than those on HD and had fewer co-morbidities present.
- Patients starting RRT without any co-morbidity present had a lower median eGFR than those with co-morbid conditions.
- Patients with a previous MI or CABG, started RRT with slightly higher mean haemoglobin than those without co-morbid conditions or other co-morbid conditions.
- On univariate survival analysis, diabetes was not associated with an increased risk of death amongst patients aged over 65 years, possibly due to its close association with other co-morbidities in this age group.
- In the multivariate survival analysis the presence of ischaemic/neuropathic ulcers was the predictor of worst survival, followed by malignancy, previous MI and age per ten year increment.
- Smoking was less common in both South Asian and Black patients than Whites (7% vs 17%) starting RRT. 23% of both South Asian and White patients started RRT with IHD compared to only 12% of Black patients.

Introduction

Description of the extent of co-morbidity amongst patients starting treatment for established renal failure is important for a number of reasons.

1. Patients with significant co-morbidity may require more inpatient and outpatient care, and their treatment is therefore likely to cost more; information on co-morbidity may therefore help commissioners and providers to plan services.
2. Marked national and international variations in the take-on rate for Renal Replacement Therapy may partly be explained by differing policies and attitudes relating to provision of RRT to patients with significant co-morbidity. These differences may result from differences in referral, differences in acceptance for RRT, or both. Study of the outcomes of RRT amongst patients with and without co-morbidity may help explain and reduce these variations.
3. Co-morbidity may influence survival amongst patients on RRT and may affect survival differently depending on the modality of RRT. Differences in survival rates between patients on different modalities of RRT and differences in survival rates between different renal units, cannot therefore be fully understood unless data on co-morbidity are collected and analysed.

Methods

Clinical staff in each renal unit are responsible for recording (in yes/no format), on their renal unit IT system, the presence or absence of 14 co-morbid conditions and on current tobacco smoking (Table 6.1) in each patient starting

Table 6.1: Co-morbid conditions listed in the Registry dataset

Angina
Previous MI within 3 months
Previous MI over 3 months ago
Previous 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

RRT. Definitions of each of these conditions are given in web Appendix B Definitions, Statistical Methodology and Analysis Criteria (www.renalreg.org). Analyses are restricted to incident patients. Many other national Registries only collect data on patients who have survived the first 90 days of RRT and for the purposes of comparisons with their results, some analyses are restricted to patients surviving the first 90 days of RRT. Complete data on co-morbidity for a given patient is considered to have been provided if there is at least one yes/no answer to one of the 14 questions. For some analyses co-morbidities have been collapsed into broader categories.

- 'Ischaemic heart disease' is defined as the presence of a 'yes' to a history either of angina; MI in past 3 months; MI > 3 months; or coronary artery bypass grafting (CABG)/ angioplasty (or more than one of these).

- 'Peripheral vascular disease' is defined as the presence of a 'yes' to a history either of claudication; ischaemic or neuropathic ulcers; non-coronary angioplasty, vascular graft, or aneurysm; or amputation for peripheral vascular disease.

- 'Vascular disease' is defined as the presence of cerebrovascular disease or any of the data items that comprise 'peripheral vascular disease'.

Data on completeness of co-morbidity returns from each renal unit may differ from those in previous reports because some renal units have provided additional data on co-morbidity of previous years' incident cohorts since original submission.

(Since 2004, the presence or absence of a clinical diagnosis of heart failure was also recordable. However, very few renal units are able to collect or submit this data item and it is not included in any of the analyses reported here).

Results

Completeness of co-morbidity returns from each participating renal unit

Table 6.2 shows that completeness of data returns still varies markedly from renal unit to renal unit with some units continuing to provide data on 100% of patients and others providing no data. There is no relationship between the size of the renal unit and the completeness of data returns. After excluding renal units that returned no data at all, the average completeness of data returns from units ranged from 1–100% (mean 63.6%) for 2005, a moderate improvement on a mean of 48.1% in 2000. Amongst all incident patients, data on co-morbidity was available on 39% of patients

Table 6.2: Completeness of co-morbidity data returns on incident patients from individual renal units (2000–2005)

	2000		2001		2002		2003		2004		2005	
	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return	No. incident patients	% return
Antrim	–	–	–	–	–	–	–	–	–	–	42	100
Bangor	–	–	0	0	29	55	33	42	36	53	38	47
Barts	–	–	–	–	–	–	–	–	187	71	180	79
Basildon	–	–	–	–	–	–	53	100	46	96	30	93
Belfast	–	–	–	–	–	–	–	–	–	–	138	99
Bradford	–	–	61	93	62	100	75	84	62	92	65	95
Brighton	–	–	–	–	–	–	–	–	119	0	108	0
Bristol	148	94	151	92	127	81	163	83	166	75	175	57
Cambridge	–	–	93	5	77	5	98	1	109	0	103	0
Cardiff	139	1	155	0	181	0	166	3	186	6	178	20
Carlisle	28	39	29	3	27	22	31	0	29	24	30	70
Carshalton	123	13	124	19	182	6	205	8	180	7	180	3
Chelmsford	–	–	–	–	–	–	–	–	55	96	40	100
Clwyd	–	–	0	0	20	0	12	0	14	0	27	0
Coventry	89	0	105	0	97	1	79	0	79	0	85	0
Derby	54	41	59	44	0	0	61	74	65	77	71	85
Dorset	–	–	–	–	–	–	71	94	62	98	51	98
Dudley	40	0	35	0	25	4	42	0	55	0	38	0
Exeter	71	39	98	35	82	50	99	51	113	44	111	25
Gloucester	47	96	50	96	55	67	53	87	54	89	62	97
Guys	126	2	115	3	146	2	100	2	104	2	111	3
H&CX	–	–	–	–	180	99	153	100	195	100	147	100
Heartlands	86	0	85	0	61	2	105	0	103	0	115	1
Hull	82	2	74	0	106	5	80	89	108	86	126	95
Ipswich	–	–	–	–	44	39	39	31	43	16	60	8
Kings	–	–	–	–	117	88	108	100	110	99	133	99
Leeds	163	90	166	88	151	85	190	83	182	77	164	59
Leicester	179	74	187	89	152	88	171	95	165	94	224	61
Liverpool	–	–	221	48	153	48	114	62	135	57	164	41
ManWst	–	–	–	–	–	–	142	30	110	35	109	24
Middlesbrough	86	70	82	90	111	100	104	0	102	1	74	0
Newcastle	–	–	–	–	109	1	106	3	106	0	93	2
Newry	–	–	–	–	–	–	–	–	–	–	28	100
Norwich	–	–	–	–	–	–	–	–	98	100	121	100
Nottingham	114	71	120	68	87	99	116	97	108	95	147	99
Oxford	159	3	172	1	171	0	186	44	170	52	156	15
Plymouth	59	0	64	3	79	3	67	1	62	16	57	0
Portsmouth	–	–	144	57	146	46	143	56	120	44	153	29
Preston	117	1	136	1	113	0	99	1	81	0	118	0
QEH	–	–	–	–	–	–	–	–	202	0	194	0
Reading	52	0	68	0	44	2	73	0	71	0	75	0
Royal Free	–	–	–	–	–	–	–	–	–	–	126	0
Sheffield	137	82	155	86	157	61	162	57	170	40	158	28
Shrewsbury	–	–	–	–	–	–	–	–	55	0	43	0
Southend	40	20	37	32	34	59	42	60	41	63	35	57
Stevenage	134	2	129	2	100	1	123	0	85	1	86	1
Sunderland	50	0	41	5	58	48	57	61	52	90	58	76
Swansea	92	79	114	74	114	82	130	96	93	92	97	96
Truro	–	–	41	51	62	63	53	83	67	81	32	84
Tyrone	–	–	–	–	–	–	–	–	–	–	24	100
Ulster	–	–	–	–	–	–	–	–	–	–	10	100
Wirral	–	–	–	–	43	0	53	0	68	0	55	0
Wolverhampton	80	100	78	99	101	99	89	100	103	95	92	70
Wrexham	53	0	35	0	42	0	33	0	29	0	43	0
York	41	90	37	92	63	81	58	84	49	92	43	91
Totals	**2,589**		**3,261**		**3,708**		**4,137**		**4,804**		**5,223**	

Table 6.3: Summary of completeness of incident patient co-morbidity returns 2000–2005

	Years						
	2000	2001	2002	2003	2004	2005	Totals
Number of renal units	28	33	39	43	49	55	
Total number of new patients	2,589	3,261	3,708	4,137	4,804	5,282	23,781
Number of patients with co-morbid data entries	1,006	1,362	1,622	2,014	2,266	2,309	10,579
Percentage of co-morbid returns							
Median percentage of centres returning co-morbidity	40.7	49.8	50.0	62.3	75.8	75.9	61.8

starting in 2000 and on only 43% in 2005 (Table 6.3).

An analysis of completeness of data returns by the type of renal unit IT system showed no pattern other than very high returns from all centres using the Mediqal system (nine centres: completeness 93.3%–100%). 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; in 2005, of entries that contained at least one entry on co-morbidity, 1.34% contained 11 answers, 1.21% contained 12 answers, 7.28% contained 13 answers, and 89.95% contained answers to all 14 questions.

Frequency of each co-morbidity condition

Table 6.4 gives the frequency of each co-morbidity (as a proportion of the total number of incident patients for whom data was available for that item) for patients aged <65 and ⩾65 as well as the total frequency of each co-morbidity in the incident population.

The denominator for each percentage reported is the number of patients for whom a yes/no answer was provided for that co-morbidity.

Frequency of multiple co-morbidity

Just under 50% of patients for whom co-morbidity data were available starting RRT in

Table 6.4: Frequency with which each condition was reported in incident RRT patients between 2000–2005

	Age <65 years		Age ⩾65 years		
Co-morbidity	No. patients	%	No. patients	%	Total % incidence
Ischaemic heart disease	673	14.1	1,377	30.9	22.2
Angina	476	9.9	1,029	23.0	16.2
MI in past 3 months	85	1.8	142	3.2	2.4
MI >3 months	271	5.6	654	14.6	9.9
CABG/angioplasty	220	4.6	300	6.7	5.6
Cerebrovascular disease	284	5.9	619	13.8	9.7
Diabetes (not a cause of ERF)	208	4.4	416	9.4	6.8
Diabetes as primary disease	1,115	23.0	751	16.6	19.9
Diabetes of either category	1,323	27.4	1,167	26.0	26.7
COPD	191	4.0	419	9.4	6.6
Liver disease	124	2.6	74	1.7	2.1
Malignancy	290	6.0	687	15.3	10.5
Peripheral vascular disease	417	8.7	701	15.6	12.0
Claudication	267	5.5	548	12.2	8.8
Ischaemic/neuropathic ulcers	160	3.3	129	2.9	3.1
Angioplasty/vascular graft	100	2.1	205	4.6	3.3
Amputation	106	2.2	67	1.5	1.9
Smoking	869	19.2	576	13.5	16.4
No co-morbidity present	2,807	57.9	1,746	38.7	48.6

Table 6.5: Number of reported co-morbidities in patients starting RRT, as a proportion of those for whom co-morbidity data was available (2000–2005)

	Number of co-morbidities					
Total	0	1	2	3	4	5+
%	47.8	25.2	13.5	7.0	3.6	2.9

2000–2005 were reported as having no co-morbidity present. More than one co-morbidity was reported as present in 27% (Table 6.5).

Frequency of co-morbidity by age band

Figures 6.1 and 6.2 illustrate the rising frequency of co-morbidity with increasing age up to age 74 in incident patients; the lower rate

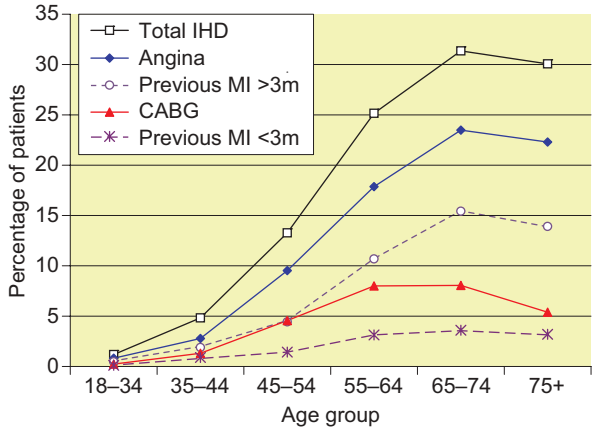

Figure 6.1: Frequency of ischaemic heart disease amongst incident patients 2000–2005 by age at start of RRT

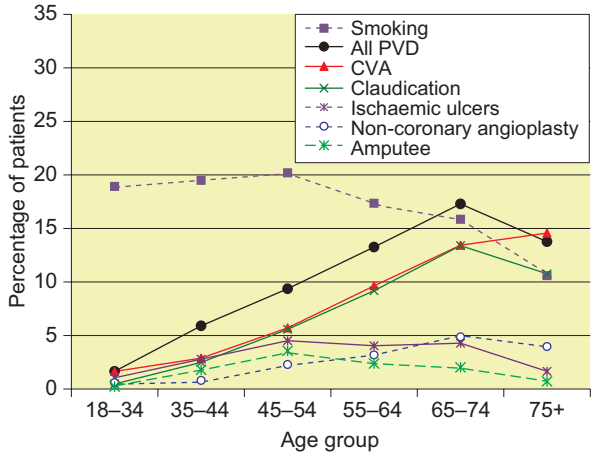

Figure 6.2: Frequency of peripheral vascular disease amongst incident patients 2000–2005 by age at start of RRT

Table 6.6: Frequency of co-morbidities in patients with diabetes as a cause of primary renal disease or as a co-morbidity compared to those without diabetes of either category

Co-morbidity	Non-diabetics	Diabetics
Ischaemic heart disease	18.6	32.6
Cerebrovascular disease	8.4	14.4
Peripheral vascular disease	8.3	23.6
Smoking	16.0	16.8
COPD	6.6	7.1
Malignancy	12.7	7.5
Liver disease	2.2	2.4

of reported co-morbidity amongst patients over 75 may reflect a 'healthy survivor effect' or decisions made by nephrologists and/or by patients aged >75 with cardiovascular co-morbidity not to embark on RRT. Smoking is less commonly reported amongst patients starting RRT aged 55 or older. Ischaemic heart disease, cerebrovascular disease and peripheral vascular disease are all more frequent amongst older compared to younger patients.

Frequency of co-morbidity amongst patients with diabetes

Diabetes was recorded as the primary renal disease in 20.2% of all patients starting RRT 2000–2005. Table 6.6 compares co-morbidity amongst patients with diabetes and patients without diabetes (as cause or co-morbidity), showing higher rates of ischaemic heart disease, cerebrovascular disease, and peripheral vascular disease amongst diabetic patients.

Age and co-morbidity in patients starting haemodialysis compared to those starting peritoneal dialysis

Figure 6.3 illustrates the younger age profile of patients being treated with peritoneal dialysis 90 days after the start of RRT, compared to those starting haemodialysis. The median age of patients on peritoneal dialysis at day 90 was 58.3 years, compared to 66.9 years for those on haemodialysis ($p < 0.001$, Kruskal-Wallis).

Table 6.7 compares the prevalence of each co-morbidity in patients on haemodialysis and peritoneal dialysis at day 0 of starting RRT, showing significantly higher prevalence (at a

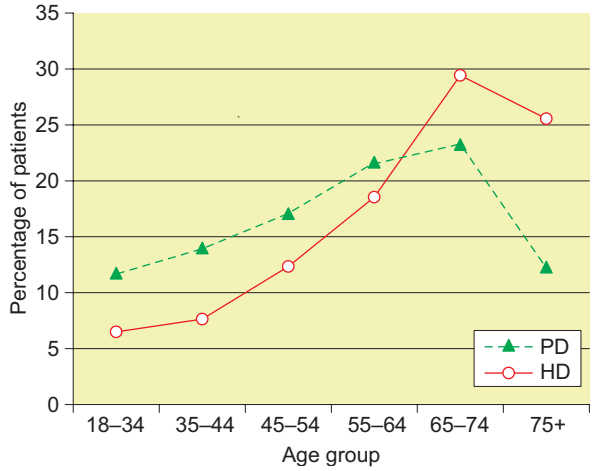

Figure 6.3: Percentage of patients in each age group starting RRT 01/01/00–30/09/05 on PD at 90 days compared to percentage on HD

higher age) amongst haemodialysis of all co-morbid conditions other than MI more than 3 months ago, CABG, smoking and non-coronary angioplasty. These data probably reflect a perception amongst UK nephrologists, nurses and their patients, that peritoneal dialysis is in general more suitable for younger and fitter patients.

The percentages out of total population of patients on that modality at 90 days, with data for that co-morbidity.

Frequency of co-morbidity by ethnic origin

For Registry returns, data on ethnic origin was retrieved from fields within renal unit IT systems that were completed by physicians or nurses. These were supplied either as 'old' Patient Administration System (PAS) codes (White = 0, Black Caribbean = 1, Black African = 2, Black/other/non-mixed origin = 3, Indian = 4, Pakistani = 5, Bangladeshi = 6, Chinese = 7) or as 'new' PAS codes (see web Appendix B www.renalreg.org). For purposes of analysis, 'new' PAS codes are collapsed into the 'old' PAS categories, and further collapsed into White (0), Black (1, 2, or 3), Asian (4, 5, or 6) and Chinese (7).

Figure 6.4 illustrates the presence or absence of co-morbidity by ethnic origin, showing a lower prevalence of co-morbid conditions amongst patients of Black or Asian origin compared to those of White origin. Figures 6.5, 6.6 and 6.7 show that the lower prevalence of co-morbidity amongst patients of Black or Asian origin is not attributable to younger age amongst these groups, as the prevalence of co-morbidity is lower even in the 18–34 year age group than in the White population. Table 6.8 shows the prevalence of major co-morbidities in each group; smoking was more common in the

Table 6.7: Percentage of patients with co-morbid conditions present in incident patients starting PD and HD 2000–2005

	HD		PD		
Co-morbidity	**%**	**Median age**	**%**	**Median age**	**p value***
Angina	17.6	71.3	14.0	67.6	<0.001
MI – more than 3 months ago	10.4	71.4	10.1	68.7	0.59
MI – within 3 months	2.9	69.8	1.7	68.4	<0.001
CABG	5.5	68.7	6.4	66.8	0.08
Cerebrovascular disease	11.0	71.6	7.4	66.5	<0.001
Diabetes non-ERF	8.0	71.4	4.5	68.1	<0.001
COPD	7.9	71.4	3.9	66.0	<0.001
Smoking	16.5	63.5	15.0	54.5	0.07
Liver disease	2.6	60.0	1.2	58.8	<0.001
Malignancy	13.0	72.1	6.5	69.6	<0.001
Claudication	9.6	70.7	7.3	66.6	<0.001
Ischaemic/neuropathic ulcers	3.8	65.4	1.9	56.7	<0.001
Angioplasty of non coronary vessels	3.5	71.5	2.9	65.6	0.18
Amputation	2.1	62.3	1.1	53.5	0.002

*p value compares the significance of the % patients in each modality

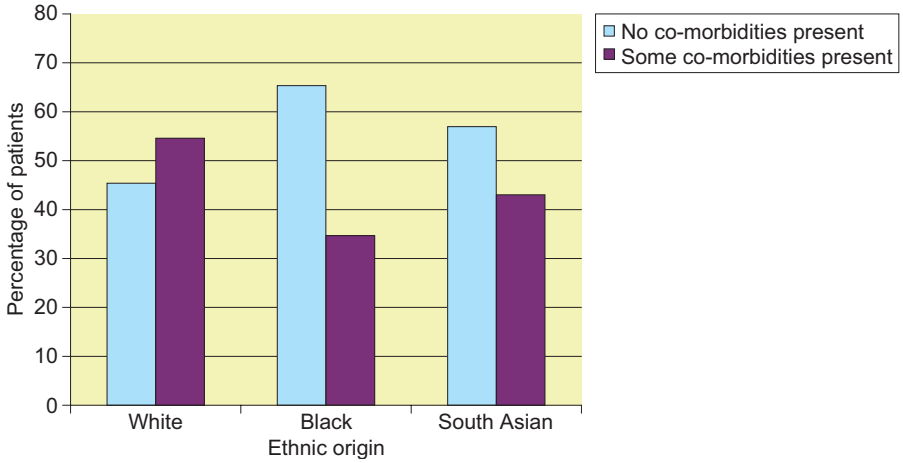

Figure 6.4: Presence or absence of co-morbid conditions at the start of RRT amongst patients starting RRT 2000–2005

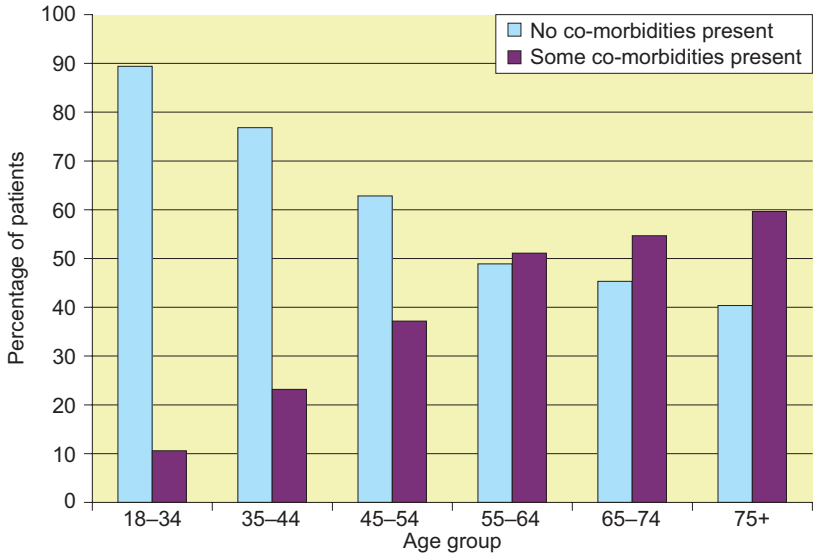

Figure 6.5: Presence or absence of co-morbid conditions at the start of RRT amongst patients of South Asian origin starting RRT 2000–2005

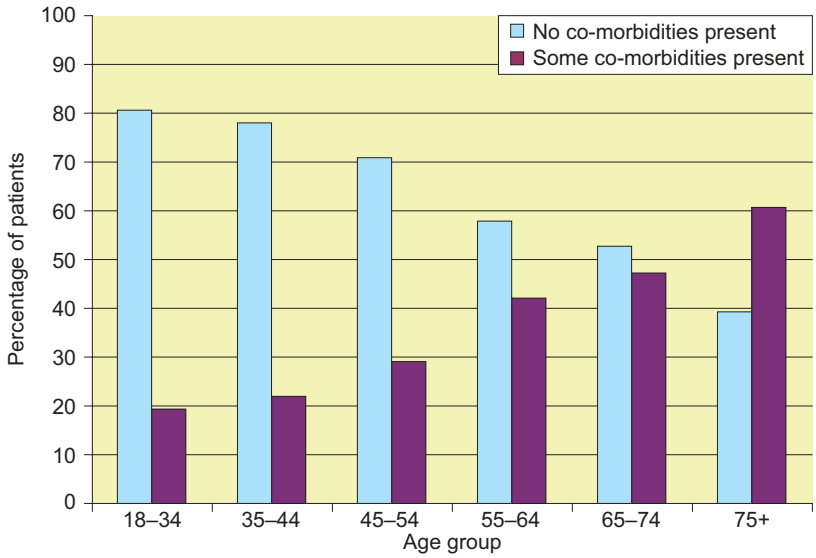

Figure 6.6: Presence or absence of co-morbid conditions at the start of RRT amongst patients of Black origin starting RRT 2000–2005

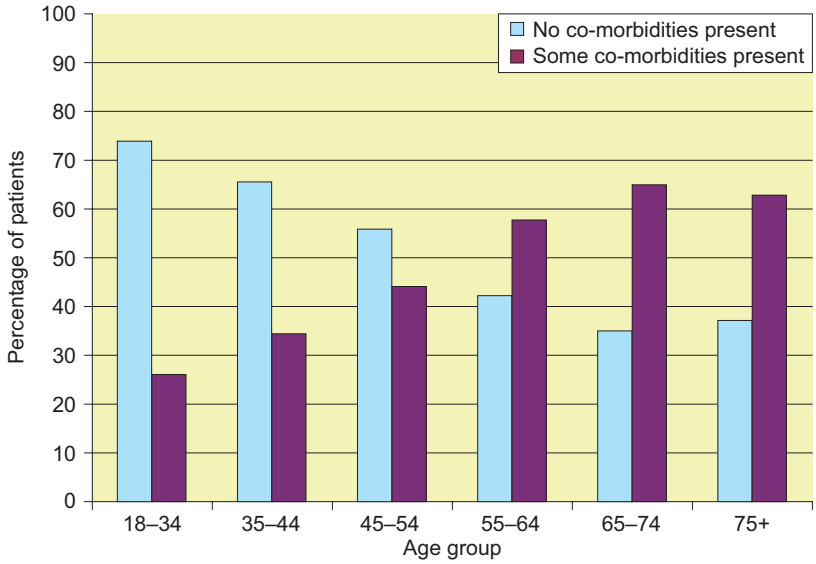

Figure 6.7: Presence or absence of co-morbid conditions at the start of RRT amongst patients of White origin starting RRT 2000–2005

Table 6.8: Prevalence of co-morbidities amongst incident patients starting RRT 2000–2005 by ethnic group, as a proportion of the total number of patients in that ethnic group for whom co-morbidity data were available

	% with co-morbidity			
	South Asian n = 725	Black n = 375	White n = 7,566	p value
Smoking	7.0	7.4	17.7	<0.0001
Cerebrovascular disease	8.2	10.2	10.1	0.24
Peripheral vascular disease	10.0	5.4	12.9	<0.0001
Ischaemic heart disease	23.7	12.4	23.2	<0.0001
Liver disease	3.9	2.9	2.1	0.01
COPD	3.7	2.4	7.5	<0.0001
Malignancy	3.3	4.5	12.4	<0.0001

Comparisons were performed using the Chi square test.

White population and ischaemic heart disease and peripheral vascular disease less common in the Black population. Table 6.9 gives details of the age structure of each major ethnic group at the start of RRT. Figure 6.8 illustrates the lower prevalence of diabetes amongst 'White' patients starting RRT compared to that in other ethnic groups.

Table 6.9: Incident patients 2000–2005 in each age group by ethnic origin, as a percentage of all patients in that ethnic group

	South Asian	Black	Chinese	Other	White
18–34	9.9	15.0	13.5	16.5	8.1
35–44	11.4	21.3	12.5	11.2	9.8
45–54	21.6	15.5	18.8	15.2	12.8
55–64	23.8	17.5	22.9	16.5	18.8
65–74	25.3	23.7	22.9	23.9	27.2
75+	8.0	6.9	9.4	16.8	23.4

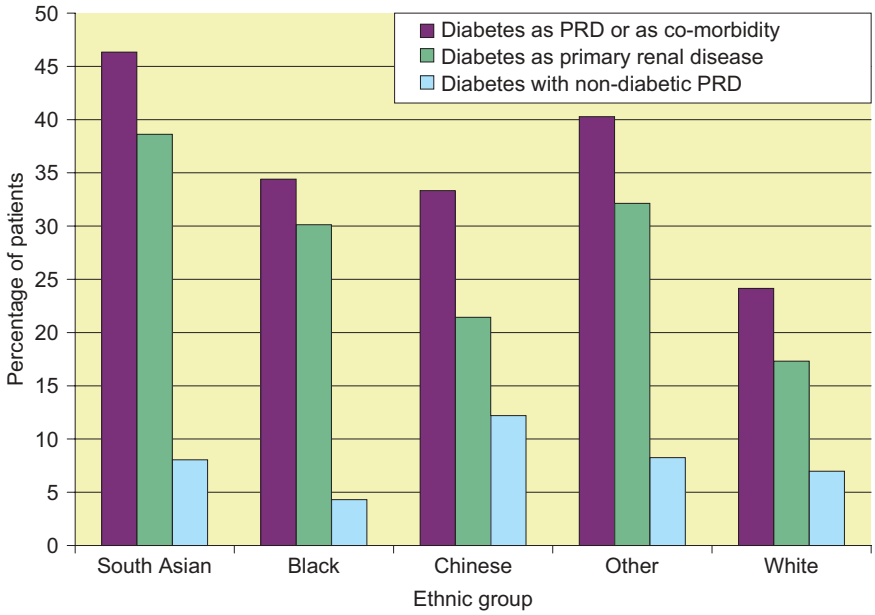

Figure 6.8: Prevalence of diabetes, either reported as the cause of primary renal disease, as a co-morbidity in patients with another reported PRD, or either of these, in each ethnic group at the start of RRT, 2000–2005

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

Using the abbreviated 4v MDRD calculation, the eGFR of patients starting RRT was calculated and is shown in Table 6.10. Data from patients with no available 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 (n = 553). Data from one centre (Hammersmith and Charing Cross) were excluded from analysis because of errors in the data extraction process of this item (n = 568), leaving 14,462 patients included in the analysis.

The log of the eGFR was taken to normalise the data and two-sample t-tests was used to

Table 6.10: eGFR within 2 weeks prior to the start of RRT 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
With any co-morbidity	7.8	7.7–7.9	<0.0001
Angina	8.2	8.0–8.4	<0.0001
MI in past 3 months	8.1	7.7–8.6	<0.0001
MI >3 months ago	8.3	8.1–8.6	<0.0001
CABG/angioplasty	8.6	8.3–8.9	<0.0001
Cerebrovascular disease	8.0	7.8–8.2	<0.0001
Diabetes (not cause of ERF)	8.0	7.8–8.3	<0.0001
Diabetes as primary disease	8.3	8.1–8.5	<0.0001
Diabetes of either category	8.2	8.1–8.4	<0.0001
COPD	8.2	7.9–8.5	<0.0001
Liver disease	7.8	7.3–8.3	0.01
Malignancy	7.4	7.2–7.7	0.01
Claudication	8.3	8.0–8.5	<0.0001
Ischaemic/neuropathic ulcers	8.3	7.9–8.8	<0.0001
Angioplasty/vascular graft	8.3	7.9–8.7	<0.0001
Amputation	8.8	8.2–9.4	<0.0001
Smoking	7.7	7.5–7.8	<0.0001

Table 6.11: Haemoglobin concentration at the start of RRT in patients, by co-morbidity

	Hb mean (g/dl)	Hb 95% CI	p value	% Hb >10 g/dl
Without co-morbidity	10.1	10.0–10.1	Ref	52.3
With any co-morbidity	10.0	10.0–10.1	0.093	49.8
Angina	10.1	10.0–10.2	0.54	51.6
MI in past 3 months	10.0	9.7–10.2	0.47	51.4
MI >3 months ago	10.3	10.2–10.5	<0.001	55.6
CABG/angioplasty	10.4	10.2–10.6	<0.001	57.5
Cerebrovascular disease	10.1	9.9–10.2	0.82	51.5
Diabetes (not cause of ERF)	10.0	9.9–10.2	0.49	50.2
Diabetes as primary disease	10.0	9.9–10.0	0.93	50.7
COPD	9.9	9.7–10.0	0.042	48.6
Liver disease	9.6	9.3–9.9	0.002	40.7
Malignancy	9.9	9.8–10.0	0.004	46.6
Claudication	10.0	9.9–10.1	0.45	50.5
Ischaemic/neuropathic ulcers	9.8	9.6–10.0	0.013	43.5
Angioplasty/vascular graft	10.2	10.0–10.5	0.19	54.3
Amputation	9.8	9.5–10.1	0.13	46.0
Smoking	10.0	9.9–10.1	0.07	47.8

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 being carried out, only a p value <0.01 was considered statistically significant. This should not imply that these differences imply a clinical significance as they may be only small variations.

The (geometric) mean eGFR prior to starting RRT in patients who are recorded as starting without any co-morbidity present is 7.1 ml/min/1.73 m^2. Patients starting with different co-morbidities were compared against this value.

In each case, eGFR appears to have been slightly higher amongst patients with co-morbidity compared to patients without 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 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 52% of patients achieving a haemoglobin >10 g/dl. Patients starting with different co-morbidities were compared against this value (Table 6.11). Haemoglobin concentrations at the start of RRT were slightly higher amongst patients with ischaemic heart disease than in those without, and lower amongst those with liver disease or malignancy. In addition to the direct influence of co-morbidity, EPO prescribing patterns and late referral of patients will have an influence on these data.

Co-morbidity and subsequent kidney transplantation

This analysis was confined to incident patients in each of the years 2000–2005 from centres that had returned ⩾80% complete data for co-morbidity in that year (see Table 6.2). Table 6.12 shows that patients who underwent transplantation had less co-morbidity at the start of RRT than those who died or did not receive a transplant.

Figure 6.9 gives the age distribution of those who had received a transplant by the end of 2005 compared to those who remained untransplanted. Over the age of 65 years, the majority of incident patients are unlikely to undergo kidney transplantation, and this is very rare in patients starting RRT over the age of 75.

Table 6.12: Co-morbidity amongst incident patients 2000–2005 who underwent transplantation compared to those who remained on dialysis or died

	Not transplanted		Transplanted	
Co-morbidity	**Number**	**%**	**Number**	**%**
Patients with co-morbidity data	5,873		865	
Without co-morbidity	2,680	45.6	644	74.5
Ischaemic heart disease	1,423	24.3	40	4.6
Peripheral vascular disease	782	13.3	25	2.9
Cerebrovascular disease	615	10.5	26	3.0
Diabetes (not cause of ERF)	447	7.7	21	2.4
COPD	440	7.5	19	2.2
Liver disease	151	2.6	5	0.6
Malignancy	746	12.7	13	1.5
Smoking	861	15.1	126	15.6

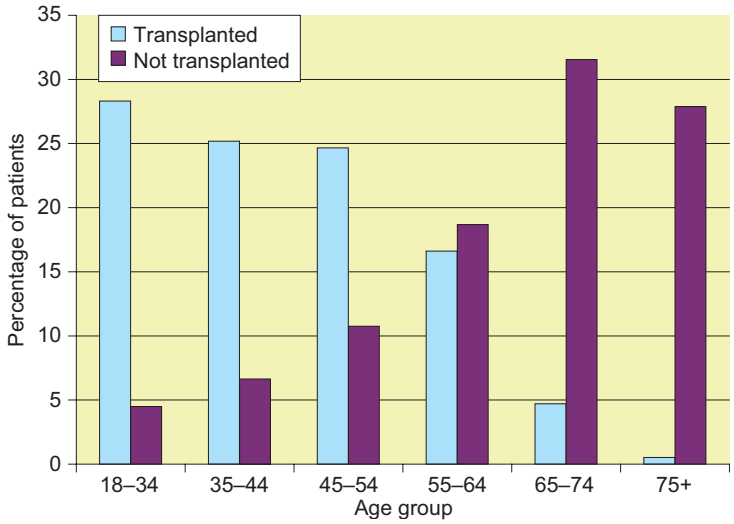

Figure 6.9: Age distribution of the incident cohort who received a transplant compared to those who remained on dialysis or died

Co-morbidity and subsequent survival – Introduction

These analyses were performed on patients starting RRT between 01/01/2000 and 30/09/2005, to allow at least three months follow-up from the start of RRT. The 1 year after 90 days analyses only include patients who survived at least 90 days on RRT. The death rate is high in the first 90 days and highly variable between centres, due for instance to variation in policies on inclusion of patients with acute kidney injury requiring dialysis. Use of this "90 day rule" also allows direct comparison of survival statistics with those from other national registries.

The effect within each renal unit of adjusting overall survival for co-morbidity can be found in Chapter 12.

Co-morbidity and survival within 90 days of commencing RRT

The Registry collects data on all patients with a 'timeline' entry that have started RRT for ERF. Patients who present acutely, and who are initially classified as Acute Renal Failure requiring dialysis, but continue to require long-term dialysis can be re-classified as having had ERF from the date of their first RRT. (Most other national registries only start the collection of data at 90 days after the first RRT.) This allows the UK Registry, unlike other registries, to collect data on factors affecting outcomes including survival, in the first 90 days of RRT.

The univariate model (Table 6.13), does not allow adjustment for age, so patients were first stratified by age group (less than 65 years and

Table 6.13: Univariate analysis of the risk of death within the first 90 days of RRT associated with co-morbid conditions at the start of RRT

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Angina	2.5	<0.0001	1.2	0.10
Ischaemic heart disease	2.2	<0.0001	1.1	0.19
Claudication	1.8	0.04	1.1	0.28
Ischaemic/neuropathic ulcers	3.4	<0.0001	1.8	0.002
Peripheral vascular disease	2.9	<0.0001	1.2	0.16
Cerebrovascular disease	2.2	0.0036	1.3	0.01
Vascular disease (IHD, PVD, CVA)	2.5	<0.0001	1.2	0.06
Diabetes as primary disease	1.5	0.04	0.7	0.009
Diabetes (not as cause of ERF)	1.4	0.33	1.2	0.22
Diabetes of either category	1.5	0.02	0.9	0.16
Liver disease	5.5	<0.0001	1.0	0.94
Malignancy	4.2	<0.0001	1.7	<0.0001
COPD	2.4	0.004	1.3	0.09
Smoking	0.8	0.37	1.2	0.16

65 years and over) to make some account for the increasing incidence of co-morbidity with age which would otherwise obscure the analysis. On univariate analysis stratified for age, most co-morbidities were associated with an increased risk of death both amongst patients aged <65 years and those aged ⩾65 years. However, there was no increased risk of death associated with diabetes mellitus as a co-morbidity in the absence of diabetes as a cause of primary renal disease; and smoking was not associated with an increased risk of death (Table 6.13). Some co-morbidities may appear not to be associated with an increased risk of death because of low numbers – for instance, liver disease aged ⩾65. The observation that the risk of death amongst those ⩾65 is not greater in the presence of ischaemic heart disease may be down to either competing risks or to negative selection caused by clinicians or patients opting not to start RRT in the presence of severe ischaemic heart disease. Of special interest in this univariate survival analysis was that diabetes was not associated with an increased risk of death amongst patients aged ⩾65 years, possibly due to its close association with other co-morbidities in this age group.

On multivariate analysis using the stepwise Cox proportional hazards model, age, and six of the co-morbid conditions were identified as significant independent predictors of the risk of death (Table 6.14). 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.

There were 9,047 patients included in the analysis. Variables included in the model

Table 6.14: Cox proportional hazards model for predictors of death within the first 90 days of starting RRT during 01/01/00–30/9/05

Variable	**Hazard ratio**	**95% CI**	**p value**
Ischaemic/neuropathic ulcers	2.3	1.7–3.3	<0.0001
Liver disease	2.1	1.3–3.2	0.001
Malignancy	1.8	1.5–2.2	<0.0001
MI in past 3 months	1.7	1.2–2.5	0.003
Age (per 10 years)	1.6	1.5–1.8	<0.0001
MI more than 3 months ago	1.3	1.0–1.6	0.03
Angioplasty/vascular graft	0.6	0.4–1.0	0.034

Table 6.15: 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

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Angina	1.8	0.0001	1.3	0.0008
Ischaemic heart disease	2.0	<0.0001	1.4	<0.0001
Claudication	2.2	<0.0001	1.2	0.07
Ischaemic/neuropathic ulcers	3.2	<0.0001	2.1	<0.0001
All peripheral vascular disease	2.2	<0.0001	1.3	0.00
Cerebrovascular disease	1.7	0.0118	1.5	<0.0001
Vascular disease (IHD, PVD, CVA)	2.1	<0.0001	1.4	<0.0001
Diabetes as primary disease	2.0	<0.0001	1.0	0.73
Diabetes (not as cause of ERF)	2.7	<0.0001	1.3	0.01
Diabetes of either category	2.5	<0.0001	1.1	0.18
Malignancy	5.0	<0.0001	1.5	<0.0001
Liver disease	2.6	0.0001	1.3	0.29
COPD	1.4	0.19	1.4	0.002
Smoking	1.1	0.41	1.3	0.011

included: age per 10 years, angina, myocardial infarction <3 months ago, myocardial infarction more than 3 months ago, coronary artery bypass grafting or coronary angioplasty, cerebrovascular disease, diabetes (whether as a cause of primary renal disease or as a co-morbidity), chronic obstructive pulmonary disease, liver disease, malignancy, claudication, ischaemic/neuropathic ulcers, angioplasty/vascular graft, amputation and smoking.

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

In all analyses, patients starting RRT are only included if they survived at least 90 days on RRT. The death rate is high in the first 90 days, and highly variable between centres, due for instance to variation in policies on inclusion of patients with acute kidney injury requiring dialysis. Use of this "90 day rule" also allows direct comparison of survival statistics with those from other national registries.

On univariate analysis (Table 6.15) stratified for age, most co-morbidities were associated with an increased risk of death both in patients starting RRT aged <65 years and in those ⩾65 years. Diabetes as a primary cause of renal failure was not associated with an increased risk of death amongst patients over 65 years, possibly due to its close association with other co-morbidities in this age group. COPD was not associated with an increased risk of death in patients <65 years.

On multivariate analysis using the stepwise Cox proportional hazards model, eight variables were identified as independent predictors of death (Table 6.16). Recent MI was no longer

Table 6.16: Cox proportional hazards model for predictors of death in the first year after completion of 90 days of starting RRT during 01/01/00–30/9/04

Variable	**Hazard ratio**	**95% CI**	**p value**
Ischaemic/neuropathic ulcers	2.0	1.5–2.7	<0.0001
Malignancy	1.9	1.6–2.3	<0.0001
Liver disease	1.5	1.0–2.3	0.03
MI more than 3 months ago	1.5	1.3–1.8	<0.0001
Age per 10 years	1.5	1.4–1.6	<0.0001
COPD	1.3	1.1–1.6	0.01
Diabetes of either category	1.3	1.1–1.5	0.0002
Cerebrovascular disease	1.3	1.1–1.6	0.006

significantly associated with an increased risk of death, possibly because the prognostic importance of this marker is time-dependent, and so would not be any more powerful a predictor than other markers of atherosclerotic vascular disease a year later. Diabetes was a powerful predictor of increased risk of death after the first 90 days.

There were 6,535 patients included in the analysis. Variables in the model included: age per 10 years, angina, myocardial infarction less than 3 months ago, myocardial infarction more than 3 months ago, coronary artery bypass grafting or coronary angioplasty, cerebrovascular disease, diabetes (whether as a cause of primary renal disease or as a co-morbidity), chronic obstructive pulmonary disease, liver disease, malignancy, claudication, ischaemic/neuropathic ulcers, angioplasty/vascular graft, amputation and smoking.

Discussion

These analyses demonstrate that co-morbidity is common amongst UK patients starting RRT, with over 50% of all patients having some recorded co-morbidity (using data from centres with >80% returns). Reporting of the presence or absence of these simple markers of co-morbidity to the Registry is still poor in many centres, although this situation is gradually improving. Unlike many data items recorded in renal unit IT systems, the recording of the presence or absence of co-morbidity is probably not required for the routine day-to-day care of these patients. It is anticipated however, that the introduction of a system of tariff-based payment by results in England might act to encourage clinicians to improve the systematic recording of co-morbidity. The Registry is also exploring the possibility of linking to the Hospital Episode Statistics dataset within the Secondary Users Service, which would allow data to be obtained on hospital discharge codes, very much along the lines of the approach used by the United States Renal Data System.

These and other previously published analyses using a variety of co-morbidity scores[1–26] also demonstrate that co-morbidity is a powerful predictor of survival in patients on RRT. The publication of de-anonymised survival statistics for each renal unit in this year's report should also provide a stimulus to renal unit Directors to ensure that they collect and report complete data on co-morbidity.

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Chapter 7: Haemodialysis Dose and Serum Bicarbonate

Charlie Tomson, David Thomas, Raman Rao, Dirk van Schalkwyk and David Ansell

Summary

- Data from 21 renal units was insufficient to allow analyses of the dose of dialysis in those units. Amongst the remainder, there is evidence of a progressive increase in the proportion of patients meeting the Renal Association audit standard for Urea Reduction Ratio (URR).
- In the UK as a whole, 81% of prevalent haemodialysis patients met the standard for URR in 2005. Greater achievement of the standard in a given unit is associated with a higher median URR in that unit, although there is some evidence that some units have been able to narrow the distribution of achieved URR values.
- Achievement of the standard remains, as in previous years' Reports, less common amongst patients recently established on haemodialysis compared to those established on haemodialysis for longer.
- Correction of acidosis, as measured by serum bicarbonate concentration remains highly variable, although there is continued uncertainty about the interpretation of routine measurements of venous serum bicarbonate concentration in haemodialysis patients.
- Overall, around 64% of UK haemodialysis patients, and 50% of peritoneal dialysis patients met the Renal Association standard for serum bicarbonate in 2005.

Introduction

Dialysis dose is an important predictor of outcome amongst patients receiving conventional thrice weekly dialysis and is highly susceptible to clinical intervention. Serum bicarbonate in contrast, bears an uncertain relationship to outcome, is highly influenced by non patient-related factors such as delay in analysis after venepuncture and it is less clear how clinicians can improve achievement of the desired bicarbonate concentration.

Completeness of data

No data on URR were received from Barts, Brighton, Hammersmith/Charing Cross, Royal Free, Newcastle or Wirral. Both Brighton and Newcastle are running CCL Clinicalvision which currently does not support calculation of URRs. Most remaining centres returned data on >90% of patients, the exceptions being Belfast (89%), Cambridge (56%), Carshalton (64%), Chelmsford (80%), Clwyd (88%), Dudley (71%), Dundee (2%), Guys (81%), Kings (79%), Manchester West (52%), Oxford (66%), Preston (76%), Swansea (69%), Wolverhampton (79%) and Wrexham (69%) (Table 7.1).

The Scottish Renal Registry does not currently report serum bicarbonate data from Scottish Renal Units to the UK Renal Registry.

The completeness is recorded as within the last six months for England, Wales and Northern Ireland centres and within the last year for Scotland.

Centres reporting data on less than 20 patients or 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 for that centre.

Dialysis dose

Introduction

The Renal Association guidelines offer both Kt/V and URR as markers of haemodialysis dose. The relevant audit standards agreed by the Renal Association[1] are as follows:

Table 7.1: Percentage completeness of data returns

	URR	Bicarb HD	Bicarb PD		URR	Bicarb HD	Bicarb PD
Abrdn	98			L H&CX	0	99	98
Airdrie	92			L Kings	79	92	82
Antrim	97	99	89	L Rfree	0	0	1
B Heart	95	95	100	Leeds	98	100	98
B QEH	95	95	88	Leic	95	87	94
Bangor	94	95	91	Livrpl	94	98	98
Basldn	99	99	100	ManWst	52	0	0
Belfast	89	95	94	Middlbr	96	98	100
Bradfd	96	100	100	Newc	0	100	100
Brightn	0	56	49	Newry	99	99	86
Bristol	99	100	100	Norwch	98	100	100
Camb	56	68	100	Nottm	100	79	17
Cardff	93	82	96	Oxford	66	94	98
Carlis	91	93	100	Plymth	97	99	97
Carsh	64	83	90	Ports	98	99	81
Chelms	80	99	97	Prestn	76	86	82
Clwyd	88	94	92	Redng	97	99	100
Covnt	94	16	62	Sheff	94	99	99
D&Gall	100			Shrew	96	100	100
Derby	96	99	94	Stevng	99	98	98
Dorset	96	100	98	Sthend	96	97	95
Dudley	71	77	91	Sund	97	97	100
Dundee	2			Swanse	69	97	99
Dunfn	98			Truro	97	99	97
Edinb	98			Tyrone	93	98	100
Exeter	98	99	99	Ulster	97	100	100
GlasRI	95			Wirral	0	9	4
GlasWI	96			Wolve	79	99	98
Glouc	94	100	97	Wrexm	69	81	85
Hull	94	98	96	York	99	100	100
Inverns	95			**Eng**	**72**	**81**	**77**
Ipswi	95	100	98	**NI**	**93**	**97**	**92**
Klmarnk	99			**Sct**	**88**		
L Barts	0	0	0	**Wls**	**83**	**88**	**94**
L Guys	81	88	99	**UK**	**75**	**83**	**78**

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 and HD) 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 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 (Appendix 2). The method used should remain consistent within renal units and should be reported to the Registry. (B)

For pragmatic reasons (because most centres do not report duration of dialysis or weight loss during dialysis) the Registry has chosen URR for comparative audit. Data on post-dialysis sampling methods were last collected by telephone survey in 2002[2]. No reliable data is held on whether the important variations in post-dialysis sampling methodology identified at that time still persist.

As in all other analyses, data are taken from the last quarter of the year (unless otherwise stated); if that data point is missing, data from the 3rd quarter are taken. Data on frequency of dialysis are not routinely reported by all centres and were last collected systematically as part of the 2002 National Renal Survey[3]. For the purposes of the analyses reported below, data from patients known to be receiving twice weekly dialysis are omitted. However, not all centres report frequency of dialysis, so it is possible that some data from a very small number of patients receiving twice weekly dialysis are included in the analyses, but this would not have a large influence on the overall centre mean.

HD session length has been shown to predict outcome independently of URR[4]. The Registry is able to collect data on recorded session time but a few centres report prescribed session time. No data are currently collected on dialyser characteristics (eg surface area, clearance, flux, membrane type).

Several centres in the UK now use on-line measurement of ionic dialysance to measure small molecular clearance during haemodialysis, relying on small studies that have demonstrated a close linear relationship between this measure and conventional measures of urea clearance[4]. 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 continued comparative audit.

No consensus has yet been reached on a 'common currency' by which to define the dose of peritoneal dialysis and so no attempt has been made to report comparative audits of peritoneal dialysis dose. Consensus is required on whether the Registry should collect 'raw' data from 24 hour urine and dialysate collections or calculated weekly Kt/V_{urea} and creatinine clearance; if the latter, a uniform methodology for derivation of these values will be required.

Achieved URR

Median URR achieved in each renal unit is shown in Figure 7.1. The percentage of reported patients meeting the Renal Association audit

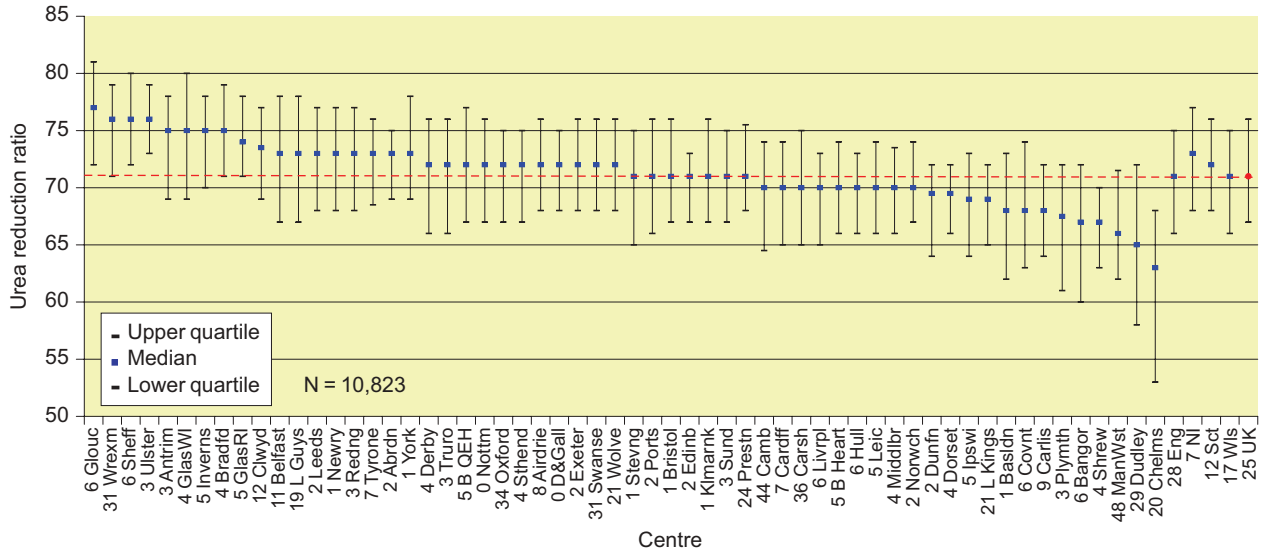

Figure 7.1: Median URR achieved in each centre, 2005

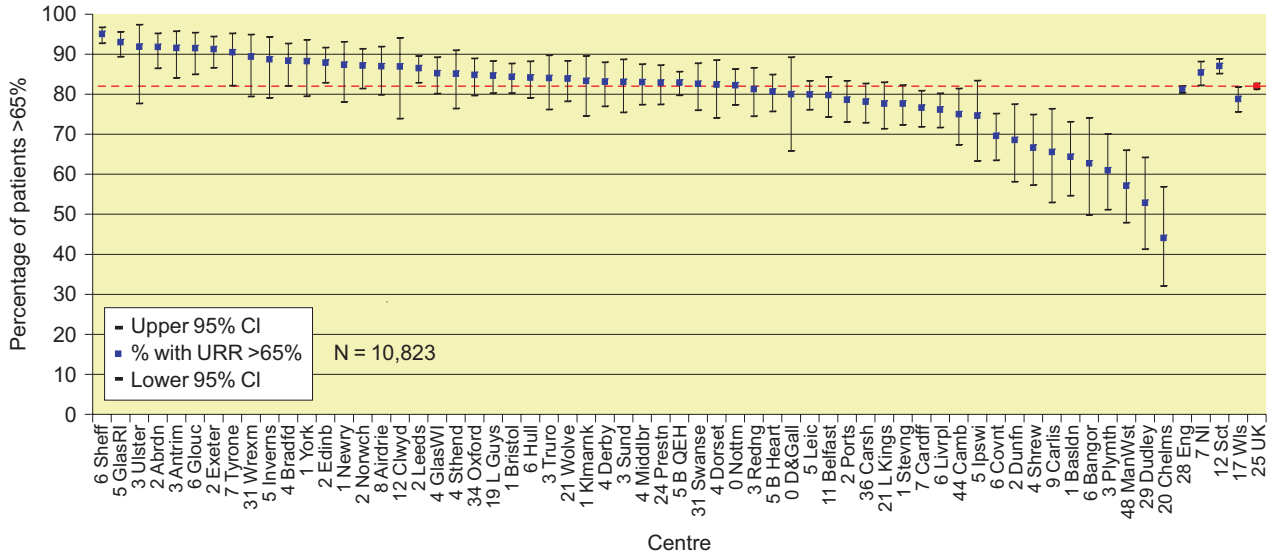

Figure 7.2: Percentage of patients with URR ⩾65% in each centre, 2005

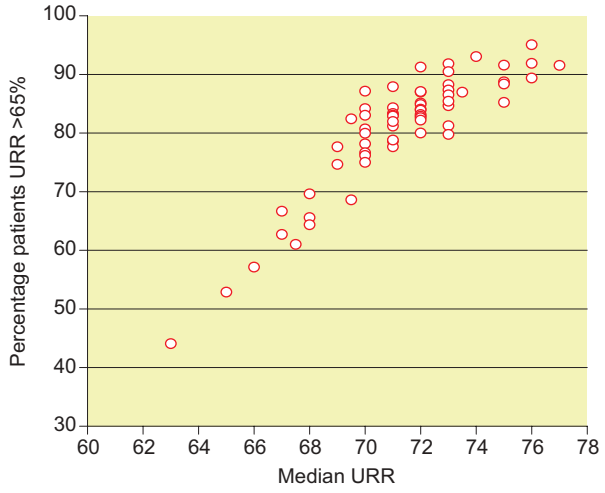

Figure 7.3: Relationship between achievement of the standard for URR and the median URR in each centre, 2005

standard of a URR of ⩾65% is shown in Figure 7.2. Figure 7.3 demonstrates that the two are closely related; however, the dispersion of values on this plot above a URR of 68% suggests that some higher performing units are achieving the standard in a high proportion of patients by narrowing the distribution rather than simply shifting the distribution upwards[5].

Changes in URR over time

Figure 7.4 shows the change in median URR between 1998 and 2005 in each renal unit. Figure 7.5 shows the change in percentage of reported dialysis patients with a URR ⩾65% in each unit over 1998–2005. Figure 7.6 shows summary data for England and Wales over the same time period. Although the median URR has remained at 71% over the last 3 years, the percentage of patients achieving a URR >65% has risen from 77% to 81%.

Variation of achieved URR with time on dialysis

As in previous analyses, the percentage of patients with URR ⩾65% is higher amongst patients who have been on RRT for longer than in those who recently started (Figure 7.7). However, the latter group has improved from 48% in 1999 to 68% in 2005. Figure 7.8 shows the percentage of patients with URR ⩾65% during the first quarter of treatment.

Commentary

There has been a progressive increase over time in the proportion of UK haemodialysis patients meeting the Renal Association audit standards for URR. However, although an increased dialysis dose is being achieved in patients just starting RRT, there is evidence that these standards are less frequently met in patients starting dialysis than in 'well-established' patients. This is possibly due to difficulties relating to vascular access in the first few months of dialysis. Previous reports[3] analysed whether this was partly due to selective drop-out (to death or other modalities) of those not initially achieving the audit standard and it was shown that this was not the case, with lower

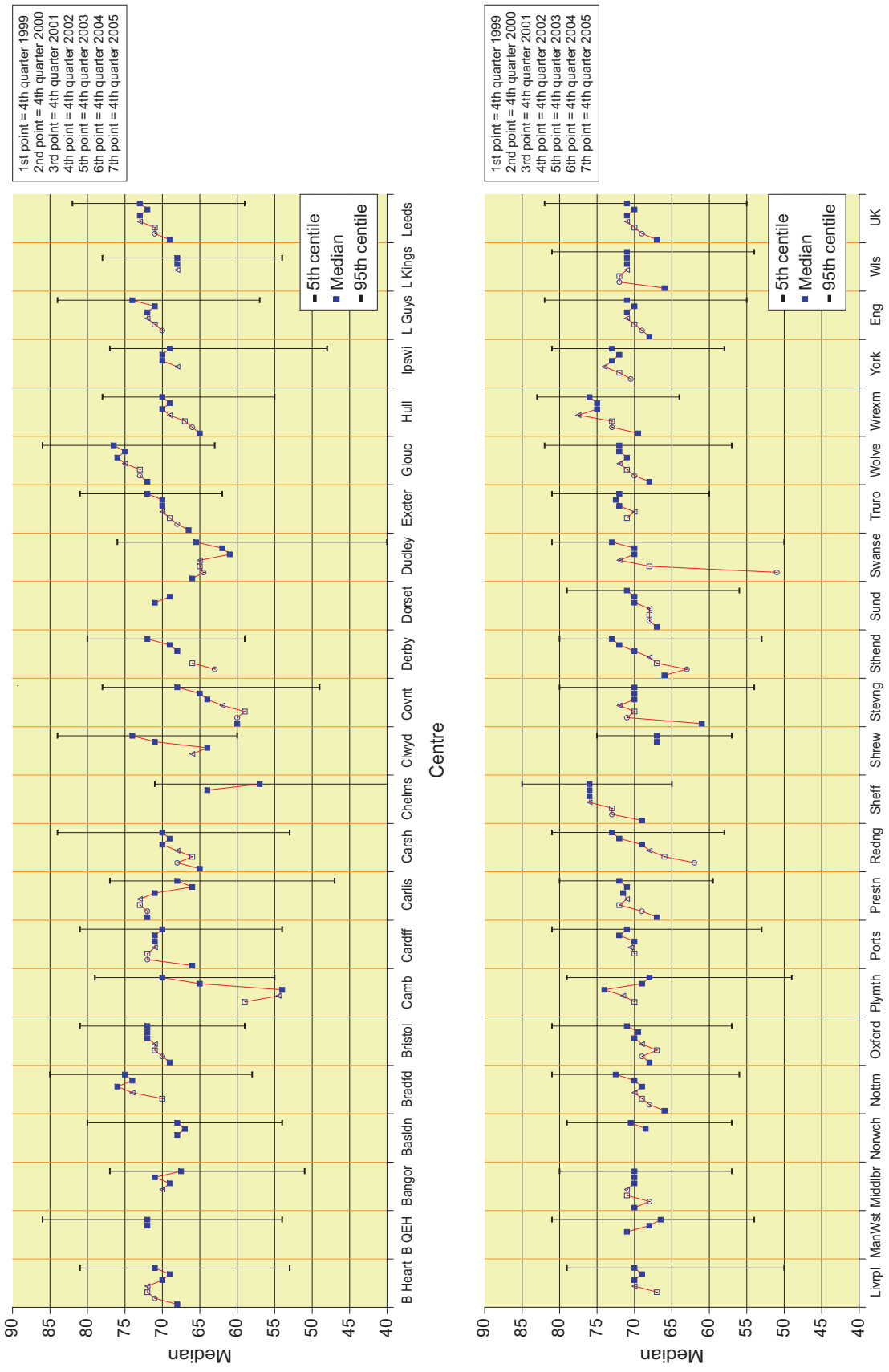

Figure 7.4: Change in median URR in each centre between 1998 and 2005

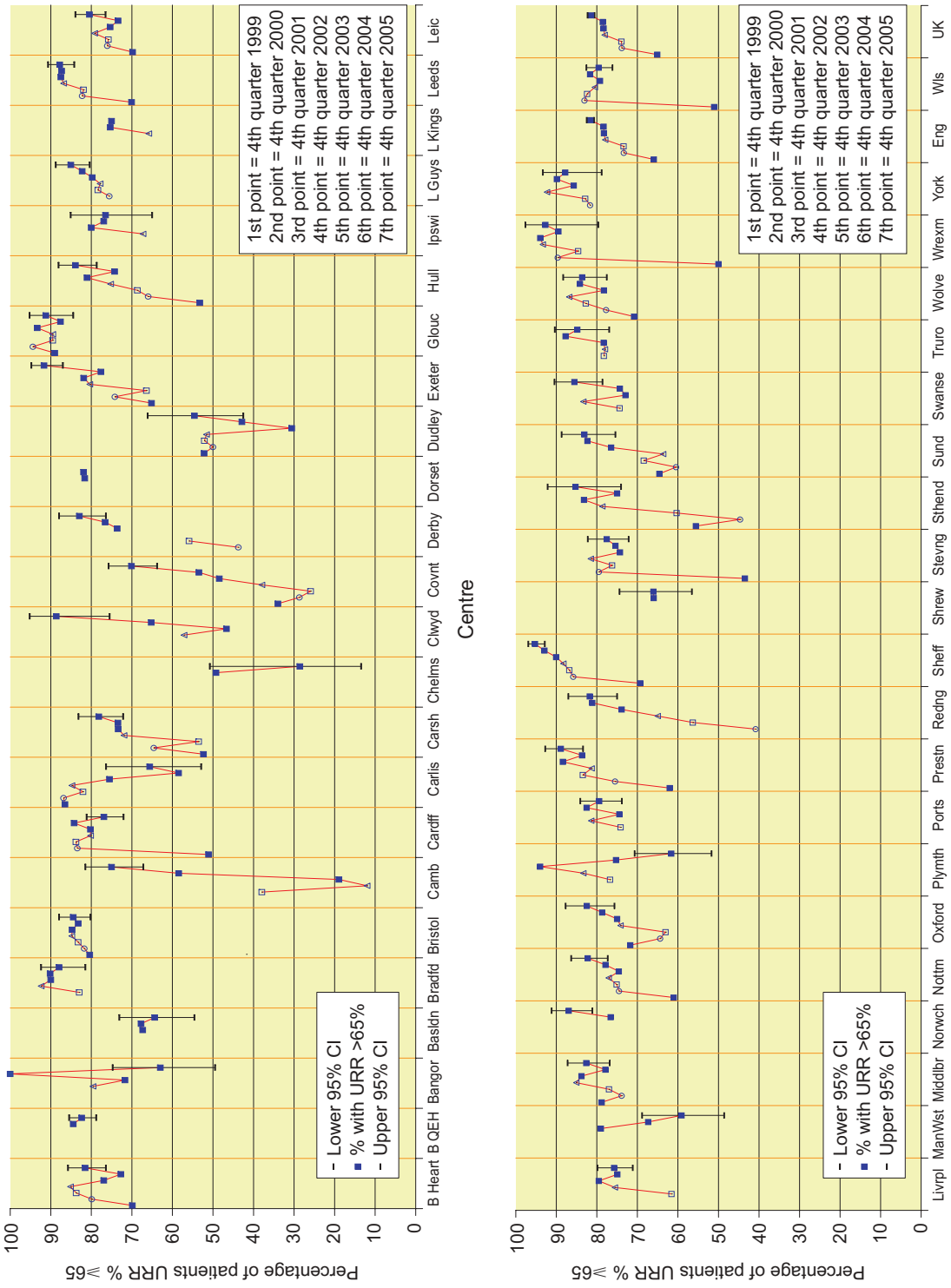

Figure 7.5: Change in achievement of the standard for URR in each centre between 1998 and 2005

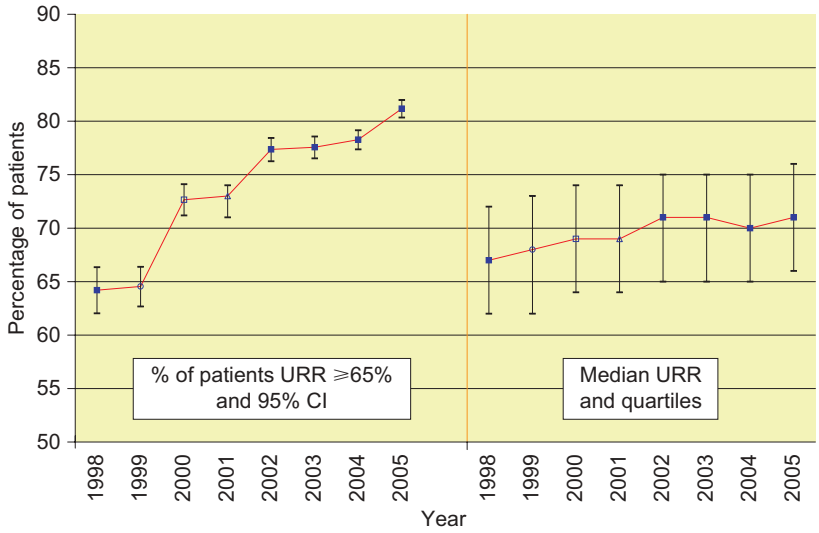

Figure 7.6: Change in the percentage of patients with URR ⩾65% and the median URR between 1998 and 2005 in England and Wales

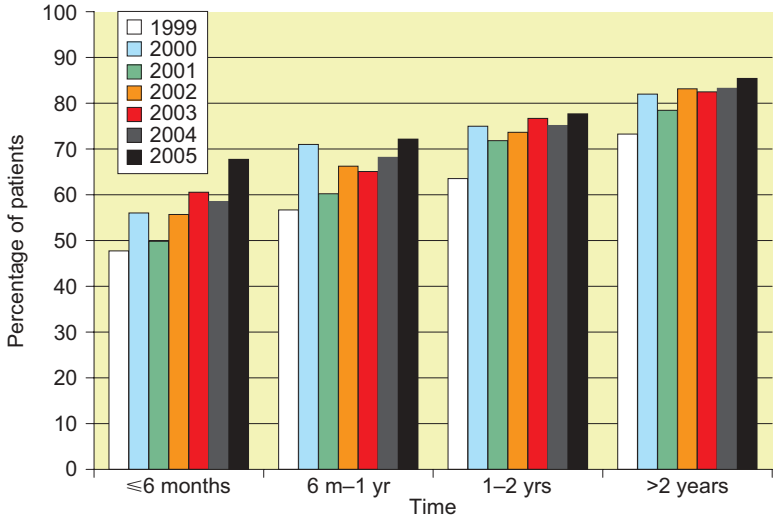

Figure 7.7: Percentage of prevalent haemodialysis patients achieving URR ⩾65% against duration on haemodialysis

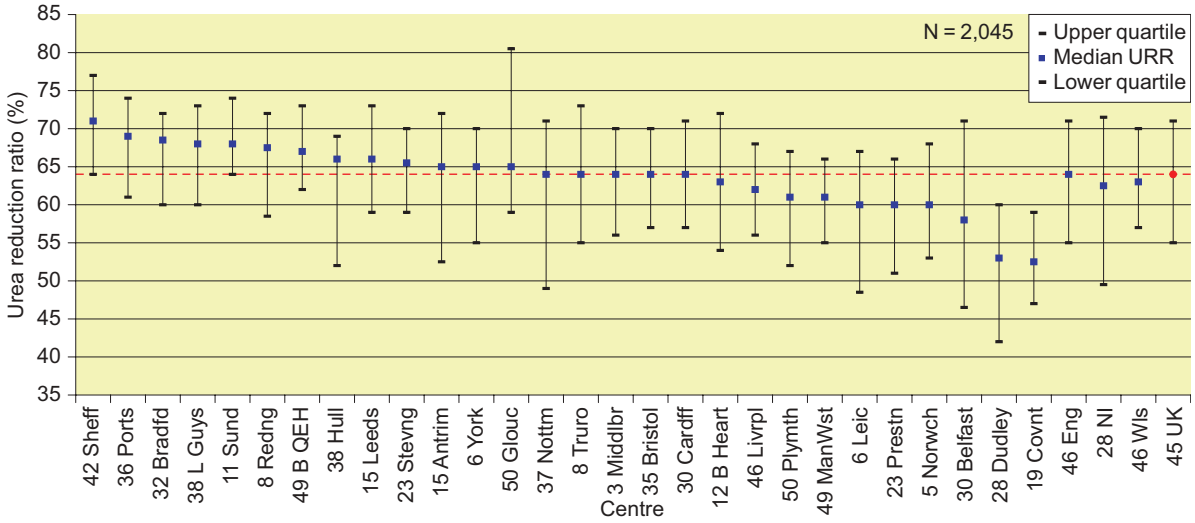

Figure 7.8: Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2005

URRs achieved throughout the first year even in those patients that survived at least two years.

Serum bicarbonate

Introduction

The relevant audit standard agreed by the Renal Association[1] is as follows:

Serum bicarbonate, before a haemodialysis (HD) session, measured with minimal delay after venepuncture should be between 20 and 26 mmol/l. (C)

For continuous ambulatory peritoneal dialysis (CAPD) patients serum bicarbonate, measured with minimal delay after venepuncture, should be between 25 and 29 mmol/l. (B)

Haemodialysis

Median pre-dialysis serum bicarbonate amongst prevalent haemodialysis patients in each renal unit is given in Figure 7.9; the percentage of patients in each unit meeting the Renal Association standards is given in Figure 7.10. Figure 7.11 presents the same data as in Figure 7.10 as a funnel plot and Table 7.2 can be used to look up the data for individual centres.

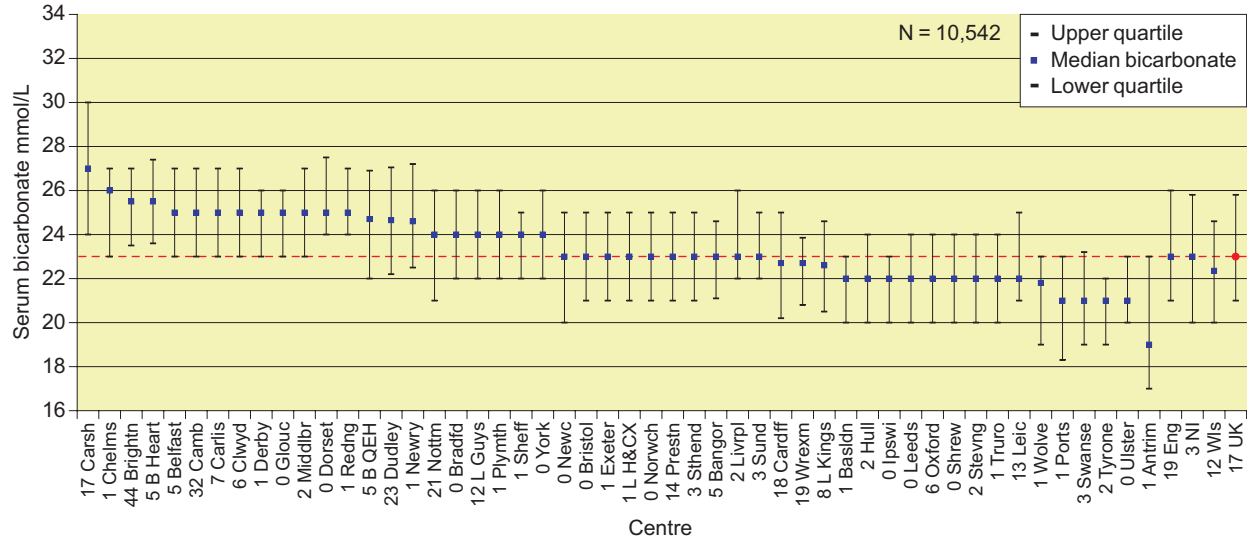

Figure 7.9: Median serum bicarbonate concentration amongst prevalent patients on haemodialysis, 2005

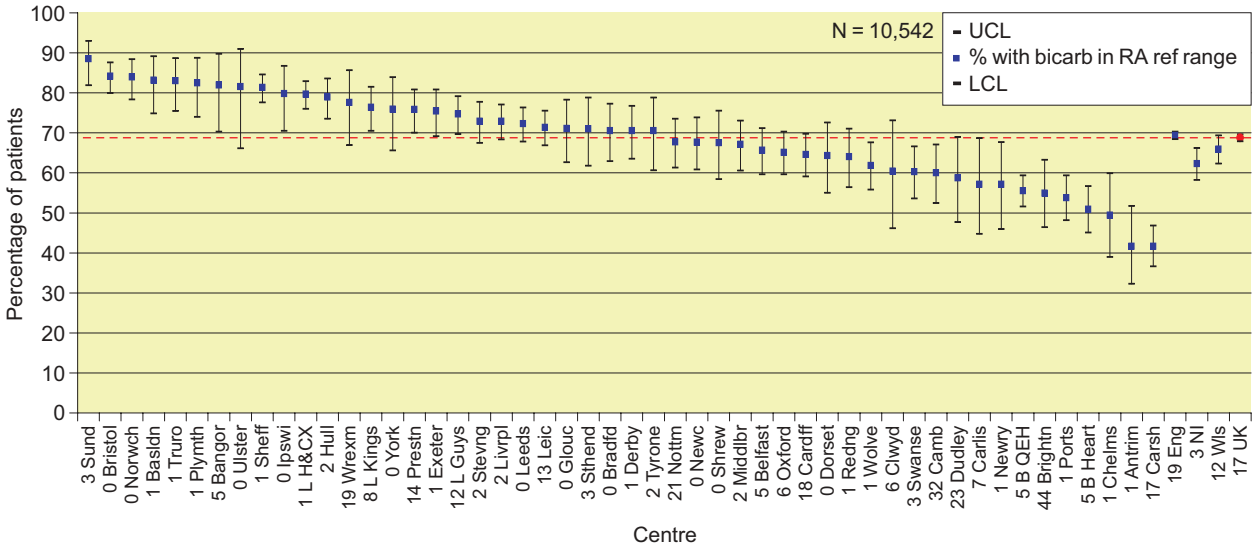

Figure 7.10: Percentage of prevalent haemodialysis patients with serum bicarbonate in the range 20–26 mmol/L, 2005

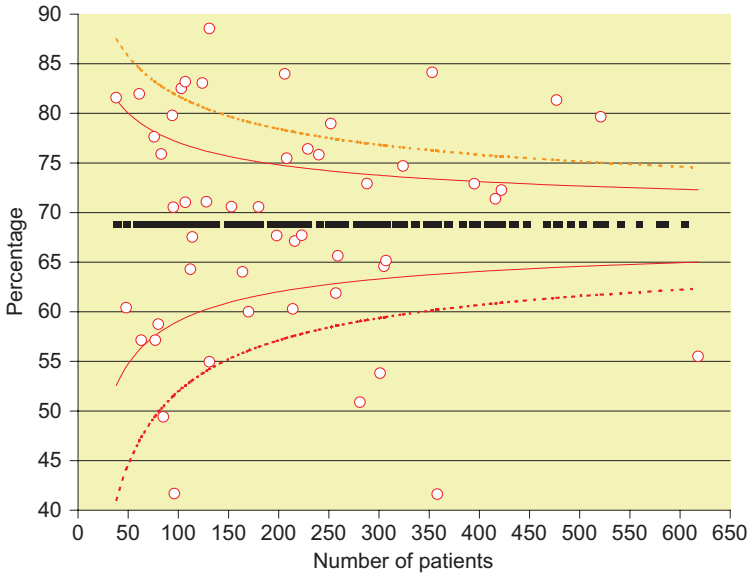

Figure 7.11: Funnel plot of the data in Figure 7.10

Table 7.2: Percentage of prevalent haemodialysis patients with serum bicarbonate in the range 20–26 mmol/L by centre

Centre	Total HD patients	% in RA ref range	Centre	Total HD patients	% in RA ref range
Ulster	38	82	Newc	198	68
Clwyd	48	60	Norwch	206	84
Bangor	61	82	Exeter	208	75
Carlis	63	57	Swanse	214	60
Wrexm	76	78	Middlbr	216	67
Newry	77	57	Nottm	223	68
Dudley	80	59	L Kings	229	76
York	83	76	Prestn	240	76
Chelms	85	49	Hull	252	79
Ipswi	94	80	Wolve	257	62
Tyrone	95	71	Belfast	259	66
Antrim	96	42	B Heart	281	51
Plymth	103	83	Stevng	288	73
Basldn	107	83	Ports	301	54
Sthend	107	71	Cardff	305	65
Dorset	112	64	Oxford	307	65
Shrew	114	68	L Guys	324	75
Truro	124	83	Bristol	353	84
Glouc	128	71	Carsh	358	42
Brightn	131	55	Livrpl	395	73
Sund	131	89	Leic	416	71
Bradfd	153	71	Leeds	422	72
Redng	164	64	Sheff	477	81
Camb	170	60	L H&CX	521	80
Derby	180	71	B QEH	618	56

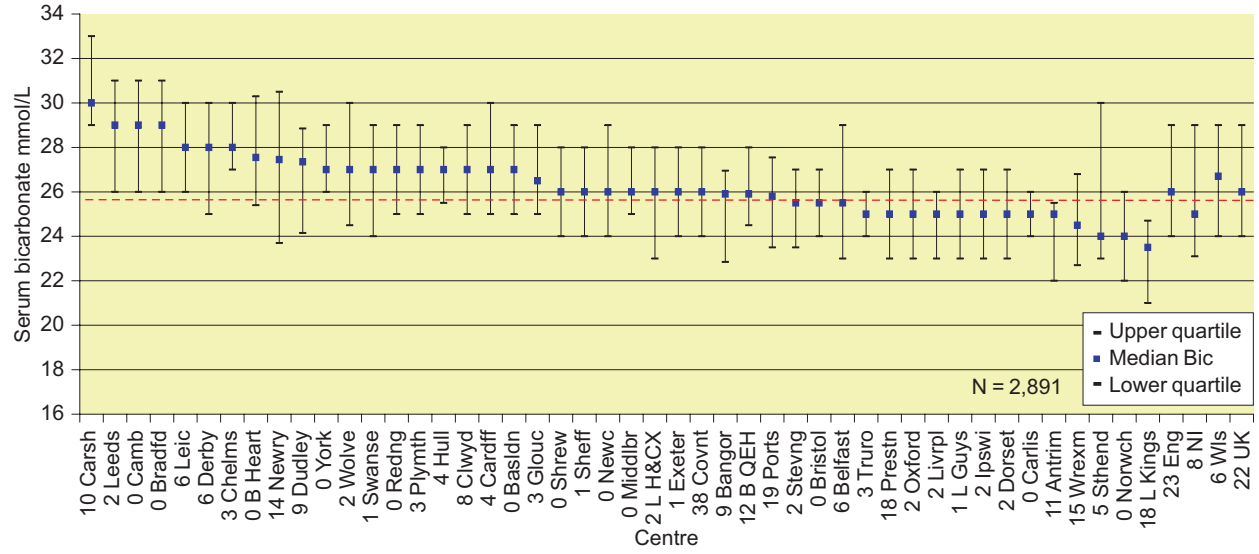

Figure 7.12: Median serum bicarbonate concentration amongst prevalent peritoneal dialysis patients, 2005

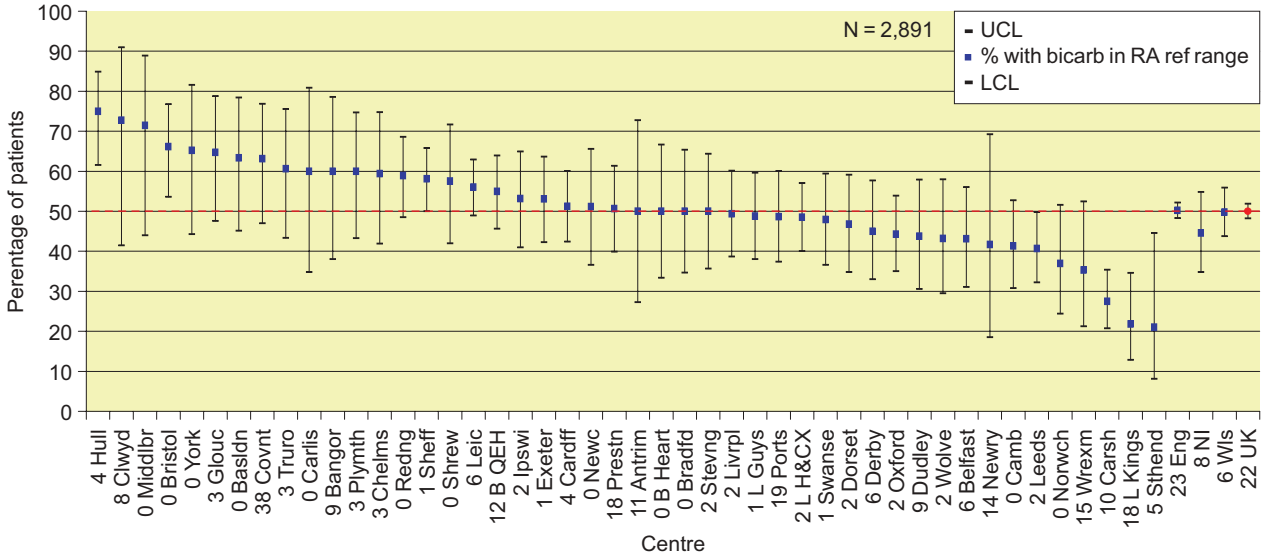

Figure 7.13: Percentage of prevalent peritoneal dialysis patients with serum bicarbonate in the range 25–29 mmol/L, 2005

Peritoneal dialysis

Median serum bicarbonate amongst prevalent peritoneal dialysis patients in each renal unit is given in Figure 7.12; the percentage of patients in each unit meeting the Renal Association standards is shown in Figure 7.13. Figure 7.14 presents the same data as in Figure 7.13 as a funnel plot and Table 7.3 can be used to look up the data for individual centres.

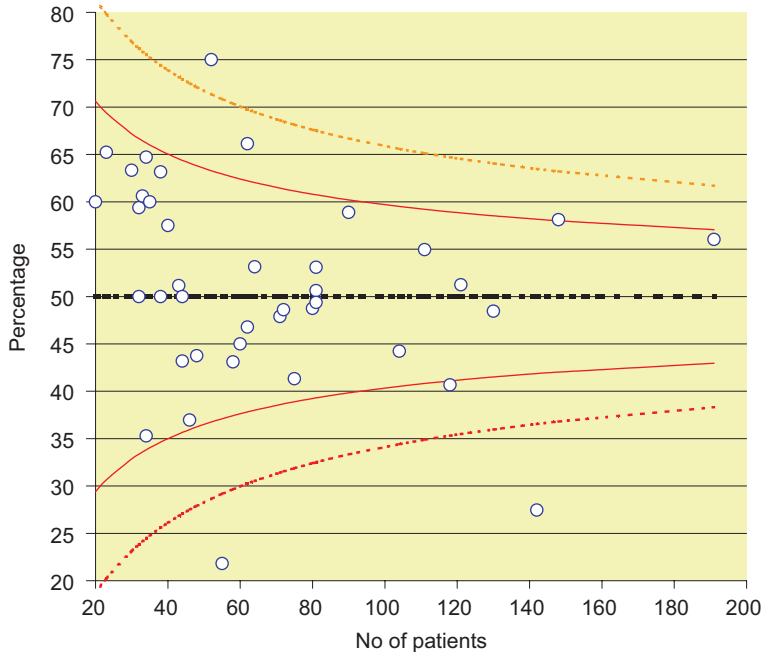

Figure 7.14: Funnel plot of the data in Figure 7.13

Table 7.3: Percentage of prevalent PD patients with serum bicarbonate in the range 20–26 mmol/L by centre

Centre	Total PD patients	% in RA ref range	Centre	Total PD patients	% in RA ref range
Bangor	20	60	Derby	60	45
York	23	65	Dorset	62	47
Basldn	30	63	Bristol	62	66
B Heart	32	50	Ipswi	64	53
Chelms	32	59	Swanse	71	48
Truro	33	61	Ports	72	49
Glouc	34	65	Camb	75	41
Wrexm	34	35	L Guys	80	49
Plymth	35	60	Exeter	81	53
Bradfd	38	50	Prestn	81	51
Covnt	38	63	Livrpl	81	49
Shrew	40	58	Redng	90	59
Newc	43	51	Oxford	104	44
Stevng	44	50	B QEH	111	55
Wolve	44	43	Leeds	118	41
Norwch	46	37	Cardff	121	51
Dudley	48	44	L H&CX	130	48
Hull	52	75	Carsh	142	27
L Kings	55	22	Sheff	148	58
Belfast	58	43	Leic	191	56

Transplant

Median serum bicarbonate amongst prevalent transplant patients in each renal unit is given in Figure 7.15. Mean serum creatinine and eGFR for the same populations are given in Table 7.4.

Commentary

An in-depth survey of the causes of variations between renal units in performance against the audit standard for serum bicarbonate concentration was reported in the 2004 Report[6]. Few of these causes of variation have been

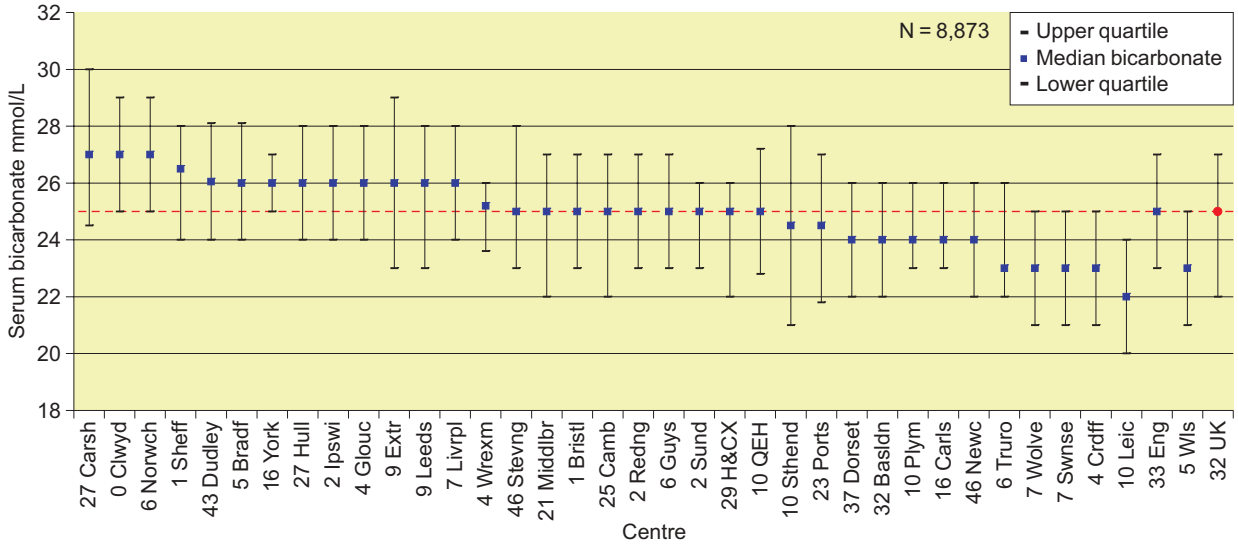

Figure 7.15: Median serum bicarbonate concentration amongst prevalent transplant patients, 2005

Table 7.4: Analysis of bicarbonate by CKD stage for prevalent transplant patients compared with dialysis patients

	Stage 1–2T (⩾60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
Number of patients	3,028	7,537	1,971	321	13,715
% of patients	23.6	58.6	15.3	2.5	
eGFR ml/min/1.73 m^2					
mean ± SD	73.0 ± 12.5	44.9 ± 8.3	24.0 ± 4.0	11.4 ± 2.6	
Median	69.6	44.8	24.6	12.1	
Bicarbonate mmol/L					
mean ± SD	26.4 ± 3.0	25.6 ± 3.4	23.4 ± 3.6	21.5 ± 4.0	24.0 ± 3.8

eliminated and the analyses reported here should therefore be interpreted with caution. However, more renal units than expected fall outside three standard deviations from the mean, suggesting that real differences in unit performance are present; it is recommended that those units whose data fall below the 3SD line review their practices relating to measurement of serum bicarbonate and to the correction of acidosis.

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Chapter 8: Management of Anaemia in Haemodialysis and Peritoneal Dialysis Patients

Donald Richardson, Alex Hodsman, Dirk van Schalkwyk, Charlie Tomson and Graham Warwick

Summary

- 41% of UK patients commence RRT with an Hb <10.0 g/l. The mean Hb at commencement of RRT is 10.3 g/dl.
- 85% of patients on dialysis in the UK have a Hb ⩾10.0 g/dl by 6 months after commencement of RRT.
- The median Hb on haemodialysis in the UK is 11.8 g/dl with an IQR of 10.7–12.8 g/dl. 86% of haemodialysis patients in the UK have a Hb ⩾10.0 g/dl. The median Hb on peritoneal dialysis in the UK is 12.0 g/dl with an IQR of 11.0–12.9 g/dl. 90% of peritoneal dialysis patients in the UK have a Hb ⩾10.0 g/dl.
- In the UK, 49% of patients on PD and 48% of patients on haemodialysis have a Hb between 10.5–12.5 g/dl.
- The median ferritin in UK haemodialysis patients is 413 μg/L (IQR 262–623), 95% of UK haemodialysis patients have a ferritin ⩾100 μg/L.
- The median ferritin in UK PD patients is 256 μg/L (IQR 147–421), 86% of UK peritoneal dialysis patients have a ferritin ⩾100 μg/L.
- A higher proportion of HD patients than PD patients receive ESA therapy (88% vs 76%). The ESA dose is higher for HD than PD patients (9204 vs 6080 IU/week).

Introduction

This chapter describes data reported to the Renal Registry relating to management of renal anaemia through 2005. 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 cohort for 2005. The Registry extracts quarterly data electronically from renal units in England, Wales and Northern Ireland and is sent data annually from the Scottish Renal Registry. Patients treated by dialysis during the last quarter of 2005 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 and ferritin from each patient in the last two quarters of 2005 was used for analysis. For incident patients, data from their first quarter on dialysis was used. Patients who do not have this data are excluded from the analyses. Data from Northern Ireland and Scotland are included for the first time this year. Patients are analysed as a complete cohort and divided by modality into groups. Some analysis is also done on a combined dialysis group.

The completeness of data items are analysed at unit and country level. All patients are included in analyses but units with less than 50% completeness are excluded from the caterpillar plots showing unit performance. Both at unit and country level, data are also excluded from plots when there are less than 20 patients with data. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

The data are analysed to calculate summary statistics. These are maximum, minimum and average (mean and median) values. Standard deviation and quartile ranges are also calculated. These data are represented as caterpillar plots showing median values and quartile ranges.

The percentage achieving Renal Association standards is 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 χ^2 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 annually from 1998 to 2005.

Haemoglobin

The NSF part 1[1] and the Renal Association standards document 3rd edition[2] state that individuals with CKD should achieve a haemoglobin of 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 UK Renal Registry does not collect a specific haemoglobin value 6 months from meeting a nephrologist. Some indication of whether the standard is reached comes from the Hb at the start of renal replacement therapy. The Registry plans to collect pre-dialysis data for patients who then commence 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] now recommend a target haemoglobin of between 10.5 and 12.5 g/dl (with ESA dose changes considered at 11 and 12 g/dl), perhaps recognising the difficulty of narrowing the distribution of haemoglobin to between 11–12 g/dl. For this reason data are also presented in terms of the new NICE guidelines. However, it should be recognised that the data reported in this chapter were collected before the publication of the NICE guidelines. In light of the normalisation of haemoglobin study in haemodialysis patients[6] (Besarab *et al.*, NEJM), and also now the results of the CREATE[7] and CHOIR[8] studies in CKD patients demonstrating similar outcomes regards increased mortality at higher target Hb, the new NICE desired outcome range 10.5–12.5 g/dl may be very relevant to reduction in patient risk as well as the most cost effective use of resources.

Haemoglobin of patients with CKD

In patients new to dialysis, the starting haemoglobin currently gives the only indication we have of concordance with current anaemia management recommendations in the pre-dialysis group. Patients not receiving dialysis (conservative care) are by definition excluded from the dataset. The Registry aims to collate data on a defined pre-dialysis/non-dialysis group in the future.

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

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

Centre	% data return	Median Hb g/dl	90% range	Interquartile range	% Hb $\geqslant$ 10 g/dl
Abrdn	100	10.5	8.9–12.8	9.6–11.0	70
Airdrie	44	n/a	n/a	n/a	n/a
Antrim	60	11.3	9.7–13.2	10.5–11.9	88
B Heart	96	9.9	7.4–13.0	9.0–11.2	50
B QEH	83	10.0	7.7–12.7	9.3–11.2	53
Bangor	100	10.5	8.0–13.7	9.5–11.6	71
Basldn	100	10.4	7.4–12.8	9.3–11.6	60
Belfast	88	10.1	6.5–13.3	8.6–11.3	52
Bradfd	98	10.3	7.9–12.9	9.2–11.7	56
Brightn	74	10.6	7.9–14.1	9.7–11.5	63
Bristol	100	10.2	7.5–14.2	9.2–11.5	55
Camb	80	10.5	8.4–14.1	9.5–12.0	61
Cardff	99	10.6	8.0–13.5	9.6–11.6	68
Carlis	100	10.9	8.8–13.7	9.4–11.6	67
Carsh	95	10.6	8.2–13.2	9.4–11.7	65
Chelms	97	9.8	7.0–14.9	8.8–10.8	45

Table 8.1: (continued)

Centre	% data return	Median Hb g/dl	90% range	Interquartile range	% Hb ⩾10 g/dl
Clwyd	86	10.7	8.7–12.9	10.0–11.2	75
Covnt	85	10.1	7.4–13.1	9.3–11.3	55
D&Gall	100	n/a	n/a	n/a	n/a
Derby	84	10.1	7.7–12.4	9.1–10.9	53
Dorset	100	10.7	7.9–13.5	9.7–12.2	63
Dudley	100	10.4	7.1–13.2	9.3–11.3	62
Dundee	76	10.8	7.5–16.6	9.4–11.9	63
Dunfn	100	n/a	n/a	n/a	n/a
Edinb	100	10.6	9.3–13.2	9.8–11.4	67
Exeter	100	9.7	7.4–12.6	9.0–10.7	46
GlasRI	100	10.2	8.3–12.3	9.4–11.0	65
GlasWI	97	10.5	8.6–15.6	10.1–12.9	83
Glouc	100	10.0	8.0–12.8	8.8–11.2	54
Hull	93	10.1	7.3–12.8	8.8–11.1	53
Inverns	75	n/a	n/a	n/a	n/a
Ipswi	100	10.4	8.4–13.6	9.5–11.5	67
Klmarnk	78	n/a	n/a	n/a	na
L Barts	0	n/a	n/a	n/a	n/a
L Guys	82	10.4	8.1–13.8	9.4–12.0	60
L H&CX	99	10.2	8.2–12.7	9.3–11.1	61
L Kings	99	10.2	8.0–13.6	9.4–11.4	56
L Rfree	97	10.2	8.1–13.1	9.5–11.2	66
Leeds	100	10.7	7.3–13.4	9.2–11.85	59
Leic	99	10.0	7.6–12.9	9.1–11.0	52
Livrpl	92	10.8	8.6–13.9	9.8–12.0	71
ManWst	87	10.4	8.0–13.5	9.4–11.8	62
Middlbr	99	9.9	7.2–12.7	8.8–11.3	48
Newc	95	10.7	7.4–12.5	9.2–11.6	60
Newry	33	n/a	n/a	n/a	n/a
Norwch	98	10.3	8.2–13.3	9.4–11.4	63
Nottm	99	10.1	7.8–12.6	9.0–11.0	52
Oxford	99	10.3	8.3–13.1	9.5–11.7	64
Plymth	70	10.2	8.0–12.3	9.4–11.5	63
Ports	99	10.3	8.3–13.6	9.3–11.9	56
Prestn	95	9.9	7.1–13.6	8.7–11.3	48
Redng	100	10.3	7.9–13.5	9.1–11.6	56
Sheff	100	10.2	7.9–13.2	9.0–11.5	54
Shrew	98	11.2	8.6–14.0	10.2–12.1	82
Stevng	86	10.4	8.7–13.0	9.8–11.7	73
Sthend	94	10.1	7.3–12.5	8.9–11.1	59
Sund	100	10.4	7.7–14.2	9.4–11.6	59
Swanse	100	9.5	7.8–12.9	8.9–10.8	38
Truro	100	10.2	7.6–12.3	9.4–11.2	67
Tyrone	95	10.1	7.4–12.3	9.4–11.0	56
Ulster	89	n/a	n/a	n/a	n/a
Wirral	2	n/a	n/a	n/a	n/a
Wolve	96	10.3	7.4–14.0	9.2–11.6	57
Wrexm	54	9.9	6.9–12.9	9.1–11.7	42
York	100	10.8	7.7–13.5	10.0–11.6	76
Eng	89	10.3	7.8–13.3	9.3–11.5	58
NI	76	10.4	6.9–13.2	8.9–11.4	59
Sct	90	10.5	8.2–14.2	9.6–11.5	69
Wls	94	10.3	7.9–13.2	9.2–11.5	59
UK	89	10.3	7.8–13.3	9.3–11.5	59

Note: Median Hb for units with less than 20 new patients or data returns <50% are not shown

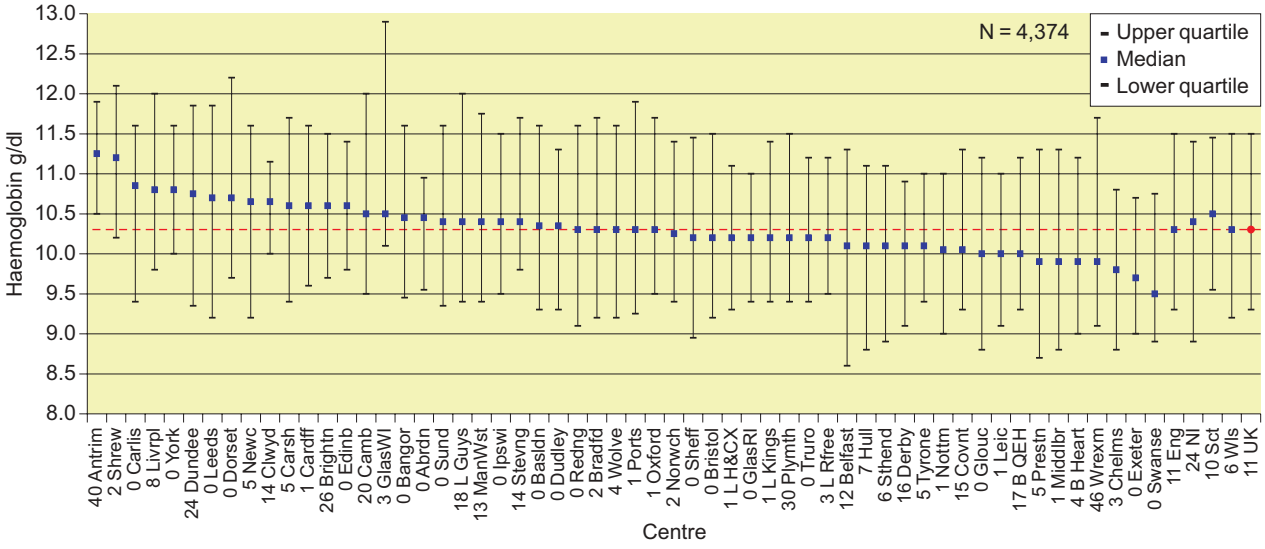

Figure 8.1: Haemoglobin median and interquartile range for incident patients

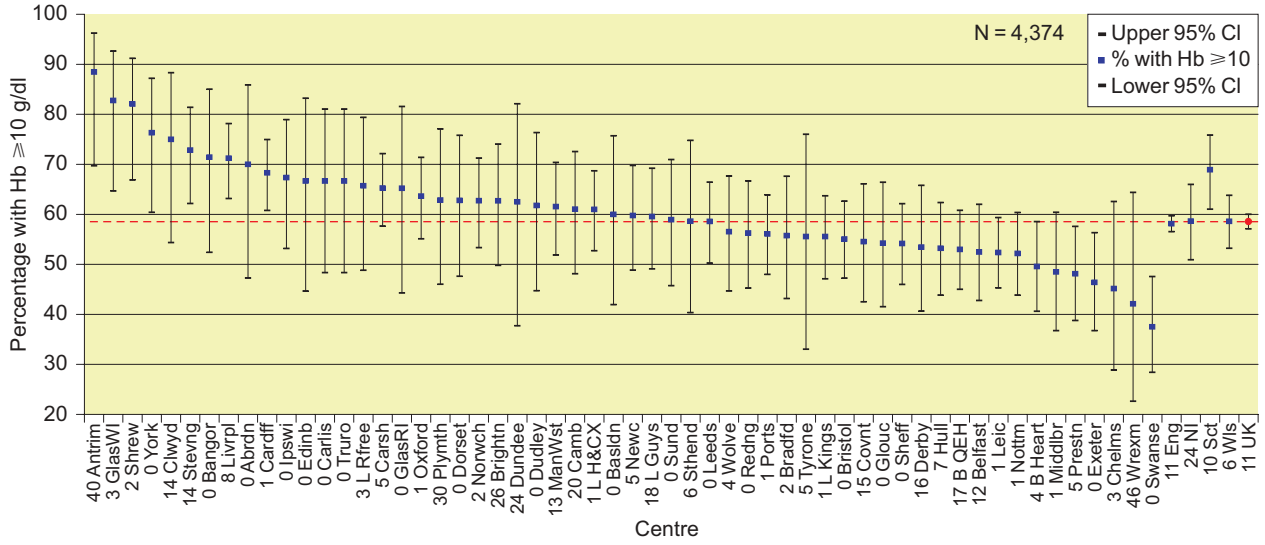

Figure 8.2: Percentage of incident patients, by centre, achieving RA target

unit returns with incomplete data sets are obviously open to criticism. Returns of <50% are excluded from unit level analysis. It is unlikely, although possible, that exclusion of data from these units will alter the overall conclusions.

The current starting median haemoglobin in the UK is 10.3 g/dl with 59% of patients starting dialysis with an Hb ⩾10 g/dl. Thus 41% of patients commence dialysis therapy with an Hb <10.0 g/dl. There is a wide range of compliance with the audit standard of Hb ⩾10 g/dl between units, from 38–88%. The wide range in starting Hb may reflect different practices in referral to nephrologists or differences in funding for predialysis ESA therapy. The median starting Hb is shown in Figure 8.1 and the percentage starting with an Hb ⩾10.0 g/dl by unit are given in Figure 8.2.

The distribution of haemoglobin in incident patients by unit is shown in Figure 8.3.

Figures 8.4 and 8.5 illustrate the improvement in correction of anaemia over the first year of haemodialysis in incident patients. Data on the haemoglobin prior to starting RRT and the relationship between this variable and comorbidity is presented in Chapter 6[9].

Both these figures suggest that availability of and/or better utilisation of ESA products for

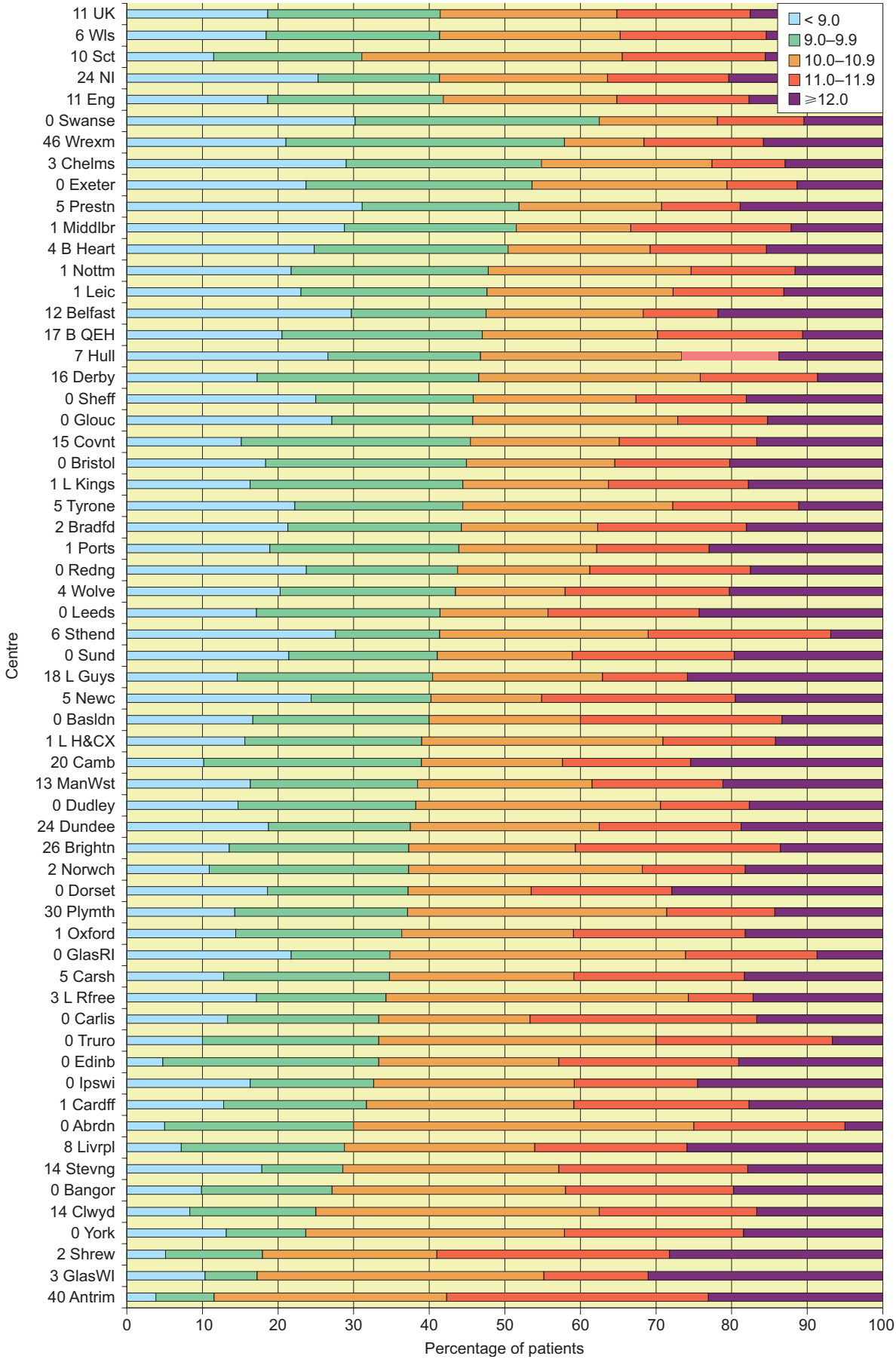

Figure 8.3: Distribution of haemoglobin in incident dialysis patients

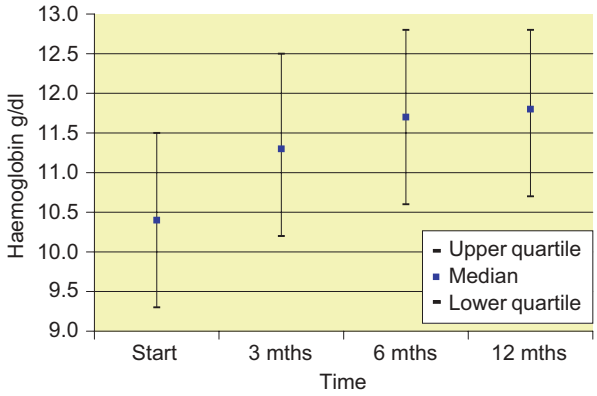

Figure 8.4: Quarterly median haemoglobin for incident patients in 2005

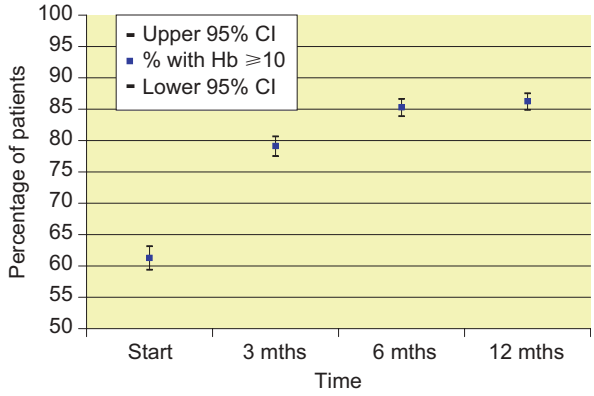

Figure 8.5: Quarterly percentage of incident patients with haemoglobin ⩾10 g/dl in 2005

use in the dialysis population is much improved in recent times with 85% compliance by 6 months after commencement of dialysis. It is uncertain whether poor availability of ESA funding, reluctance to treat or late referral is responsible for the ongoing prevalence of relative anaemia in patients commencing RRT.

Haemoglobin of prevalent haemodialysis patients

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

The median haemoglobin for haemodialysis patients by unit and compliance with the minimum standard Hb ⩾10 g/dl and the Hb ⩾11 g/dl standard are shown in Figures 8.6, 8.7 and 8.8 respectively.

The distribution of Hb in the haemodialysis population is shown, by unit, in Figure 8.9. The compliance with the new NICE guidelines for outcome haemoglobin 10.5–12.5 g/dl is shown in Figure 8.10. It should be noted that the dataset predates the NICE guidelines published in 2006. In Table 8.2 the inter-quartile range for the UK is 1.9 g/dl. Even at the 'ideal' median Hb of 11.5 g/dl and a normal distribution for

Table 8.2: Haemoglobin data for prevalent patients on haemodialysis

Centre	% data return	Median Hb g/dl	90% range	Quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10	% with Hb ⩾11
Abrdn	98	11.7	9.1–14.2	10.5–12.5	11.6	1.5	88	64
Airdrie	100	12.0	8.9–14.4	10.8–12.7	11.7	1.6	86	72
Antrim	92	12.1	10.5–13.9	11.4–13.0	12.2	1.1	98	88
B Heart	94	11.6	8.9–14.0	10.2–12.4	11.4	1.6	81	60
B QEH	97	11.8	8.7–14.5	10.5–12.9	11.7	1.8	84	68
Bangor	94	11.8	8.9–13.6	11.0–12.7	11.7	1.5	84	77
Basldn	99	11.8	9.1–13.9	10.5–12.5	11.5	1.5	81	66
Belfast	93	11.8	9.0–14.5	10.7–12.9	11.8	1.7	86	71
Bradfd	100	12.8	9.8–14.8	11.8–13.8	12.7	1.6	94	85
Brightn	69	10.6	8.2–13.1	9.4–11.9	10.6	1.6	69	46
Bristol	100	12.0	9.0–14.3	10.9–12.9	11.9	1.6	90	73
Camb	69	11.4	8.5–13.5	10.0–12.6	11.3	1.6	76	58
Cardff	98	12.2	9.3–14.7	11.1–13.3	12.1	1.7	90	77
Carlis	93	11.4	9.0–14.6	10.2–12.4	11.4	1.7	83	64
Carsh	88	11.7	8.9–14.8	10.6–12.8	11.8	1.7	86	70
Chelms	98	11.7	8.9–14.1	10.6–12.6	11.5	1.7	85	65
Clwyd	94	12.0	10.3–13.9	11.4–12.7	12.1	1.2	96	86
Covnt	98	11.3	8.9–13.7	10.4–12.4	11.4	1.5	85	63
D&Gall	100	10.9	9.1–13.6	10.1–12.0	11.1	1.4	76	49

Table 8.2: (continued)

Centre	% data return	Median Hb g/dl	90% range	Quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10	% with Hb ⩾11
Derby	100	11.8	8.3–14.3	10.6–13.0	11.7	1.9	81	68
Dorset	99	11.8	8.7–13.9	10.7–12.7	11.6	1.6	87	71
Dudley	84	11.3	8.2–14.6	9.7–12.5	11.2	1.9	70	51
Dundee	95	11.8	8.4–13.7	10.7–12.6	11.6	1.6	86	72
Dunfn	99	11.5	8.9–13.8	10.5–12.4	11.4	1.6	83	67
Edinb	98	12.1	9.7–14.0	11.2–12.9	12.0	1.3	94	81
Exeter	99	11.4	8.7–13.5	10.5–12.3	11.3	1.5	84	66
GlasRI	98	11.6	8.5–13.9	10.5–12.6	11.5	1.6	83	67
GlasWI	98	11.8	8.8–14.3	10.6–12.8	11.6	1.7	84	68
Glouc	99	12.2	9.1–14.1	11.0–13.0	11.9	1.6	86	76
Hull	99	11.7	8.6–13.7	10.7–12.6	11.6	1.5	85	69
Inverns	96	12.0	9.7–14.1	11.0–12.7	11.8	1.4	92	75
Ipswi	100	11.6	9.2–13.4	10.7–12.4	11.5	1.4	87	67
Klmarnk	99	12.0	8.8–14.4	10.8–13.1	11.9	1.7	85	72
L Barts	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
L Guys	89	11.5	8.9–13.8	10.3–12.6	11.4	1.6	81	61
L H&CX	99	11.9	9.1–13.9	10.9–12.7	11.7	1.5	88	73
L Kings	100	11.4	8.5–13.5	10.3–12.3	11.3	1.6	81	61
L Rfree	93	11.4	9.1–13.6	10.4–12.4	11.4	1.4	83	62
Leeds	100	12.4	9.7–15.0	11.3–13.3	12.3	1.5	94	83
Leic	98	11.8	9.1–14.0	10.8–12.7	11.7	1.6	88	71
Livrpl	98	12.1	9.1–14.9	10.9–13.3	12.1	1.7	88	72
ManWst	81	11.9	8.7–14.3	10.4–12.7	11.6	1.7	82	66
Middlbr	99	11.8	8.7–13.9	10.7–12.7	11.6	1.6	86	69
Newc	100	12.1	8.7–14.5	11.1–12.9	11.8	1.8	88	76
Newry	96	12.0	9.5–14.0	11.2–12.6	11.9	1.3	95	78
Norwch	100	12.1	9.7–14.0	11.3–13.0	12.0	1.3	94	80
Nottm	100	11.3	8.9–13.7	10.6–12.3	11.4	1.5	87	63
Oxford	99	11.7	9.1–14.4	10.7–12.7	11.7	1.6	87	70
Plymth	92	11.4	8.0–14.2	10.3–12.4	11.3	1.7	81	58
Ports	99	12.0	8.8–14.3	10.7–13.1	11.8	1.7	85	70
Prestn	97	11.5	9.2–14.0	10.5–12.6	11.6	1.5	85	64
Redng	99	11.8	9.4–13.8	10.8–12.5	11.7	1.3	87	72
Sheff	99	11.9	9.2–14.5	10.9–12.9	11.9	1.6	90	72
Shrew	100	12.2	9.7–14.4	11.4–13.0	12.2	1.4	94	83
Stevng	83	11.5	9.1–13.4	10.5–12.5	11.4	1.4	86	66
Sthend	97	11.6	9.1–13.6	10.7–12.3	11.4	1.3	85	66
Sund	98	11.7	8.3–14.5	10.4–13.0	11.7	1.8	83	66
Swanse	97	11.8	9.3–14.4	10.8–12.9	11.9	1.5	89	72
Truro	99	11.3	9.2–12.9	10.5–11.9	11.3	1.1	89	66
Tyrone	93	12.1	9.7–13.9	11.3–12.9	12.0	1.5	92	82
Ulster	100	12.1	9.4–13.7	11.0–12.7	11.9	1.2	92	84
Wirral	7	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wolve	100	12.2	8.8–14.8	11.1–13.3	12.2	1.7	92	78
Wrexm	82	11.8	7.3–13.8	10.0–12.6	11.2	1.9	77	62
York	100	12.5	8.6–15.3	11.6–13.3	12.4	1.7	90	85
Eng	90	11.7	8.9–14.2	10.6–12.7	11.7	1.6	86	69
NI	94	12.0	9.2–14.2	11.0–12.9	11.9	1.5	91	77
Sct	98	11.8	8.9–14.1	10.7–12.7	11.7	1.6	86	70
Wls	95	12.0	9.1–14.5	10.9–13.1	11.9	1.6	88	75
UK	92	11.8	9.0–14.2	10.7–12.8	11.7	1.6	86	70

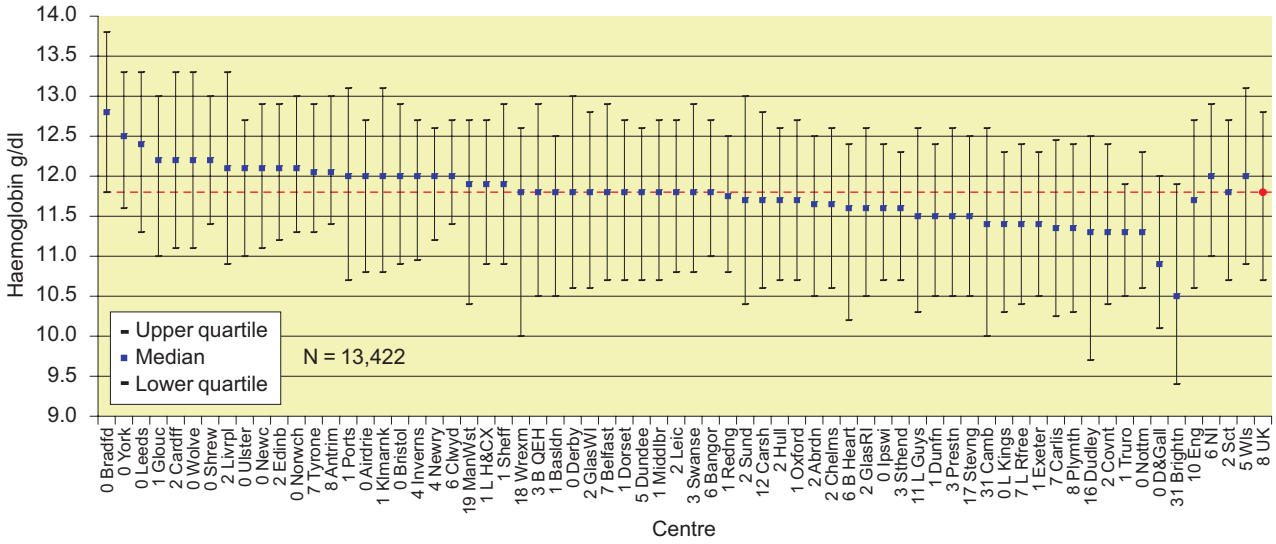

Figure 8.6: Median haemoglobin: HD

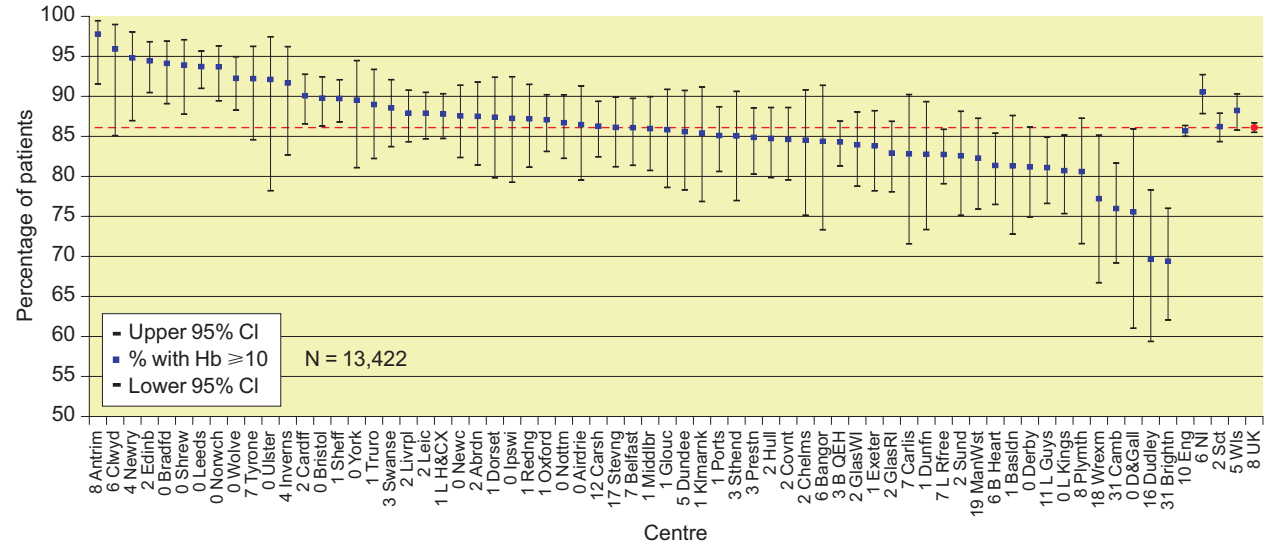

Figure 8.7: Percentage of HD patients with Hb ⩾10 g/dl

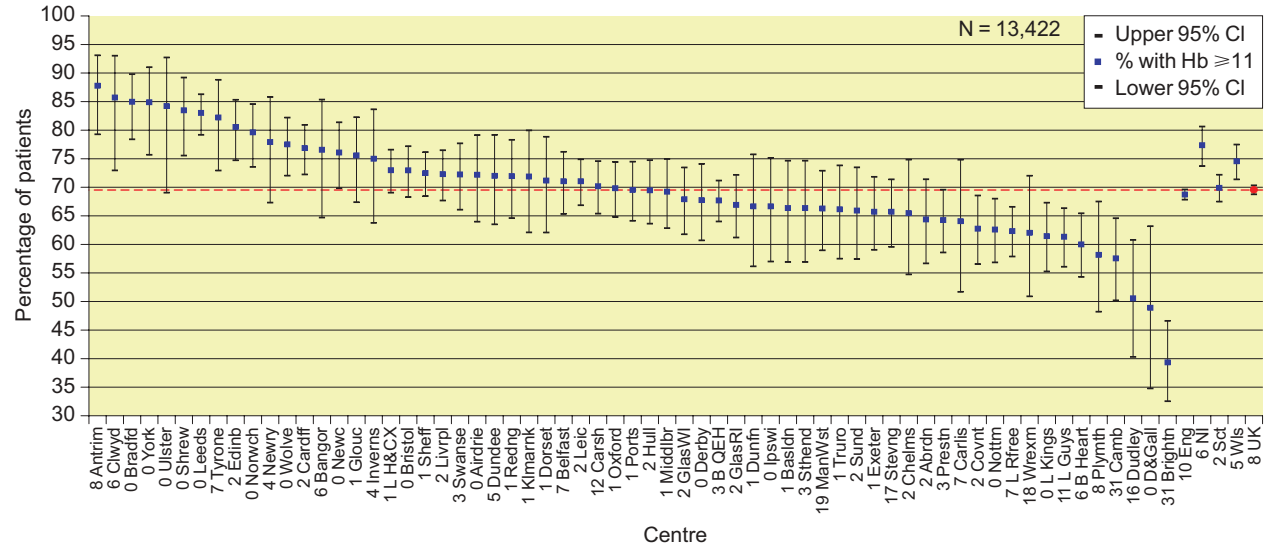

Figure 8.8: Percentage of HD patients with Hb ⩾11 g/dl

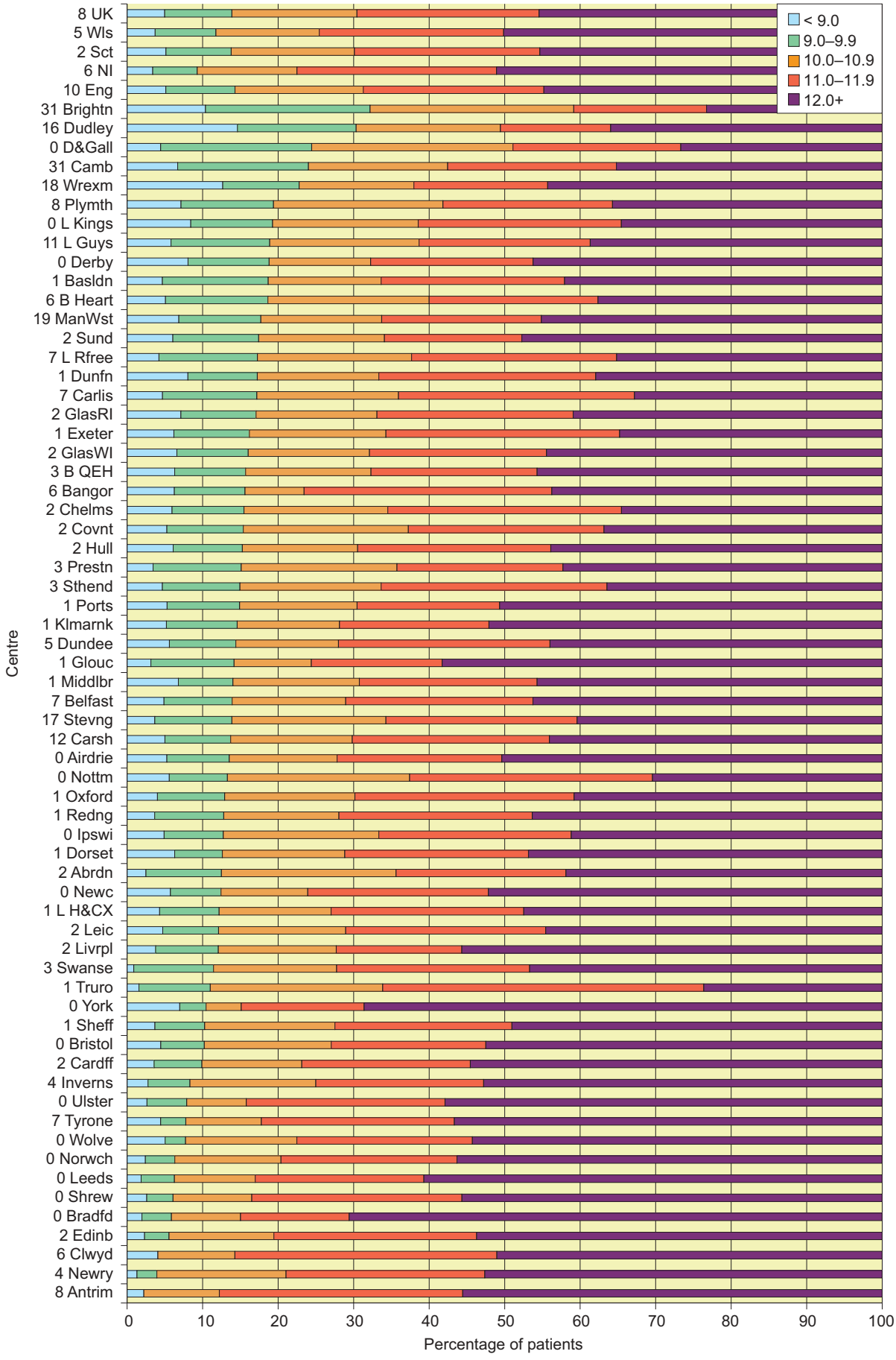

Figure 8.9: Distribution of haemoglobin in patients on HD

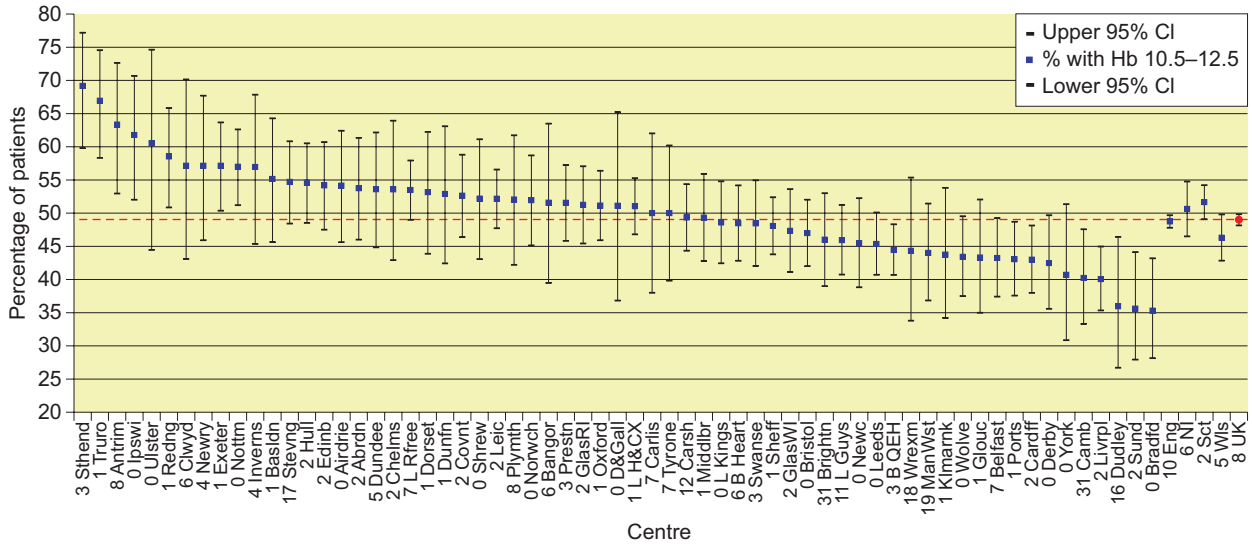

Figure 8.10: Percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

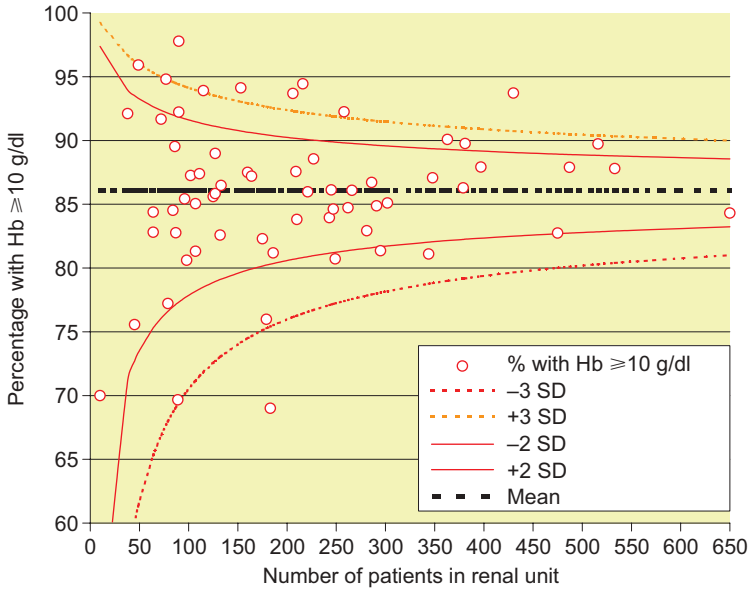

Figure 8.11: Funnel plot for percentage of HD patients with Hb ⩾10 g/dl

Hb, compliance is unlikely to be greater than ~50% unless the Hb distribution can be systematically narrowed.

The funnel plot for haemoglobin outcome allows a unit to identify whether its Hb outcome is statistically different from the national distribution of Hb outcomes. This is true for high or low unit Hb outcomes. In the context of the NICE guidelines this may become increasingly useful to use in conjunction with a measure of compliance with 10.5–12.5 g/dl outcome range. A funnel plot for compliance with UK minimum standards for Hb is shown in Figure 8.11 and should be used in conjunction with Table 8.3 to identify an individual unit by size (X axis) and percentage achieving Hb >10 g/dl (Y axis).

Haemoglobin of prevalent peritoneal dialysis patients

The compliance with data returns and haemoglobin outcome for peritoneal dialysis patients are shown in Table 8.4.

The median haemoglobin for peritoneal dialysis patients by unit and compliance with the UK minimum standard Hb ⩾10 g/dl and

Table 8.3: Percentage of HD patients achieving Renal Association audit standard of Hb ⩾10 g/dl by unit for 2005

Centre	Total	% with Hb ⩾10 g/dl	Centre	Total	% with Hb ⩾10 g/dl
Abrdn	160	88	Klmarnk	96	85
Airdrie	133	86	L Guys	344	81
Antrim	90	98	L H&CX	533	88
B Heart	295	81	L Kings	249	81
B QEH	650	84	L Rfree	475	83
Bangor	64	84	Leeds	430	94
Basldn	107	81	Leic	487	88
Belfast	266	86	Livrpl	397	88
Bradfd	153	94	ManWst	175	82
Brightn	183	69	Middlbr	221	86
Bristol	381	90	Newc	209	88
Camb	179	76	Newry	77	95
Cardff	363	90	Norwch	206	94
Carlis	64	83	Nottm	286	87
Carsh	379	86	Oxford	348	87
Chelms	84	85	Plymth	98	81
Clwyd	49	96	Ports	302	85
Covnt	247	85	Prestn	291	85
D&Gall	45	76	Redng	164	87
Derby	186	81	Sheff	516	90
Dorset	111	87	Shrew	115	94
Dudley	89	70	Stevng	245	86
Dundee	125	86	Sthend	107	85
Dunfn	87	83	Sund	132	83
Edinb	216	94	Swanse	227	89
Exeter	210	84	Truro	127	89
GlasRI	281	83	Tyrone	90	92
GlasWI	243	84	Ulster	38	92
Glouc	127	86	Wirral	10	70
Hull	262	85	Wolve	258	92
Inverns	72	92	Wrexm	79	77
Ipswi	102	87	York	86	90

EBPG standard of Hb ⩾11 g/dl are shown in Figures 8.12, 8.13 and 8.14.

The compliance with the new NICE guidelines for outcome haemoglobin 10.5–12.5 g/dl is shown in Figure 8.15. Again, the dataset predates the NICE guidelines published in 2006. In Table 8.4 the inter-quartile range for the UK for the PD population is also 1.9 g/dl (as for HD). The same comments apply regarding compliance for the PD population as for the HD population.

The distribution of haemoglobin in peritoneal dialysis patients is shown in Figure 8.16.

A funnel plot for compliance with UK minimum standards for Hb in peritoneal dialysis is shown in Figure 8.17. The graph is to be used in reference with Table 8.5.

Haemoglobin in incident patients

The percentage of new and prevalent patients compliant with Hb ⩾10.0 g/dl is shown in Figure 8.18.

Compliance with UK and EBPG standards in each unit are correlated with the median Hb outcome in each unit. This is shown in Figures 8.19–22. These graphs demonstrate that, in general, it is necessary to shift the distribution of haemoglobin values in a population to the right in order to ensure that only a small proportion of the population have values falling below a given audit standard. However,

Table 8.4: Haemoglobin data for prevalent patients on peritoneal dialysis

Centre	% data return	Median Hb g/dl	90% range	Quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10	% with Hb ⩾11
Abrdn	95	11.9	8.2–14.2	11.0–13.3	11.8	1.8	86	76
Airdrie	100	11.8	10.0–12.9	11.1–12.3	11.8	1.5	96	81
Antrim	83	n/a	n/a	n/a	n/a	n/a	n/a	n/a
B Heart	100	11.9	8.3–13.2	10.7–12.5	11.5	1.4	91	69
B QEH	94	11.9	7.9–14.6	10.9–12.9	11.8	1.8	86	74
Bangor	100	12.9	10.4–14.9	12.4–13.5	13.0	1.3	100	91
Basldn	100	12.5	9.8–14.2	11.7–13.5	12.4	1.5	90	87
Belfast	92	11.9	9.5–14.9	11.1–12.9	12.1	1.6	91	81
Bradfd	100	12.3	10.7–15.9	11.5–13.1	12.6	1.5	100	87
Brightn	87	12.1	8.9–14.4	11.3–13.0	12.1	1.7	88	82
Bristol	100	12.3	10.3–14.0	11.6–13.1	12.3	1.3	95	87
Camb	100	12.4	10.2–14.4	11.4–13.3	12.3	1.4	99	81
Cardff	98	12.2	10.0–14.6	11.4–13.1	12.3	1.5	96	84
Carlis	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Carsh	94	12.1	8.7–15.5	11.1–13.0	12.1	1.8	93	78
Chelms	97	12.1	9.3–14.4	11.0–13.1	12.1	1.5	94	78
Clwyd	92	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Covnt	97	12.1	9.3–15.1	10.6–13.3	11.9	1.8	81	68
D&Gall	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Derby	98	11.8	9.8–13.8	10.9–12.6	11.9	1.4	92	75
Dorset	94	12.0	8.8–14.6	11.4–12.8	12.0	1.5	90	85
Dudley	96	11.9	8.8–14.2	10.3–12.8	11.7	1.7	82	67
Dundee	98	12.0	10.3–14.3	11.6–12.9	12.2	1.2	95	88
Dunfn	100	12.2	10.6–13.5	11.7–13.0	12.2	1.1	95	86
Edinb	98	11.5	8.8–14.2	10.3–12.7	11.5	1.6	85	61
Exeter	100	12.0	9.6–14.2	10.7–12.7	11.8	1.4	90	73
GlasRI	96	11.4	9.6–13.6	10.7–12.7	11.7	1.8	91	70
GlasWI	99	11.7	8.1–14.1	10.5–12.3	11.5	1.8	83	70
Glouc	97	11.4	9.3–14.8	10.6–12.8	11.6	1.7	85	65
Hull	96	11.9	8.8–14.9	10.8–13.2	12.0	2.0	85	71
Inverns	42	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ipswi	98	12.4	10.2–15.2	11.7–13.3	12.5	1.5	97	89
Klmarnk	96	11.9	9.6–14.2	11.1–12.7	12.0	1.3	91	81
L Barts	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
L Guys	100	11.5	7.8–13.8	10.9–12.8	11.5	1.8	89	74
L H&CX	98	11.8	9.6–14.9	11.0–12.9	11.9	1.6	92	78
L Kings	100	12.4	9.0–14.1	11.1–13.4	12.1	1.7	90	82
L Rfree	98	11.2	9.4–13.6	10.5–12.0	11.3	1.2	87	65
Leeds	98	12.2	10.0–15.6	11.4–13.5	12.5	1.6	96	85
Leic	98	11.7	8.3–14.3	10.5–12.5	11.6	1.8	86	69
Livrpl	96	12.4	10.3–14.3	11.6–13.2	12.4	1.4	96	86
ManWst	89	11.9	8.3–14.7	10.3–13.3	11.8	2.0	81	66
Middlbr	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Newc	100	12.5	8.0–14.3	10.8–13.3	12.0	1.9	86	74
Newry	86	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Norwch	100	12.2	9.3–14.0	11.5–12.9	12.1	1.4	91	80

Table 8.4: (continued)

Centre	% data return	Median Hb g/dl	90% range	Quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10	% with Hb ⩾11
Nottm	100	11.4	9.5–13.7	10.7–12.2	11.5	1.3	89	70
Oxford	100	12.2	8.9–14.4	11.2–13.0	12.1	1.6	90	79
Plymth	92	12.1	10.5–14.2	11.2–13.2	12.2	1.2	100	82
Ports	99	12.2	9.3–15.6	10.8–13.3	12.2	1.9	90	72
Prestn	98	11.5	7.6–13.6	10.2–12.3	11.2	1.8	78	63
Redng	100	12.0	9.4–15.2	11.1–13.0	12.1	1.7	91	78
Sheff	100	12.0	9.2–14.7	10.9–12.9	11.9	1.7	90	74
Shrew	100	12.4	10.3–15.3	11.5–13.4	12.5	1.4	100	88
Stevng	98	11.7	9.9–14.4	10.8–12.7	11.8	1.5	91	68
Sthend	95	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sund	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Swanse	99	12.2	9.4–14.0	10.9–12.9	11.9	1.5	89	75
Truro	100	12.1	9.4–14.5	11.4–12.9	12.2	1.5	94	82
Tyrone	80	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ulster	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wirral	4	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wolve	100	12.5	10.5–15.7	11.6–13.3	12.6	1.5	98	91
Wrexm	80	12.7	10.1–14.3	11.4–13.4	12.4	1.3	97	88
York	100	12.4	10.7–14.0	11.2–13.2	12.3	1.2	100	83
Eng	91	12.0	9.2–14.6	11.0–12.9	11.9	1.7	90	76
NI	89	12.0	9.5–14.6	11.3–13.0	12.2	1.5	93	83
Sct	93	11.9	9.0–14.2	11.0–12.7	11.8	1.6	89	75
Wls	95	12.3	9.8–14.4	11.3–13.2	12.3	1.5	95	82
UK	92	12.0	9.2–14.5	11.0–12.9	12.0	1.6	90	76

Note: Median Hb for units with less than 20 new patients or data returns <50% are not shown

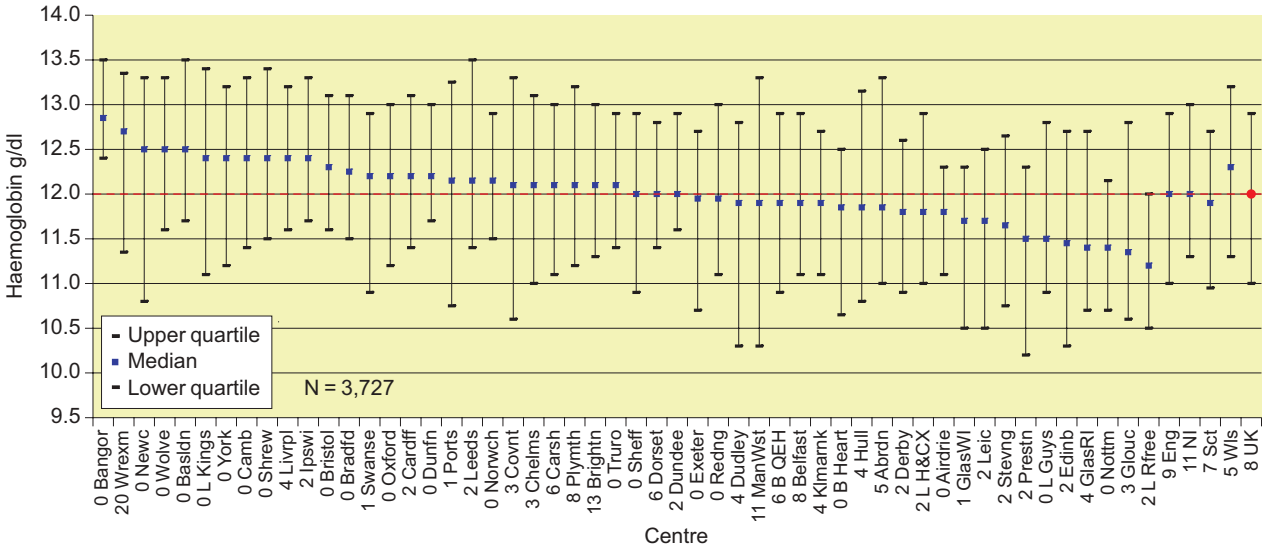

Figure 8.12: Median haemoglobin: PD

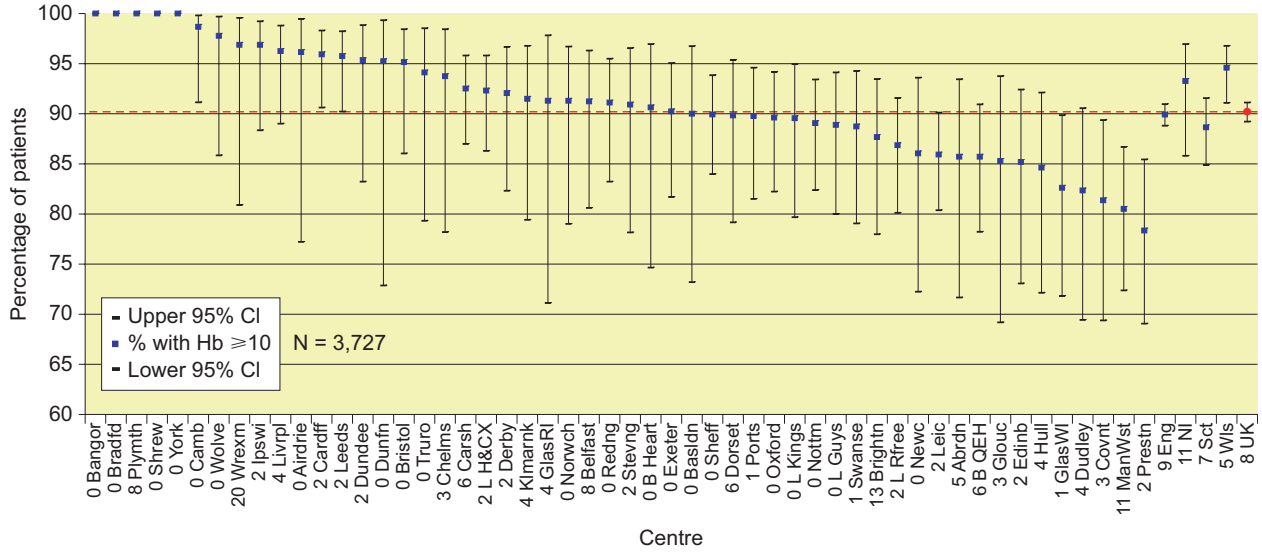

Figure 8.13: Percentage of PD patients with Hb ⩾10 g/dl

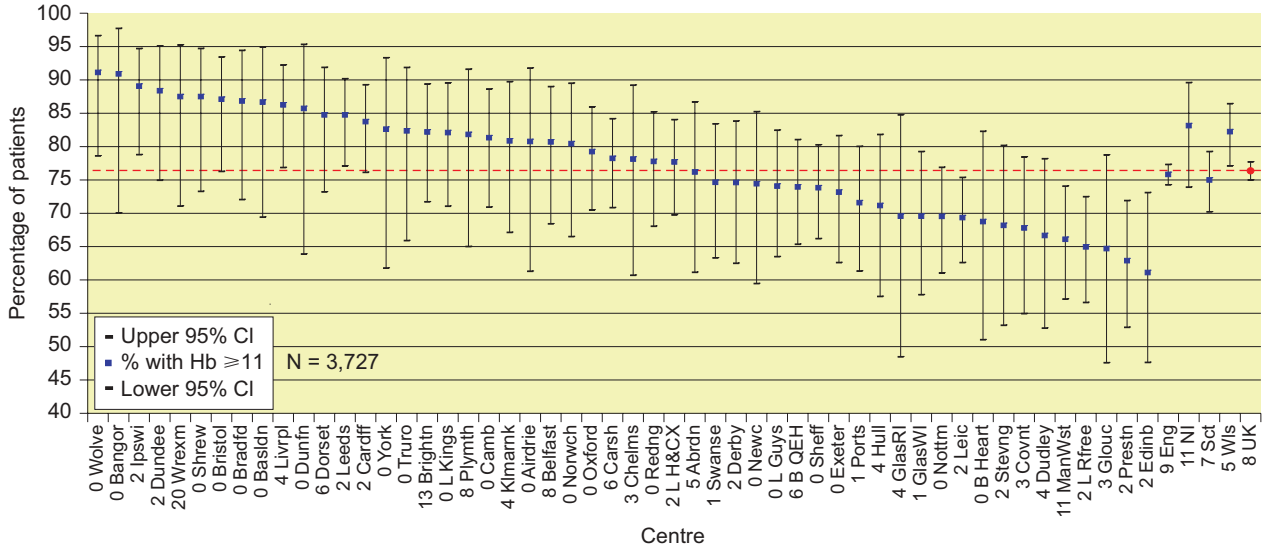

Figure 8.14: Percentage of PD patients with Hb ⩾11 g/dl

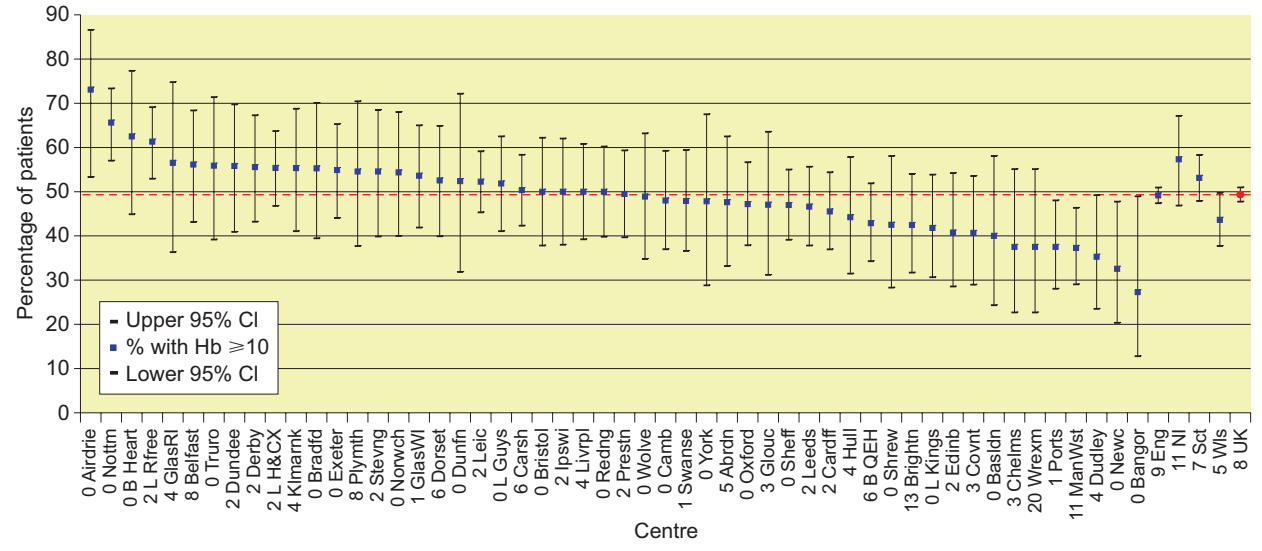

Figure 8.15: Percentage of PD patients with Hb ⩾10.5 and ⩽12.5 g/dl

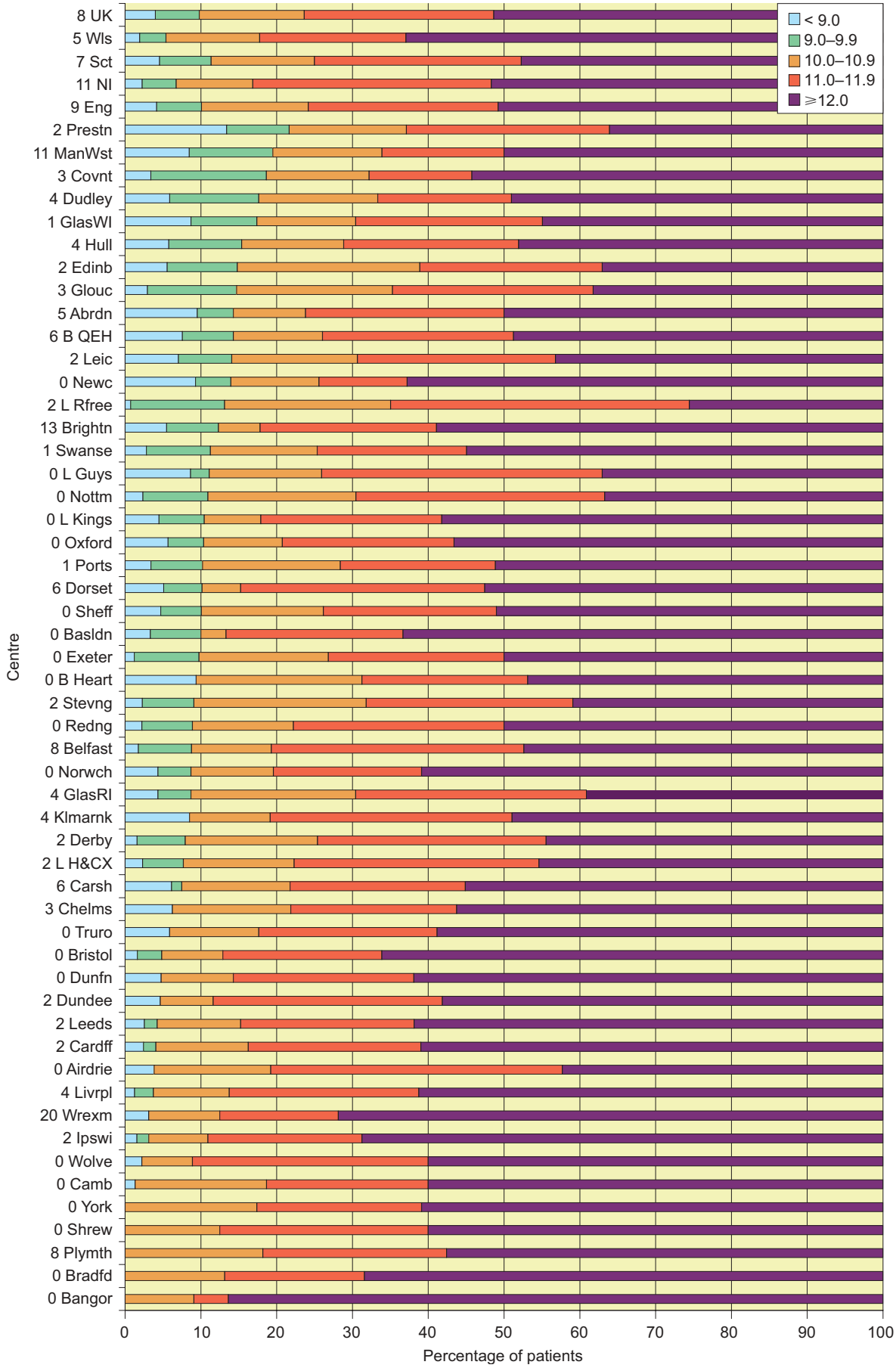

Figure 8.16: Distribution of haemoglobin in patients on PD

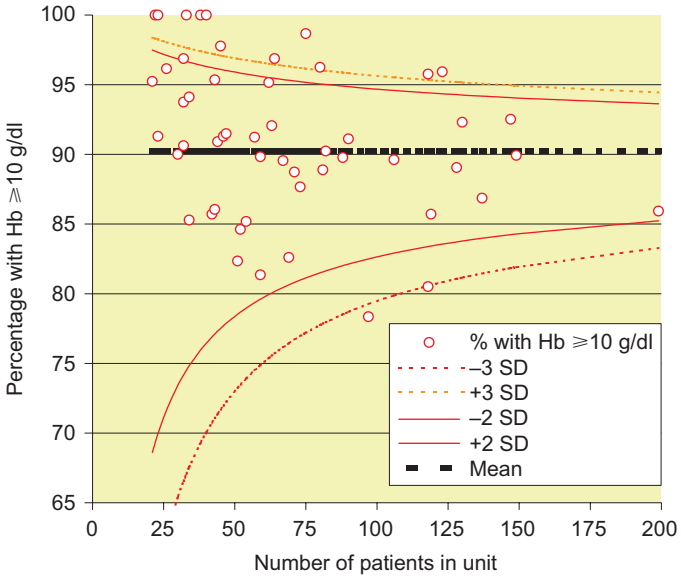

Figure 8.17: Funnel plot for percentage of PD patients with Hb ⩾10 g/dl

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

Centre	Total	% with Hb ⩾10 g/dl	Centre	Total	% with Hb ⩾10 g/dl
Abrdn	42	86	Ipswi	64	97
Airdrie	26	96	Klmarnk	47	91
B Heart	32	91	L Guys	81	89
B QEH	119	86	L H&CX	130	92
Bangor	22	100	L Kings	67	90
Basldn	30	90	L Rfree	137	87
Belfast	57	91	Leeds	118	96
Bradfd	38	100	Leic	199	86
Brightn	73	88	Livrpl	80	96
Bristol	62	95	ManWst	118	81
Camb	75	99	Newc	43	86
Cardff	123	96	Norwch	46	91
Carsh	147	93	Nottm	128	89
Chelms	32	94	Oxford	106	90
Covnt	59	81	Plymth	33	100
Derby	63	92	Ports	88	90
Dorset	59	90	Prestn	97	78
Dudley	51	82	Redng	90	91
Dundee	43	95	Sheff	149	90
Dunfn	21	95	Shrew	40	100
Edinb	54	85	Stevng	44	91
Exeter	82	90	Swanse	71	89
GlasRI	23	91	Truro	34	94
GlasWI	69	83	Wolve	45	98
Glouc	34	85	Wrexm	32	97
Hull	52	85	York	23	100

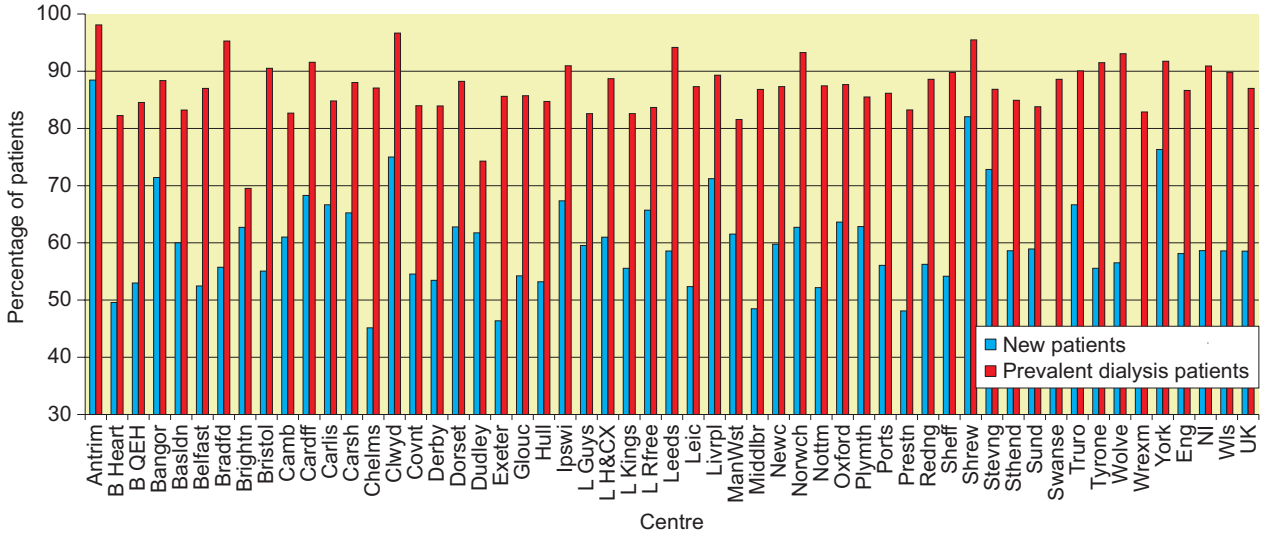

Figure 8.18: Percentage of new and prevalent dialysis patients with Hb ⩾10 g/dl

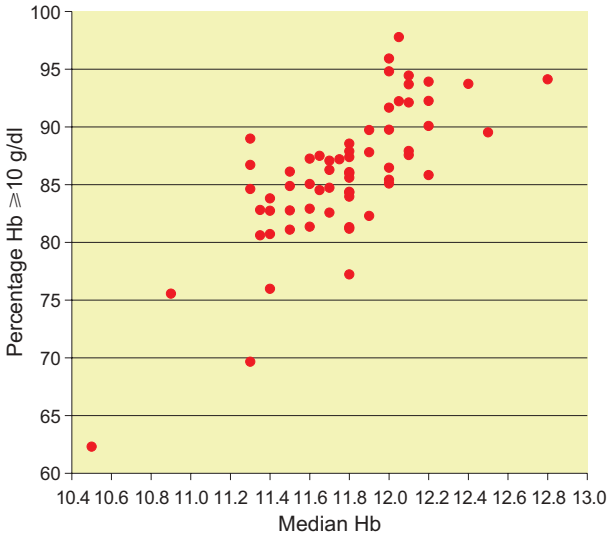

Figure 8.19: Percentage of patients with Hb ⩾10 g/dl plotted against median Hb: HD

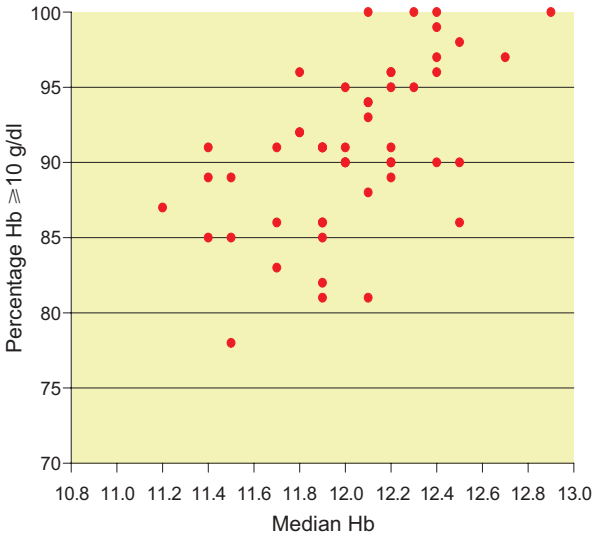

Figure 8.21: Percentage of patients with Hb ⩾10 g/dl plotted against median Hb: PD

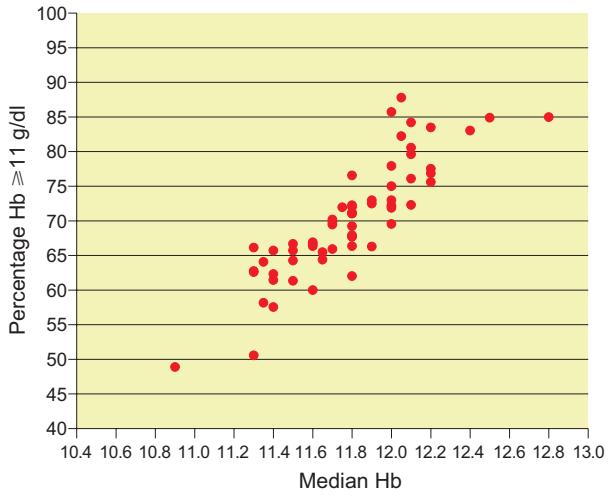

Figure 8.20: Percentage of patients with Hb ⩾11 g/dl plotted against median Hb: HD

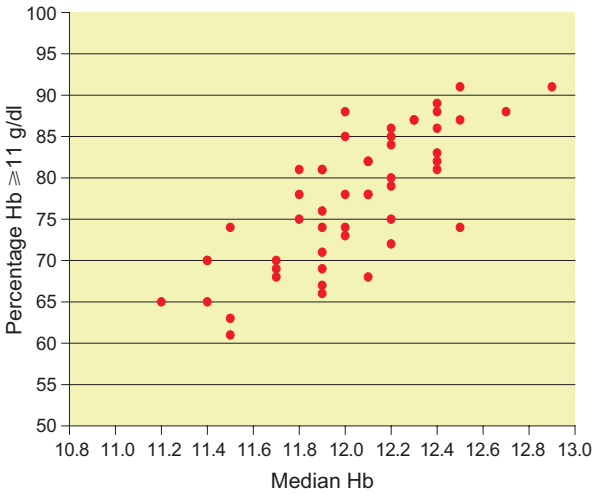

Figure 8.22: Percentage of patients with Hb ⩾11 g/dl plotted against median Hb: PD

they also demonstrate that there is considerable variation between units in the relationship between median Hb and percentage achieving the audit standard; some units are able to achieve a high proportion meeting the standard at a lower median Hb than others. This is achieved by narrowing the distribution of Hb values. Tables 8.2 and 8.4 also demonstrate this: the standard deviation for Hb values varies considerably between units. Preliminary analysis of previous years' data shows that some renal units have achieved a narrow distribution of Hb values year on year – for instance, Truro. Those with a low standard deviation have succeeded in narrowing the distribution of Hb values, and are therefore able to achieve a higher proportion of patients with Hb values above the minimum audit standard without also achieving a high proportion of patients with high Hb values. The

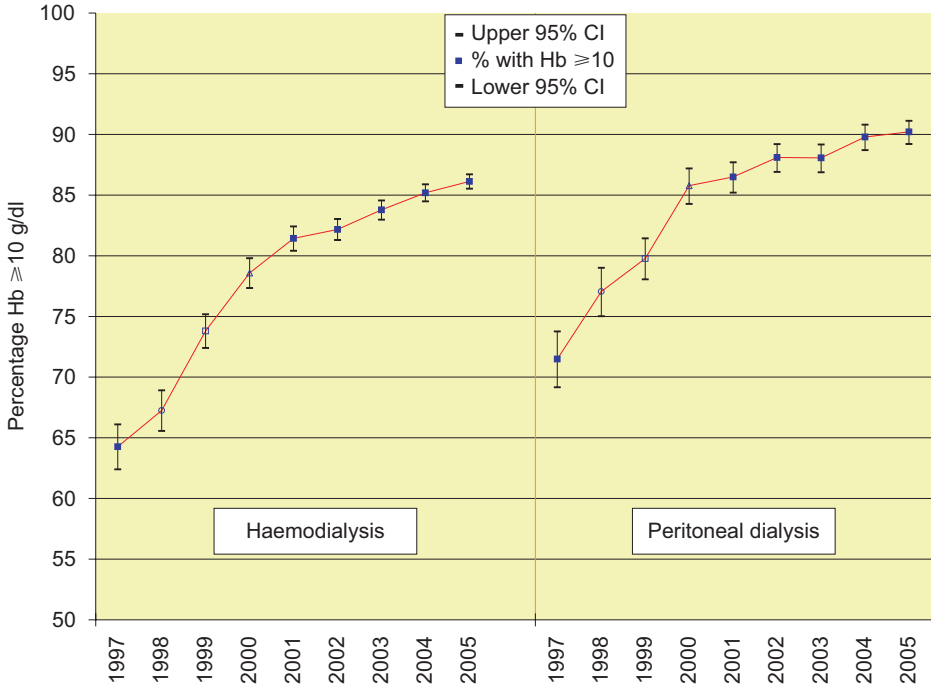

Figure 8.23: Percentage of dialysis patients with Hb ⩾10 g/dl 1997–2005

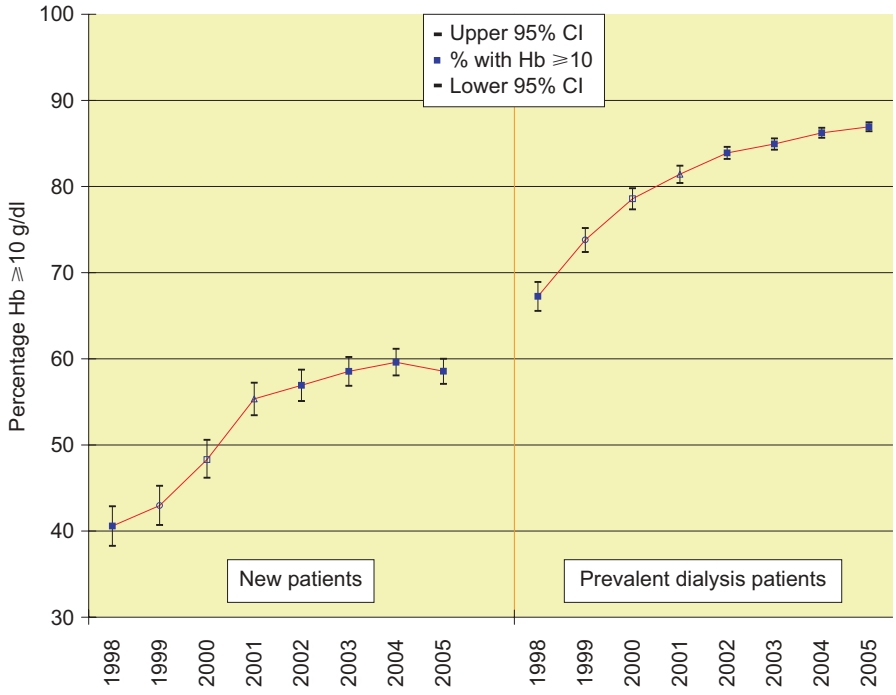

Figure 8.24: Percentage of new dialysis patients with Hb ⩾10 g/dl 1998–2005

accumulating evidence that full correction of anaemia may be harmful in kidney disease, together with the high cost of full correction, should drive attempts to learn from those units that have successfully narrowed the distribution of values.

Haemoglobin outcome in England and Wales for haemodialysis and peritoneal dialysis populations in terms of compliance with Hb $\geqslant$10.0 g/dl continue to increase year on year (Figure 8.23).

Equally, compliance for Hb $\geqslant$10.0 g/dl in patients new to dialysis in England and Wales continues to increase (Figure 8.24).

Changes in Haemoglobin by length of time on dialysis over time

In the haemodialysis population the median haemoglobin outcome improves in the first 6 months to become compliant with the UK minimum standard and remains stable up to 2 years post commencement of dialysis therapy. In the peritoneal dialysis population however the Hb outcome improves out to 1 year and then decreases out to 2 years. It is uncertain whether this reflects fall in residual renal function, salt and water overload, or other factors as yet undetermined. The actual outcome in the PD population however, decreases to the same level as for HD patients from a higher baseline (Figures 8.25, 8.26).

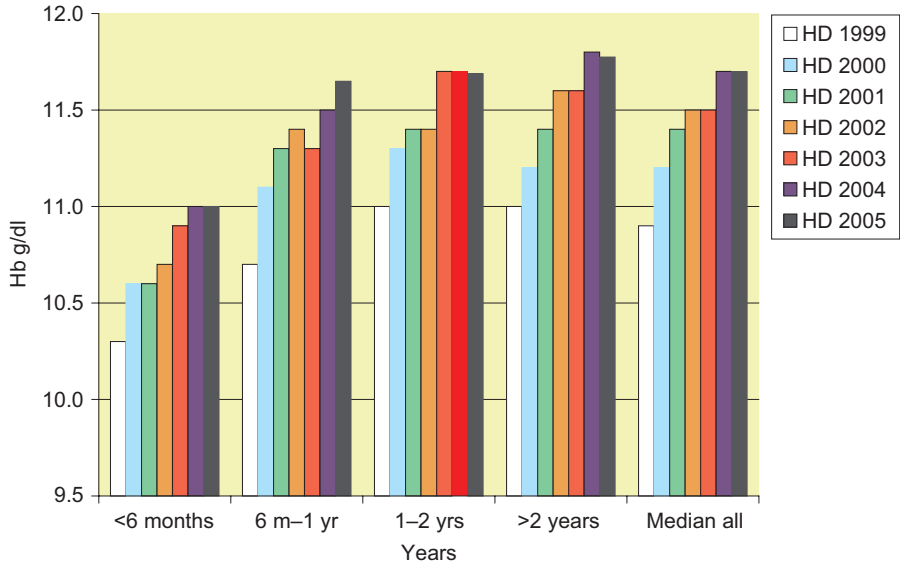

Figure 8.25: Median Haemoglobin by length of time on RRT: HD

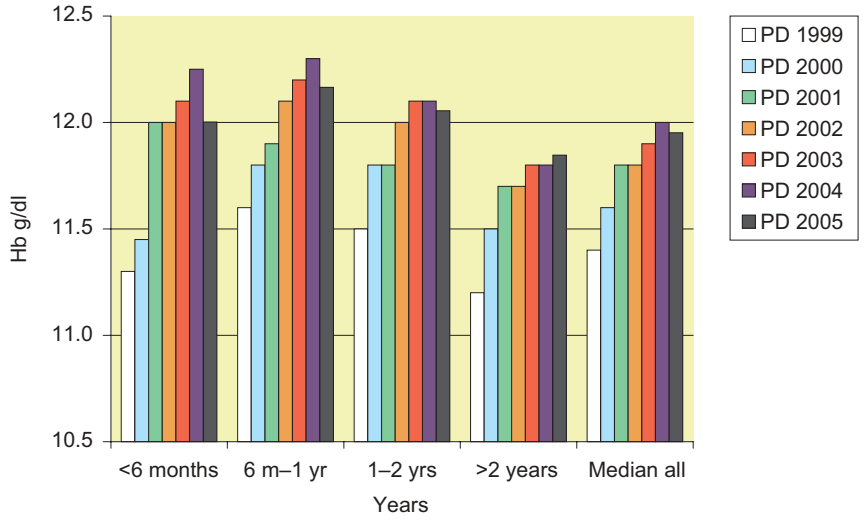

Figure 8.26: Median Haemoglobin by length of time on RRT: PD

Factors affecting Haemoglobin

National and international recommendations for target iron status in chronic kidney disease remain unchanged from previous reports. The 2002 Renal Association Standards Document (SDIII)[2], revised European Best Practice Guidelines (EBPGII)[3] and Dialysis Outcomes Quality Initiatives (DOQI) guidelines[4] and UK NICE Anaemia guidelines[5] 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

SDIII 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, SDIII and EBPGII advocate population targets 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 200–250 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 IV 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 units have easy access. Since TSAT is measured infrequently in many centres, and most UK units continue to use serum ferritin for routine iron management, ferritin remains the chosen index of iron status for this report.

Information on the use of Erythropoietin Stimulating Agents was excluded from the 2003 report due to data collection problems. These problems were addressed, allowing ESA data from 23 units to be presented in the 2004 report and for 30 units in the 2005 report. In the 2006 report these data remain incomplete but have improved with 36 units returning ESA data. 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 are made with regard to frequency or route of administration.

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 use serum ferritin as the sole indicator of iron status. Completeness of ferritin returned from England and Wales improved compared to 2005. Scotland is included here for the first time. Lack of an automated biochemistry or haematology link into the IT renal system might account for a very low rate of return in some units. In other cases of missing data, renal units may need to address organisational processes to ensure that serum ferritin is checked.

Serum ferritin

Percentage returns, median serum ferritin concentrations and interquartile ranges are presented in Table 8.7 and Figure 8.27 for haemodialysis and Table 8.8 and Figure 8.28 for peritoneal dialysis. The percentages of patients achieving a serum ferritin over 100 µg/L and over 200 µg/L are shown in Figures 8.29 and

Table 8.6: Completeness of serum ferritin returns

Centre	HD %	PD %	Centre	HD %	PD %
Abrdn	1	0	L H&CX	99	98
Airdrie	0	0	L Kings	100	100
Antrim	96	94	L Rfree	84	97
B Heart	94	100	Leeds	100	98
B QEH	97	96	Leic	95	96
Bangor	94	95	Livrpl	96	98
Basldn	99	100	ManWst	60	90
Belfast	90	85	Middlbr	97	100
Bradfd	100	100	Newc	100	95
Brightn	64	86	Newry	99	93
Bristol	100	100	Norwch	100	100
Camb	65	100	Nottm	100	100
Cardff	96	97	Oxford	89	95
Carlis	93	100	Plymth	98	97
Carsh	82	85	Ports	98	96
Chelms	98	91	Prestn	100	100
Clwyd	90	92	Redng	98	96
Covnt	98	85	Sheff	99	100
D&Gall	0	0	Shrew	100	100
Derby	97	86	Stevng	99	98
Dorset	99	97	Sthend	96	95
Dudley	73	92	Sund	93	100
Dundee	0	2	Swanse	98	99
Dunfn	0	0	Truro	98	100
Edinb	0	0	Tyrone	3	80
Exeter	100	100	Ulster	100	100
GlasRI	0	0	Wirral	3	0
GlasWI	0	0	Wolve	99	100
Glouc	98	91	Wrexm	82	80
Hull	97	98	York	100	100
Inverns	0	0	Eng	89	90
Ipswi	98	78	NI	79	88
Klmarnk	0	0	Sct	0	0
L Barts	1	0	Wls	95	94
L Guys	87	100	UK	80	81

Table 8.7: Serum ferritin in HD patients

Centre	% data return	Median ferritin	90% range	Quartile range	% ferritin $\geqslant 100\,\mu g/L$
Antrim	96	421	138–994	274–586	96.8
B Heart	94	228	61–642	156–325	89.2
B QEH	97	269	91–551	180–362	93.5
Bangor	94	630	209–1,322	459–799	100.0
Basldn	99	334	120–604	250–415	98.1
Belfast	90	469	115–1,109	290–673	95.3
Bradfd	100	520	176–1,104	356–699	98.0
Brightn	64	293	44–1,200	160–440	86.5
Bristol	100	442	112–1,132	288–646	96.3
Camb	65	260	52–1,030	167–407	87.6

Table 8.7: (continued)

Centre	% data return	Median ferritin	90% range	Quartile range	% ferritin ⩾100 μg/L
Cardff	96	491	159–1,058	333–696	99.2
Carlis	93	337	172–745	228–504	98.4
Carsh	82	306	66–722	200–410	92.9
Chelms	98	472	203–1,087	341–671	98.8
Clwyd	90	328	168–613	239–449	100.0
Covnt	98	290	57–973	165–464	88.7
Derby	97	454	141–1,178	301–652	96.1
Dorset	99	451	162–774	275–555	99.1
Dudley	73	338	39–992	254–513	92.2
Exeter	100	335	139–685	250–436	98.1
Glouc	98	365	73–911	237–600	92.0
Hull	97	397	161–840	297–529	99.6
Ipswi	98	398	64–1,067	215–611	91.0
L Barts	1	n/a	n/a	n/a	n/a
L Guys	87	399	90–1,023	263–575	92.6
L H&CX	99	585	141–1,330	342–859	96.6
L Kings	100	442	138–970	300–586	97.2
L Rfree	84	397	83–1,121	245–557	93.8
Leeds	100	518	179–953	393–667	97.4
Leic	95	360	90–1,080	223–562	93.6
Livrpl	96	530	88–1,390	302–777	94.1
ManWst	60	541	95–1,676	238–866	93.0
Middlbr	97	443	73–1,674	247–813	93.6
Newc	100	411	191–971	298–574	97.6
Newry	99	438	159–1,030	288–618	100.0
Norwch	100	874	300–1,493	557–1,134	99.5
Nottm	100	586	240–1,139	456–745	98.6
Oxford	89	301	68–849	181–408	90.4
Plymth	98	384	152–816	254–549	97.1
Ports	98	277	97–791	203–384	93.6
Prestn	100	630	124–1,500	451–918	95.3
Redng	98	678	286–1,192	458–906	100.0
Sheff	99	543	104–1,257	370–738	95.2
Shrew	100	363	111–804	213–563	96.5
Stevng	99	489	190–963	351–668	99.0
Sthend	96	337	196–681	270–426	99.1
Sund	93	369	103–1,327	237–581	94.4
Swanse	98	393	78–770	247–544	93.9
Truro	98	485	204–909	352–637	99.2
Tyrone	3	n/a	n/a	n/a	n/a
Ulster	100	421	122–882	311–539	97.4
Wirral	3	n/a	n/a	n/a	n/a
Wolve	99	454	148–1,158	343–603	97.7
Wrexm	82	523	129–1,262	345–635	97.5
York	100	579	233–916	441–740	98.8
Eng	89	407	101–1,140	259–620	95.0
NI	79	438	133–1,037	287–635	96.6
Wls	95	465	136–999	304–645	97.6
UK	80	413	105–1,127	262–623	95.3

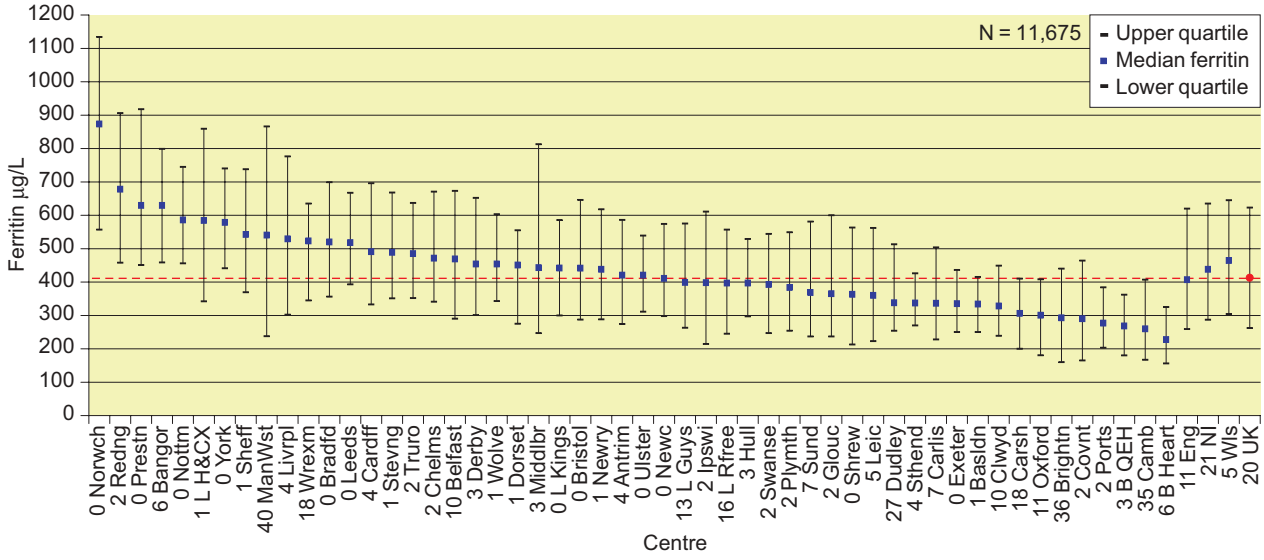

Figure 8.27: Median serum ferritin: haemodialysis

Table 8.8: Serum ferritin in PD patients

Centre	% data return	Median ferritin	90% range	Quartile range	% ferritin ⩾100 µg/L
Antrim	94	n/a	n/a	n/a	n/a
B Heart	100	173	36–663	95–254	75
B QEH	96	158	25–535	80–287	65
Bangor	95	298	44–679	169–461	86
Basldn	100	193	34–780	92–321	73
Belfast	85	206	49–1,070	104–404	75
Bradfd	100	290	35–959	138–473	82
Brightn	86	290	77–830	175–455	93
Bristol	100	229	24–596	133–361	87
Camb	100	198	31–557	93–307	75
Cardff	97	204	34–762	96–345	73
Carlis	100	n/a	n/a	n/a	n/a
Carsh	85	160	28–564	99–256	74
Chelms	91	260	77–442	131–357	93
Clwyd	92	n/a	n/a	n/a	n/a
Covnt	85	216	20–565	94–369	75
Derby	86	322	96–829	218–489	95
Dorset	97	264	91–727	203–374	93
Dudley	92	215	26–735	107–371	78
Exeter	100	209	54–573	151–305	84
Glouc	91	180	83–674	150–305	91
Hull	98	295	98–636	226–414	94
Ipswi	78	184	26–703	54–323	67
L Barts	0	n/a	n/a	n/a	n/a
L Guys	100	220	79–604	151–335	89
L H&CX	98	263	57–1,371	165–435	88
L Kings	100	267	53–626	162–375	90
L Rfree	97	351	79–1,242	197–598	93
Leeds	98	335	88–748	245–484	95
Leic	96	272	57–983	164–481	91
Livrpl	98	256	89–796	154–432	90

Table 8.8: (continued)

Centre	% data return	Median ferritin	90% range	Quartile range	% ferritin ⩾100 µg/L
ManWst	90	215	63–890	126–373	87
Middlbr	100	n/a	n/a	n/a	n/a
Newc	95	327	95–788	195–454	93
Newry	93	n/a	n/a	n/a	n/a
Norwch	100	389	113–832	280–667	96
Nottm	100	329	93–984	208–458	93
Oxford	95	224	40–887	115–458	77
Plymth	97	262	26–1,289	112–505	77
Ports	96	239	71–754	141–367	89
Prestn	100	251	54–915	123–437	86
Redng	96	493	80–928	345–630	93
Sheff	100	270	52–856	193–454	90
Shrew	100	289	58–819	214–404	90
Stevng	98	172	26–620	119–270	82
Sthend	95	n/a	n/a	n/a	n/a
Sund	100	n/a	n/a	n/a	n/a
Swanse	99	204	32–756	131–367	80
Truro	100	198	70–555	117–282	88
Tyrone	80	n/a	n/a	n/a	n/a
Ulster	100	n/a	n/a	n/a	n/a
Wirral	0	n/a	n/a	n/a	n/a
Wolve	100	189	59–664	127–384	87
Wrexm	80	372	154–645	276–487	100
York	100	388	240–892	297–470	100
Eng	90	259	49–830	150–425	86
NI	88	224	51–814	115–391	81
Wls	94	229	34–756	126–370	79
UK	81	256	49–816	147–422	86

Note: Median Hb for units with less than 20 new patients or data returns <50% are not shown

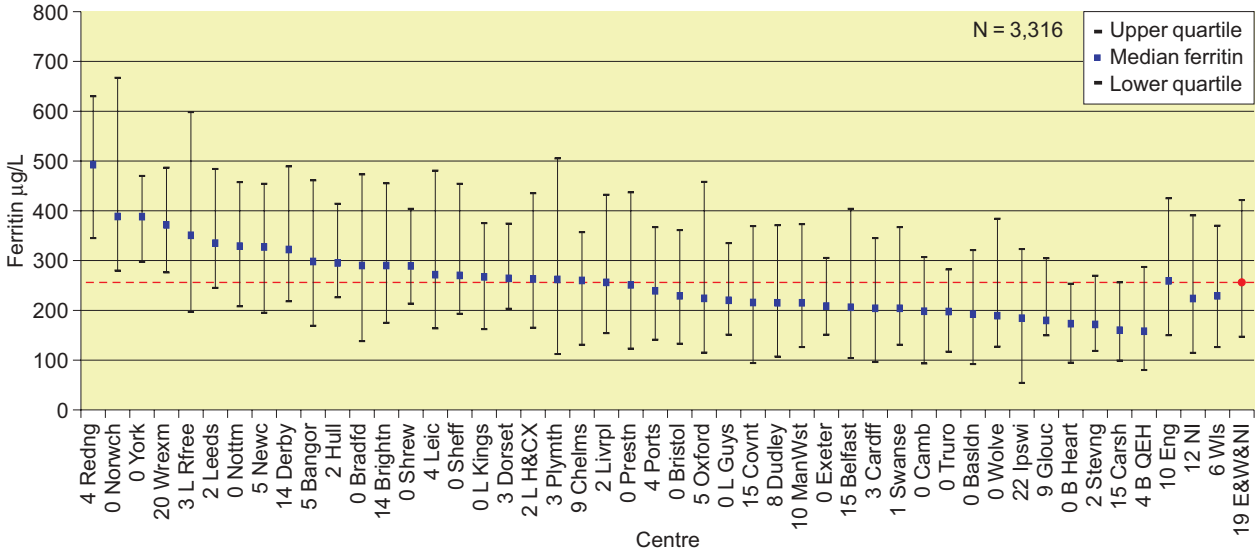

Figure 8.28: Median serum ferritin: peritoneal dialysis

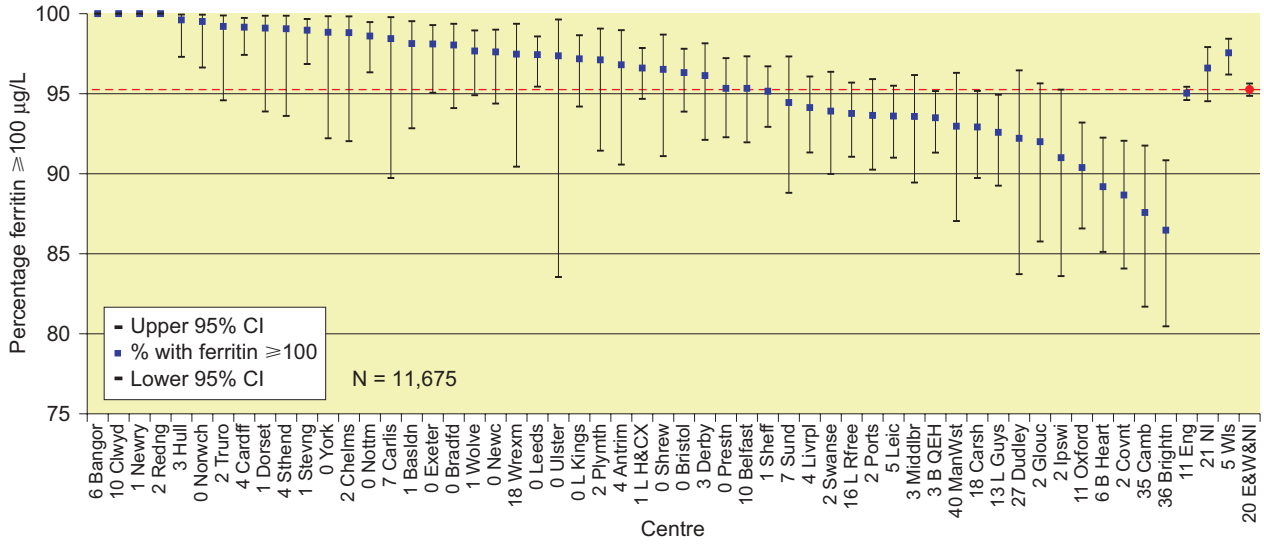

Figure 8.29: Percentage of HD patients with serum ferritin ⩾100 µg/L

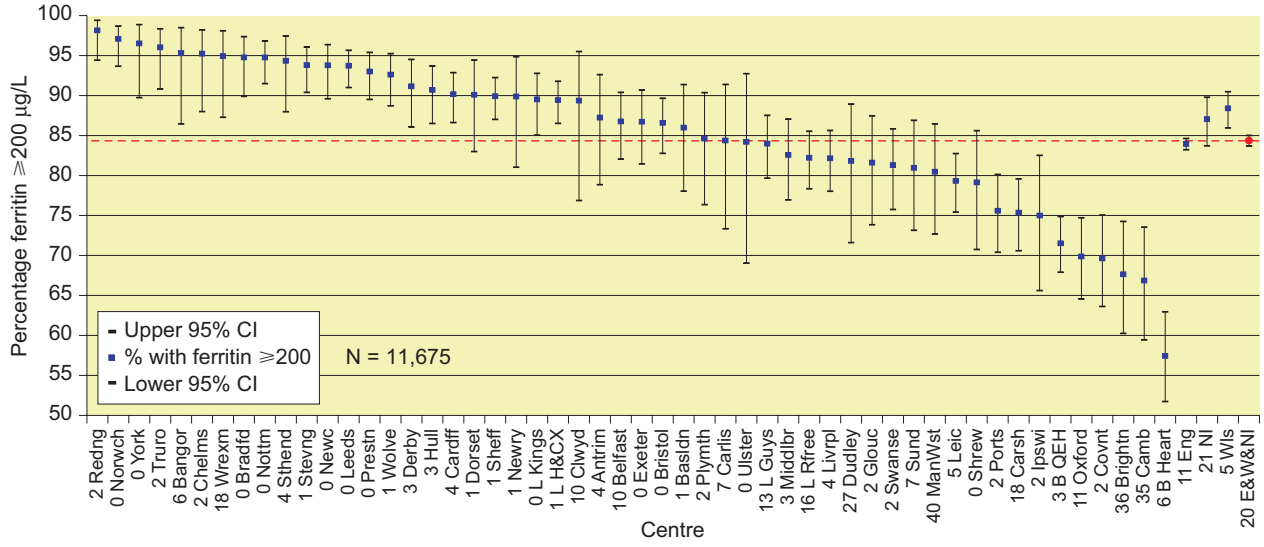

Figure 8.30: Percentage of HD patients with serum ferritin ⩾200 µg/L

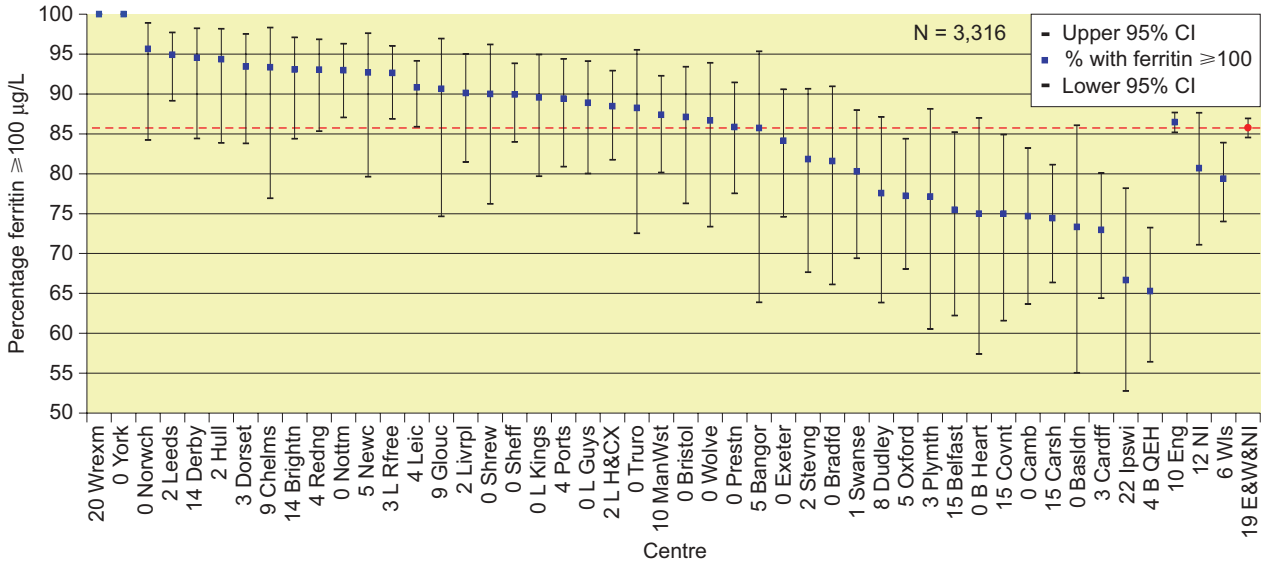

Figure 8.31: Percentage of PD patients with serum ferritin ⩾100 µg/L

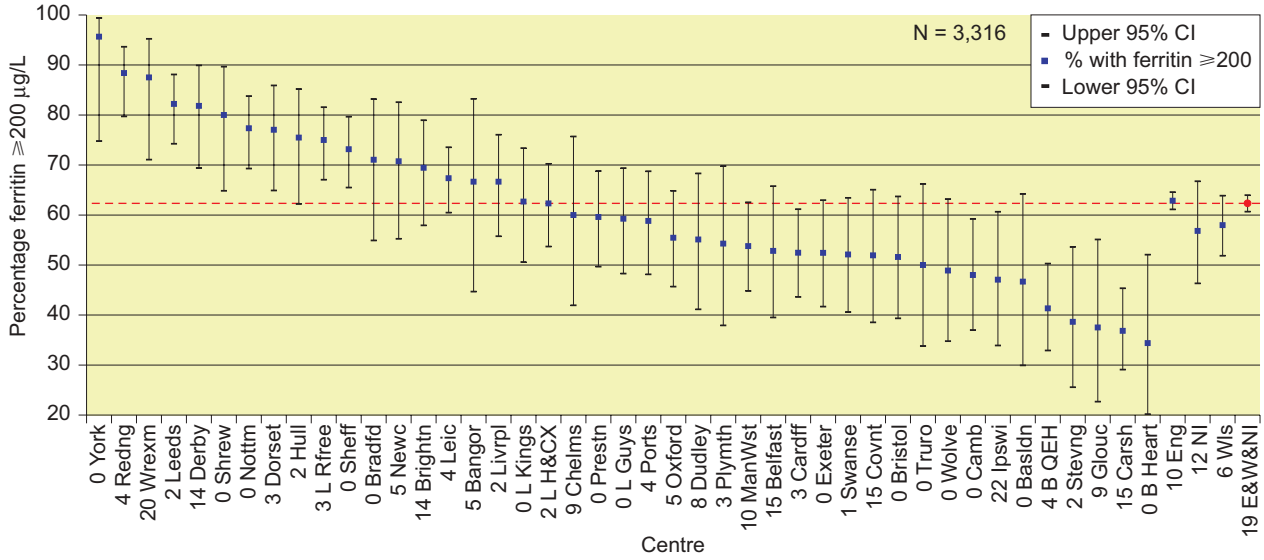

Figure 8.32: Percentage of PD patients with serum ferritin ⩾200 µg/L

8.30 respectively, for HD, and for PD in Figures 8.31 and 8.32.

Percentage of serum ferritin ⩾800 µg/l in HD and PD are shown in Table 8.9.

All centres achieved greater than 85% compliance with a serum ferritin over 100 µg/L for HD. The PD population has lower ferritin values (PD 256 µg/l, (IQR 147–422) vs HD 413 µg/l, (IQR 262–623)) but all units have

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

	HD		PD	
Centre	**% Ferritin ⩾800**	**95% CI**	**% Ferritin ⩾800**	**95% CI**
Antrim	10	5.1–17.4	0	n/a
B Heart	2	0.7–4.0	3	0.4–19.1
B QEH	1	0.6–2.5	2	0.4–6.4
Bangor	25	15.9–37.0	5	0.7–27.1
Basldn	2	0.5–7.2	3	0.5–20.2
Belfast	14	9.9–18.4	9	4.0–20.7
Bradfd	14	9.1–20.1	8	2.6–21.8
Brightn	11	7.2–16.9	7	2.9–15.6
Bristol	15	11.8–19.0	2	0.2–10.6
Camb	7	4.1–12.1	0	n/a
Cardff	16	12.6–20.2	3	1.2–8.4
Carlis	3	0.8–11.7	0	n/a
Carsh	4	2.2–6.2	3	1.1–7.7
Chelms	14	8.3–23.5	0	n/a
Clwyd	2	0.3–13.6	0	n/a
Covnt	9	5.9–13.2	0	n/a
Derby	15	10.9–21.5	5	1.8–15.6
Dorset	4	1.4–9.2	5	1.6–14.2
Dudley	5	2.0–13.0	4	1.0–14.9
Exeter	4	2.2–8.0	4	1.2–10.7
Glouc	8	4.4–14.2	3	0.4–19.1
Hull	7	4.1–10.3	2	0.3–12.2
Ipswi	9	4.7–16.4	2	0.3–12.6
L Barts	33	4.3–84.6	–	–
L Guys	11	7.8–14.5	4	1.2–10.9

Table 8.9: (continued)

	HD		PD	
Centre	**% Ferritin ⩾800**	**95% CI**	**% Ferritin ⩾800**	**95% CI**
L H&CX	28	24.6–32.3	12	7.1–18.3
L Kings	8	5.6–12.6	1	0.2–9.8
L Rfree	12	9.1–15.2	15	9.7–21.7
Leeds	12	8.9–15.0	4	1.8–9.8
Leic	11	8.2–13.8	8	4.7–12.3
Livrpl	23	19.3–27.7	5	1.9–12.4
ManWst	29	21.7–37.3	8	4.0–13.9
Middlbr	25	19.5–30.9	14	3.6–42.7
Newc	14	10.2–19.8	5	1.2–17.5
Newry	13	6.9–22.0	0	n/a
Norwch	56	49.5–62.9	7	2.1–18.4
Nottm	19	14.8–23.8	6	3.2–12.0
Oxford	6	3.9–9.3	8	4.0–15.0
Plymth	6	2.6–12.3	6	1.4–20.2
Ports	4	2.5–7.3	4	1.1–10.4
Prestn	35	29.8–40.6	7	3.4–14.1
Redng	31	24.8–39.0	10	5.5–18.9
Sheff	19	16.2–23.0	6	3.2–11.2
Shrew	5	2.4–11.1	5	1.3–17.9
Stevng	13	9.4–17.1	2	0.3–14.4
Sthend	3	0.9–8.4	0	n/a
Sund	16	10.5–23.3	30	10.0–62.4
Swanse	4	2.4–7.9	4	1.4–12.3
Truro	9	4.9–15.1	0	n/a
Tyrone	67	15.4–95.7	0	n/a
Ulster	5	1.3–18.7	0	n/a
Wirral	60	20.0–90.0	–	–
Wolve	8	5.1–11.8	2	0.3–14.2
Wrexm	11	6.0–20.5	0	n/a
York	12	6.4–20.3	9	2.2–28.9
Eng	13	12.8–14.1	6	4.8–6.4
NI	12	9.6–15.6	6	2.4–12.9
Wls	12	9.9–14.5	3	1.6–6.1
UK	13	12.7–13.9	5	4.7–6.2

median values for PD greater than 100 μg/l and 36 of the 44 plotted units have 25th percentile for ferritin greater than 100 μg/l.

Changes in serum ferritin 1999–2005

Over time the percentage of patients on HD and PD with a ferritin ⩾100 and the ferritin outcome has levelled off with a median ferritin in the HD population just over 400 μg/L and in the PD population, 250 μg/L (see Figures 8.33 and 8.34).

Serum ferritin and length of time on renal replacement therapy

Ferritin outcome climbs steadily over the first 2 years on dialysis (see Figures 8.35 and 8.36).

Erythropoiesis Stimulating Agents

36 renal units now submit data on ESA utilisation. For the UK, only 14% and 10% of HD and PD respectively patients had an Hb <10 g/dl.

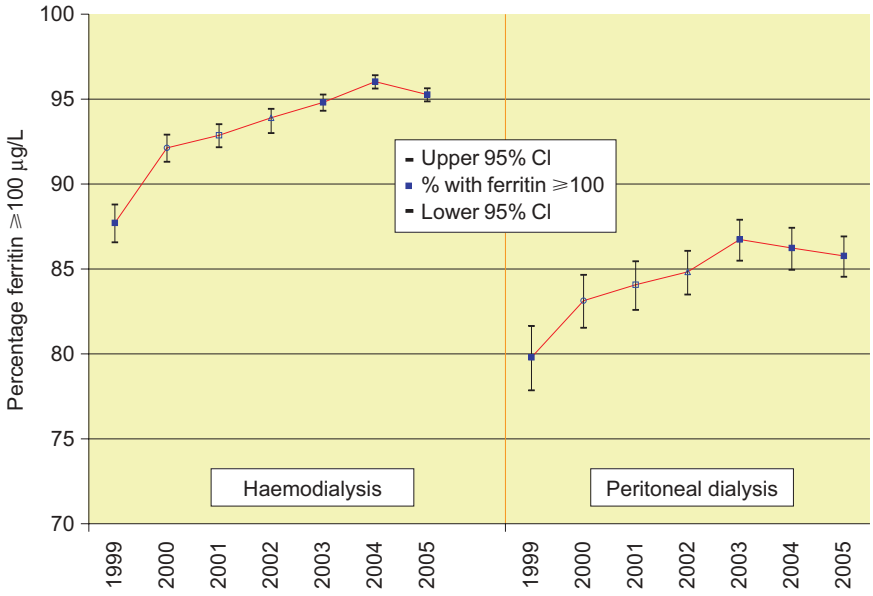

Figure 8.33: Change in achievement of serum ferritin ⩾100 µg/L: 1999–2005

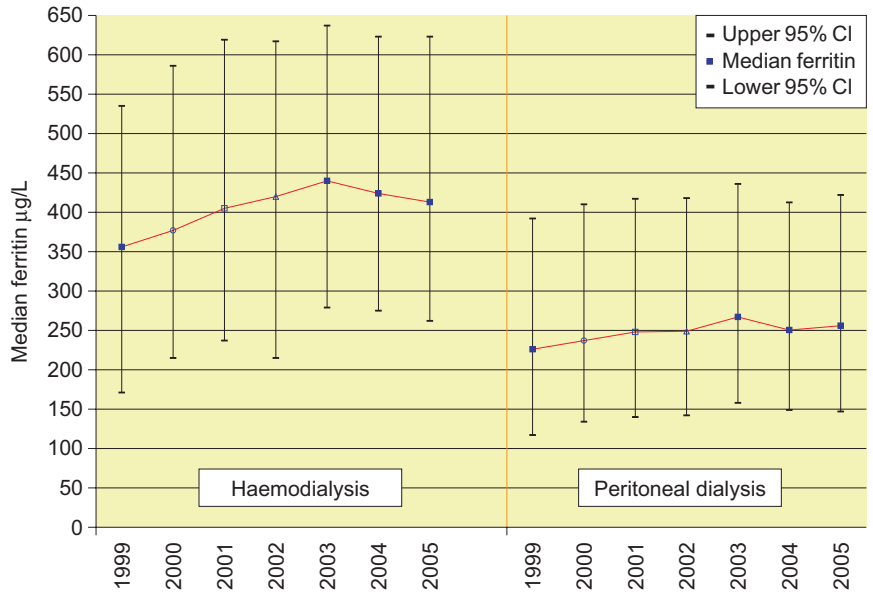

Figure 8.34: Change in median serum ferritin: 1999–2005

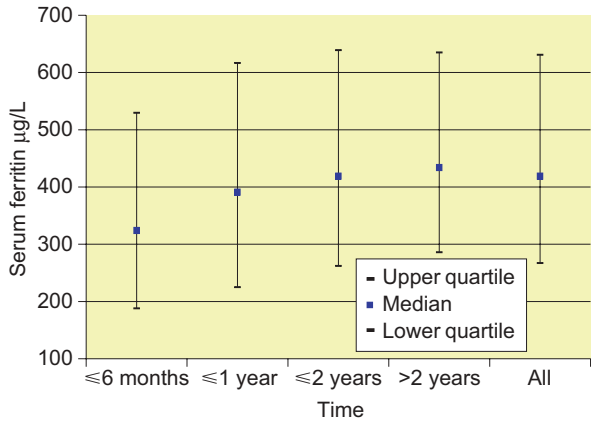

Figure 8.35: Median ferritin by length of time on RRT: HD

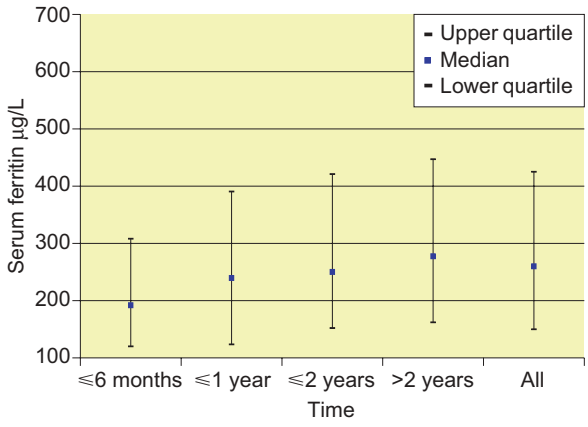

Figure 8.36: Median serum ferritin by length of time on RRT: PD

This would leave a medium size renal unit (700,000 population), with approximately 200 patients on HD and 100 on PD, ***with 28 and 10 patients respectively with a haemoglobin <10 g/dl***. These numbers are very small and interpretation of the variation in percentage of patients with an Hb <10 g/dl and not on ESAs should be viewed with caution.

In a similar way to the rest of the Registry data, the ESA data is collected from renal IT systems, although, as previously, in contrast to the automated laboratory links, this relies on manual data entry. The reliability of these data depends on who is entering the data (doctor, EPO nurse, or data clerk), whether the renal unit is prescribing the ESA directly (within the renal unit budget) or whether ESAs are prescribed by the GP (i.e. from the PCT budget). In the latter case, the data in the renal IT system may not always be updated 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.

Table 8.10 reports data on ESA use in the HD population and Table 8.11 similarly for the PD population. It remains the case that ESA requirements are greater for HD than PD

Table 8.10: ESA prescribing in HD patients

Centre	% on EPO	Mean weekly dose for pts on EPO	Median weekly dose for pts on EPO	% of those with Hb <10 g/dl who are on EPO	% with Hb ⩾10 g/dl and not on EPO
Antrim	97	8,348	8,000	100	3
B Heart	88	10,561	10,000	96	11
B QEH	100	10,853	10,000	100	n/a
Bangor	91	8,434	6,000	90	3
Basldn	93	9,700	9,000	100	6
Belfast	87	9,011	8,000	100	9
Bradfd	96	6,386	6,000	100	4
Bristol	95	8,753	6,000	100	5
Camb	60	10,468	8,000	84	13
Cardff	93	9,125	8,000	92	5
Carlis	57	10,436	10,000	70	33
Chelms	92	10,867	8,000	100	7
Clwyd	79	7,683	6,000	100	16
Covnt	67	10,565	8,000	55	26
Dudley	95	7,563	6,000	100	4
Exeter	94	8,183	6,000	97	5
Glouc	95	10,479	9,000	94	4
Ipswi	86	9,838	8,000	69	10
L Guys	64	n/a	n/a	62	29
Leeds	95	7,276	6,000	89	4
Leic	94	9,099	8,000	97	5
Livrpl	93	9,216	8,000	98	5
Middlbr	91	6,720	6,000	97	8
Oxford	84	8,547	8,000	100	15
Plymth	95	9,313	9,000	95	3
Redng	90	6,000	6,000	100	10
Sheff	92	10,255	8,000	98	8
Shrew	93	11,049	12,000	86	6
Sthend	93	8,816	6,000	100	6
Sund	90	9,099	9,000	96	8
Swanse	91	9,830	8,000	88	7
Truro	78	5,690	4,000	86	20
Tyrone	90	8,459	6,000	100	9
Ulster	92	7,771	6,000	100	8

Table 8.10: (continued)

Centre	% on EPO	Mean weekly dose for pts on EPO	Median weekly dose for pts on EPO	% of those with Hb <10 g/dl who are on EPO	% with Hb ⩾10 g/dl and not on EPO
Wolve	93	10,494	8,500	95	6
York	98	8,262	6,000	89	1
Eng	88	9,241	8,000	91	9
NI	90	8,681	8,000	100	8
Wls	91	9,298	8,000	91	6
UK	88	9,204	8,000	92	8

Table 8.11: ESA prescribing in PD patients

Centre	% on EPO	Mean weekly dose for pts on EPO	Median weekly dose for pts on EPO	% of those with Hb <10 g/dl who are on EPO	% with Hb ⩾10 g/dl and not on EPO
Antrim	67	2,397	2,000	n/a	27
B Heart	75	7,917	8,000	100	25
B QEH	100	7,521	6,000	100	n/a
Bangor	73	4,533	4,000	n/a	27
Basldn	67	4,200	3,500	100	33
Belfast	46	5,640	4,500	80	49
Bradfd	66	5,412	4,000	n/a	34
Bristol	79	4,316	4,000	100	21
Camb	72	7,080	5,300	100	28
Cardff	83	n/a	n/a	100	15
Carlis	40	5,833	3,500	100	60
Chelms	76	6,360	5,000	50	22
Clwyd	50	7,667	7,000	n/a	45
Covnt	49	7,867	4,500	36	39
Dudley	89	5,140	4,000	100	12
Exeter	84	5,040	4,000	100	16
Glouc	77	7,822	6,000	100	24
Ipswi	71	4,907	4,000	100	30
L Guys	49	3,600	3,600	56	46
Leeds	78	5,609	4,000	100	20
Leic	77	5,154	4,000	96	22
Livrpl	87	5,157	4,000	100	13
Middlbr	57	4,875	4,000	n/a	43
Oxford	87	5,379	4,000	91	12
Plymth	89	5,581	6,000	n/a	12
Redng	70	6,000	6,000	88	29
Sheff	79	8,881	6,000	93	21
Shrew	88	7,147	6,000	n/a	13
Sthend	80	5,467	4,000	100	16
Sund	70	6,071	6,000	n/a	30
Swanse	75	8,401	6,000	100	24
Truro	85	3,772	3,500	100	15
Tyrone	40	3,000	3,000	n/a	25
Ulster	100	5,000	5,000	n/a	n/a
Wolve	82	5,545	4,000	100	18
York	87	5,389	4,000	n/a	13
Eng	77	6,043	4,000	89	22
NI	51	4,597	4,000	67	43
Wls	78	7,557	6,000	100	21
UK	76	6,080	4,000	89	22

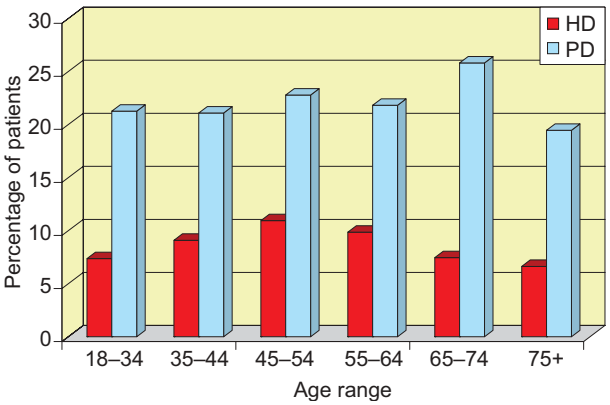

Figure 8.37: Percentage of patients who are not on EPO and have Hb ⩾10 g/dl, by age group and modality

patients with a higher proportion of HD patients requiring ESA therapy (88% vs 76%) and the ESA dose is higher for HD than PD patients (9,204 vs 6,080 IU/week). A significantly higher proportion of PD patients maintain a haemoglobin ⩾10 g/dl without a requirement for ESA therapy (Figure 8.37).

Age and ESA provision

ESA requirements are higher on HD than PD across the age spectrum (Figure 8.38). In the anaemic patients, the difference in ESA use between HD and PD appears to differ across the age spectrum (Figure 8.39), however, the numbers this plot is based on are relatively small which may account for the apparent large drop for PD patients aged 55–64.

ESA prescription and gender

Haemoglobin levels in females are lower than in males and ESA utilisation is higher for females than males (Table 8.12). A greater proportion of females require ESA therapy than males but

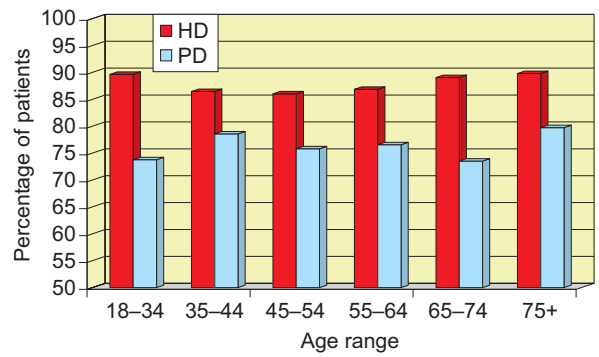

Figure 8.38: Percentage of dialysis patients on EPO, by age group and modality

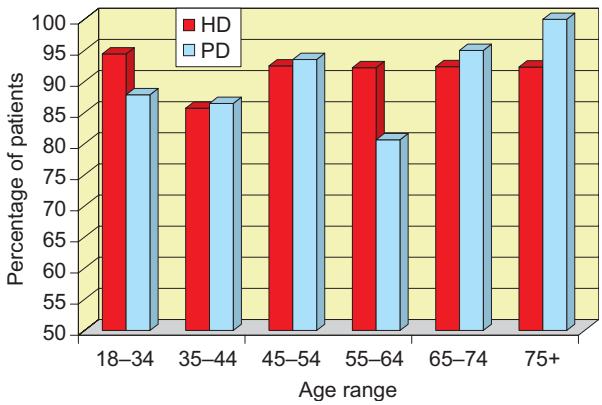

Figure 8.39: Percentage of patients with Hb ⩾10 g/dl who are on EPO, by age group and gender

Table 8.12: Percentage of patients on EPO, by gender and modality

Gender	Treatment modality	% on EPO
Male	HD	87
Female	HD	90
Male	PD	74
Female	PD	80

the difference is greater in the PD population (Figures 8.40 and 8.41).

ESAs and time on renal replacement therapy

From Table 8.13 the percentage of HD patients receiving ESAs during their first year of dialysis corresponds with the overall national median percentage for the HD population (88%). For PD, the percentage treated with ESAs during the first year of dialysis was slightly below that of the overall national median (76%), but subsequently exceeded this from 2–3 years onwards. As in last years Report, this may reflect delay in the commencement of ESAs in PD patients, or

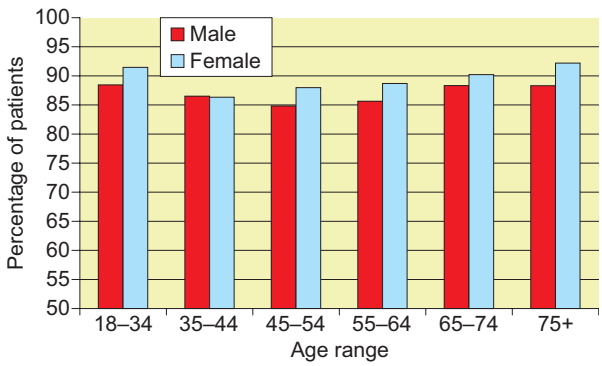

Figure 8.40: Provision of EPO by age and gender: HD

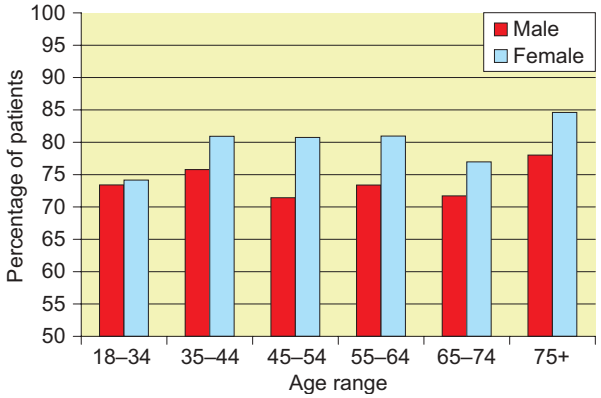

Figure 8.41: Provision of EPO by age and gender: PD

more probably the effect of a progressive loss of residual renal function from the second year of RRT onwards, resulting in increasing anaemia and therefore ESA requirements.

ESA dose and success with guideline compliance

As in previous reports, centres prescribing higher doses of ESAs were not necessarily more successful in meeting haemoglobin targets, reflecting the importance of other influences on renal anaemia including iron status, residual renal function, case mix and dialysis dose (Figures 8.42 and 8.43).

Table 8.13: Percentage of patients on EPO by time on RRT

Time on treatment	<1 year	1–2 years	2–3 years	3–5 years	5–10 years	>10 years
% patients HD	85 (1,148)	87 (1,316)	90 (1,018)	91 (1,403)	90 (1,327)	85 (894)
% patients PD	70 (322)	76 (341)	76 (264)	80 (273)	77 (229)	78 (138)

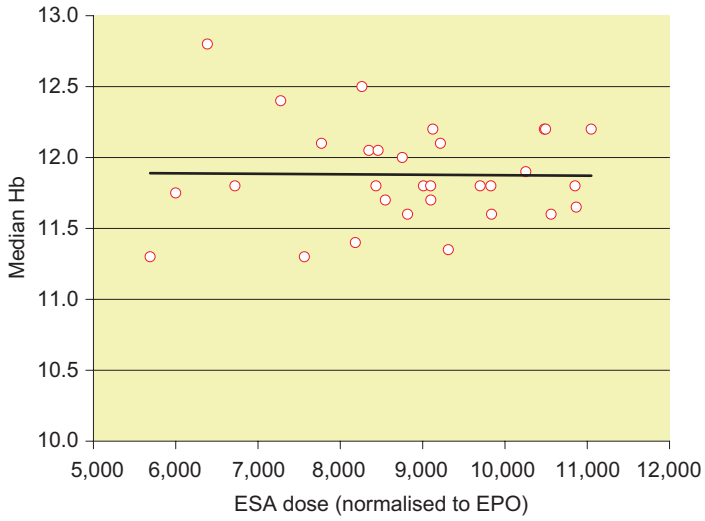

Figure 8.42: Median Hb versus mean ESA dose

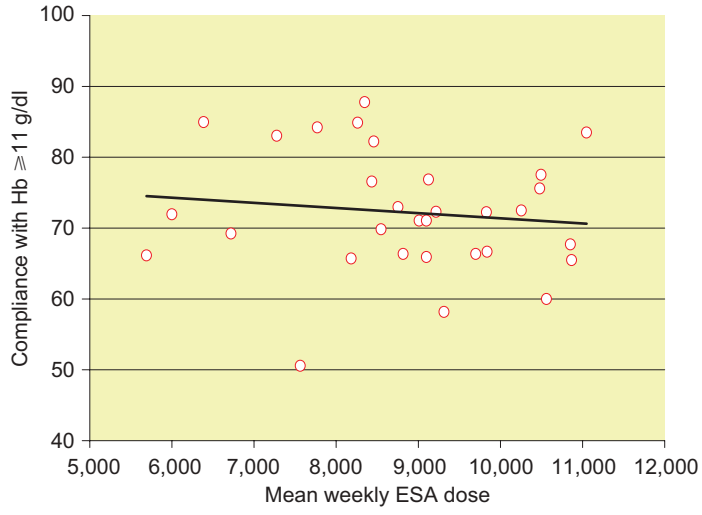

Figure 8.43: Compliance with EBPG versus mean ESO dose

Conclusion

Haemoglobin outcome for patients on haemodialysis and peritoneal dialysis in the UK are increasingly compliant with Renal Association minimum standards. Haemoglobin outcomes reside below the EBPG outcome that declares all patients should achieve a haemoglobin >11.0 g/dl. Recently published NICE guidance, however, suggests that higher outcomes are not cost effective. The presentation in this year's report of percentage of patients between 10.5 and 12.5 g/dl alongside the funnel plots for Hb outcome may enable units to plan their desired future Hb outcome in light of the NICE guidance. Ferritin outcome appears to have reached a steady state in the UK dialysis population and the percentage of patients with serum ferritin greater than 100 μmol/L seen in this year's report show that the provision of intravenous iron for UK dialysis patients is maintained.

Although the returns on ESA treatment remain incomplete, the number of units returning data has increased. The doses received remained higher in HD than PD, though in contrast to HD, the number of PD patients receiving ESAs increased with time on dialysis. The haemoglobin outcome does not show a relationship with prescribed ESA dose amongst the dataset submitted to the registry. However ESA type, frequency of administration and route of administration may all affect the dose requirements in addition to the other variables mentioned above that can affect erythropoetic response.

Overall, the data demonstrate that UK renal units continue to accord a high priority to the management of factors influencing haemoglobin. Local priorities in the treatment of renal anaemia may need to be adjusted in line with new NICE guidance.

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Chapter 9: Serum Calcium, Phosphate, Parathyroid Hormone, Albumin, Aluminium and Cholesterol Achievement on Replacement Therapy

Ed Lamb, Alex Hodsman, Dirk van Schalkwyk, David Ansell and Graham Warwick

Summary

- In the UK there is a continuing year-on-year trend towards improvement in serum phosphate control in dialysis patients although overall it still remains poor. The RA target (<1.8 mmol/L) was achieved in 65% of patients overall, (71% of PD patients, 63% of HD patients).

- Seventy-six percent of UK dialysis patients achieve a corrected calcium concentration within the RA target range. As with serum phosphate, there is a trend of continuing year-on-year improvement.

- Nearly two-thirds (69%) of patients achieve a calcium × phosphate product within the KDOQI guidelines (<4.4 $mmol^2/L^2$): again, achievement seems to have improved year-on-year. Control was better in PD patients compared to HD patients (73% versus 67% achieving the standard).

- There remains large between-centre variation in the ability of renal centres to achieve the UK Renal Association target for plasma PTH. As seen in previous years, overall achievement was poor (median 63%, range 47–92% compliance with the standard).

- Most transplant patients achieve good phosphate and calcium control (99%, range 95–100%) and the percentage of patients achieving serum calcium concentrations within the target range was 84% (range 43–97%). Nearly all (99%) of transplant patients achieved calcium × phosphate product concentrations within the KDOQI target range.

- There would appear to be wide variation in clinical practice with respect to aluminium monitoring with a suggestion that few centres are following current UK RA guidelines.

- Overall in the UK 83% of HD, 70% of PD and 62% of transplant patients achieve a total cholesterol concentration <5 mmol/L. The percentage of patients with cholesterol <5 mmol/L has increased significantly year-on-year in all three modalities.

Introduction

Disorders of mineral metabolism are a common complication of CKD. Bone disease is a significant cause of morbidity and there is increasingly convincing evidence that vascular calcification and the high rates of cardiovascular morbidity and mortality seen in patients with CKD may also be linked to abnormal mineral metabolism. In light of this, KDIGO have issued a consensus statement to provide a unifying classification of these abnormalities which is now termed CKD-MBD (CKD – Mineral and Bone disorder)[1].

There have now been several recent large observational cohort studies which have shown an association between hyperphosphataemia and increased mortality in dialysis patients[2,3,4]. However, there are no prospective trials showing that improving phosphate control prolongs survival. These observational studies have also shown some association with calcium concentrations and survival but this relationship is much less clearly defined.

The achievement of audit standards in this area is recognised to be poor worldwide. It remains poor overall in the UK although the UK is the first country to demonstrate a year on year improvement in serum phosphate[5].

Growing interest has stemmed from the introduction of new treatments which may aid in modifying markers of mineral metabolism and potentially prolong patient survival. The nature of any definite survival benefit from non-calcium containing phosphate binders, new vitamin D sterols[6] and calcimimetics remains to be defined with the results of the DCOR study of sevalamer versus calcium based phosphate binders proving negative. However, it seems likely that some or all of these newer therapeutic agents will lead to improved control of calcium phosphate balance and hopefully patient survival.

Methods

This chapter analyses the prevalent RRT cohort for 2005. The definition of the cohort is found in the appendix at the end of the chapter. The number preceding the centre name in each figure indicates the percentage of missing data for that centre. Data from Northern Ireland are included for the first time this year.

The Registry extracts quarterly data electronically from UK renal units. Quarterly values are extracted for the last two quarters for calcium and phosphate, the last three quarters for iPTH and the entire year for cholesterol and aluminium. Patients who do not have these data are excluded from the analyses. Patients are analysed both as a complete cohort and also divided by RRT modality into groups. Some analyses are also performed on a combined dialysis group. The completeness of data are analysed at unit and country level. All patients are included in analyses but units with less than 50% completeness are excluded from the caterpillar plots showing unit performance. Data are also excluded from plots when there are less than 20 patients with data both at unit and country level.

These data are analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges). These data are represented as caterpillar plots showing median values and quartile ranges. Where applicable, the percentage achieving the Renal Association or other surrogate standard is also calculated and represented as caterpillar plots with 95% confidence intervals. For the percentage achieving standards, chi-squared testing is used to identify significant variability between centres. Longitudinal analysis has also been performed for some data to calculate overall changes in achievement of standards annually from 1998 to 2005.

Serum phosphate

The Renal Association Standard states:

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

The Renal Association sets no standard for the lower limit of serum phosphate in contrast to the KDOQI guidelines[7] which set a lower limit of 1.13 mmol/L: the KDOQI upper limit is 1.78 mmol/L, consistent with the Renal Association standard. The draft 4th edition of the Renal Association standards propose a lower limit of serum phosphate of 1.1 mmol/L.

Data completeness

The completeness of data by modality is shown in Table 9.1.

Achievement of serum phosphate

Serum phosphate control amongst dialysis patients remains poor with 65% of patients overall achieving the Renal Association standard. In general, the phosphate control is better on peritoneal dialysis (71% achieve the standard), compared to haemodialysis (63% achieve the standard) (Figures 9.1 and 9.2). Encouragingly the year-on-year improvement in phosphate control noted in previous *Registry* reports seems to have continued (Figure 9.3). The variation between units is wide (Figures 9.1 and 9.2). For both HD ($\chi^2 = 397$, $p < 0.001$) and PD ($\chi^2 = 102$, $p < 0.001$) modalities, the percentage of patients with a serum phosphate below 1.8 mmol/L differed significantly between centres. Amongst patients who had received a transplant, phosphate control was good (median 1.01 mmol/L, mean inter-quartile range 0.87 to 1.18 mmol/L, Figure 9.4) with all units achieving the target in at least 97% of patients. There was no evidence of significant variation between units ($\chi^2 = 61$, $p = 0.1395$).

Table 9.1: Data completeness by centre for serum phosphate

	HD	PD	Tx
Antrim	99	89	90
B Heart	96	100	83
B QEH	97	94	89
Bangor	96	100	0
Basldn	99	100	85
Belfast	94	94	96
Bradfd	100	100	92
Brightn	66	86	72
Bristol	100	100	98
Camb	69	100	94
Cardff	97	97	95
Carlis	93	100	86
Carsh	88	96	88
Chelms	99	97	56
Clwyd	92	92	100
Covnt	98	97	74
Derby	99	94	0
Dorset	100	97	64
Dudley	83	94	93
Exeter	99	100	92
Glouc	99	97	98
Hull	99	96	89
Ipswi	100	98	95
L Barts	0	0	0
L Guys	88	99	93
L H&CX	99	98	97
L Kings	100	100	93
L Rfree	93	97	72
Leeds	100	98	93
Leic	98	96	81
Livrpl	98	98	91
ManWst	81	89	84
Middlbr	98	100	96
Newc	100	98	97
Newry	99	93	70
Norwch	100	100	94
Nottm	99	100	88
Oxford	99	99	97
Plymth	99	97	92
Ports	99	88	83
Prestn	100	100	87
Redng	99	100	92
Sheff	99	99	98
Shrew	98	98	97
Stevng	93	100	67
Sthend	97	95	80
Sund	96	100	99
Swanse	97	99	98
Truro	99	100	94
Tyrone	98	100	59
Ulster	100	100	100
Wirral	7	0	n/a
Wolve	99	98	86
Wrexm	82	85	n/a
York	100	96	97
Eng	91	91	85
NI	96	93	88
Wls	95	96	96
UK	91	91	86

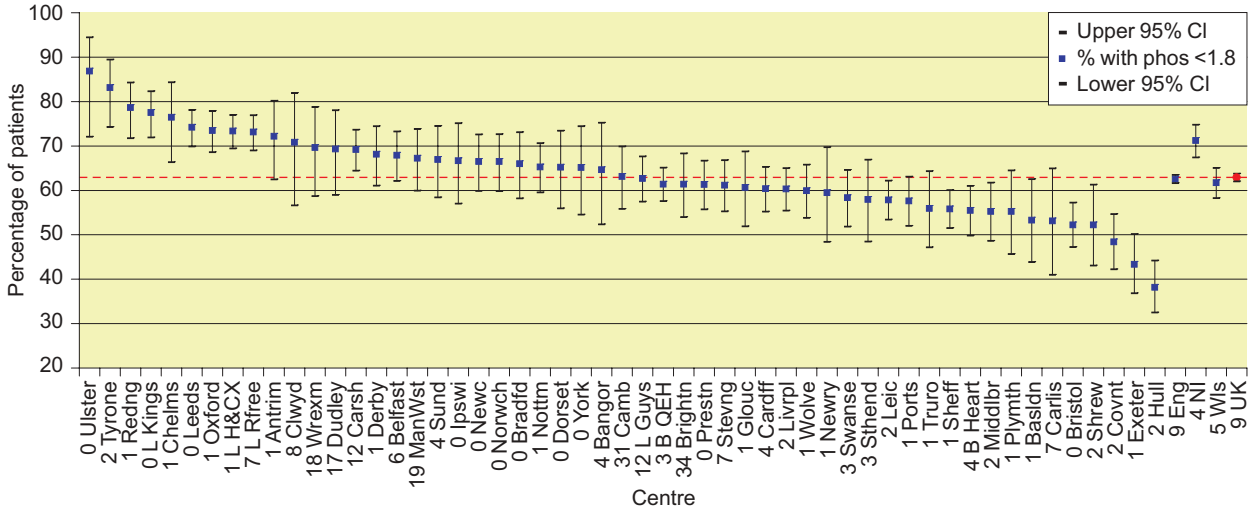

Figure 9.1: Percentage of HD patients with serum PO_4 <1.8 mmol/L

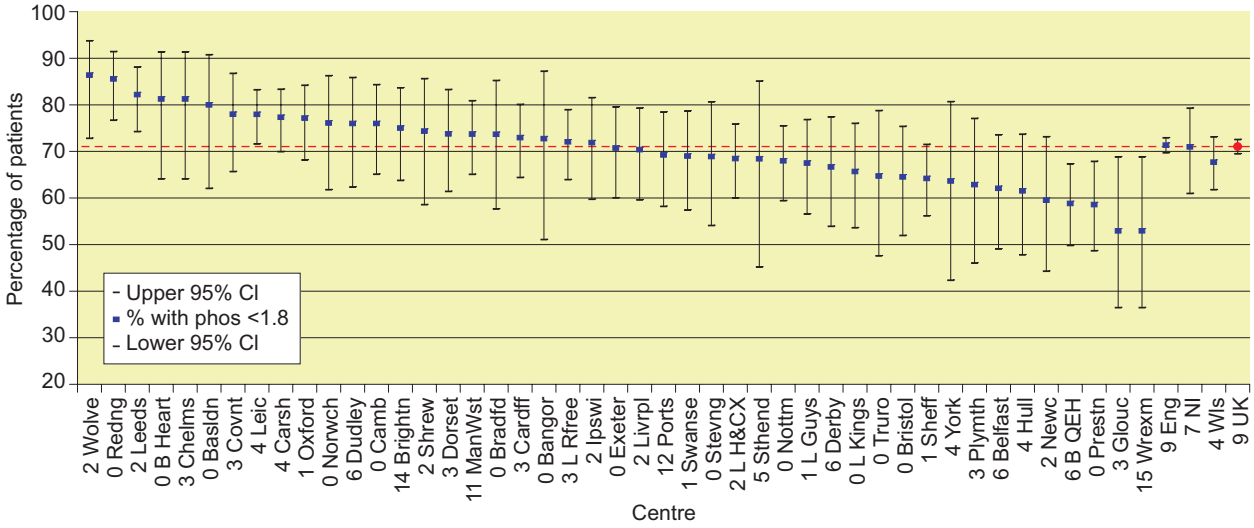

Figure 9.2: Percentage of PD patients with PO_4 <1.8 mmol/L

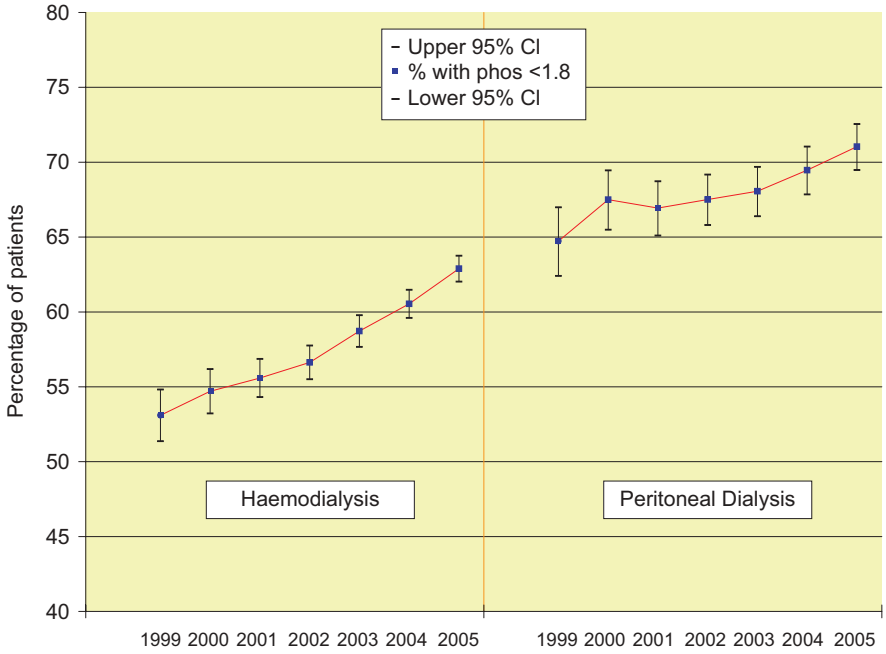

Figure 9.3: Change in percentage of patients achieving serum phosphate 1999–2005

Identification of outliers in achievement of serum phosphate

The Registry is currently exploring different methods of analysing and presenting performance data for achievement of RA standards. Use of a funnel plot helps to demonstrate centre performance against unit size (defined by number of patients) and prediction of outlier limits by plotting the threshold of 2 (95% limit) and 3 (99.8% limit) standard deviations (sd) from the UK mean. These limits correspond to p values of 0.05 and 0.002 respectively. This helps to identify renal units that are performing statistically 'better' or 'worse' than average. With 50 centres, one unit may each fall above and below the 2 sd line by chance, but none should fall outside the 3 sd line by chance.

This year for the first time, achievement of the phosphate standard in haemodialysis patients is presented using a funnel plot. This is an exploratory analysis into the usefulness of these data for renal units. Figure 9.5 shows that 8 units have 'better' than expected performance

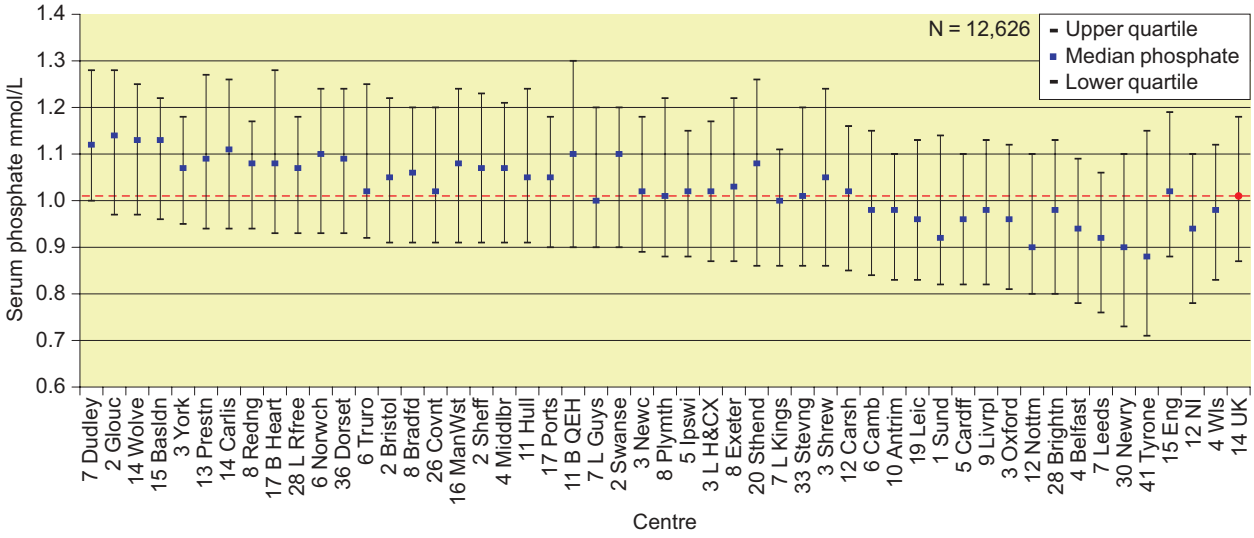

Figure 9.4: Median serum phosphate for transplant patients

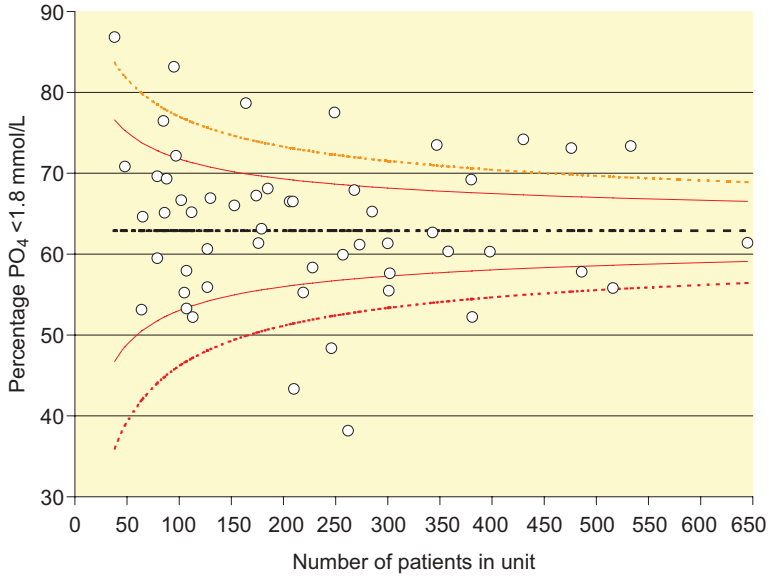

Figure 9.5: Funnel plot for percentage of HD patients with PO_4 <1.8 mmol/L

although there are also 4 units that have 'worse' than expected performance against the line of 3 sd.

In last years report the UKRR demonstrated that older patients have a better achievement of the phosphate standard (Report 2005 Chapter 13), so a part of the demonstrated variation in Figure 9.5, may be accounted for by the difference in the median age of patients as these data are unadjusted for age. Table 9.2 can be used to assist individual units to identify themselves by cross-referencing unit size (X axis) with the percentage of patients with phosphate <1.8 mmol/L (Y axis) in Figure 9.5.

These data should help exploration and promote discussion of the reasons for differences in these outlying units. Although these differences are statistically significant, it should be stressed that it cannot be automatically assumed that this means they are clinically important.

Table 9.2: Percentage of HD patients achieving PO_4 <1.8 mmol/L by unit for 2005

Treatment centre	Total	% in RA ref range	Treatment centre	Total	% in RA ref range
Antrim	97	72	L Rfree	476	73
B Heart	301	55	Leeds	430	74
B QEH	645	61	Leic	486	58
Bangor	65	65	Livrpl	398	60
Basldn	107	53	ManWst	174	67
Belfast	268	68	Middlbr	219	55
Bradfd	153	66	Newc	209	67
Brightn	176	61	Newry	79	59
Bristol	381	52	Norwch	206	65
Camb	179	63	Oxford	347	73
Cardff	358	60	Plymth	105	55
Carlis	64	53	Ports	302	58
Carsh	380	69	Prestn	300	61
Chelms	85	76	Redng	164	79
Clwyd	48	71	Sheff	516	56
Covnt	246	48	Shrew	113	52
Derby	185	68	Stevng	273	61
Dorset	112	65	Sthend	107	58
Dudley	88	69	Sund	130	67
Exeter	210	43	Swanse	228	58
Glouc	127	61	Truro	127	56
Hull	262	38	Tyrone	95	83
Ipswi	102	67	Ulster	38	87
L Guys	343	63	Wolve	257	60
L H&CX	533	73	Wrexm	79	70
L Kings	249	78	York	86	65

Serum calcium

The Renal Association Standard 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.***

Comparative audit in this area remains difficult, due to differences in analytical methods between units (and even between satellite units managed by one clinical team), different mathematical methods being applied to correct 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 unit will be making clinical decisions based on their local corrected calcium results, these data are in some sense the most valid and this data has been chosen for illustration. Some units provide data already corrected for albumin concentration and these are analysed directly; uncorrected calcium data provided by some units is corrected using a formula in widespread use[8]:

$$\text{Corrected calcium} = \text{uncorrected calcium} + [(40 - \text{albumin}) \times 0.02]$$

Data completeness

The completeness of data by modality is shown in Table 9.3.

Achievement of serum calcium

The median corrected calcium is 2.3 mmol/L (mean inter-quartile range 2.26 to 2.49 mmol/L) for HD patients and 2.40 mmol/L for PD patients (mean inter-quartile range 2.30 to 2.51 mmol/L) with 76% of dialysis patients (75% HD and 79% PD) achieving a concentration within the Renal Association target range (Figure 9.6). There has been a general trend towards improved performance over the period

Table 9.3: Data completeness by centre for corrected calcium

	HD	PD	Tx		HD	PD	Tx
Antrim	99	89	90	Livrpl	98	98	91
B Heart	96	100	84	ManWst	82	89	84
B QEH	97	94	90	Middlbr	98	100	96
Bangor	96	100	n/a	Newc	100	100	97
Basldn	99	100	92	Newry	99	93	70
Belfast	94	94	95	Norwch	100	100	94
Bradfd	100	100	97	Nottm	99	100	88
Brightn	66	85	72	Oxford	99	99	97
Bristol	100	100	98	Plymth	99	100	94
Camb	69	100	94	Ports	99	88	89
Cardff	97	97	96	Prestn	100	100	89
Carlis	93	100	91	Redng	99	100	93
Carsh	88	96	89	Sheff	99	99	98
Chelms	99	97	67	Shrew	98	98	97
Clwyd	92	92	100	Stevng	93	100	66
Covnt	98	97	83	Sthend	97	95	83
Derby	99	94	n/a	Sund	96	100	99
Dorset	99	98	95	Swanse	97	99	98
Dudley	83	94	93	Truro	99	100	94
Exeter	99	100	92	Tyrone	98	100	59
Glouc	99	97	99	Ulster	100	100	100
Hull	99	96	89	Wirral	7	n/a	n/a
Ipswi	100	98	95	Wolve	99	100	96
L Barts	0	0	0	Wrexm	82	85	0
L Guys	88	99	93	York	95	100	59
L H&CX	99	98	97	Eng	91	91	86
L Kings	100	100	94	NI	96	93	88
L Rfree	93	97	72	Wls	95	96	96
Leeds	98	98	92	UK	91	91	87
Leic	98	96	81				

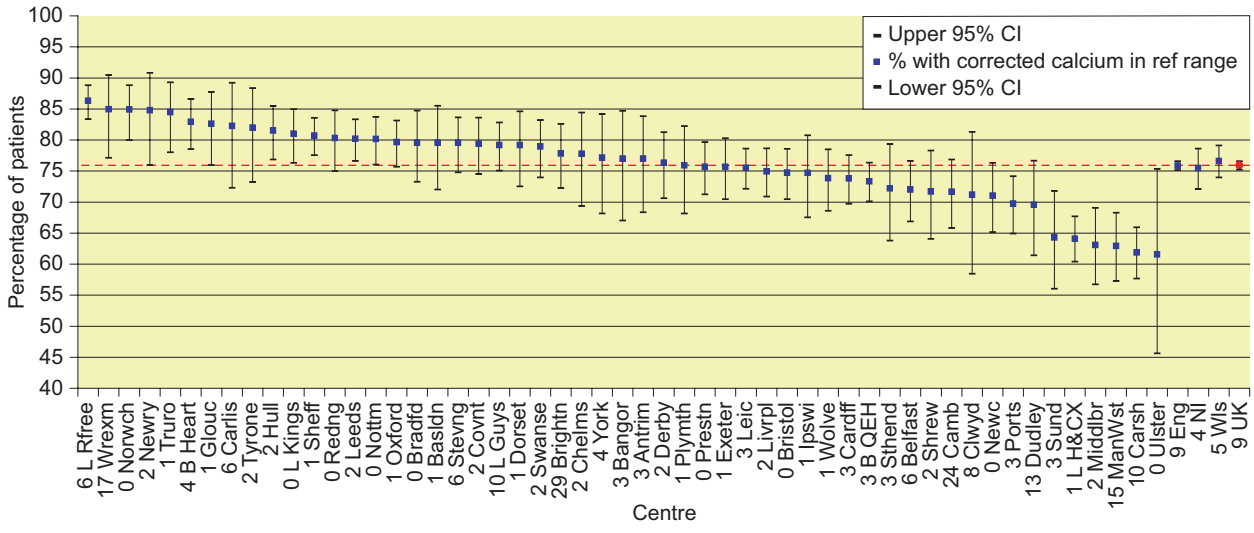

Figure 9.6: Percentage of dialysis patients with corrected calcium within 2.2–2.6 mmol/L

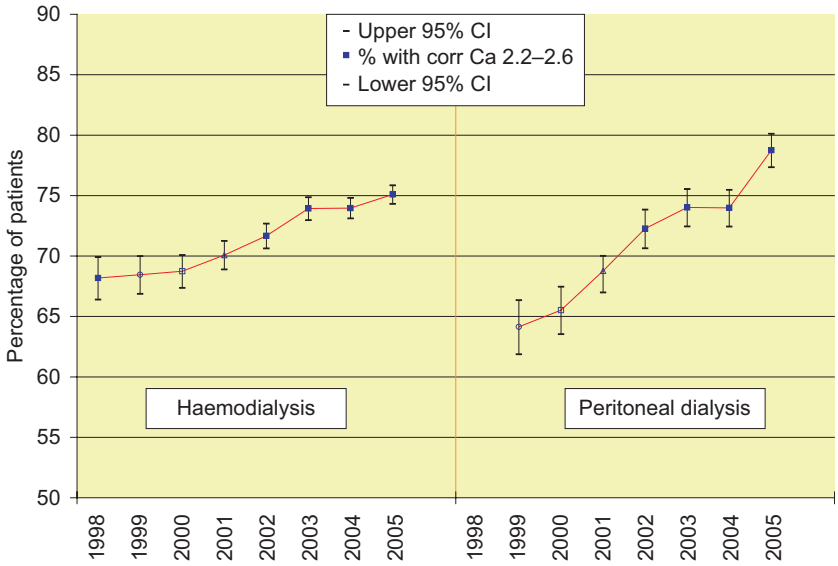

Figure 9.7: Change in percentage of patients achieving serum corrected Ca 2.2–2.6 mmol/L, 1998–2005

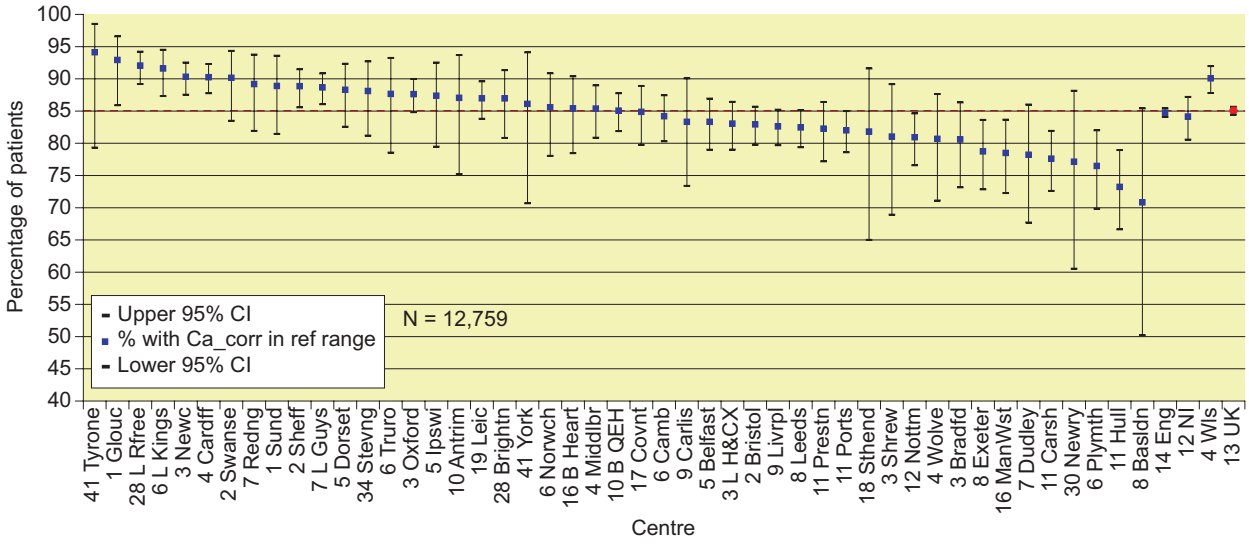

Figure 9.8: Percentage of patients with corrected calcium 2.2–2.6 mmol/L: transplant

1998–2005 with a quite marked improvement in the PD population in particular in the last year (Figure 9.7). The variation between units is wide: for both HD ($\chi^2 = 299$, $p < 0.0001$) and PD ($\chi^2 = 96$, $p = 0.0002$) modalities, the percentage of patients with serum corrected calcium within the RA target range differed significantly between centres.

Achievement of the calcium target amongst patients who had received a transplant was better than that amongst dialysis patients, with 85% of transplant patients achieving corrected calcium concentrations within the target range (Figures 9.8 and 9.9). The percentage of transplant patients with a serum corrected calcium within the RA target range differed significantly between centres ($\chi^2 = 191$, $p < 0.0001$).

Serum calcium × phosphate product

The Renal Association has no standard for the serum calcium × phosphate product.

The Renal Association currently has no standard for the serum calcium × phosphate product, but the draft 4th edition of the Renal Association guidelines recommends that the product should be less than 4.8 $mmol^2/L^2$. The KDOQI guidelines recommend the product should be less than 4.4 $mmol^2/L^2$ (= 55 mg^2/dl^2). Two thirds (69%) of patients achieve this but the range of 49–84% between units remains wide (Figure 9.10). Control is better on PD, with 73% (range 47–89%) of patients achieving the standard when compared with 67% of

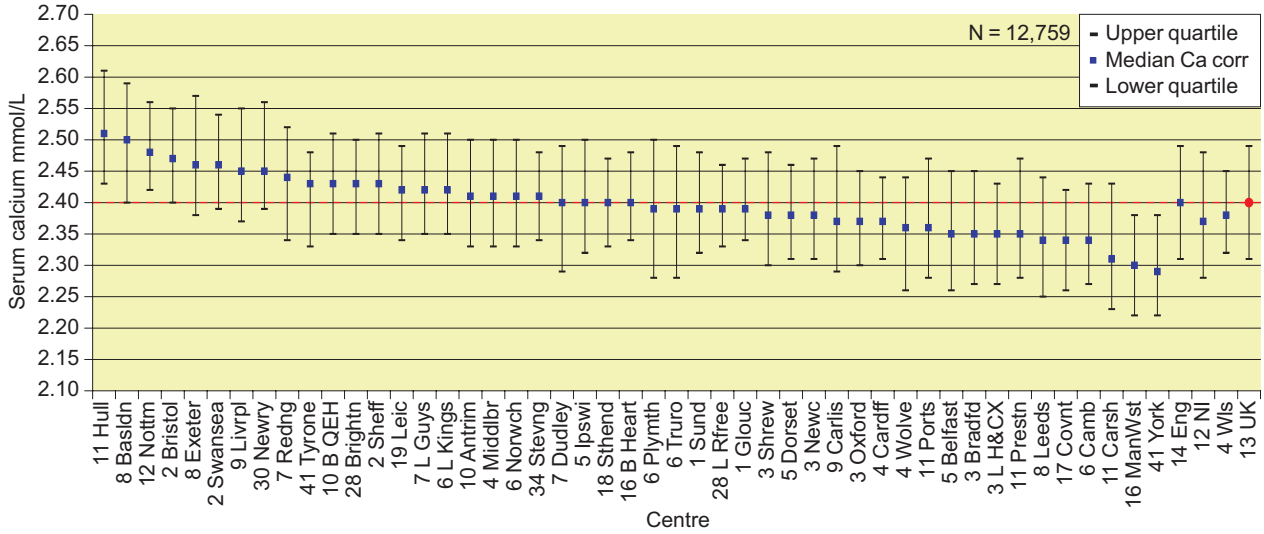

Figure 9.9: Median serum corrected calcium concentration: transplant

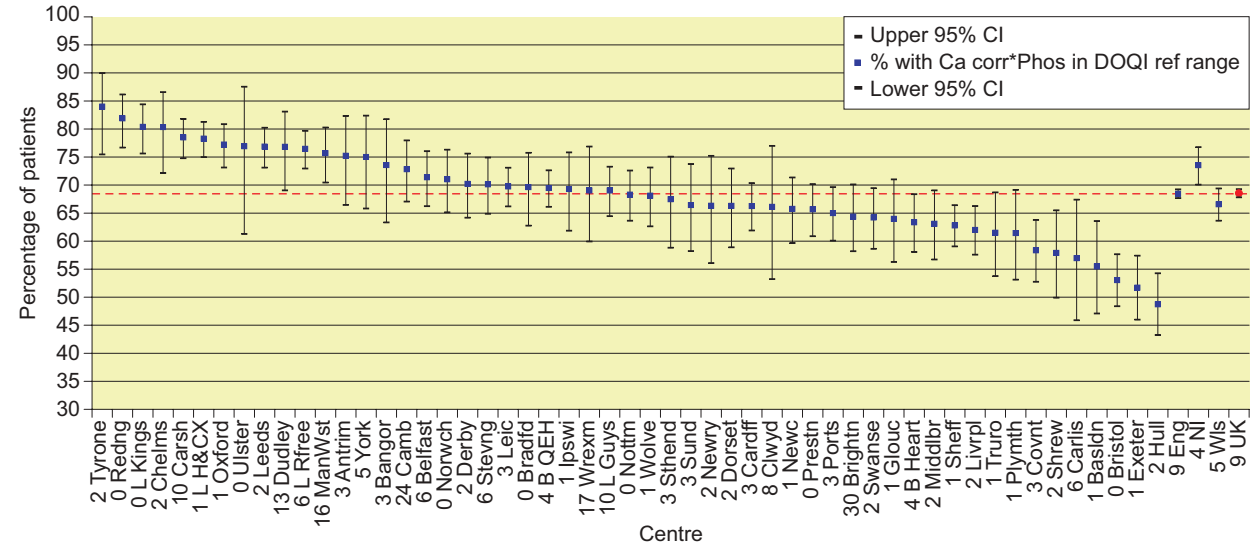

Figure 9.10: Percentage achieving KDOQI Ca × PO_4 target: dialysis

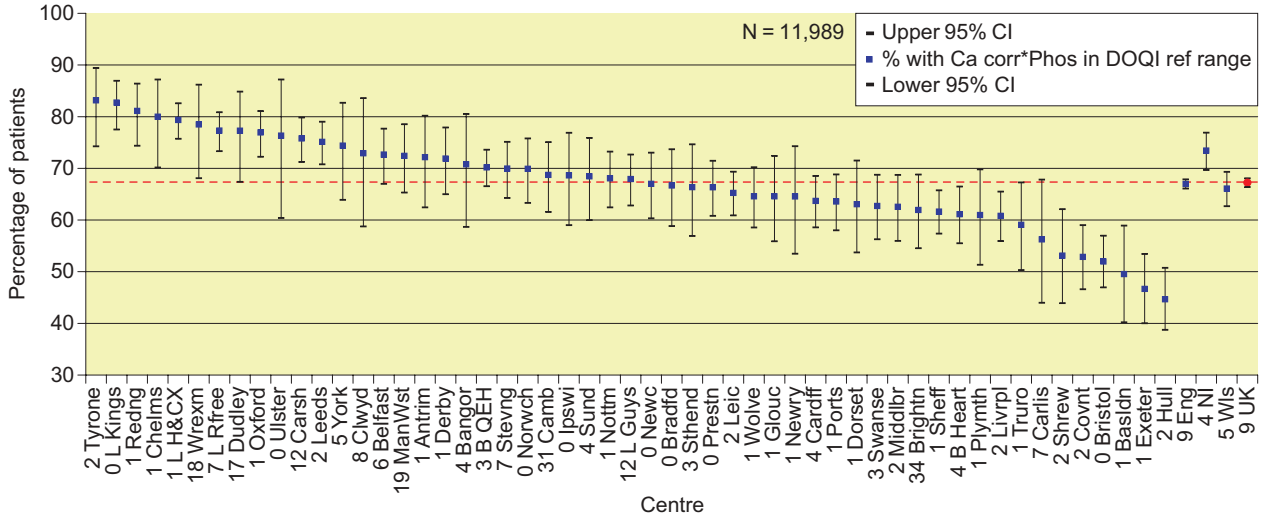

Figure 9.11: Percentage of patients achieving Ca × PO_4 target: HD

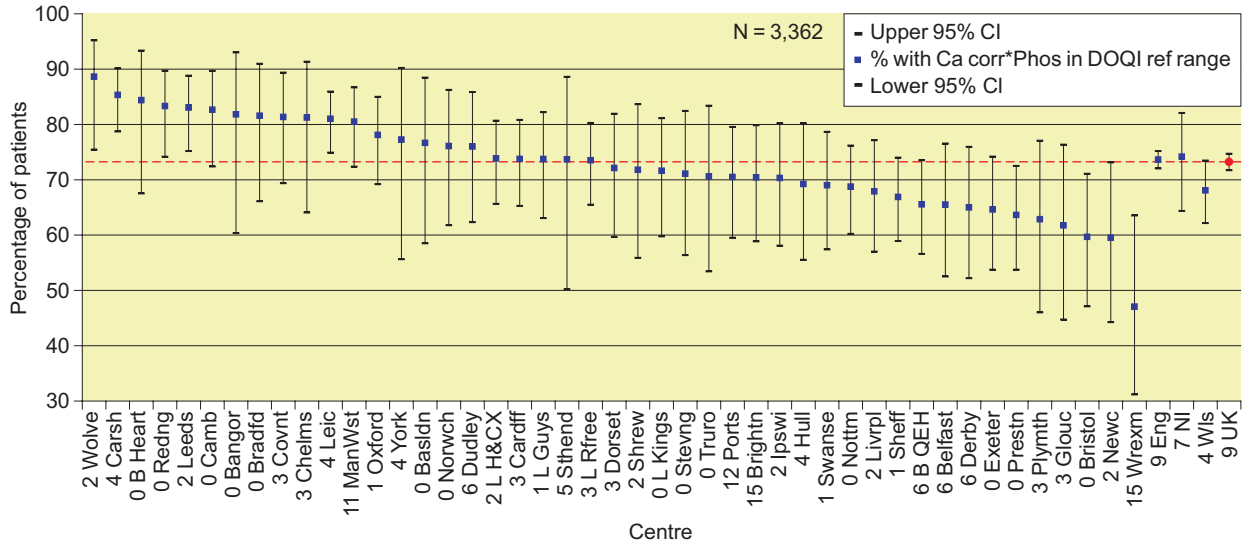

Figure 9.12: Percentage of patients achieving KDOQI for Ca × PO_4: PD

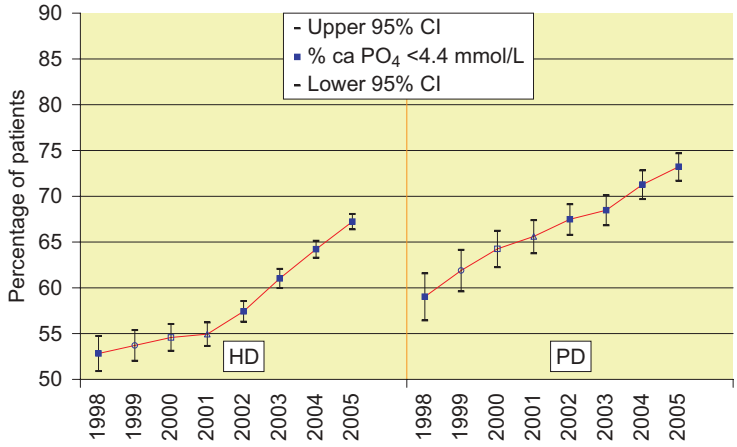

Figure 9.13: Change in percentage of patients achieving KDOQI target for Ca × PO_4 target 1998–2005

patients on HD (range 45–83%) and this is shown in Figures 9.11 and 9.12. The variation between units was significant for both HD ($\chi^2 = 417$, $p < 0.001$) and PD ($\chi^2 = 120$, $p < 0.001$) modalities. There is evidence of a year-on-year improvement in attainment of this standard (Figure 9.13).

Serum parathyroid hormone

The Renal Association Standard 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.***

Comparison of serum PTH values from different units is difficult due to the variety of methods and reference ranges in use. 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 is also similar to the upper limit of the KDOQI guidelines (31 pmol/L). In the UK, no lower limit for PTH is specified although KDOQI recommends a limit of 15 pmol/L.

Data completeness

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

Achievement of serum iPTH

The median PTH for all dialysis patients was 22 pmol/L although the range of medians was

Table 9.4: Data completeness by centre for PTH

	HD	PD	Tx		HD	PD	Tx
Antrim	98	78	12	Livrpl	86	94	45
B Heart	85	84	30	ManWst	78	86	75
B QEH	68	79	51	Middlbr	93	93	9
Bangor	93	95	100	Newc	97	93	34
Basldn	99	100	46	Newry	86	93	16
Belfast	91	85	20	Norwch	97	87	14
Bradfd	97	95	34	Nottm	99	96	71
Brightn	49	74	19	Oxford	88	89	36
Bristol	98	94	81	Plymth	75	47	18
Camb	63	97	28	Ports	96	44	9
Cardff	84	96	19	Prestn	98	99	40
Carlis	90	100	15	Redng	95	98	50
Carsh	64	71	13	Sheff	96	85	10
Chelms	95	85	11	Shrew	96	95	28
Clwyd	90	75	29	Stevng	94	96	29
Covnt	83	74	21	Sthend	94	75	13
Derby	0	0	0	Sund	97	100	99
Dorset	92	89	27	Swanse	96	93	31
Dudley	23	38	15	Truro	99	100	45
Exeter	96	98	23	Tyrone	92	40	9
Glouc	95	89	26	Ulster	97	100	50
Hull	90	76	28	Wirral	1	0	n/a
Ipswi	93	97	29	Wolve	98	100	77
L Barts	0	0	0	Wrexm	60	63	n/a
L Guys	84	98	33	York	99	96	36
L H&CX	57	97	56	Eng	76	75	32
L Kings	90	84	10	NI	92	83	17
L Rfree	0	1	0	Wls	86	89	21
Leeds	99	98	22	UK	77	76	31
Leic	93	79	37				

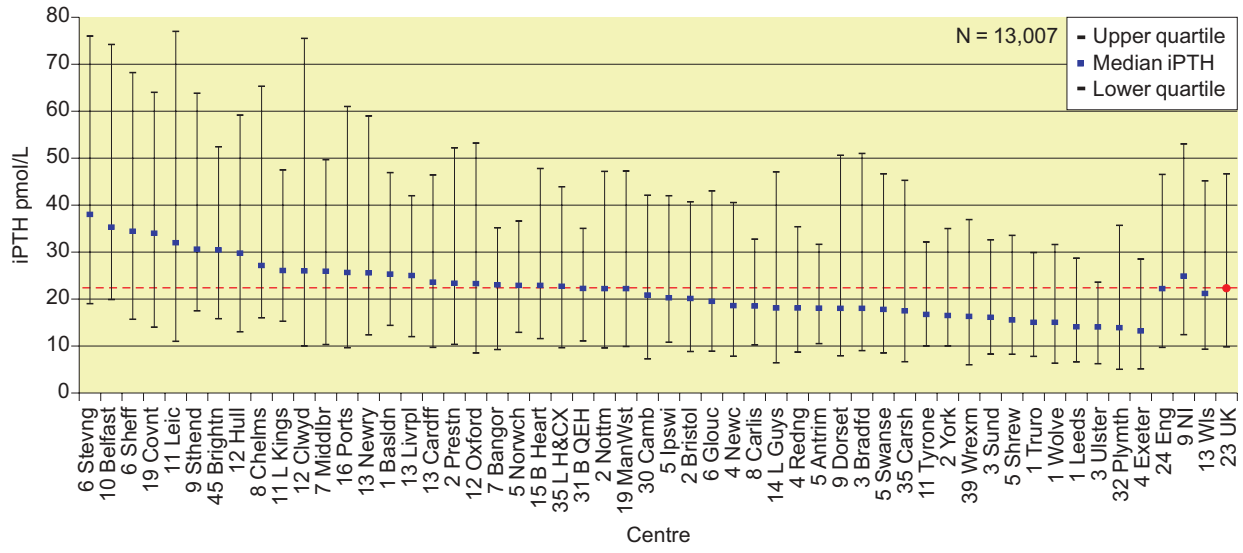

Figure 9.14: Median PTH: dialysis

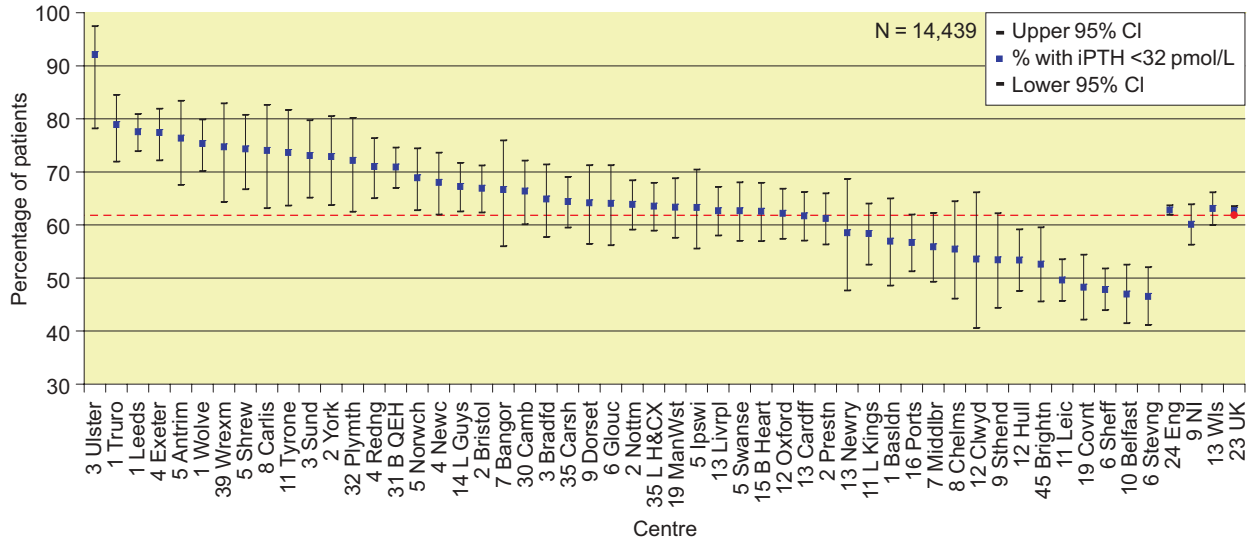

Figure 9.15: Percentage with iPTH <32 pmol/L: dialysis

wide (13 to 38 pmol/L), with four centres achieving a median concentration above the upper limit set for all patients which indicates that fewer than 50% of patients were within target (Figure 9.14). Median PTH appeared to be slightly higher overall amongst PD (25, inter-quartile range 12–47, range of medians 15 to 48 pmol/L) patients compared to HD (22, inter-quartile range 10–47, range of medians 13 to 38 pmol/L) patients. Overall, 63% of dialysis patients (61% PD; 63% HD) achieved the RA standard, but the spread of data was remarkable, ranging from 47 to 92% compliance with the standard (Figure 9.15). This analysis is almost certainly compromised by the wide variations in analytical recovery of PTH in commercial assays and also the lack of security around the reference limits that laboratories have selected as being appropriate for their assays[9]. Laboratory standardisation of these measurements remains under discussion.

Albumin

The RA has no standard for the serum albumin.

The RA Standards document recognises the importance of serum albumin as a marker of outcome, but does not recommend setting an audit standard for serum albumin, predominantly due to lack of standardisation of albumin assays between laboratories. Serum albumin concentration is influenced significantly by the dye used in the assay method; either bromocresol green (BCG) or bromocresol purple (BCP) and has been discussed at length in previous reports.

For the Registry report in previous years, centres have been separated by methodology of albumin measurements. This year data was analysed on quarterly median albumin by each HD satellite unit or main unit (n = 181 centres), over a 7 year period. Except where albumin methodologies were changed, median albumin results remained unchanged over time to within 1 g/L. As there would have been a large shift in patients over this time period, this probably indicates that differences between centres in median albumin are accounted for by laboratory methodologies.

In the 2005 Report Chapter 10, it was commented on that continued presentation of albumin achievement data in the Registry annual report was of limited value. Unless there were strong calls from the renal community with an opposing viewpoint, these data would not be published in the following years report. For this reason the data on median albumin by centre are not shown.

The Registry continues to collect individual patient data on albumin which will be incorporated in analyses of patient outcome, as 'within patient' fall in serum albumin remains an important surrogate marker of patient survival.

Aluminium

The Renal Association Standard states:

> ***Serum aluminium concentration should be measured every three months in all patients on HD and in all PD patients receiving oral aluminium hydroxide.***

During 2005 the Registry received aluminium data from 13,168 HD samples and 3,690 PD samples. Overall, 36% of HD patients and 9% of PD patients (compared to 39% of HD patients and 15% of PD patients in 2004) had a serum aluminium concentration checked once during the year. However, there was enormous variation in reported compliance with this standard with 15 centres reporting no aluminium data for HD patients and a further 13 centres reporting data in <10% of their patients. Amongst PD patients, 30 centres reported no aluminium data and a further 12 centres, data in <10% of their patients.

It is possible that the Registry is not capturing all of the aluminium monitoring that is taking place, not least because aluminium measurement is not generally available in local laboratories and there may therefore be practical limitations in respect of data transmission back to the renal unit database. However, it also seems probable that many renal centres have abandoned routine monitoring of aluminium in dialysis patients or have at least deviated from the RA standard recommendations in terms of frequency of testing. Generally it is acknowledged that aluminium-related bone disease is a diminishing problem and water treatment facilities in HD units are tested on a monthly basis for aluminium. The KDOQI guidelines are slightly less stringent than the RA guidelines, with the recommendation that serum aluminium should be measured at least yearly and every three months in patients receiving aluminium-containing medications[7]. The draft 4th Edition of the RA guidelines advises limiting serum aluminium concentration monitoring to patients receiving oral aluminium hydroxide.

Cholesterol

The Renal Association Standard states:

> ***Primary prevention:***
> ***Statins should be considered in dialysis patients with a 10-year risk of coronary disease >30% to achieve a total cholesterol concentration <5 mmol/L or a 30% reduction from baseline.***
>
> ***Secondary prevention:***
> ***In patients in whom lipid-lowering drug treatment is used, total cholesterol should be reduced by 30% or to below 5 mmol/L, whichever reduction is the greater.***

Data completeness

The completeness of data by modality is shown in Table 9.5.

Achievement of serum cholesterol

The Registry collects serum total cholesterol data, audited against a target concentration of 5 mmol/L. New data items added to the quarterly Registry extraction downloads from renal systems include HDL cholesterol and use of 'statins'. These new data items will greatly enhance the interpretation of the cholesterol data.

Amongst HD patients the median serum cholesterol was 3.9 mmol/L (inter-quartile range 3.3–4.6 mmol/L) and 83% of patients achieved the target of <5 mmol/L, although this ranged between units from 71% to 92% (Figure 9.16). Amongst PD patients the median serum cholesterol was 4.4 mmol/L (inter-quartile range 3.7–5.1 mmol/L) and 70% of patients achieved the target of <5 mmol/L, although this ranged between units from 54% to 89% (Figure 9.17). Amongst transplant recipients the median serum cholesterol was 4.7 mmol/L (inter-quartile range 4.1–5.3 mmol/L) and 62% of patients achieved the target of <5 mmol/L, although this ranged between units from 38% to 80% (Figure 9.18).

Chi-square testing indicates that the difference between centres for all three treatment modalities is significant ($p < 0.0001$). As in previous years, cholesterol concentrations are lower in HD patients than PD patients and higher in transplant patients than in dialysis patients (Figure 9.19).

Table 9.5: Percentage of patients with complete returns of cholesterol values by modality

	HD	PD	Tx		HD	PD	Tx
Antrim	98	83	55	Livrpl	15	0	23
B Heart	43	94	55	ManWst	77	83	87
B QEH	96	97	92	Middlbr	98	100	79
Bangor	79	100	100	Newc	95	98	98
Basldn	99	100	96	Newry	99	93	80
Belfast	91	95	97	Norwch	100	100	94
Bradfd	87	97	95	Nottm	97	95	84
Brightn	31	58	42	Oxford	91	89	77
Bristol	92	84	95	Plymth	92	89	96
Camb	63	100	90	Ports	65	44	64
Cardff	82	98	88	Prestn	100	98	86
Carlis	88	100	95	Redng	95	97	97
Carsh	73	72	56	Sheff	93	72	97
Chelms	66	82	44	Shrew	98	100	75
Clwyd	54	33	100	Stevng	47	78	63
Covnt	2	2	1	Sthend	95	90	85
Derby	67	25	0	Sund	96	100	99
Dorset	92	94	91	Swanse	96	99	99
Dudley	29	68	63	Truro	97	100	63
Exeter	95	84	92	Tyrone	98	100	59
Glouc	94	91	74	Ulster	100	100	100
Hull	87	48	66	Wirral	0	0	n/a
Ipswi	90	95	93	Wolve	92	87	90
L Barts	0	0	1	Wrexm	76	75	0
L Guys	93	100	93	York	85	96	89
L H&CX	99	98	98	Eng	76	76	75
L Kings	94	94	90	NI	95	93	86
L Rfree	89	94	66	Wls	83	92	90
Leeds	86	86	94	UK	77	78	76
Leic	81	92	83				

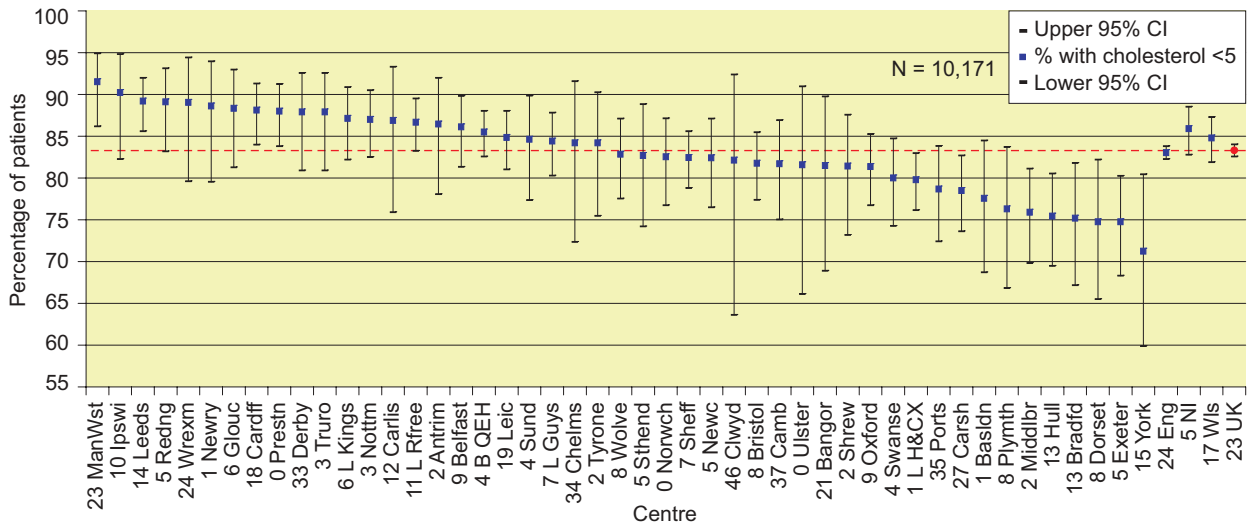

Figure 9.16: Percentage of patients with cholesterol <5: HD

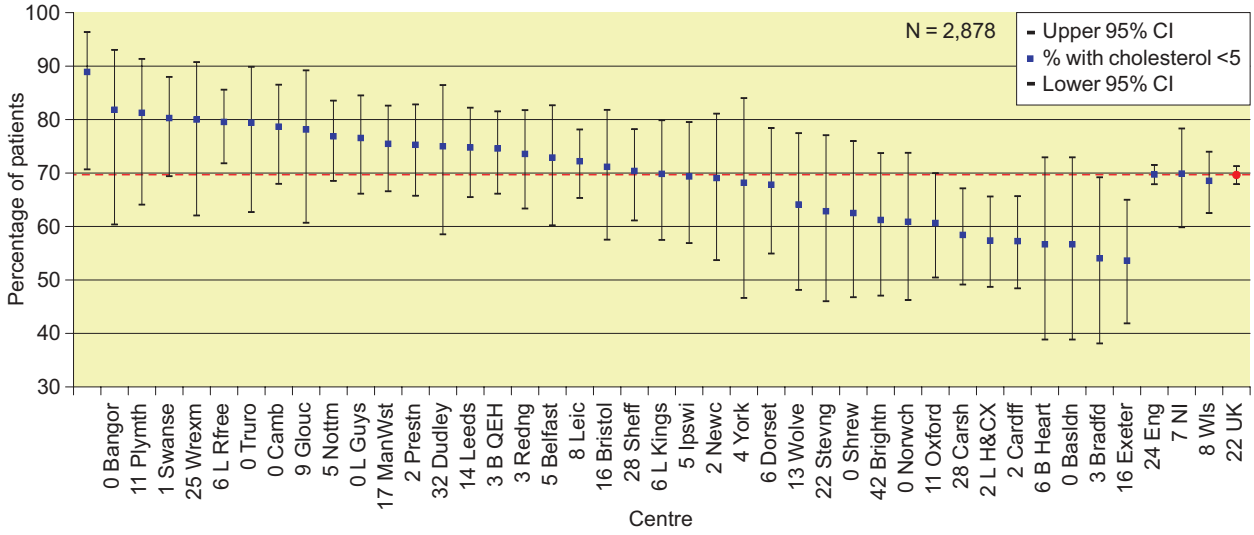

Figure 9.17: Percentage of patients with cholesterol <5: PD

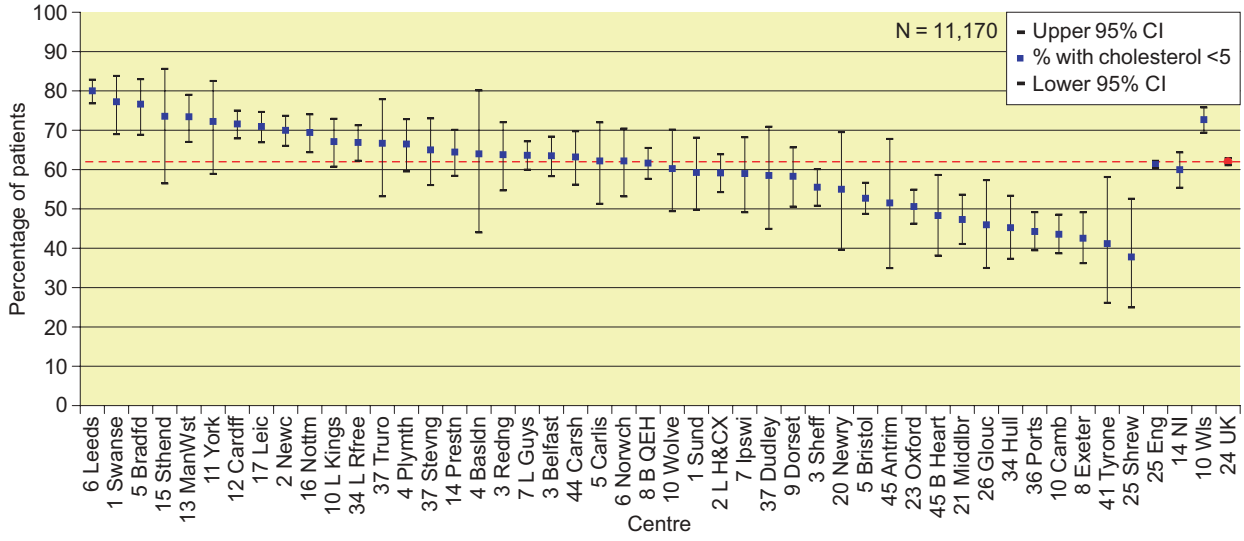

Figure 9.18: Percentage of patients with cholesterol <5: Tx

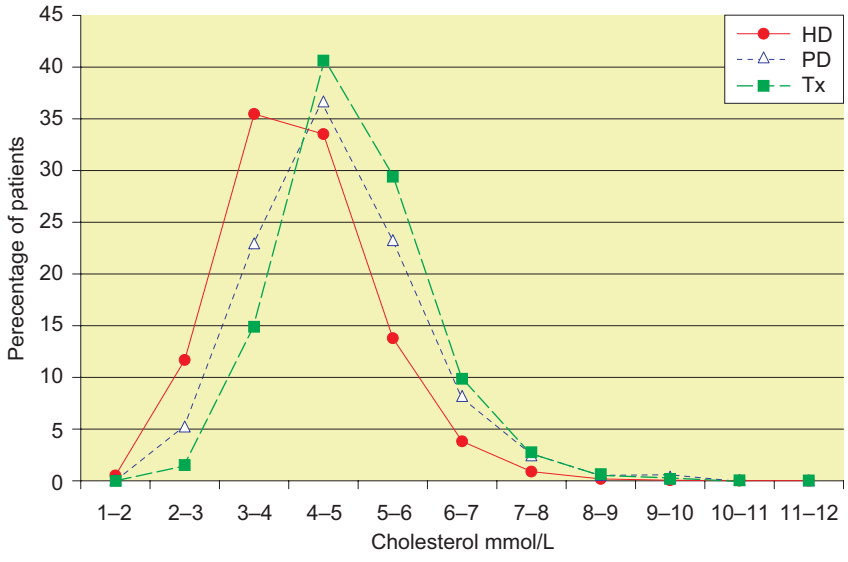

Figure 9.19: Distribution of serum cholesterol by modality

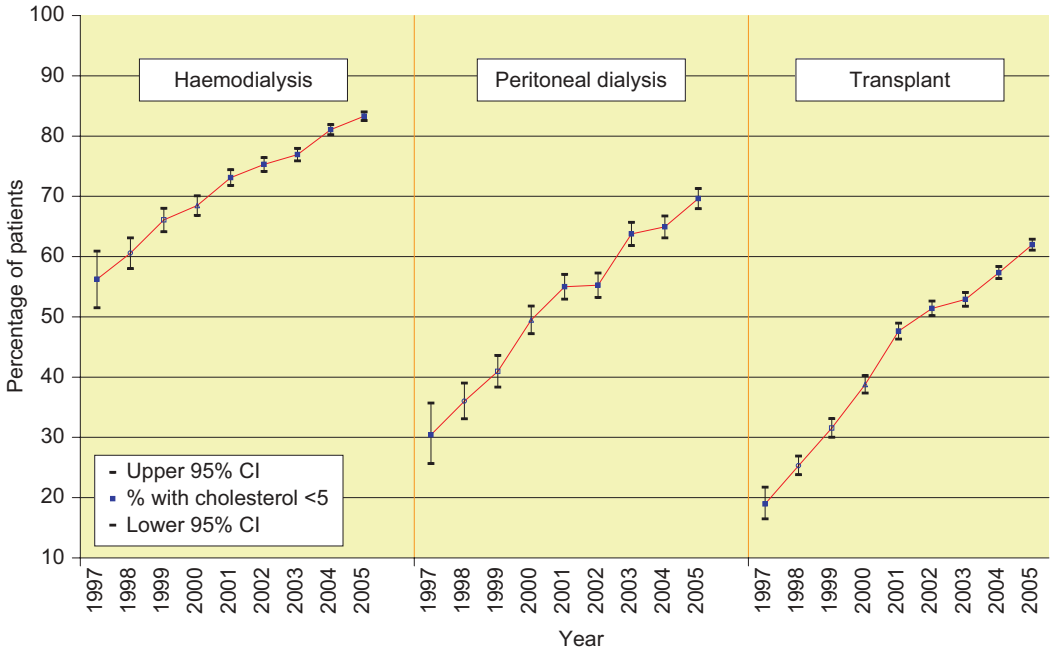

Figure 9.20: Percentage of patients with cholesterol <5 by modality 1997–2005

In all three treatment modalities there have been marked year-on-year improvements in the percentage of patients achieving the target concentration (Figure 9.20). As discussed above, the Registry does not currently collect prescribing data to enable this to be linked to a lipid-lowering treatment effect and these data are 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 influence of steroids, calcineurin inhibitors and sirolimus.

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Appendix for definition of prevalent cohort for biochemistry chapter

Definition of prevalent cohort

- Prevalent patients are defined as all patients (including the incident cohort for that year) alive on 31st December for that year
- Dataset called **Qtreat**

Qtreat

- Usual UKRR checking programs run on dataset
- Exclusion criteria applied to create dataset **Qtemp**

Exclusion criteria are:

- Patients who had died before the first day of the quarter
- Patients on dialysis with a treatment centre of elsewhere (not identified)
- Patients receiving treatment at a non-Registry site
- Patients with no date of starting ERF treatment
- Patients who had been receiving treatment for a negative number of days i.e. incorrect starting dates or incorrect patient number on data sent in
- Patients who had recovered before the start of the quarter
- Where data on a patient are submitted from more than one centre, only data from the primary centre are used

Qtemp

- Further exclusion criteria applied to Qtemp to create dataset called **Quarter**

Exclusion criteria are:

- Patients who have transferred out of the centre (qhcent) by the end of the quarter
- Patients who had not yet transferred in to the centre (qhcent) by the end of the quarter
- Patients who had recovered by the end of the quarter
- Patients who had stopped treatment by the end of the quarter
- Patients who had died by the end of the quarter
- Patients who were lost to follow up by the end of the quarter

Quarter

- Further exclusion criteria applied to quarter to create dataset called **Bichem**

Exclusion criteria are:

- Patients who had been on ERF treatment for $\leqslant$90 days at the end of the quarter
- Patients who changed treatment modality in the quarter
- Patients who transferred into the centre (qhcent) at some time in the quarter

Chapter 10: Factors Which May Influence Cardiovascular Disease in Dialysis and Transplant Patients – Blood Pressure

Janice Harper, Alex Hodsman, Julie Gilg, David Ansell and Andrew J Williams

Summary

- Many renal units still fail to return blood pressure data to the Renal Registry. In England, Northern Ireland and Wales, the percentage of HD patients achieving the combined blood pressure standard (<140/90 pre-dialysis) average 43% (inter unit range 16–60%) and post-dialysis (<130/80) average 48% (range 22–66%). On average 27% (range 12–48%) of PD patients achieve the standard of <130/80 and 26% of renal transplant patients (range 16–40%).

- Over the last 8 years there has been no significant change in systolic or diastolic blood pressure achievement.

- Better co-morbidity data returns are required by the Registry to perform blood pressure survival analyses.

Introduction

International and UK blood pressure guidelines[1,2,3,4] recommend a target blood pressure below 130/80 mmHg for patients with chronic kidney disease (CKD), diabetes and established atherosclerosis. The intention is to reduce cardiovascular complications and progression to renal failure. So far, clinical trials involving CKD patients have all been designed to assess low blood pressure on renal progression as the primary endpoint. Cardiovascular data from these trials are inconclusive and were reviewed in some detail in last year's report. Blood pressure guidelines take no account of epidemiological data that describe a U-shaped relationship between baseline systolic blood pressure and 1 year mortality. Several reports show higher cardiovascular mortality for haemodialysis patients with baseline pre and post systolic blood pressure <110 mmHg[5,6]. The UK Renal Registry has also shown increased all-cause mortality at 1 year for incident haemodialysis patients with baseline pre and post systolic blood pressure <120 mmHg[7]. This raises concern that achieving lower blood pressure targets may be detrimental for some dialysis patients. In 2006, two studies of USA haemodialysis patients analysed the changing relationship of blood pressure with mortality over several years. In the first, hazard ratios for three year all-cause mortality for 56,338 incident patients were 2.5 for a baseline systolic blood pressure <120 mmHg and 1.4 for baseline systolic blood pressure 120–139 mmHg[8]. Hazard ratios were 5.5 and 1.9 respectively when blood pressure variability was included in the analysis. In the second study[9] the hazard ratio for two year all-cause mortality for 16,959 incident patients was 1.7 for baseline systolic blood pressure 110–119 mmHg. Interestingly, the hazard ratio fell to 0.8 and 0.7 for the third and fourth year respectively. This is the first data to suggest achieving low blood pressure guidelines may be beneficial for dialysis patients. In the same study a baseline systolic blood pressure >170 mmHg was only associated with increased all-cause mortality after three years. Intuitively one would expect early deaths to affect patients with established heart failure as hypertension precedes cardiac failure by many years but neither study included co-morbidity data to delineate causal associations. Finally, data from the Irbesartan Diabetic Nephropathy Trial[10] showed improved renal function and patient survival down to a systolic blood pressure of 120 mmHg. Below this, all-cause mortality increased (relative risk 1.25) for both patients with and without pre-existing cardiovascular disease. It will be difficult to prove whether low blood pressure may be beneficial as poor health is a common confounding factor in renal patients.

Last year less than one third of patients on RRT in England and Wales achieved the blood pressure standard. However, the renal unit at

York consistently achieves the best blood pressure results across all treatment modalities suggesting a rational approach to monitoring and therapy. Their patients are sent to a dietician for salt restriction initially. Then patients achieve dry weight by ultrafiltration or diuretics. Finally, antihypertensive medication is increased. Several publications in the last year support this strategy. An audit of 469 prevalent haemodialysis patients dialysing in seven different centres in the UK compared blood pressure control with varying dialysate sodium concentration[11]. All patients were advised to restrict salt intake to 5 g/day. Patients dialysing with sodium concentration 137–139 mmol/L had significantly lower pre and post systolic blood pressure compared to those dialysed against 140 mmol/L. They also had lower interdialytic weight gains and were prescribed fewer antihypertensive drugs. Intradialytic hypotension correlated with age rather than dialysate sodium concentration. Similarly, a prospective study of 46 prevalent peritoneal dialysis patients in Turkey showed reduced salt intake and use of hypertonic solutions could maintain blood pressure below 130/85 mmHg over a two year period without antihypertensive medication[12]. Left ventricular hypertrophy was detected in only 8% of patients after two years. No patient lost residual renal function, ultrafiltration rate or dialysis adequacy during the study. The published evidence suggests salt and water balance is important to achieve blood pressure standards in dialysis patients.

Blood Pressure Control

The RA standards for control of hypertension were established in August 2002:

Pre-haemodialysis blood pressure <140/90 mmHg.

Post-haemodialysis, peritoneal dialysis and renal transplant blood pressure <130/80 mmHg.

Methods

The Registry extracts quarterly blood pressure data electronically from UK renal units. Data from Northern Ireland is included for the first time this year. A single blood pressure reading is extracted for each patient, the last BP recorded in quarter four. If this is not available, the last BP from quarter three is taken. Patients with no blood pressure data for the last two quarters of 2005 are excluded. All patients with data are included in the statistical analysis. Renal units with sparse data for a given treatment modality (data for less than 50% of patients or less than 20 patients) are omitted from renal unit level results/figures. This approach is taken because small numbers do not skew the data but do give unreliable estimates at the renal unit level.

Each year a number of analyses are performed for the prevalent cohort on RRT (see Appendix at the end of the Chapter for definition of prevalent cohort). This report presents data for 2005.

- Completeness of data is analysed at renal unit and national level for patients on haemodialysis, peritoneal dialysis and renal transplant recipients.

- Distributions of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and pulse pressure (PP) are defined for different treatment modalities. Maximum and minimum values are recorded and average values (mean and median), standard deviations and quartile ranges calculated. The data are presented as caterpillar plots showing median values and quartile ranges for renal units and nations. Data were also analysed by primary diagnosis. The number preceding each centre name indicates the percentage of patients with missing data at that centre.

- These data are analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges). These data are represented as caterpillar plots showing median values and quartile ranges. Where applicable, the percentage achieving Renal Association or other surrogate standard is also calculated and represented as caterpillar plots with 95% confidence intervals. For the percentage achieving standards, chi-squared testing is used to identify significant variability between centres and countries. Data are also analysed by primary diagnosis.

Results

Data Returns

Poor returns (less than 50%) were obtained from 20 centres for HD data, 31 centres for PD data and 35 centres for Tx data (Table 10.1). For most renal units, the problem is in transferring the clinical data to their renal IT systems. For a few units, the data may not be extracted from the correct database table within their renal IT system, in which case they should contact the Registry directly.

Overall the completeness of returns is improving but still remains poor for transplant patients. Northern Ireland is omitted from the figures for PD as data is available for only twelve patients.

Distribution of blood pressure by modality

Figures 10.1 and 10.2 show histograms of systolic and diastolic blood pressure, for pre-HD data. Blood pressure distributions for post-HD, PD and Tx are also approximately normal. Peaks above the curve indicate digit bias. Figure 10.3 shows systolic, diastolic and pulse pressure distributions for each modality (post-HD data is shown).

The median blood pressure pre-HD, post-HD, PD and Tx is 143/75, 128/69, 136/80 and 136/79 mmHg. Median pulse pressure for each group is 66, 59, 57 and 57 mmHg respectively. The HD population has the widest spread for blood pressure. Standard deviations (SBP/DBP) pre-HD, post-HD, PD and Tx are 26/15, 25/14, 23/13 and

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	7	3	0	0	Middlesbrough	97	96	100	52
Bangor	88	88	100	0	Newcastle	0	0	0	1
Barts	0	0	0	0	Newry	0	0	0	4
Basildon	99	99	87	4	Norwich	99	98	4	0
Belfast	86	85	18	22	Nottingham	99	99	100	88
Bradford	2	2	100	94	Oxford	87	84	82	10
Brighton	6	6	0	0	Plymouth	0	0	0	0
Bristol	100	99	98	69	Portsmouth	0	99	0	0
Cambridge	66	65	1	0	Preston	0	0	0	0
Cardiff	5	0	4	94	QEH	37	0	0	0
Carlisle	93	93	0	0	Reading	96	49	99	96
Carshalton	78	77	1	0	Royal Free	0	0	0	0
Chelmsford	98	98	91	22	Sheffield	100	97	99	97
Clwyd	4	2	75	86	Shrewsbury	100	99	18	5
Coventry	99	97	90	72	Southend	96	95	0	0
Derby	98	98	95	0	Stevenage	99	98	16	1
Dorset	99	99	68	11	Sunderland	96	96	0	0
Dudley	77	77	62	81	Swansea	79	79	18	9
Exeter	99	99	91	23	Truro	77	76	68	91
Gloucester	96	0	0	0	Tyrone	95	94	0	0
Guys	73	73	6	1	Ulster	100	97	100	50
H&CX	0	0	0	0	Wirral	3	0	4	n/a
Heartlands	94	94	0	1	Wolverhampton	3	99	98	85
Hull	92	92	57	1	Wrexham	0	0	0	n/a
Ipswich	99	98	92	94	York	100	99	100	95
Kings	0	0	0	0	England	58	58	43	30
Leeds	98	98	96	68	Northern Ireland	64	62	12	15
Leicester	95	92	96	81	Wales	32	30	18	81
Liverpool	19	2	29	71	England, Northern Ireland and Wales	57	56	40	32
ManWst	0	0	0	0					

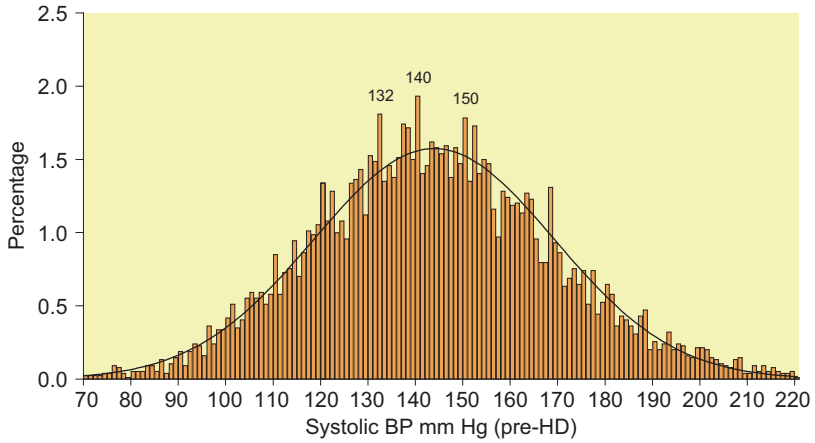

Figure 10.1: Systolic BP distribution pre-HD

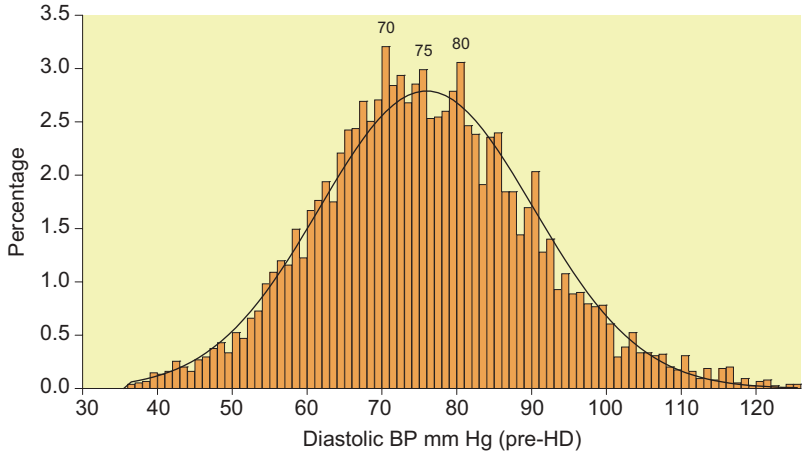

Figure 10.2: Diastolic BP distribution pre-HD

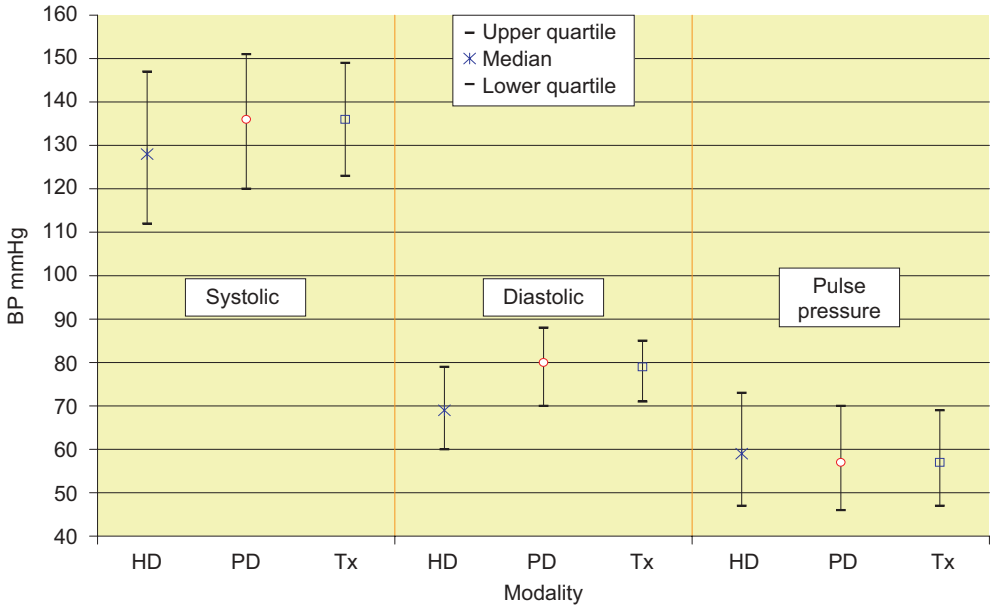

Figure 10.3: Summary of BP achievements

19/11 respectively. This compares to 18/10 for a hypertensive population. Last year in a single centre study of 317 prevalent HD patients, the Registry showed blood pressure was significantly higher at the start of the dialysis week. The wider blood pressure distribution for HD may partially therefore reflect the random timing of readings and influence of fluid overload.

Achievement of combined systolic and diastolic Standard

Figures 10.4–10.7 show a wide variation between renal units 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 averages 43% (range over renal units 16–60%) and post-dialysis averages 48% (range 22–66%). Only 27% of PD patients achieve the standard (range 12–48%) and 26% of Tx patients (range 16–40%). Chi squared testing indicates the variation between centres for HD and Tx is significant ($p < 0.001$) but not for PD. The variation between nations is also significant for HD and Tx ($p \leqslant 0.008$) but not for PD. The results are similar to last year and show control of hypertension remains inadequate across all treatment modalities but is significantly better in the HD population.

Systolic pressure alone

Figures 10.8–10.15 show wide variation between renal units achieving the systolic blood pressure (SBP) standard. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averages 45% (range 19–62%) and post-dialysis averages 51% (range 30–69%). On average 37% of PD patients achieve the standard (range 12–59%) and 35% of Tx patients (range 24–55%). Chi squared testing indicates that the variation

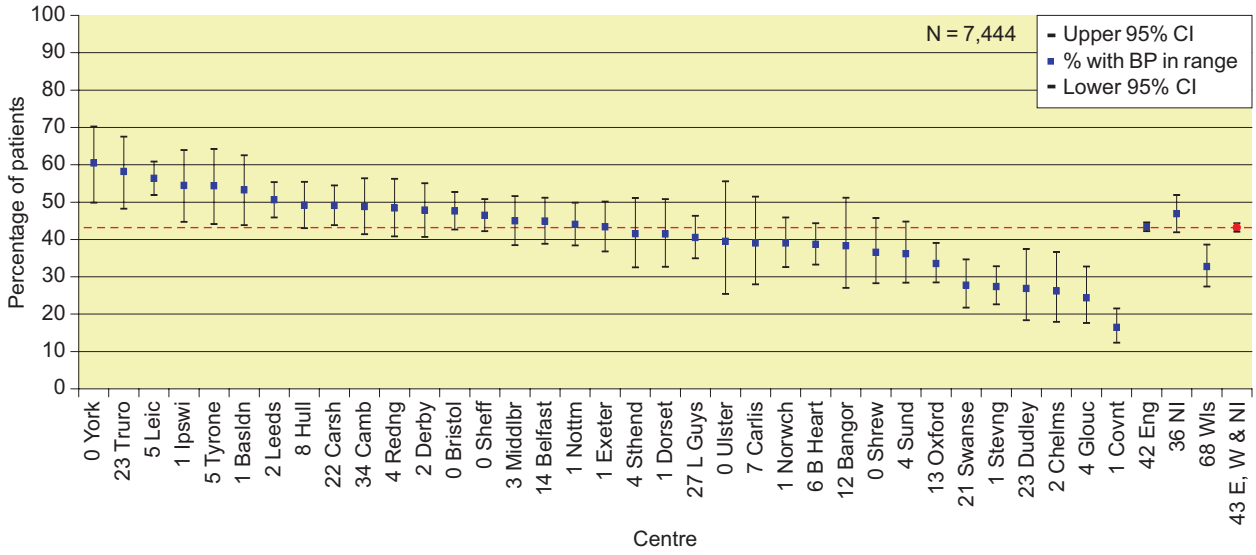

Figure 10.4: Percentage of patients with BP <140/90 mmHg: pre-HD

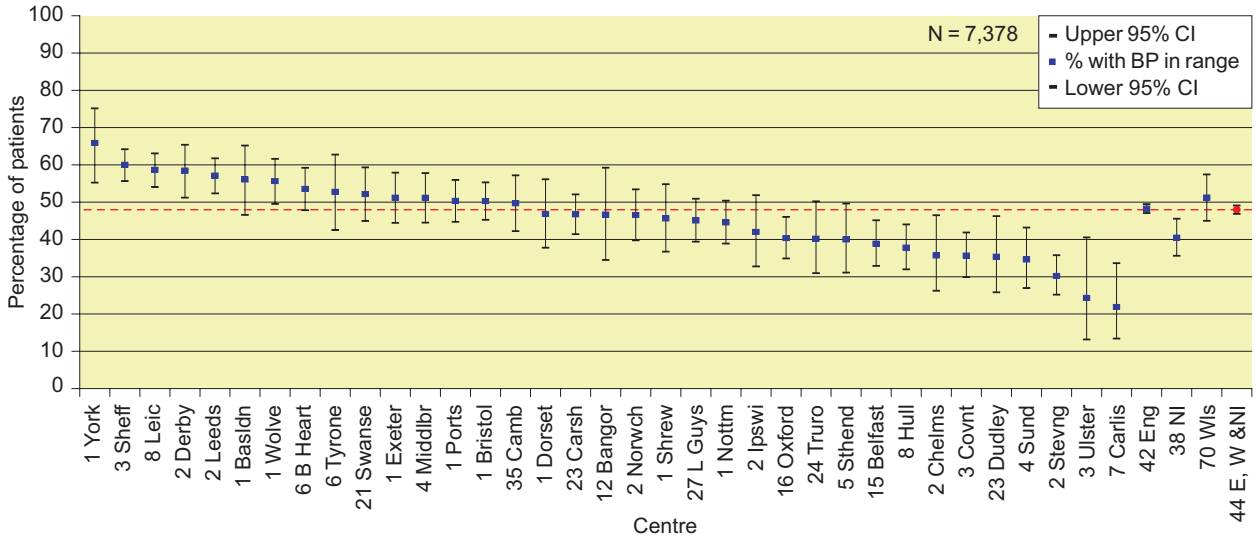

Figure 10.5: Percentage of patients with BP <130/80 mmHg: post-HD

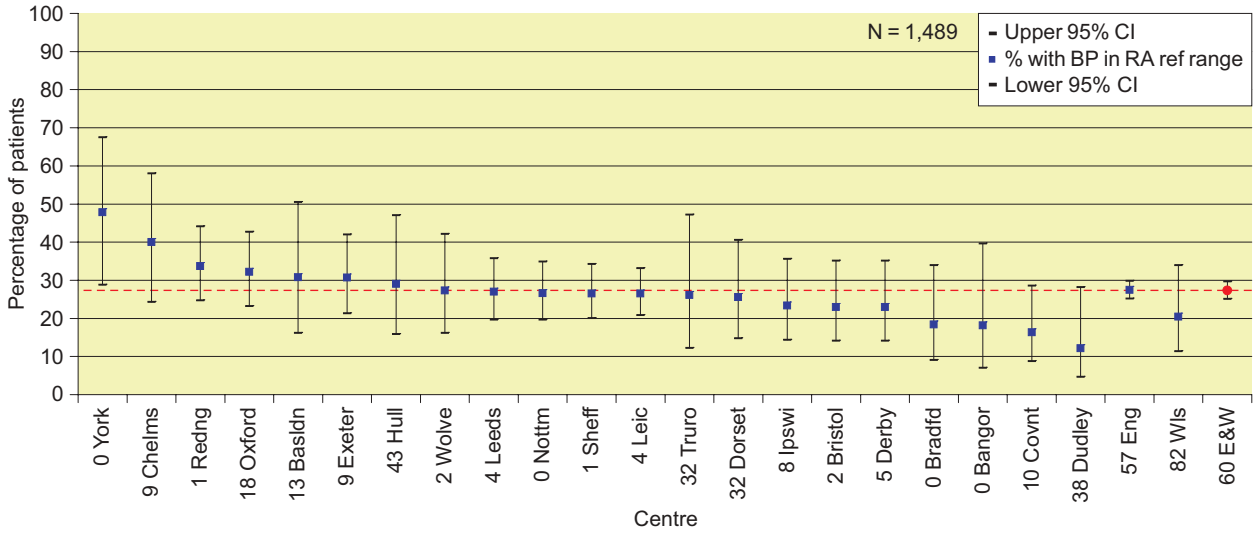

Figure 10.6: Percentage of patients with BP <130/80 mmHg: PD

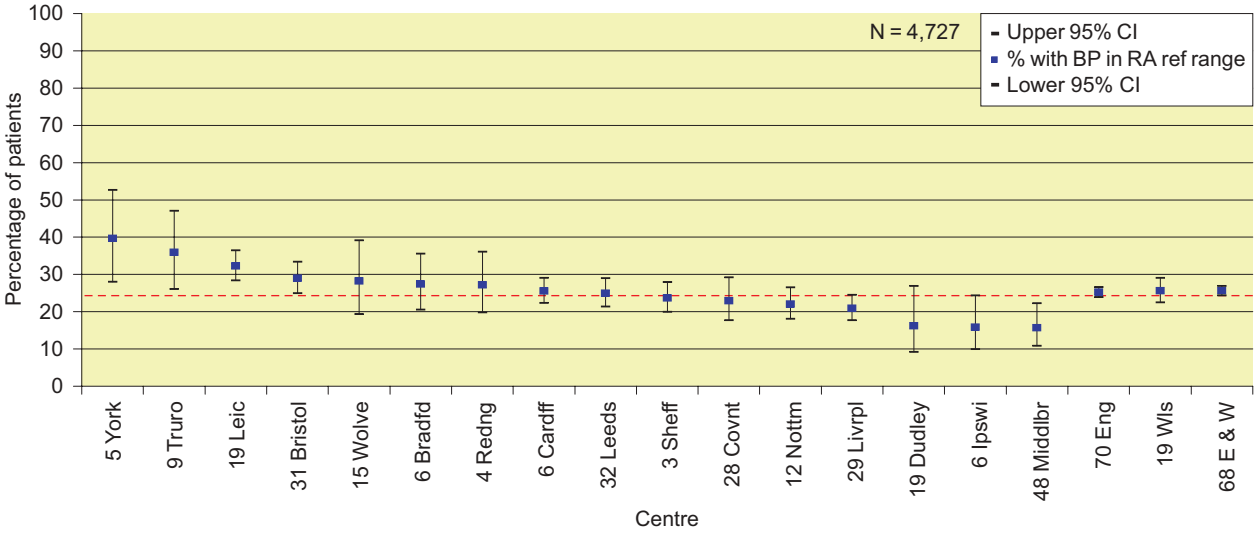

Figure 10.7: Percentage of patients with BP <130/80 mmHg: Tx

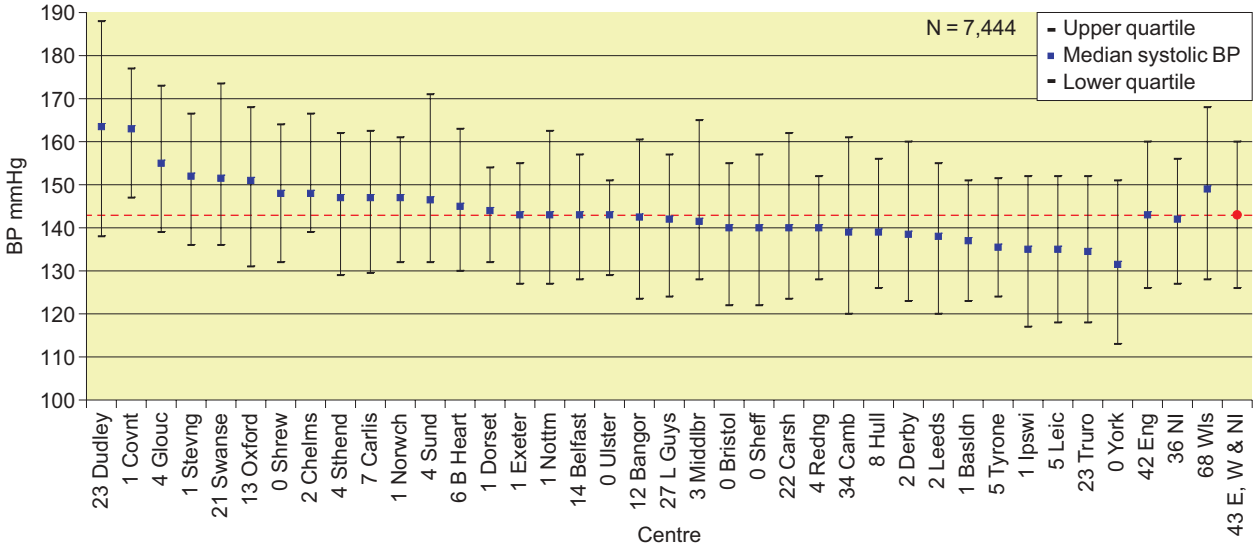

Figure 10.8: Median systolic BP: pre-HD

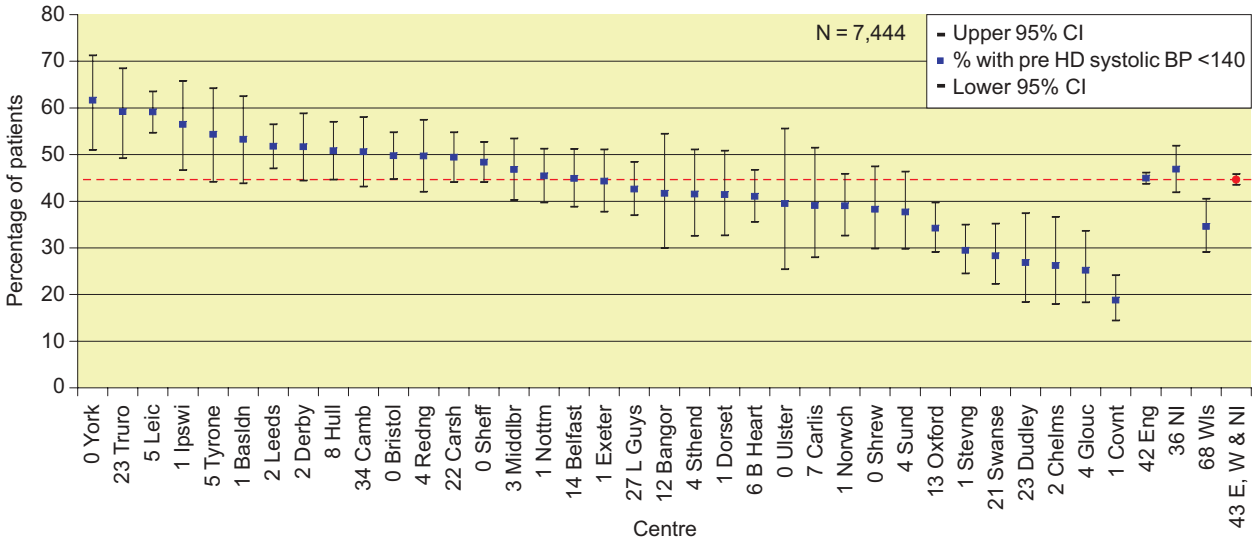

Figure 10.9: Percentage of patients with systolic BP <140 mmHg: pre-HD

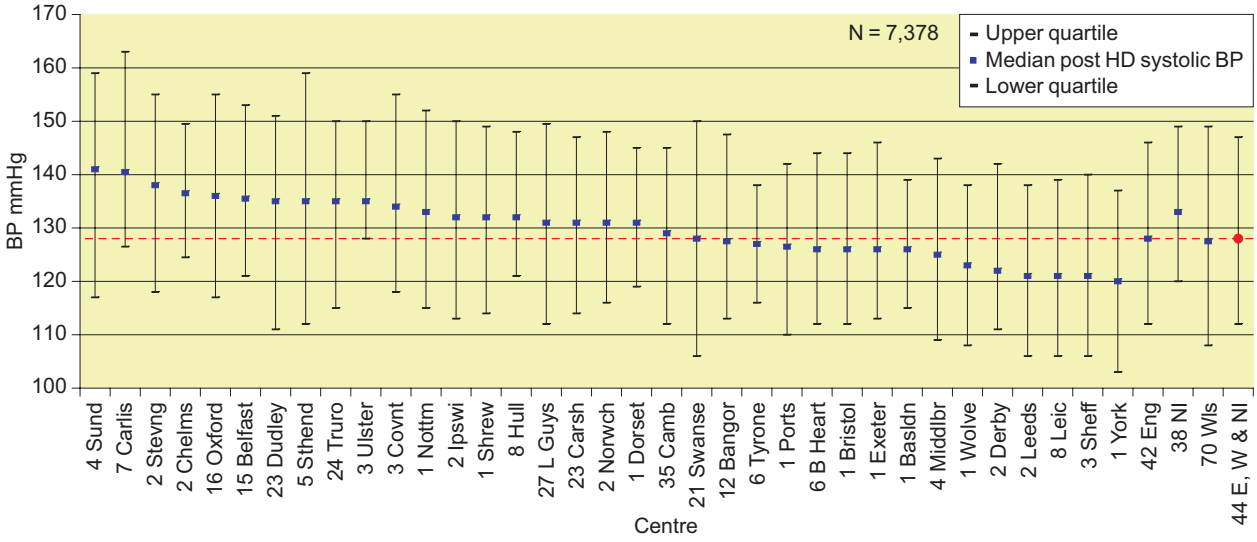

Figure 10.10: Median systolic BP <130 mmHg: post-HD

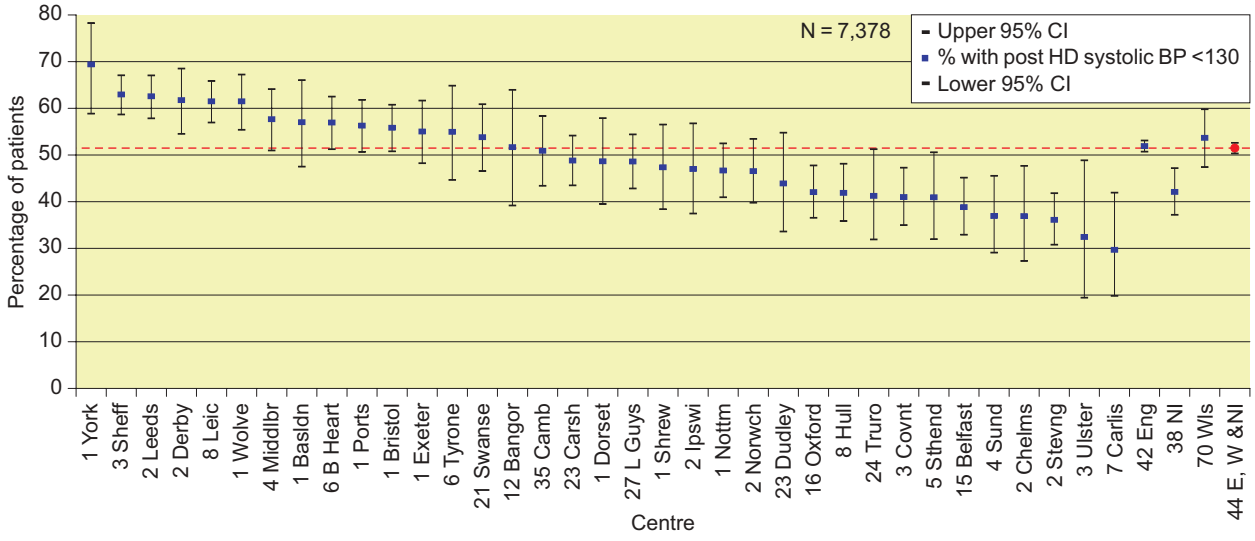

Figure 10.11: Percentage of patients with systolic BP <130 mmHg: post-HD

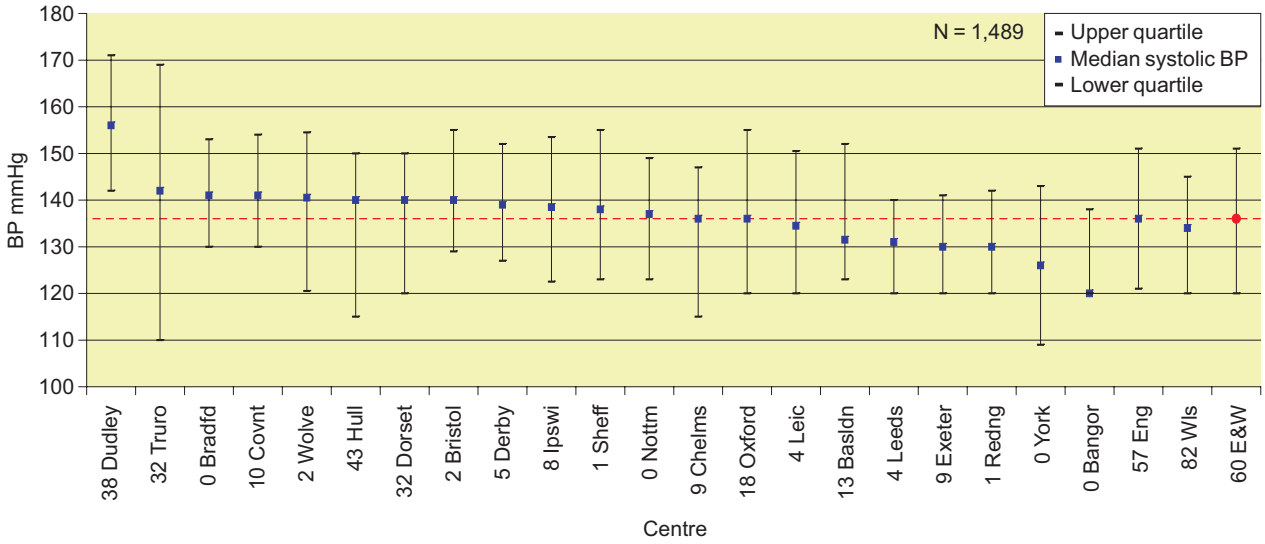

Figure 10.12: Median systolic BP: PD

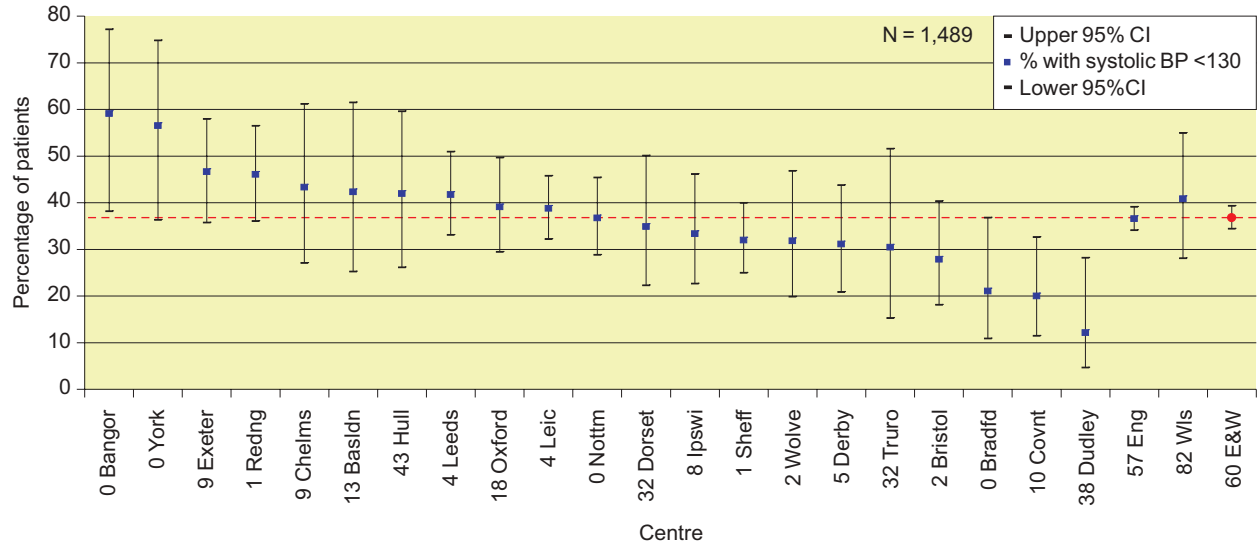

Figure 10.13: Percentage of patients with systolic BP <130 mmHg: PD

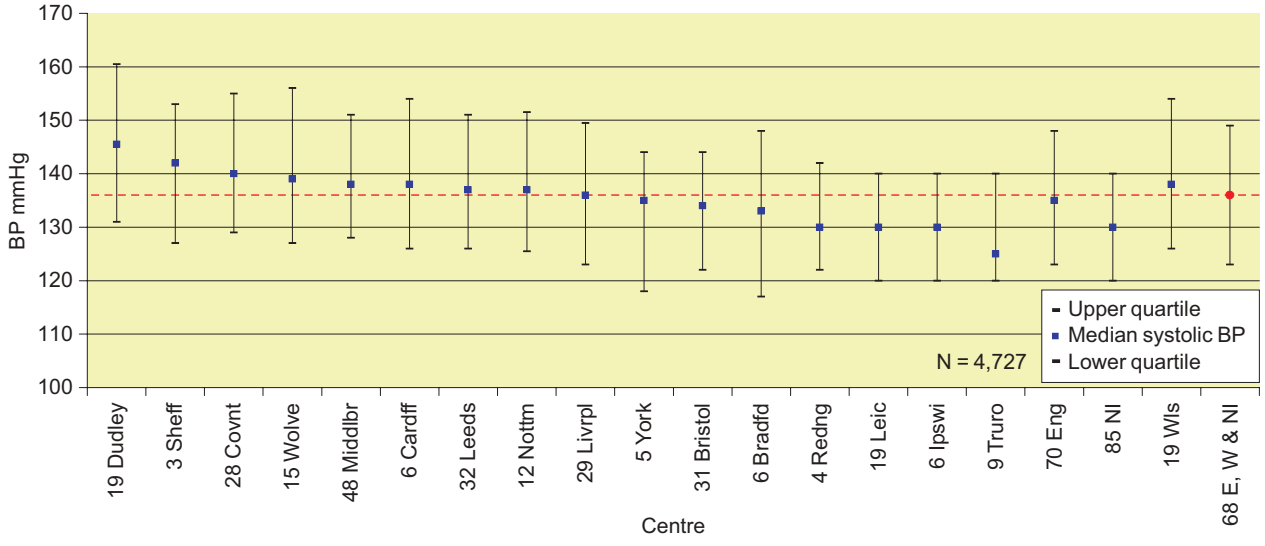

Figure 10.14: Median systolic BP: Transplant

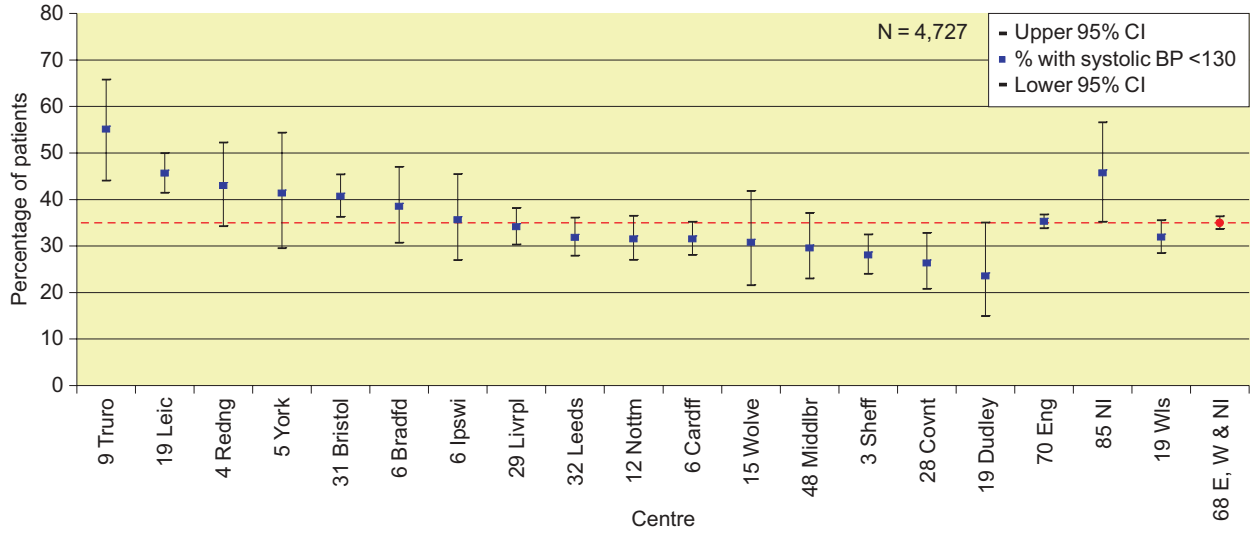

Figure 10.15: Percentage of patients with systolic BP <130 mmHg: Transplant

between centres is significant for each treatment modality ($p \leqslant 0.003$). The variation between nations is significant for HD ($p \leqslant 0.005$) and Tx ($p = 0.029$) but not for PD. Median SBP for pre-HD, post-HD, PD and Tx is 143, 128, 136 and 136 mmHg respectively.

Diastolic pressure alone

Figures 10.16–10.23 show wide variation between renal units achieving the diastolic blood pressure (DBP) standard. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averages 84% (range 69–96%) and post-dialysis averages 77% (range 59–90%). On average 47% of PD patients achieve the standard (range 27–61%) and 52% of Tx patients (range 30–74%). Chi squared testing indicates the variation between centres for HD and Tx is significant ($p < 0.001$) but not for PD. The variation between nations is significant for pre-HD and Tx ($p < 0.001$) but not for post-HD or PD.

The median DBP for pre-HD, post-HD, PD and Tx is 75, 69, 80 and 79 mmHg respectively. The median, and lower quartile for Tx DBP in Northern Ireland are both 70 mmHg. These values are the same because there are only 81 observations and there is evidence of digit bias. The data shows approximately half (50.6%) of the observations recorded as exactly 70 mmHg. It is not clear whether DBP is lowest post-HD

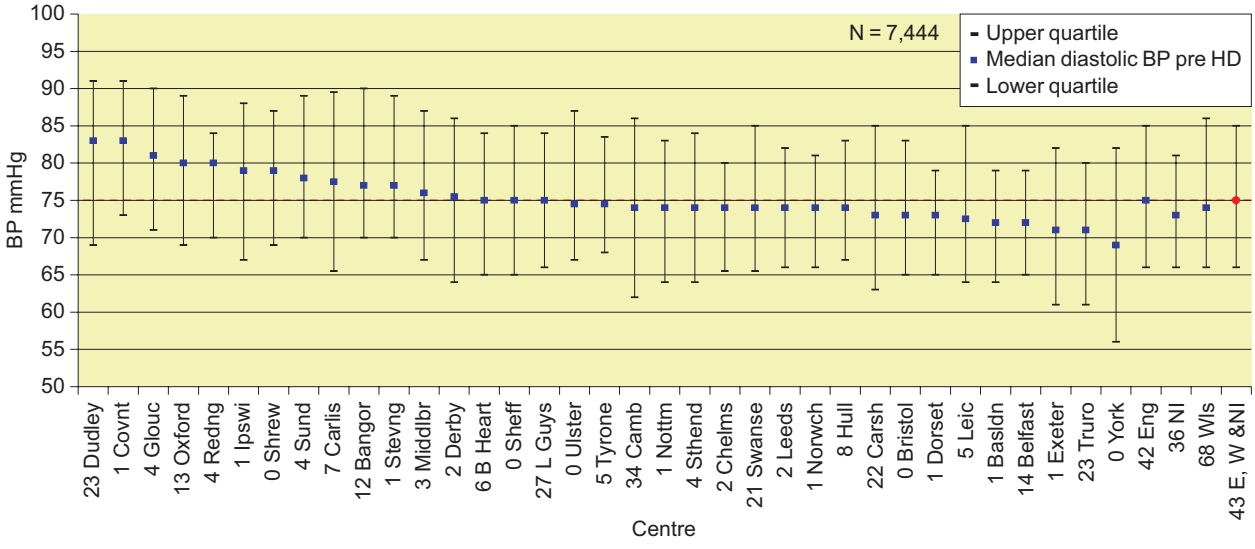

Figure 10.16: Median diastolic BP: pre-HD

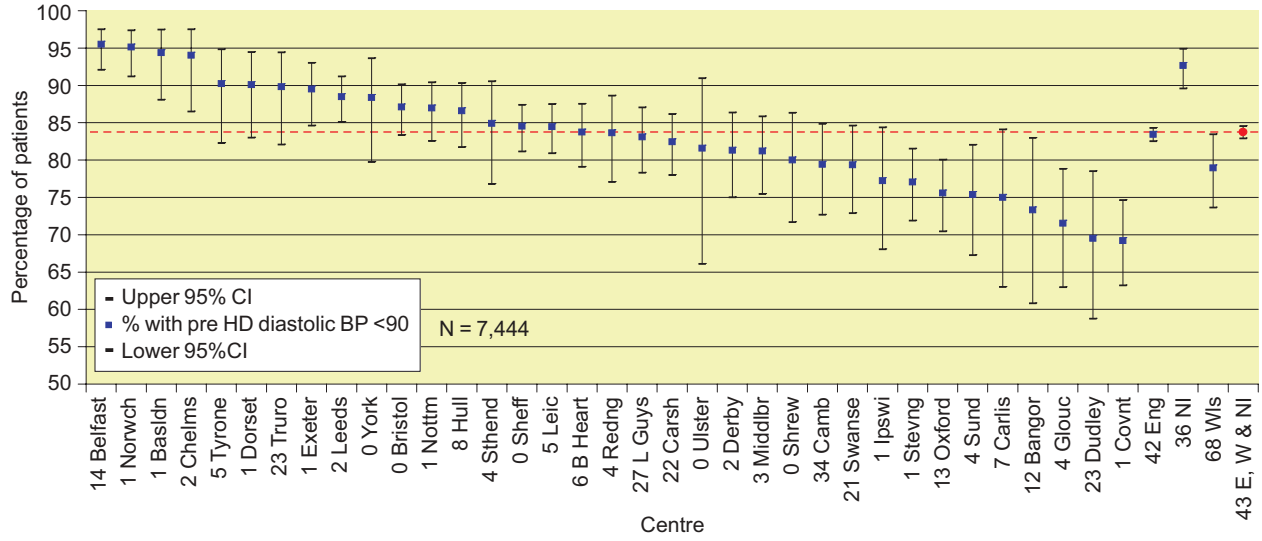

Figure 10.17: Percentage of patients with diastolic BP <90 mmHg: pre HD

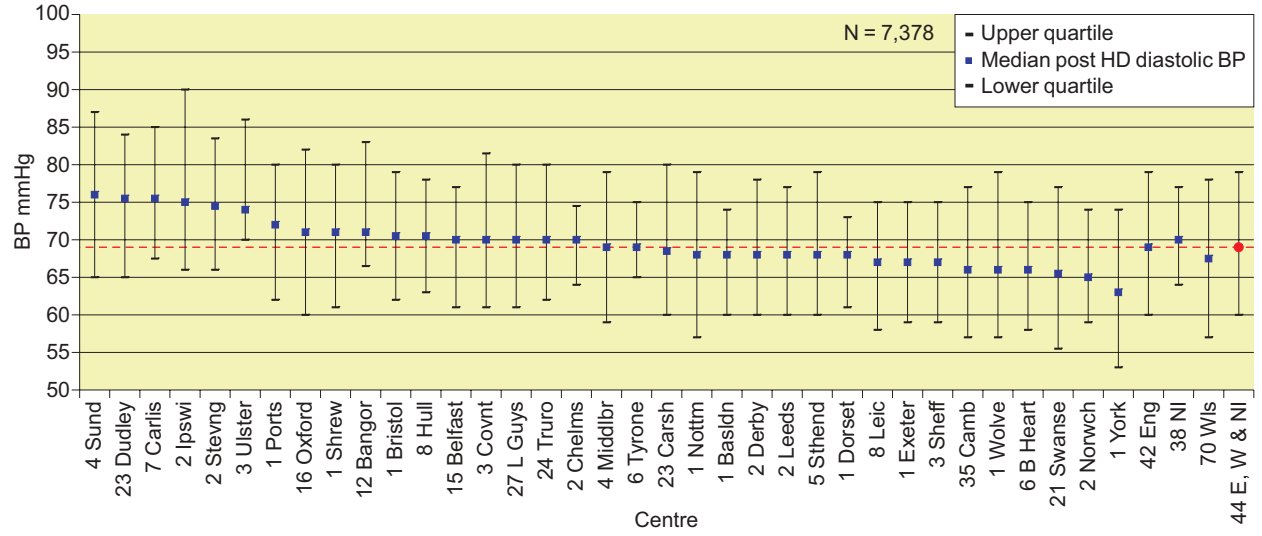

Figure 10.18: Median diastolic BP: post-HD

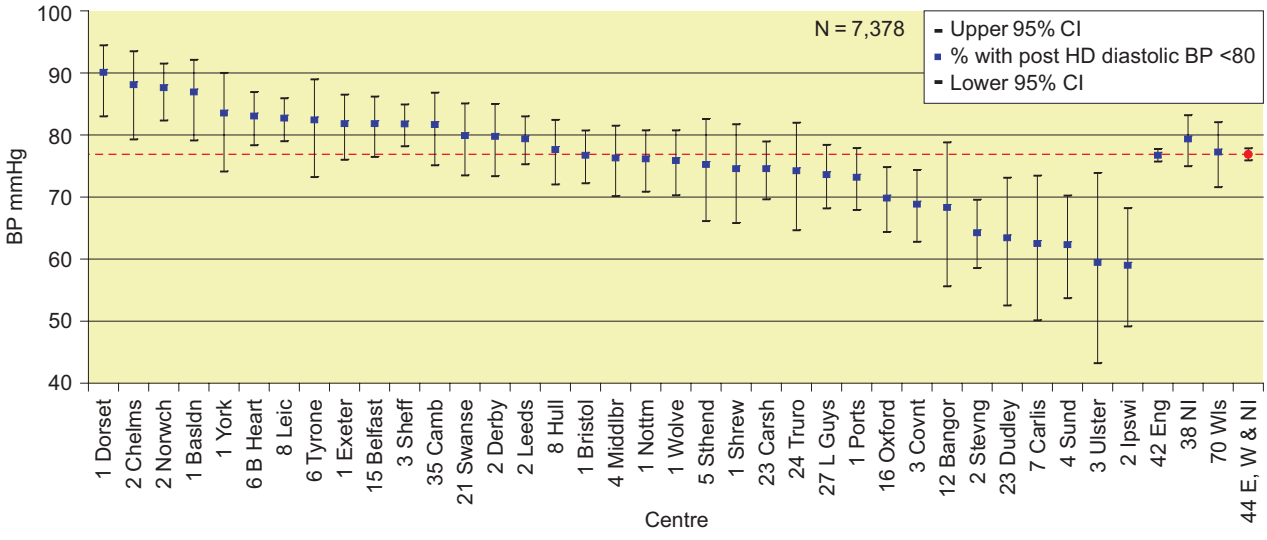

Figure 10.19: Percentage of patients with diastolic BP <80 mmHg: post-HD

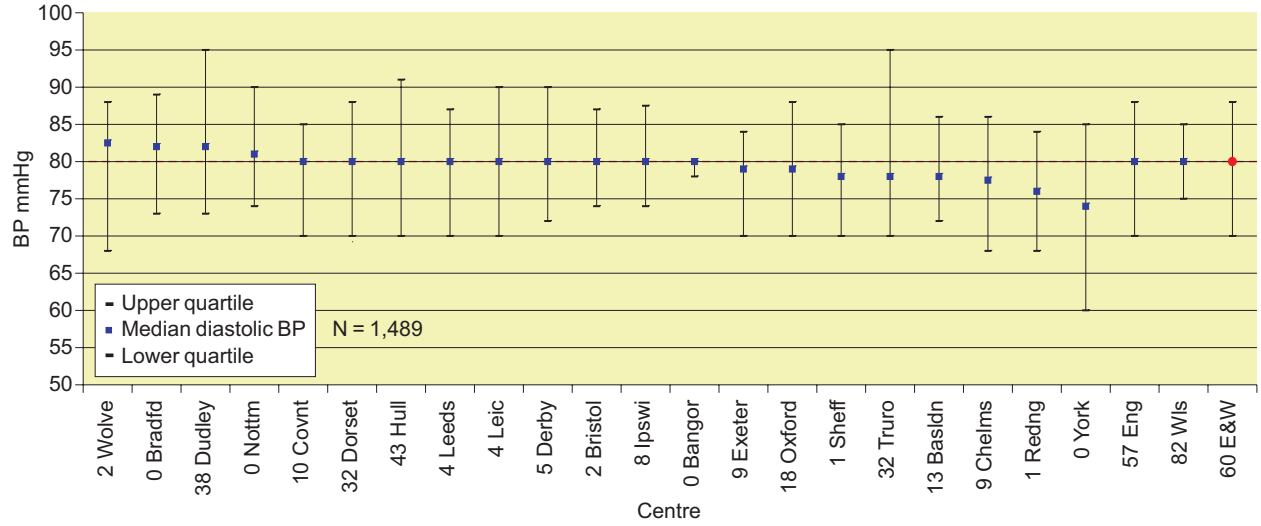

Figure 10.20: Median diastolic BP: PD

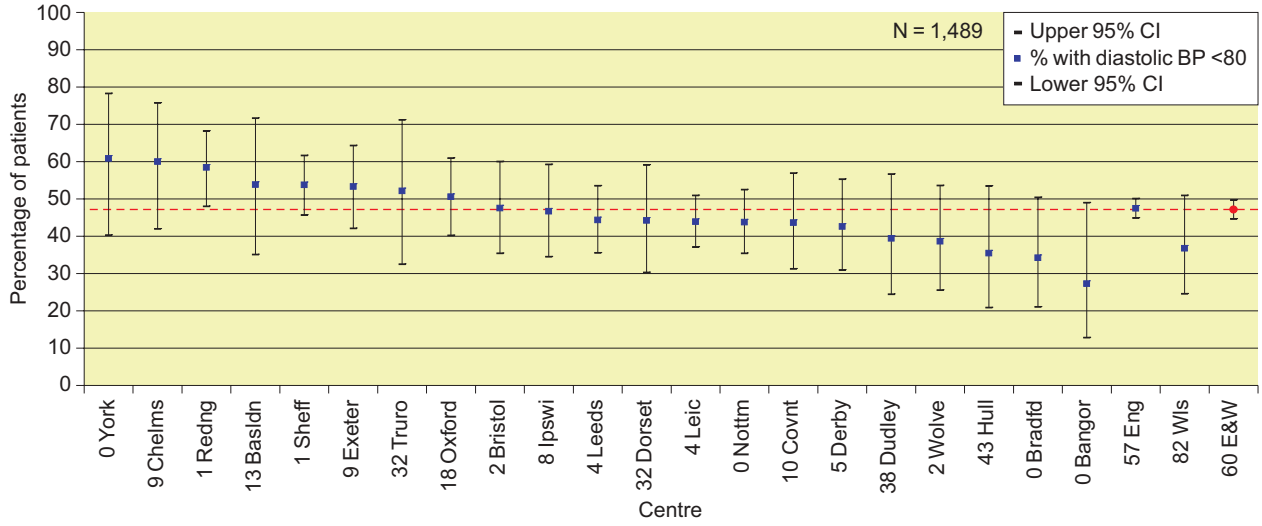

Figure 10.21: Percentage of patients with diastolic BP <80 mmHg: PD

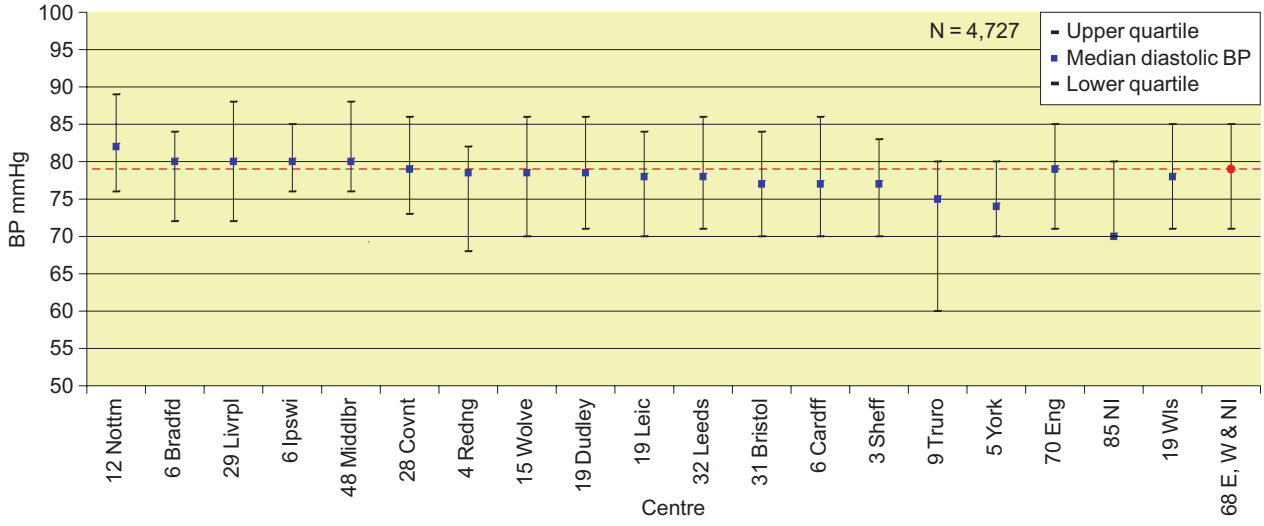

Figure 10.22: Median diastolic BP: Transplant

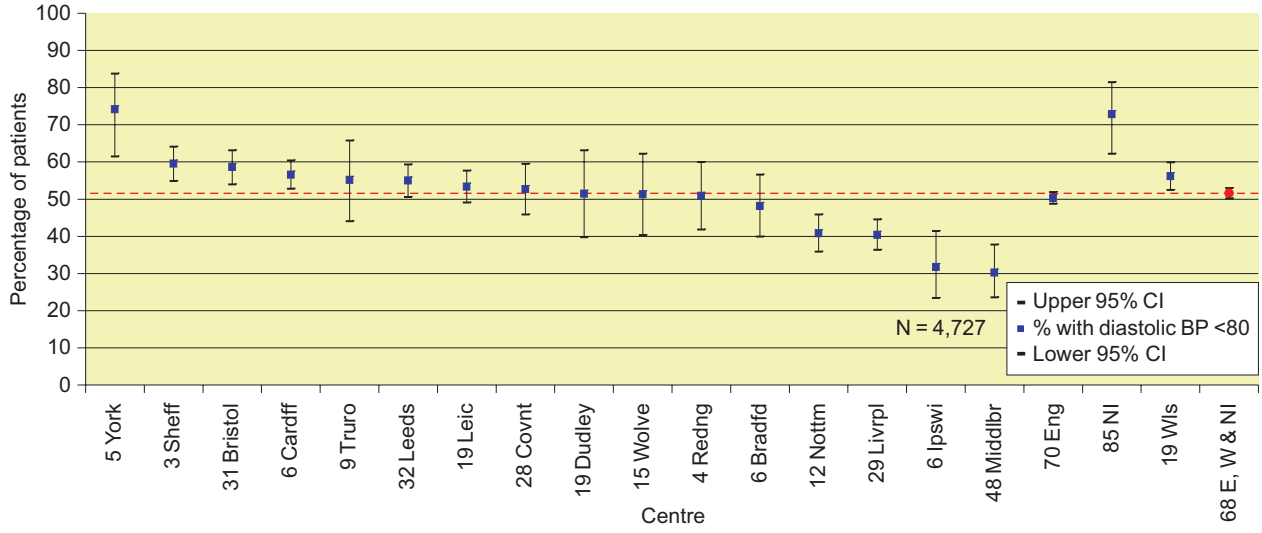

Figure 10.23: Percentage of patients with diastolic BP <80 mmHg: Transplant

because HD patients are older (DBP falls after 60 years of age in the general population due to increasing arterial stiffness) or because of the synergistic effect between ultrafiltration and antihypertensive medication.

Mean arterial pressure

Figures 10.24–10.31 show wide variation between renal units achieving the desired mean arterial pressure (MAP). MAP is 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 averages 72% (range 43–89%) and post-dialysis averages 69% (range 43–80%). On average 48% of PD patients achieve the standard (range 32–68%) and 48% of Tx patients (range 34–74%). Chi squared testing indicates that there is significant variation between centres for HD and Tx ($p < 0.001$). The variation is less marked for PD and is only of borderline significance ($p = 0.052$). The variation between nations is significant for pre-HD ($p = 0.001$) and Tx ($p < 0.001$) but not for post-HD or PD. The median MAP for pre-HD, post-HD, PD and Tx is 98, 89, 98 and 97 mmHg respectively.

Pulse pressure

Figures 10.32–10.35 show the variation between renal units for pulse pressure (PP). PP is calculated as SBP minus DBP. The median pulse pressure for pre-HD, post-HD, PD and Tx is 66, 59, 57 and 57 mmHg respectively. A high

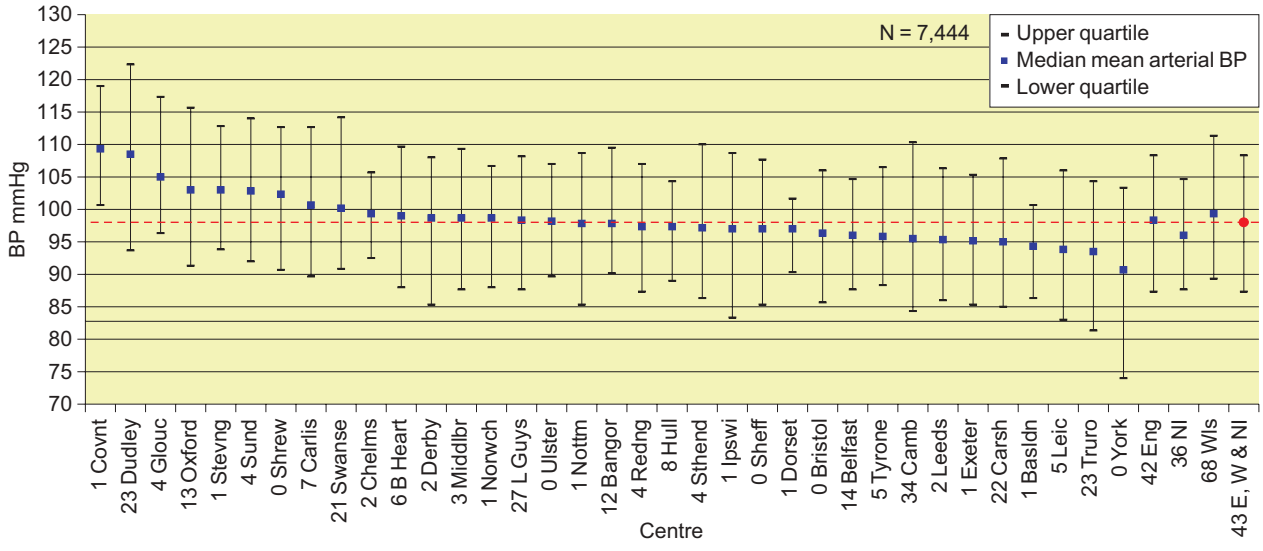

Figure 10.24: Median MAP: pre-HD

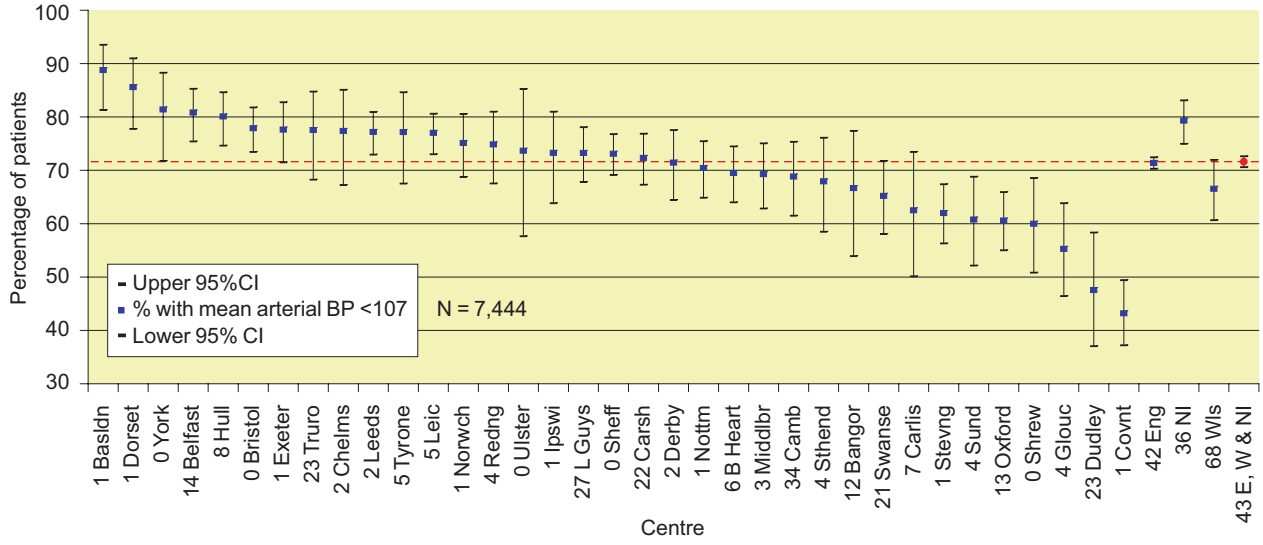

Figure 10.25: Percentage of patients with MAP <107 mmHg: pre-HD

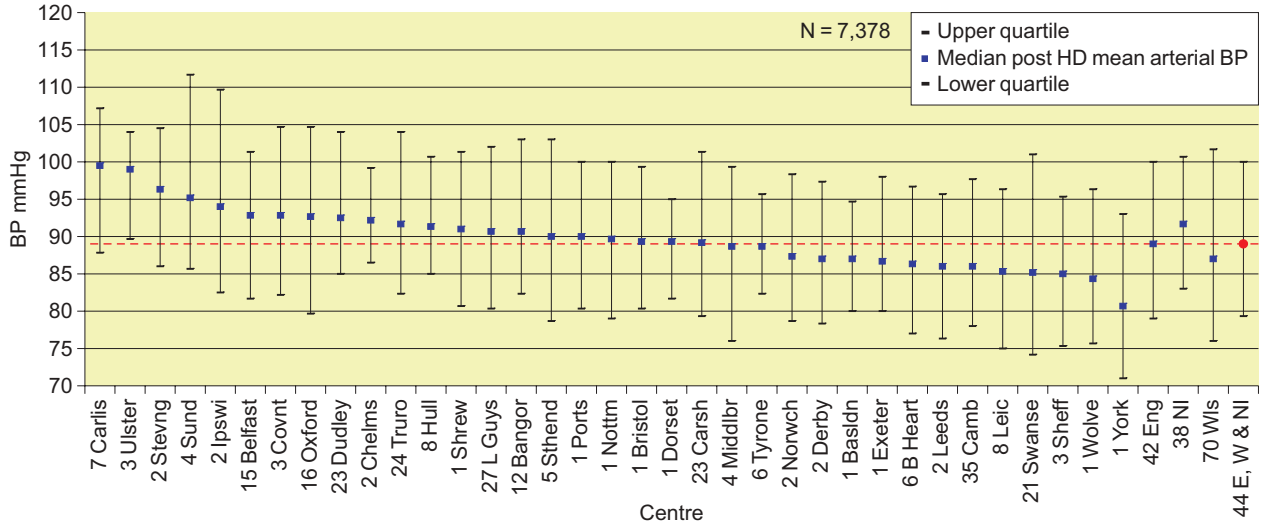

Figure 10.26: Median MAP: post-HD

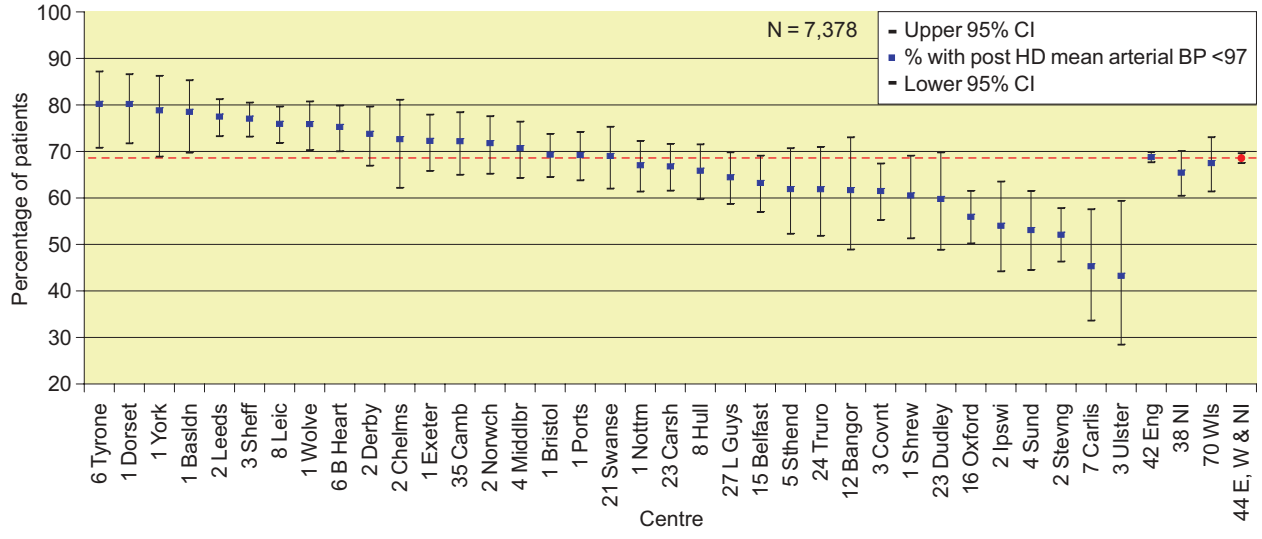

Figure 10.27: Percentage of patients with MAP <97 mmHg: post-HD

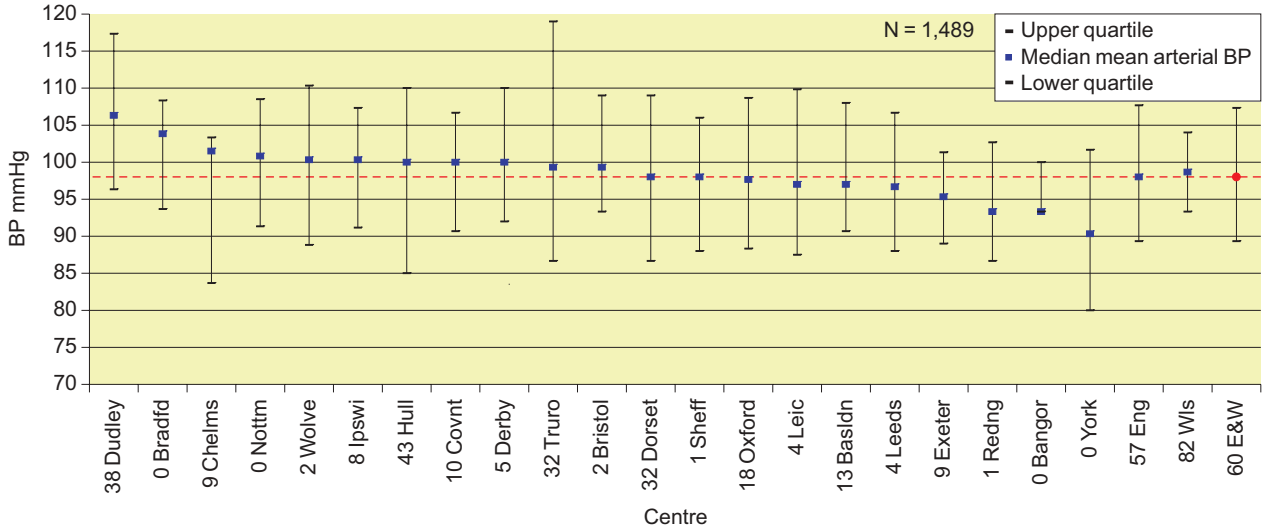

Figure 10.28: Median MAP: PD

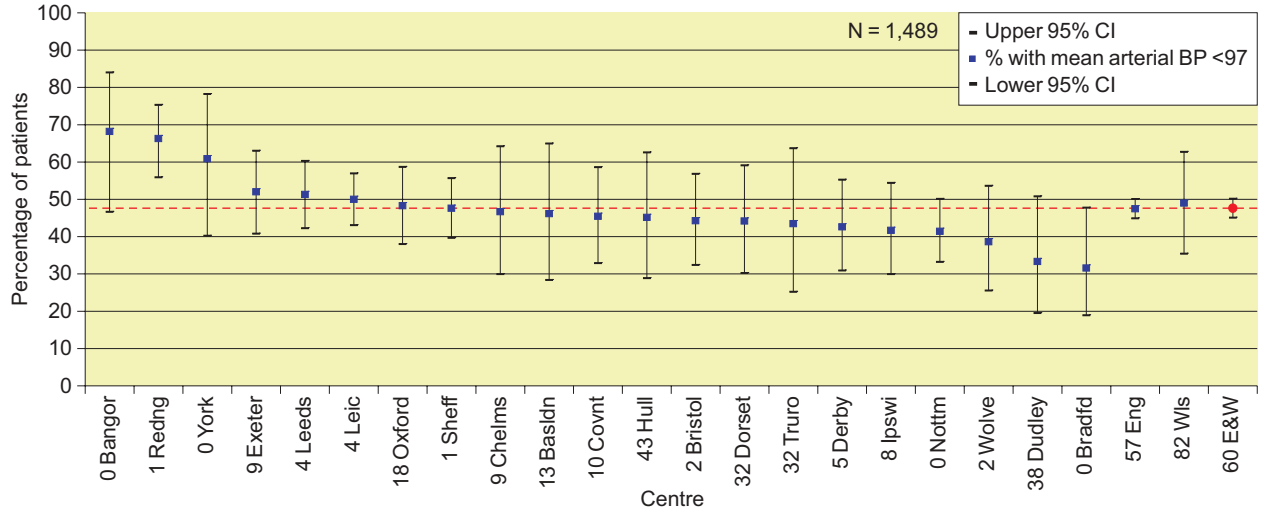

Figure 10.29: Percentage of patients with MAP <97 mmHg: PD

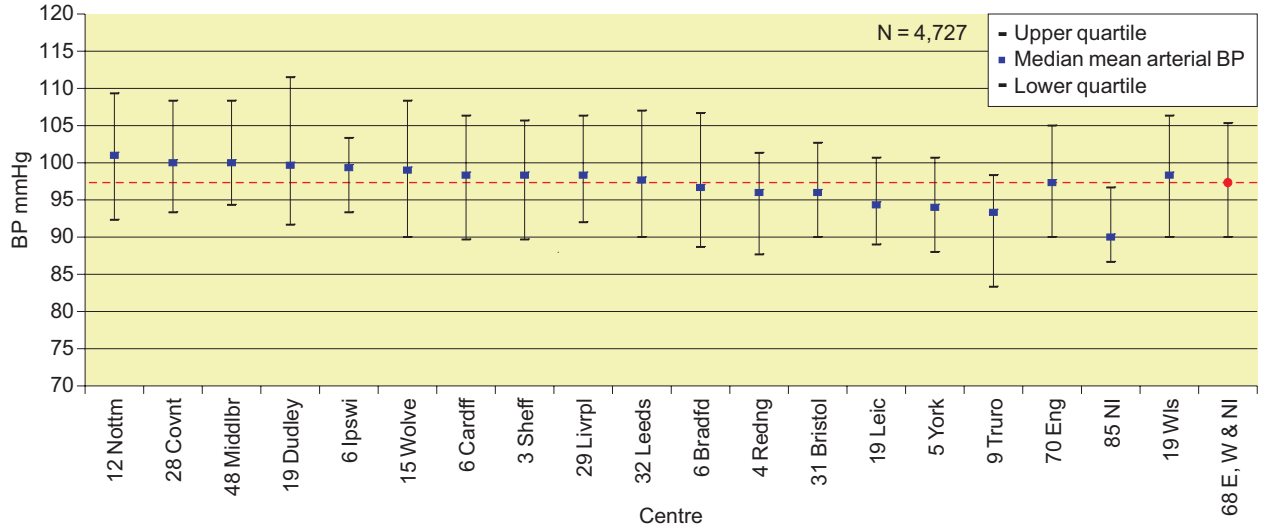

Figure 10.30: Median MAP: Transplant

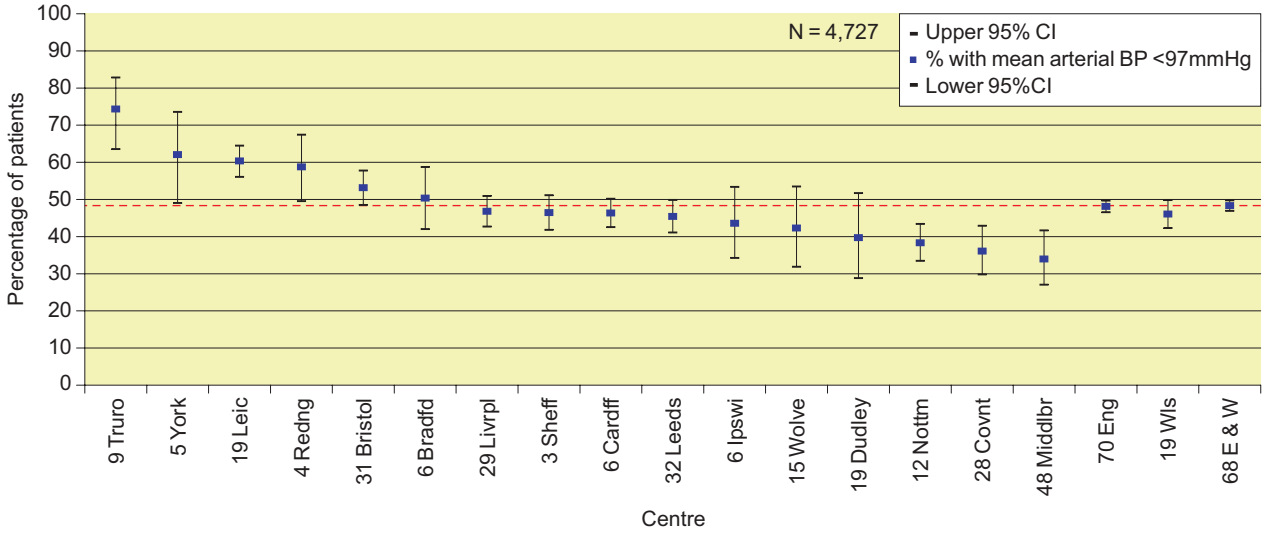

Figure 10.31: Percentage of patients with MAP <97 mmHg: Transplant

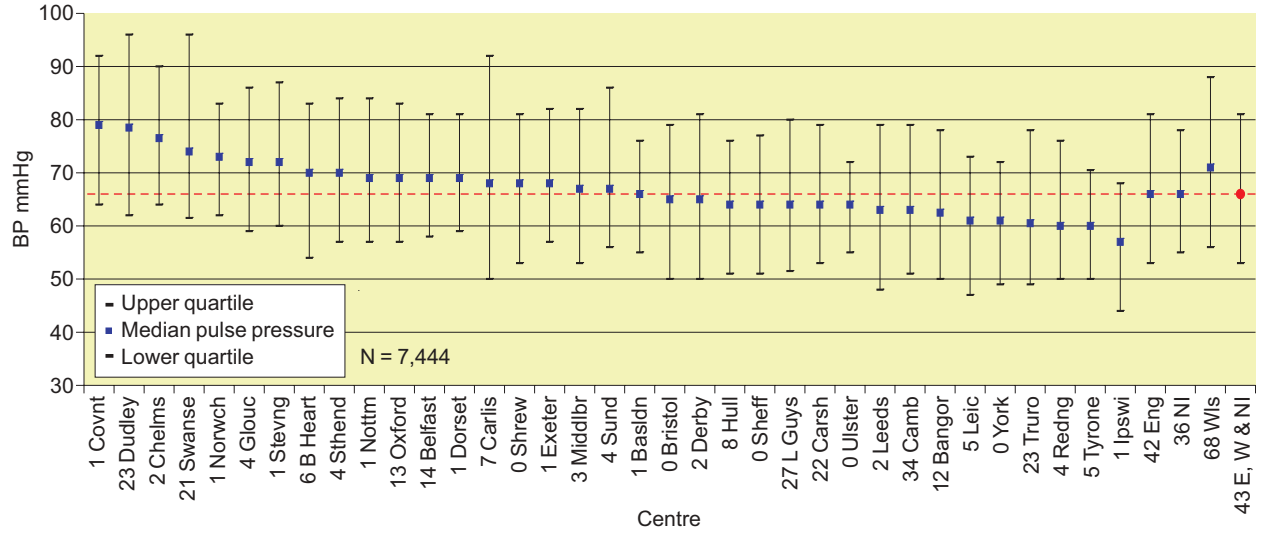

Figure 10.32: Median PP: pre-HD

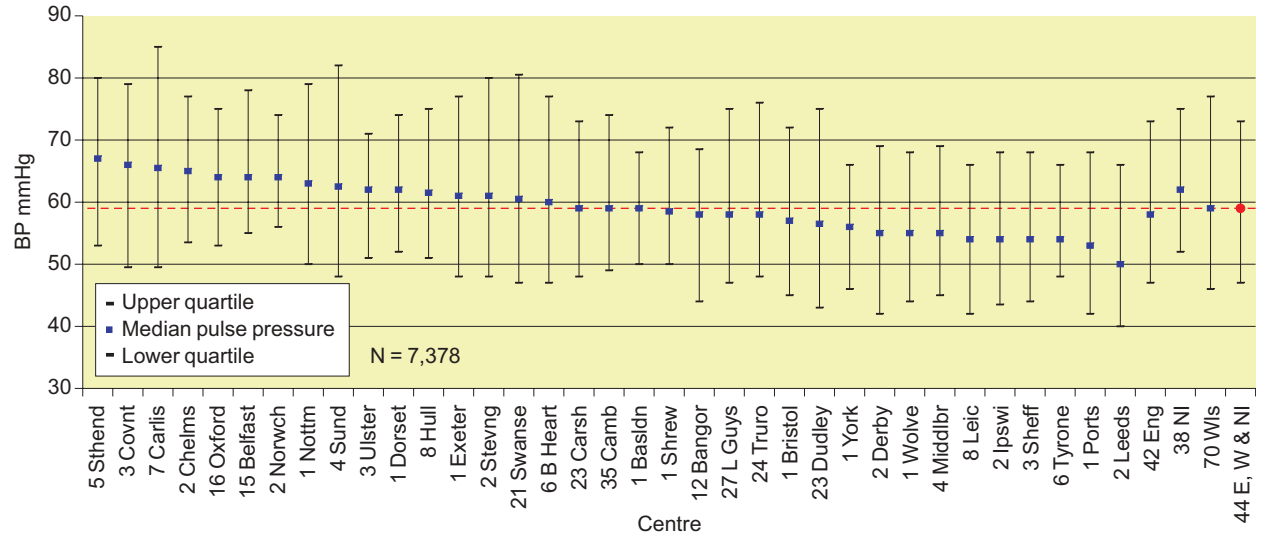

Figure 10.33: Median PP: post-HD

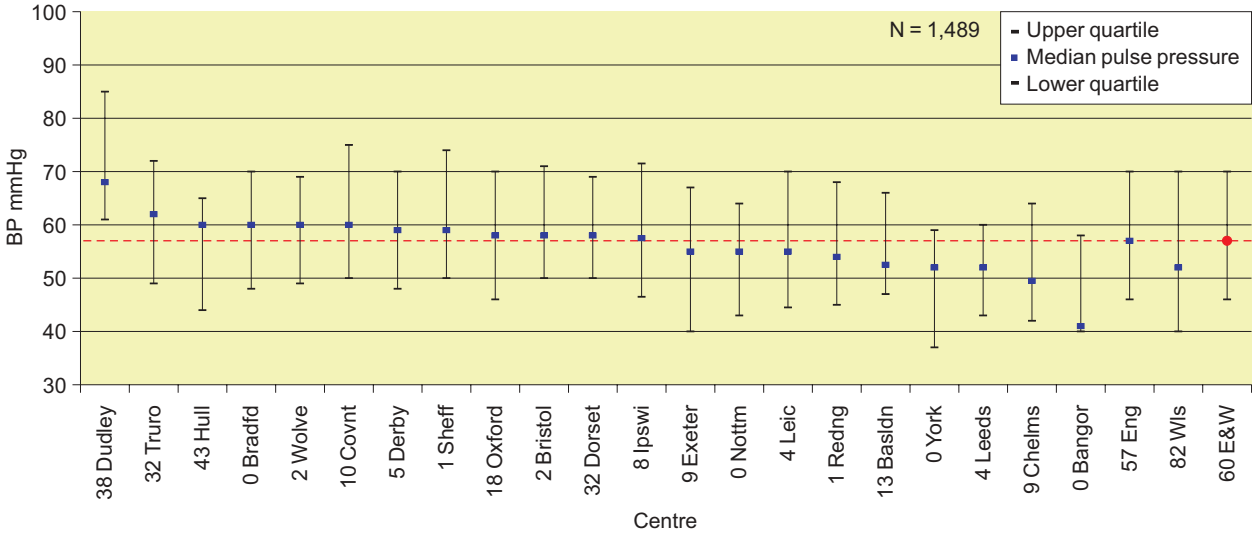

Figure 10.34: Median PP: PD

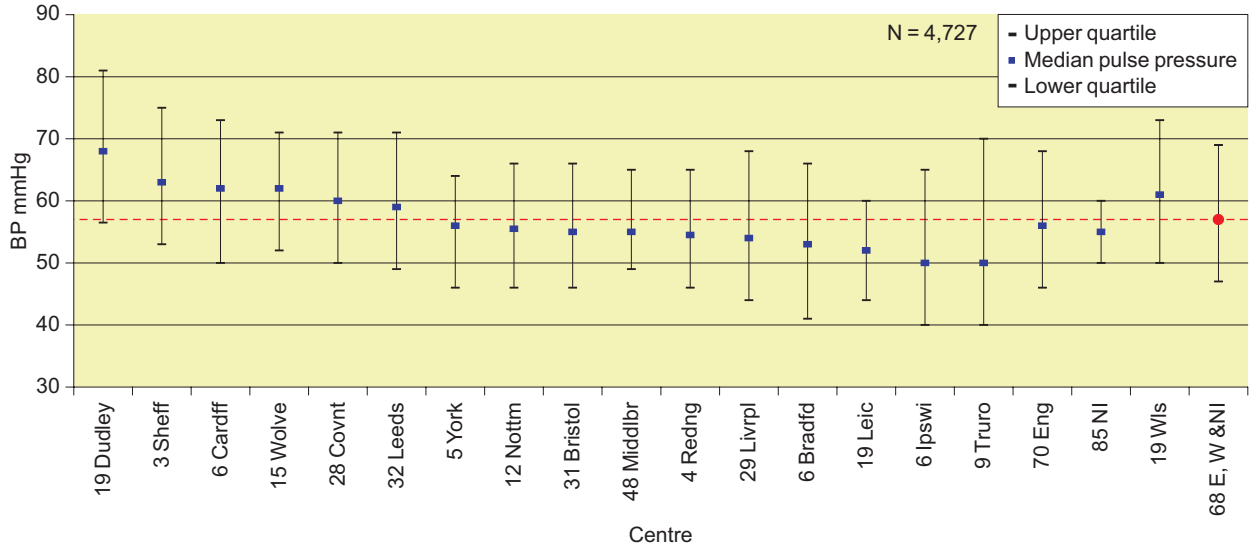

Figure 10.35: Median PP: Transplant

SBP accounts for the wider PP in HD patients pre-dialysis.

Blood pressure by primary diagnosis

Figures 10.36–10.43 show the variation in blood pressure control by primary diagnosis for each treatment modality (post-HD data is shown). Each year in the Registry Report, the data have shown a similar pattern. Systolic blood pressure is highest in patients with macrovascular disease (diabetes and renovascular disease), lower in patients with glomerulonephritis and lower still in patients with tubular disorders (PCKD and pyelonephritis).

Diabetics have the poorest blood pressure control of all the diagnostic groups. While salt intake correlates with water intake in non-diabetics, hyperglycaemia accounts for 50% of water intake by diabetics on HD[13] so may exacerbate hypertension. Blood pressure control is significantly better on HD for all diagnostic groups ($p < 0.0001$ for all groups). Combining groups, the percentage of patients achieving the BP standard on HD compared to PD or Tx are 42% vs 24% for macrovascular disease, 49% vs 26% for glomerulonephritis and 53% vs 26% for tubular disorders ($p < 0.0001$ for each comparison). This may be due to more frequent monitoring and intervention in the HD population. If so, nephrologists will need to devise

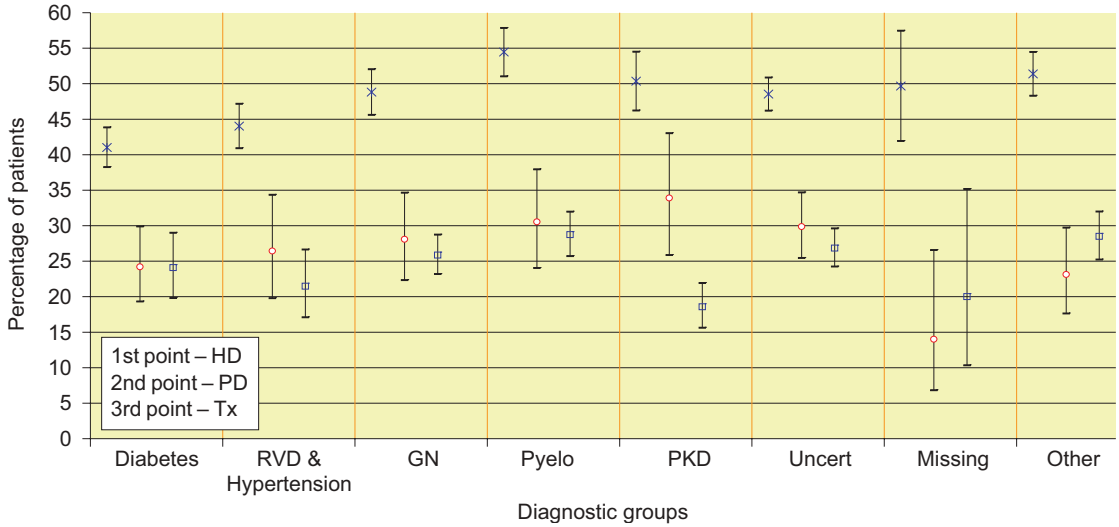

Figure 10.36: Percentage of patients with BP in standards by primary diagnosis

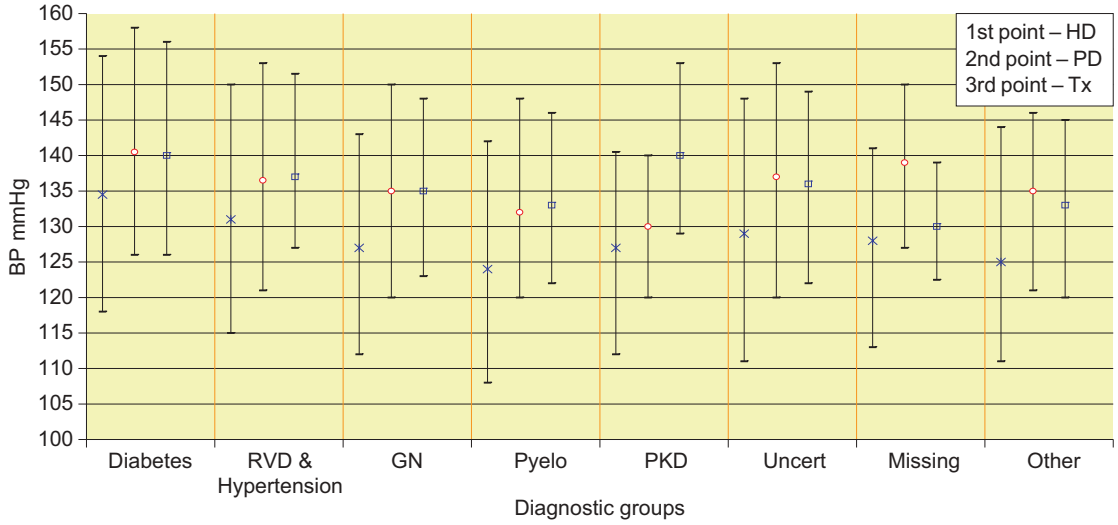

Figure 10.37: Median SBP by primary diagnosis

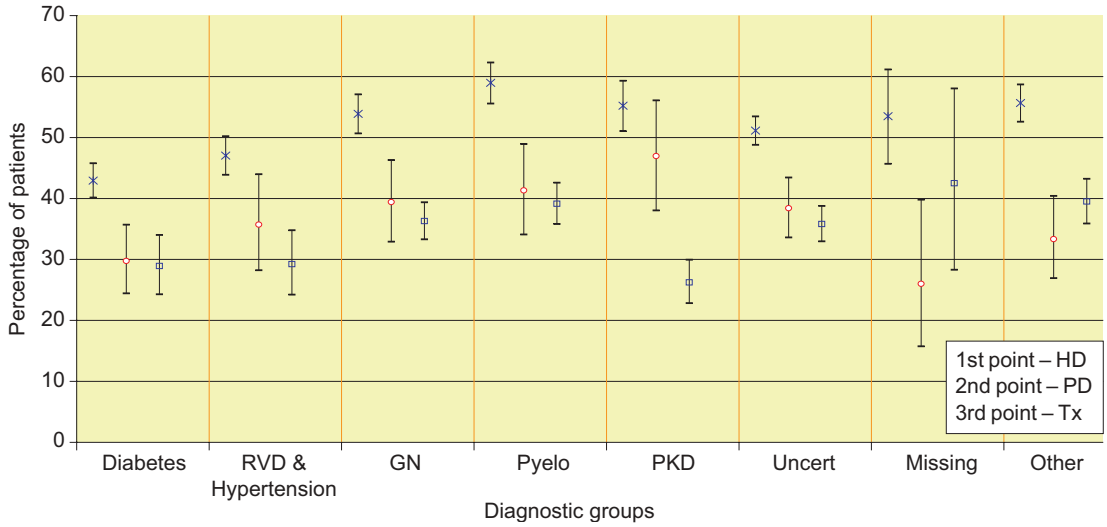

Figure 10.38: Percentage of patients with SBP in standards by primary diagnosis

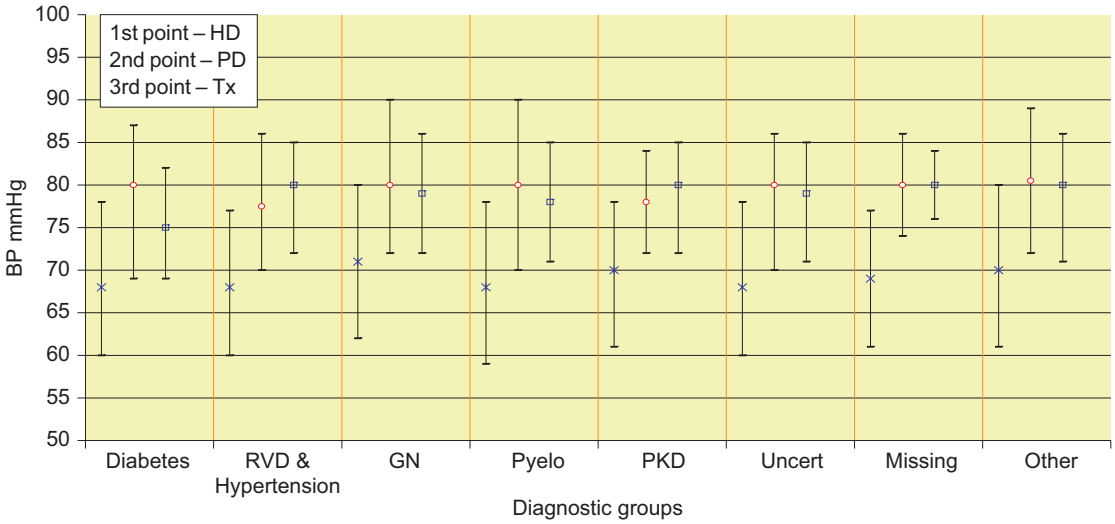

Figure 10.39: Median DBP by primary diagnosis

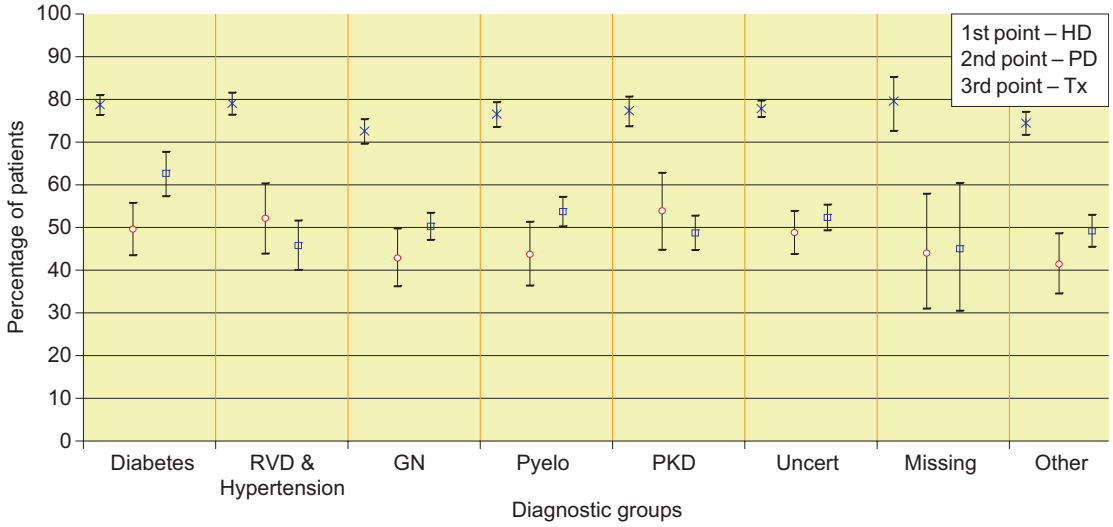

Figure 10.40: Percentage of patients with DBP in standards by primary diagnosis

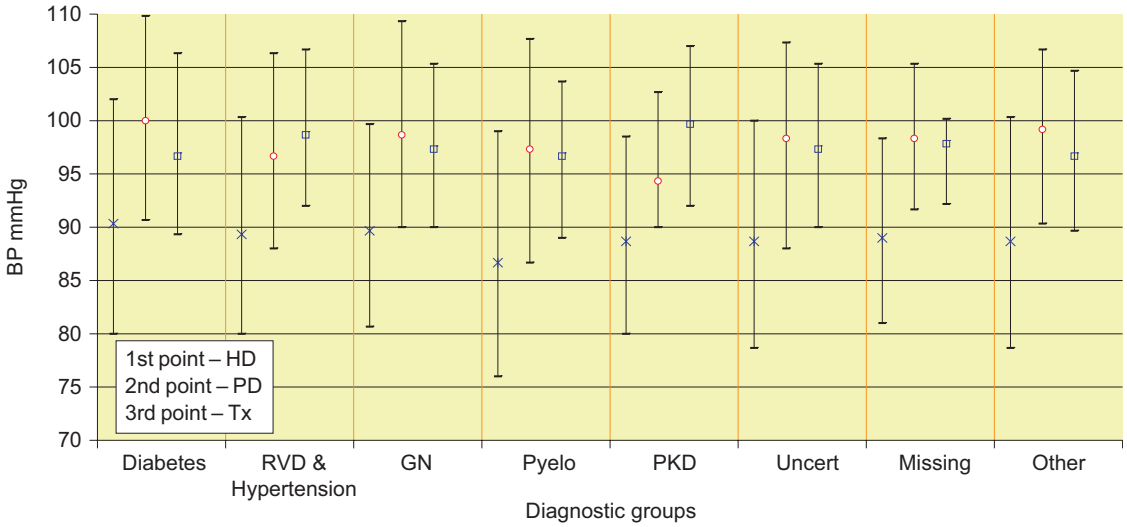

Figure 10.41: Median MAP by primary diagnosis

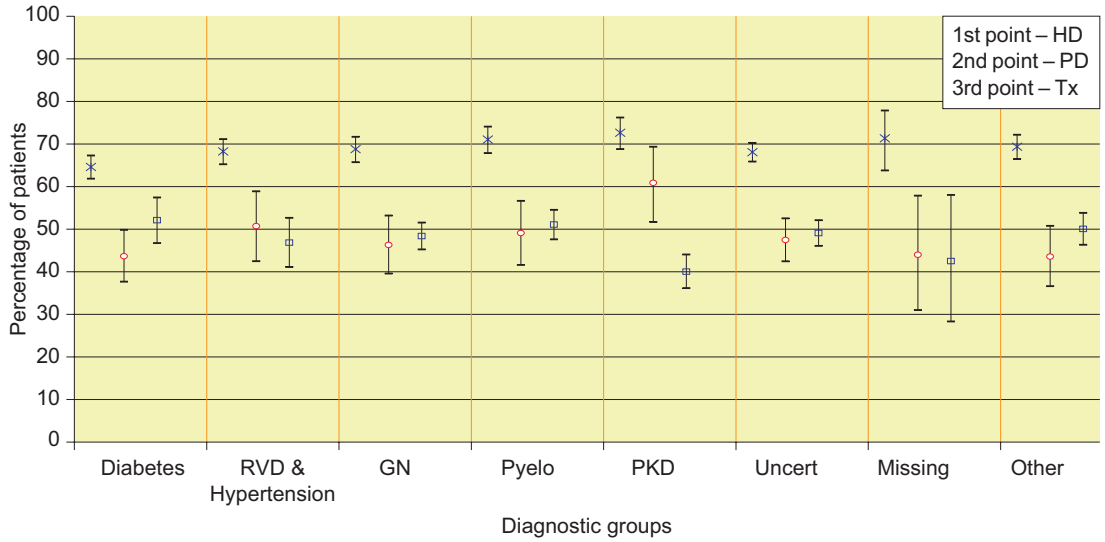

Figure 10.42: Percentage of patients with MAP in standards by primary diagnosis

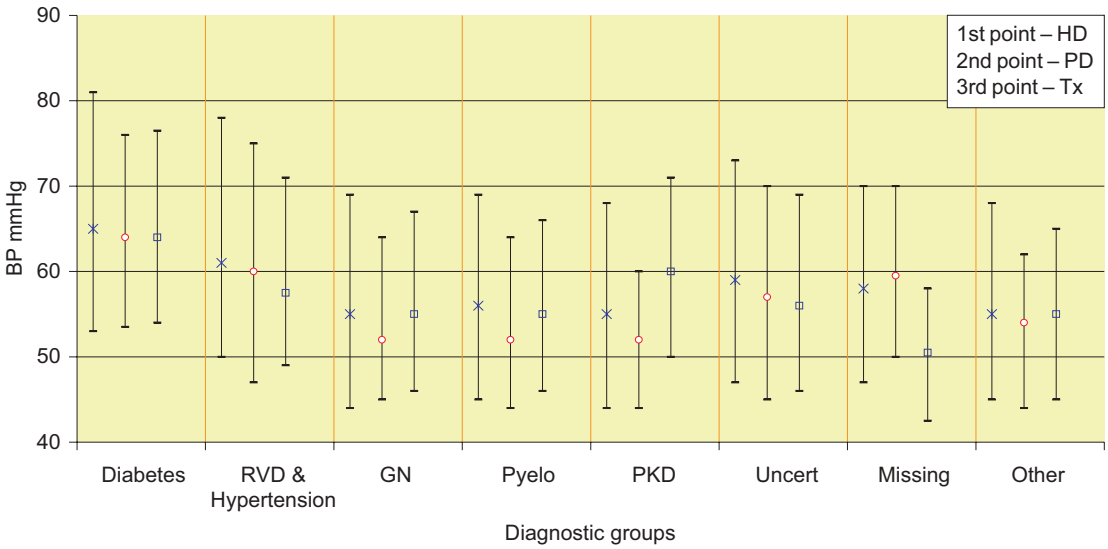

Figure 10.43: Median PP by primary diagnosis

more effective strategies for monitoring blood pressure control in outpatient populations.

Future Direction

The UK Renal Registry needs improved returns of comorbidity data for each patient to perform adjusted survival analyses. The question of whether achieving blood pressure standards are beneficial for all patients receiving RRT can then be addressed. The Registry requests that blood pressure data is logged every session for HD patients so it can assess blood pressure variability during the dialysis week.

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Appendix – Definition of the cohort for blood pressure analyses

Defining the cohort

- Analysis of prevalent patients.
- Prevalent patients are defined as all patients (including the incident cohort for that year) alive on 31st December for that year.
- Dataset called **Qtreat**.

Qtreat

- Usual UKRR checking programs run on dataset.
- Exclusion criteria applied to create dataset **Qtemp**.

Exclusion criteria are:

- Patients who had died before the first day of the quarter.
- Patients on dialysis with a treatment centre of elsewhere (not identified).
- Patients receiving treatment at a non-Registry site.
- Patients with no date of starting ERF treatment.
- Patients who had been receiving treatment for a negative number of days ie incorrect starting dates or incorrect patient number on data sent in.
- Patients who had recovered before the start of the quarter.
- Where data on a patient are submitted from more than one centre, only data from the primary centre are used.

Qtemp

- Further exclusion criteria applied to Qtemp to create dataset called **Quarter**.

Exclusion criteria are:

- Patients who have transferred out of the centre (qhcent) by the end of the quarter.
- Patients who had not yet transferred in to the centre (qhcent) by the end of the quarter.
- Patients who had recovered by the end of the quarter.
- Patients who had stopped treatment by the end of the quarter.

- Patients who had died by the end of the quarter.
- Patients who were lost to follow up by the end of the quarter.

Quarter

- Further exclusion criteria applied to quarter to create dataset called **Bichem**.

Exclusion criteria are:

- Patients who had been on ERF treatment for $\leqslant 90$ days at the end of the quarter.
- Patients who changed treatment modality in the quarter.
- Patients who transferred into the centre (qhcent) at some time in the quarter.

Chapter 11: Measures of Care in Adult Renal Transplant Recipients in the UK

Rommel Ravanan, Uday Udayaraj, Ali Bakran, Retha Steenkamp, Andrew J Williams and David Ansell

Summary

- The total number of patients active on the transplant waiting list (adult and paediatric) on 31/12/2005 was 5,736, an 8% increase from the previous year.
- On 31/12/2005 45.7% of prevalent adult RRT patients in the UK, had a functioning renal transplant which equated to 19,074 patients. During 2005, the death rate in prevalent transplant patients was 2.7 per 100 patient years. An additional 3.1% of all prevalent transplants failed with patients returning to dialysis.
- During 2005, deceased heart beating donor numbers decreased by 18% compared to 2004. In comparison, non-heart beating donors and living kidney donors increased by 35% and 17% respectively in 2005. The proportion of renal transplants performed from deceased heart beating donors fell from 68% in 2004 to 60% in 2005.
- There is wide variation in prevalence per million population (pmp) of transplanted patients resident in each local authority area across the UK.
- 11.4% of incident transplants in 2005 were to patients with diabetes.
- The median eGFR was 46.1 ml/min/1.73 m^2, with 18% of prevalent transplant recipients having an eGFR <30 ml/min/1.73 m^2.
- The median Hb in prevalent transplant recipients was 12.9 g/dl, with 10% of patients having an Hb <10 g/dl.
- The median systolic and diastolic BP was 136 and 79 mmHg respectively, with only 25% of patients within guidelines.
- Transplant function analysed by CKD stage 1–2 (eGFR <60), 3 (eGFR 30–59), 4 (eGFR 15–29) and 5 (eGFR <15), shows that these categories account for 24%, 59%, 15% and 2.5% of patients respectively.
- Haemoglobin values fall with decreasing eGFR such that of the 2.5% of transplant patients with eGFR <15 ml/min, 27% had an Hb <10 g/dl and 51% <11 g/dl.
- Control of iPTH was poor in transplant recipients in CKD stages 4 and 5, with 22% and 50% of patients respectively having a PTH >32 pmol/L (= 300 ng/L).
- Patients with failing transplants are less likely to achieve RA targets of key biochemical variables when compared to patients on dialysis.
- There is still wide variability in the completeness of data returns from individual units.

Introduction

This chapter reports on collaborative analyses carried out between the UK Renal Registry and UK Transplant (UKT), in conjunction with the support from the British Transplantation Society. This continues to be a fruitful and mutually beneficial relationship, as the details of the episode of transplantation held on the UKT database and the key clinical/biochemical variables other than just survival data held on the UKRR database complement each other. This combination of comprehensive data on transplant recipients is internationally unique and a great resource to assess renal transplant activity and its distribution across the UK, compare practices and key outcome variables between centres and to provide insight into the processes involved in the care of renal transplant patients.

Overview

In December 2005, there were 20 transplant centres in England (including 6 in London of which 1 is based in Great Ormond St. Paediatric Hospital), 1 in Northern Ireland, 2 in Scotland and 1 in Wales. The number of centres in England has been reduced by the amalgamation in London of Hammersmith with St. Mary's to form the West London Renal Transplant Centre, of the Royal Free with the Middlesex and of St. Helier's with St Georges.

Comprehensive information from 1995, 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 and patient and graft survival are available on the UKT website (www.uktransplant.org/ukt/statistics).

As of 31st December 2005, 5,736 patients (including adult and paediatric) were active on the renal or renal + pancreas transplant waiting list, an increase of 8% when compared with 2004. Live donor and non-heart-beating donor transplants continue to increase and in 2005 formed 29% and 11% of all kidney transplants performed respectively (Table 11.1), although there has been a further large fall in heart-beating donors.

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 include grafts with primary non-function (which is excluded in some countries).

Table 11.1: Kidney and kidney plus other organ transplants in the UK, 1 Jan 2004–31 Dec 2005

Organ	2004	2005	% change
Heart-beating donor kidney[1]	1,211	998	−18
Non-heart-beating kidney	147	198	35
Living donor kidney	463	543	17
Kidney and liver	15	11	−27
Kidney and heart	0	2	–
Kidney and pancreas[2]	69	102	48
Total kidney transplants	**1,905**	**1,854**	**−3**

[1]Includes en-bloc kidney transplants (3 in 2004, 5 in 2005) and double kidney transplants (5 in 2004, 6 in 2005).
[2]Includes one non heart beating kidney and pancreas transplant.

Data from the UK Renal Registry show that 3.1% of patients with a functioning transplant on 1/1/2005 returned to dialysis after their transplants failed in 2005. This has remained unchanged since 2000.

Using data from the UKRR, the death rate in the prevalent transplant cohort was 2.7 (95% CI 2.5–3.0) censoring at return to dialysis and 2.9 per 100 patient years including those who restarted dialysis. This remains unchanged from previous years.

Table 11.2: Risk-adjusted first adult kidney transplant only, graft and patient survival percentage rates for UK centres*

	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	90	97	76	84	96	100	100	100
Birmingham	90	95	83	87	93	99	86	93
Bristol	95	95	86	91	95	100	97	100
Cambridge	90	95	77	86	95	99	89	100
Cardiff	90	96	83	88	95	98	85	93
Coventry	93	95	85	86	97	100	87	81
Edinburgh	92	97	81	86	98	98	82	93
Glasgow	89	95	81	87	97	98	85	100
Guy's	91	96	80	86	96	100	95	95
Hammersmith	94	91	83	86	85	100	88	100
Leeds	90	95	76	82	96	97	94	95
Leicester	87	93	79	85	97	98	82	94
Liverpool	90	97	76	89	93	96	84	95
Manchester	91	96	77	83	97	100	78	94
Middlesex	87	95	81	87	89	100	100	100
Newcastle	90	95	80	79	93	97	90	90
Nottingham	88	93	77	83	95	100	85	97
Oxford	94	94	85	85	94	99	91	97
Plymouth	87	90	73	86	71	89	83	100
Portsmouth	91	96	79	82	92	94	91	95
Royal Free	91	93	77	90	93	100	81	100
Royal London	92	95	81	82	95	100	84	97
Sheffield	90	98	80	87	91	100	84	91
St George's	93	97	86	86	94	97	87	92
St Mary's	96	99	84	86	95	99	95	100
All centres	**91**	**95**	**80**	**85**	**95**	**98**	**88**	**95**

Cohorts for survival rate estimation:
1 year survival: 1 Jan 2000–31 Dec 2004.
5 year survival: 1 Jan 1996–31 Dec 2000.
First grafts only – re-grafts excluded for patient survival estimation.
*Information courtesy of UKT. Number of patients and 95%CI for each data point can be obtained from the UKT website.

Post transplant follow up

There are 65 renal units which send data electronically to the UK Renal Registry with 53 also providing additional demographic, laboratory and blood pressure data for renal transplant patients during 2005. The 5 remaining UK renal units (Canterbury, Manchester RI, Stoke, London St Marys & London St Georges) not yet linked electronically have supplied summary statistics. Three centres (Chelmsford, Clwyd & Derby) have been excluded from data analyses below due to small numbers (<10 pts in each unit). Due to differences in the timing of repatriation of patients after transplantation from the transplanting centre to the host/non-transplanting renal unit, caution needs to be exercised when comparing results between centres. The number of prevalent patients on renal replacement therapy (RRT) in each renal unit and the proportion of transplant patients are shown in Table 11.3.

On 31/12/2005 45.7% of UK RRT patients had a functioning renal transplant. This ratio seems to have stabilised over the last 3 years. During the period 1997–2002 it had decreased from 51.0% to 46.0%.

Table 11.3: Distribution of prevalent patients on RRT and modalities 31/12/2005

Centre	Total	% HD	% PD	% Tx
Birmingham Heartlands	541	62	8	30
Birmingham QEH	1,518	47	9	43
Basildon	169	66	18	15
Bradford	367	46	12	42
Brighton	618	48	15	37
Bristol	1,165	37	6	57
Cambridge	819	35	10	55
Carlisle	185	42	11	46
Carshalton	1,002	48	17	35
Chelmsford	134	66	28	7
Coventry	638	43	10	46
Derby	277	73	26	2
Dorset	381	33	19	48
Dudley	258	46	21	33
Exeter	583	42	16	42
Gloucester	282	51	13	36
Hull	588	51	12	38
Ipswich	289	38	24	38
Kent & Canterbury	569	28	34	32
London Barts	1,337	37	16	46
London St Georges	544	34	9	56
London Guys	1,225	33	7	60
London H&CX	1,137	50	13	37
London Kings	636	46	12	41
London Royal Free	1,346	41	11	48
London St Marys	1,149	53	0	47
Leeds	1,341	35	10	55
Leicester	1,430	38	16	46
Liverpool	1,361	34	7	60
Manchester Hope	631	38	22	40
Manchester Royal Inf	1,420	23	12	65
Middlesborough	573	41	4	55
Newcastle	867	27	5	68
Norwich	409	57	12	31
Nottingham	894	36	16	48
Oxford	1,196	33	10	58
Plymouth	369	33	10	57
Portsmouth	1,085	32	10	59
Preston	772	43	15	42
Reading	409	45	26	29
Sheffield	1,166	47	14	39
Shrewsbury	236	53	22	26
Stevenage	567	56	9	35
Stoke	560	42	18	41
Southend	181	66	12	23
Sunderland	278	55	5	40
Truro	269	52	15	33
Wirral	192	84	16	–
Wolverhampton	440	66	13	21
York	182	51	14	35
England	**34,585**	**42**	**12**	**46**

Table 11.3: (continued)

Centre	Total	% HD	% PD	% Tx
Antrim	189	56	11	33
Belfast	749	42	9	49
Newry	155	58	10	32
Tyrone	169	62	4	35
Ulster	44	93	2	5
N. Ireland	**1,306**	**50**	**9**	**41**
Bangor	101	72	27	1
Cardiff	1,272	33	11	56
Clwyd	83	77	14	8
Swansea	473	56	17	27
Wrexham	146	70	30	–
Wales	**2,075**	**44**	**14**	**41**
Aberdeen	417	43	12	46
Airdrie	171	85	15	–
Dumfries & Galloway	69	71	19	10
Dundee	359	41	14	45
Dunfermline	150	65	17	18
Edinburgh	670	35	9	56
Glasgow Royal	350	92	7	1
Glasgow Western	1,243	21	6	73
Inverness	200	43	21	37
Kilmarnock	181	57	28	14
Scotland	**3,810**	**43**	**11**	**46**
England	**34,585**	**42**	**12**	**46**
N.Ireland	**1,306**	**50**	**9**	**41**
Wales	**2,075**	**44**	**14**	**41**
Scotland	**3,810**	**43**	**11**	**46**
UK	**41,776**	**42**	**12**	**46**

Demographic variables

Age and gender

There has been no significant change in the gender ratio of incident and prevalent transplant patients between 1998 and 2005 (Table 11.4; Fig. 11.1). This ratio reflects that found in patients starting RRT and indicates there is no gender bias in patient selection for transplantation. The median age of patients has been slowly rising.

Centre and Local Authority prevalence of renal transplant patients

In the UK there are approximately 19,000 RRT patients with a functioning renal transplant and the numbers under follow up in each UK renal unit are shown in Table 11.5. The prevalence (pmp) of patients with renal transplants living in each local authority (LA) is shown in Table 11.6 and was derived from the patient postcode which was validated against the full address using software from QAS systems. LA boundaries and population numbers were obtained from the UK 2001 census and the methodology is described in Appendix D on the web (www.renalreg.org). As 5 renal units in England are not yet submitting individual patient data electronically, any partially covered LA areas have been removed (this includes many areas in London due to high rates of cross boundary flow).

Although differences in local arrangements for transplant follow up impact on the proportion of patients followed up in transplant centres as opposed to referring renal units, this

Table 11.4: Median age and gender ratio of incident and prevalent transplant patients covered by the Registry

	Incident transplants			Prevalent transplants		
Year	Number	Median age	M:F ratio	Number	Median age	M:F ratio
1998	632	42.2	1.6	6,152	48.6	1.6
1999	654	42.6	1.8	6,693	48.7	1.6
2000	802	44.9	1.6	7,993	48.7	1.6
2001	976	44.7	1.6	10,065	48.7	1.6
2002	1,040	46.9	1.5	11,646	49.4	1.6
2003	1,173	45.3	1.5	12,689	49.5	1.6
2004	1,367	45.4	1.7	15,014	49.6	1.6
2005	1,479	45.4	1.5	16,878	49.7	1.6

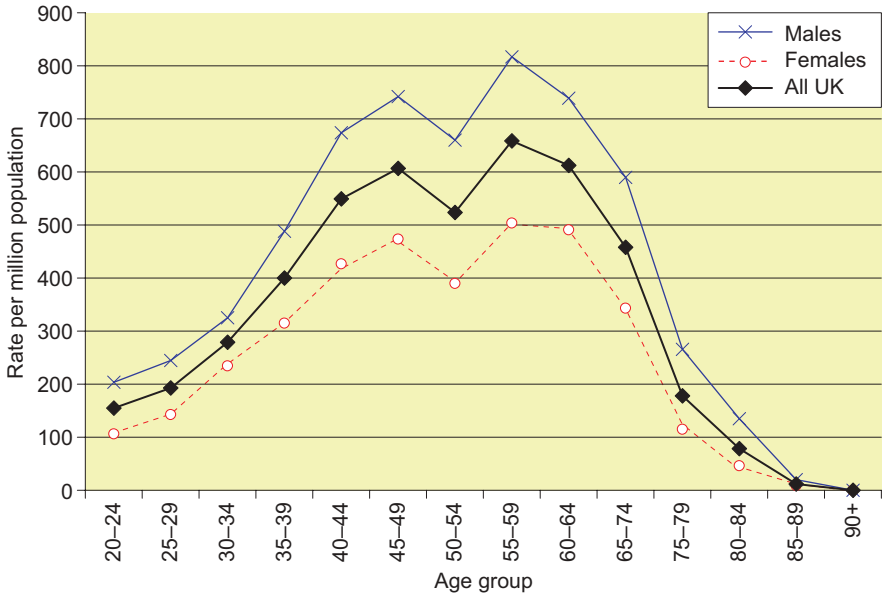

Figure 11.1: Transplant prevalence rate (pmp) by age and gender on 31.12.05

will not explain the variation in prevalence (pmp) of transplanted patients resident in different local authority areas as this has been allocated by patient postcode. These data need to be taken into consideration when planning the allocation of resources for transplant follow up, in order to ensure equity of access to medical care for these patients. Guidelines specifying minimum manpower requirements for the management of renal transplant patients are not currently available either from the British Transplantation Society or the UK Renal Association.

Co-morbidity and transplantation

The number of patients with established renal failure who are accepted onto the renal transplant waiting list is limited by co-morbidity. Comparison of the prevalence of co-morbidity (at the onset of renal replacement therapy) in dialysis patients with patients who have subsequently been transplanted (data from centres who have provided co-morbidity information on >80% of patients starting renal replacement therapy between 2000–2005) is shown in Table 11.7. Unsurprisingly there is less co-morbidity at the time of onset of renal replacement therapy in patients who are subsequently transplanted than in those who remain on dialysis, but the incidence of 'smokers' (as recorded in renal unit clinical databases) is the same in both groups. For next years report it is hoped to provide analysis of prevalence of co-morbidity in waitlisted and not waitlisted dialysis patients (in conjunction with waiting list data supplied by UKT) in comparison to patients who have been successfully transplanted.

Table 11.5: Number of prevalent transplant patients by renal unit on 31/12/05*

Dialysis centres	Number of patients	Transplant centres	Number of patients
Abrdn	190	Birm QEH	659
Airdrie	n/a	Belfast	366
Antrim	62	Bristol	660
B Heart	164	Camb	454
Bangor	n/a	Cardff	718
Basldn	26	Carsh	354
Bradfd	155	Covnt	296
Brightn	231	Edinb	372
Carlis	86	GlasWI	902
Chelms	9	Lond Barts	621
Clwyd	7	Lond George	307
D&Gall	7	Lond Guys	734
Derby	5	Lond Rfree	647
Dorset	182	Lond Marys	536
Dudley	85	Leeds	741
Dundee	161	Leic	660
Dunfn	27	Livrpl	814
Exeter	246	Man RI	920
Glas RI	4	Newc	588
Glouc	101	Nottm	428
Hull	222	Oxford	688
Inverns	73	Plymth	209
Ipswi	111	Ports	639
Kent	184	Sheff	459
Klmarnk	26		
Lond H&CX	416		
Lond Kings	263		
Man Wst	253		
Middlbr	313		
Newry	50		
Norwch	128		
Prestn	327		
Redng	119		
Shrew	61		
Stevng	196		
Stoke	228		
Sthend	41		
Sund	110		
Swanse	127		
Truro	88		
Tyrone	59	**England**	**15,920**
Ulster	2	**N Ireland**	**539**
Wirral	n/a	**Scotland**	**1,762**
Wolve	93	**Wales**	**853**
Wrexm	n/a	**UK**	**19,074**
York	63		

*Includes 5 units which are not electronically linked but provide summary statistics.

Table 11.6: The prevalence (pmp) of patients with renal transplant recipients by UK Local Authorities on 31/12/05

UK Area	Region	Local Authority	Population covered 2005	Rate pmp 2003	Rate pmp 2004	Rate pmp 2005
North East	County Durham and Tees Valley	Darlington	97,838	296	307	327
		Durham	493,469	338	355	373
		Hartlepool	88,610	372	418	406
		Middlesbrough	134,855	400	408	408
		Redcar & Cleveland	139,132	403	446	446
		Stockton-on-Tees	178,408	280	314	331
	Northumberland, Tyne & Wear	Gateshead	191,151	413	408	445
		Newcastle upon Tyne	259,536	328	335	362
		North Tyneside	191,658	417	407	444
		Northumberland	307,190	352	381	381
		South Tyneside	152,785	347	347	367
		Sunderland	280,807	370	385	370
North West	Cheshire & Merseyside	Halton	118,209	254	271	288
		Knowsley	150,459	312	299	292
		Liverpool	439,471	296	289	305
		Sefton	282,958	240	247	258
		St. Helens	176,843	204	221	238
		Warrington	191,080	262	277	272
		Wirral	312,293	295	298	301
	Cumbria & Lancashire	Blackburn with Darwen	137,470	138	196	175
		Blackpool	142,283	218	239	225
		Cumbria	487,607	258	277	271
		Lancashire	1,134,975	249	269	255
	Greater Manchester	Bolton	261,037	164	180	226
		Bury	180,607	39	61	100
		Oldham	217,276	87	101	110
		Rochdale	205,357	63	73	112
		Salford	216,105	139	148	171
		Wigan	301,415	133	146	169
Yorkshire & Humber	N & E Yorkshire & N Lincolnshire	East Riding of Yorkshire	314,113	226	248	264
		Kingston upon Hull, City of	243,588	263	275	291
		North East Lincolnshire	157,981	234	260	241
		North Lincolnshire	152,848	229	236	249
		North Yorkshire	569,660	246	277	286
		York	181,096	248	271	293
	South Yorkshire	Barnsley	218,063	335	349	339
		Doncaster	286,865	251	272	279
		Rotherham	248,175	262	286	266
		Sheffield	513,234	234	249	261
	West Yorkshire	Bradford	467,664	325	353	376
		Calderdale	192,405	353	395	421
		Kirklees	388,567	358	386	425
		Leeds	715,403	260	292	302
		Wakefield	315,172	261	279	305

Table 11.6: (continued)

UK Area	Region	Local Authority	Population covered 2005	Rate pmp 2003	Rate pmp 2004	Rate pmp 2005
East Midlands	Leicestershire, Northamptonshire & Rutland	Leicester	279,920	411	439	464
		Leicestershire	609,578	282	322	348
		Northamptonshire	629,676	268	192	292
		Rutland	34,563	434	463	492
	Trent	Derby	221,709	194	203	226
		Derbyshire	734,585	206	212	223
		Lincolnshire	646,644	249	288	298
		Nottingham	266,988	258	273	281
		Nottinghamshire	748,508	259	281	289
West Midlands	Birmingham & the Black Country	Birmingham	977,085		330	339
		Dudley	305,153		249	246
		Sandwell	282,904		315	339
		Solihull	199,515		226	251
		Walsall	253,498		276	288
		Wolverhampton	236,582		262	262
	Coventry, Warwickshire Hererfordshire, Worcestershire	Coventry	300,849	293	316	332
		Herefordshire, County of	174,871		263	274
		Warwickshire	505,858	322	358	356
		Worcestershire	542,105		234	260
	Shropshire & Staffordshire	Shropshire	283,173		205	237
		Telford and Wrekin	158,325		133	139
East of England	Bedfordshire & Hertfordshire	Bedfordshire	381,572	223	259	296
		Hertfordshire	1,033,978		143	229
		Luton	184,373	222	244	325
	Essex	Essex	1,310,837		224	258
		Southend-on-Sea	160,259	94	150	206
		Thurrock	143,128		196	252
	Norfolk, Suffolk & Cambridgeshire	Cambridgeshire	552,659	219	239	279
		Norfolk	796,728		222	235
		Peterborough	156,061	179	224	224
		Suffolk	668,555		220	229
London	North Central London	Barnet	314,561			315
		Camden	198,020			288
		Enfield	273,559			391
		Haringey	216,505			323
		Islington	175,797			336
	North East London	Barking & Dagenham	163,942		226	256
		Hackney	202,824		232	306
		Newham	243,889		221	250
		Redbridge	238,634		289	327
		Tower Hamlets	196,105		189	235
		Ealing	300,948	243	266	292
		Hammersmith & Fulham	165,244	224	242	248
		Hillingdon	243,006		189	263
		Hounslow	212,342		226	264

Table 11.6: (continued)

UK Area	Region	Local Authority	Population covered 2005	Rate pmp 2003	Rate pmp 2004	Rate pmp 2005
London	South East London	Bexley	218,307	362	380	403
		Bromley	295,532	281	298	328
		Greenwich	214,404	219	233	266
		Lambeth	266,169	195	222	237
		Lewisham	248,923	329	378	386
		Southwark	244,866	400	429	466
	South West London	Croydon	330,588	215	224	248
South East	Hampshire & I of Wight	Hampshire	1,240,102	278	296	294
		Isle of Wight	132,731	286	301	309
		Portsmouth	186,700	375	380	359
		Southampton	217,444	308	308	322
	Surrey & Sussex	Brighton and Hove	247,817		206	206
		East Sussex	492,326		244	250
		Surrey	1,059,017		240	252
		West Sussex	753,612		244	259
	Thames Valley	Bracknell Forest	109,616		283	255
		Buckinghamshire	479,026	340	328	342
		Milton Keynes	207,057	270	275	309
		Oxfordshire	605,489	348	363	380
		Reading	143,096	370	356	217
		Slough	119,064	319	336	353
		West Berkshire	144,485	360	360	325
		Wokingham	150,231	273	266	273
South West	Avon, Gloucestershire & Wiltshire	Bath & N.E. Somerset	169,040	207	266	284
		Bristol, City of	380,616	397	415	418
		Gloucestershire	564,559	287	319	338
		North Somerset	188,564	414	435	419
		South Gloucestershire	245,641	379	383	399
		Swindon	180,051	289	294	311
		Wiltshire	432,972	245	254	270
	Dorset & Somerset	Bournemouth	163,444		269	257
		Dorset	390,980		312	333
		Poole	138,288		275	333
		Somerset	498,095	293	303	329
	South West Peninsula	Cornwall & Scilly	501,267	277	297	333
		Devon	704,491	265	275	285
		Plymouth	240,722	366	366	420
		Torbay	129,706	285	301	332
Wales	Bro Taf	Cardiff	305,353	373	386	406
		Merthyr Tydfil	55,979	393	464	518
		Rhondda, Cynon, Taff	231,947	349	392	435
		Vale of Glamorgan	119,292	327	360	344
	Dyfed Powys	Carmarthenshire	172,842	324	324	353
		Ceredigion	74,941	294	374	347
		Pembrokeshire	114,131	280	289	333
		Powys	126,353		230	222

Table 11.6: (continued)

UK Area	Region	Local Authority	Population covered 2005	Rate pmp 2003	Rate pmp 2004	Rate pmp 2005
Wales	Gwent	Blaenau Gwent	70,064	442	400	385
		Caerphilly	169,519	354	354	366
		Monmouthshire	84,885	436	495	530
		Newport	137,012	365	380	350
		Torfaen	90,949	429	451	451
	Morgannwg	Bridgend	128,645	342	365	396
		Neath Port Talbot	134,468	312	335	357
		Swansea	223,300	367	412	416
	North Wales	Conwy	109,596	301	328	319
		Denbighshire	93,065	247	247	301
		Flintshire	148,594	262	283	303
		Gwynedd	116,843	274	274	300
		Isle of Anglesey	66,829	180	209	224
		Wrexham	128,476	325	311	311
Scotland		Aberdeen City	212,125	321	316	316
		Aberdeenshire	226,871	287	300	313
		Angus	108,400	452	517	526
		Argyll & Bute	91,306	274	252	252
		Scottish Borders	106,764	244	244	272
		Clackmannanshire	48,077	250	250	270
		West Dunbartonshire	93,378	278	257	257
		Dumfries & Galloway	147,765	277	298	311
		Dundee City	145,663	405	384	391
		East Ayrshire	120,235	225	250	258
		East Dunbartonshire	108,243	416	406	416
		East Lothian	90,088	344	344	322
		East Renfrewshire	89,311	358	381	392
		Edinburgh, City of	448,624	305	308	334
		Falkirk	145,191	317	310	324
		Fife	349,429	279	266	289
		Glasgow City	577,869	377	396	421
		Highland	208,914	268	282	316
		Inverclyde	84,203	285	321	368
		Midlothian	80,941	284	297	309
		Moray	86,940	322	334	414
		North Ayrshire	135,817	309	346	398
		North Lanarkshire	321,067	336	330	355
		Orkney Islands	19,245	468	520	572
		Perth & Kinross	134,949	319	311	326
		Renfrewshire	172,867	399	359	382
		Shetland Islands	21,988	273	318	273
		South Ayrshire	112,097	348	339	339
		South Lanarkshire	302,216	351	377	381
		Stirling	86,212	267	255	255
		West Lothian	158,714	378	347	372
		Eilean Siar	26,502	189	189	226

Table 11.6: (continued)

UK Area	Region	Local Authority	Population covered 2005	Rate pmp 2003	Rate pmp 2004	Rate pmp 2005
Northern Ireland		Antrim	48,366			331
		Ards	73,244			328
		Armagh	54,262			350
		Ballymena	58,610			239
		Ballymoney	26,895			223
		Banbridge	41,389			314
		Belfast	277,391			292
		Carrickfergus	37,658			531
		Castlereagh	66,488			436
		Coleraine	56,314			213
		Cookstown	32,581			92
		Craigavon	80,671			310
		Derry	105,066			324
		Down	63,828			251
		Dungannon	47,735			230
		Fermanagh	57,527			174
		Larne	30,833			616
		Limavady	32,422			308
		Lisburn	108,694			386
		Magherafelt	39,778			402
		Moyle	15,932			314
		Newry and Mourne	87,058			402
		Newtownabbey	79,996			288
		North Down	76,323			341
		Omagh	47,953			250
		Strabane	38,246			261
England			**42,396,371**	**261**	**273**	**294**
Scotland			**5,062,011**	**325**	**329**	**348**
Wales			**2,903,083**	**324**	**351**	**365**
Northern Ireland			**1,685,260**			**315**
Total			**52,046,725**	**274**	**283**	**304**

Table 11.7: Comparison of co-morbidity in patients starting RRT during 2000–2005 who remained on dialysis, with those who were subsequently transplanted

	Not transplanted		Transplanted	
Co-morbidity	**Number**	**%**	**Number**	**%**
Patients with co-morbidity data	5,873		865	
Without any co-morbidity	2,680	45.6	644	74.5
Ischaemic heart disease	1,423	24.3	40	4.6
Peripheral vascular disease	782	13.3	25	2.9
Cerebro-vascular disease	615	10.5	26	3.0
Diabetes (not cause of ERF)	447	7.7	21	2.4
COPD	440	7.5	19	2.2
Liver disease	151	2.6	5	0.6
Malignancy	746	12.7	13	1.0
Smoking	861	15.1	126	15.6

Table 11.8: Ethnicity of patients who received a transplant in the years 2000 to 2005

Year	% White	% South Asian	% African Caribbean	% other	% unknown
2000	65.5	3.4	2.9	1.0	27.3
2001	69.2	4.4	1.7	0.8	23.8
2002	72.5	6.5	4.4	1.4	15.1
2003	70.7	4.0	3.1	1.4	20.8
2004	68.8	6.5	4.2	1.8	18.7
2005	69.0	7.0	4.9	1.2	17.8

Ethnicity and transplantation

It is difficult to tell whether there has been any significant change in the ethnic ratio of patients receiving a renal transplant between 2000 and 2005. An apparent increase in the proportion of recipients who are of South Asian or African Caribbean ethnicity is likely to be due to improvements in the completion of data returns. This opinion is supported by the fact that there has been no reduction in the proportion of transplanted patients who are White whilst there has been a reduction in the proportion of patients reported as being of unknown ethnic origin (Table 11.8).

Other demographic variables

There has been no change in the relative proportions of the primary renal diagnosis of patients transplanted in 2005 compared with previous years (Table 11.9).

Post-transplant outcome

The number of UK renal transplant patients included in this year's Renal Registry Report has increased with more renal units contributing data to the Registry. However, there is room for improvement in the completeness of information about clinical variables from each centre (Table 11.10), with data returns from some centres being better than others. Therefore caution is needed when interpreting the following information from centres with a substantial proportion of missing data.

Methods

Prevalent patient data

Data from both transplanting and non-transplanting renal units concerning biochemical and clinical variables for patients with a functioning transplant were included in the analyses. The cohort is comprised of patients transplanted before 30 September 2005. Patients were considered as having a functioning transplant if 'transplant' was listed as the mode of renal replacement therapy in one or more of the quarters in 2005 without any other modality of treatment or death being entered for any of the subsequent quarters in 2005. Patients were assigned to the renal unit that sent the data to the Renal Registry but some patients will have received care in more than one unit. 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.

Table 11.9: Primary diagnosis of renal transplant recipients

	New transplants in 2005		Established transplants 01/01/05	
Diagnosis	%	No	%	No
Aetiology unc./Glom. NP*	19.5	289	21.9	3,288
Diabetes	11.4	168	7.3	1,090
Glomerulonephritis	18.9	280	20.1	3,015
Polycystic kidney disease	11.5	170	12.1	1,812
Pyelonephritis	11.8	174	16.3	2,443
Reno-vascular disease	6.4	94	6.5	973
Other	12.4	183	15.0	2,254
Not available	8.2	121	0.9	139

Table 11.10: Percentage completeness by centre for prevalent patients on 31/12/05

	Ethnicity		eGFR		Hb		BP	
Centre	%	Number with data	%	Number with data	%	Number with data	%	Number with data
Antrim	100.0	60	90.0	54	83.3	50	0.0	0
B Heart	100.0	163	87.7	143	86.5	141	3.1	5
B QEH	99.8	634	89.8	570	89.1	566	0.2	1
Basldn	100.0	26	92.3	24	92.3	24	3.9	1
Belfast	100.0	359	95.8	344	93.5	336	33.4	120
Bradfd	66.7	96	65.3	94	91.7	132	97.2	140
Brightn	33.8	76	27.6	62	83.6	188	0.4	1
Bristol	98.4	633	96.1	618	97.4	626	85.2	548
Camb	75.3	323	72.5	311	93.9	403	0.5	2
Cardff	41.4	289	39.7	277	96.3	672	94.7	661
Carlis	100.0	86	95.4	82	91.9	79	0.0	0
Carsh	89.9	312	81.0	281	88.2	306	0.3	1
Covnt	89.2	255	75.2	215	84.3	241	77.6	222
Dorset	98.9	178	95.0	171	93.9	169	28.9	52
Dudley	100.0	84	92.9	78	92.9	78	85.7	72
Exeter	96.7	231	90.8	217	93.7	224	28.9	69
Glouc	100.0	100	99.0	99	96.0	96	2.0	2
Hull	91.4	203	81.5	181	89.6	199	1.4	3
Ipswi	99.1	107	94.4	102	95.4	103	97.2	105
L Guys	87.7	640	84.9	620	97.0	708	1.1	8
L H&CX	100.0	408	96.8	395	96.3	393	0.0	0
L Kings	93.7	238	88.2	224	93.3	237	0.0	0
L Rfree	66.8	423	54.0	342	68.7	435	0.0	0
Leeds	69.3	501	66.9	484	94.1	680	70.7	511
Leic	88.5	568	80.7	518	81.2	521	85.1	546
Livrpl	94.0	745	86.5	686	90.7	719	82.0	650
ManWst	93.3	223	83.3	199	84.1	201	0.0	0
Middlbr	92.8	284	90.9	278	95.4	292	58.5	179
Newc	99.3	558	97.0	545	97.7	549	1.3	7
Newry	100.0	50	74.0	37	40.0	20	4.0	2
Norwch	69.1	87	65.1	82	95.2	120	0.0	0
Nottm	95.0	397	89.5	374	94.7	396	93.3	390
Oxford	30.3	200	29.7	196	97.0	640	15.6	103
Plymth	97.5	195	94.5	189	95.5	191	0.0	0
Ports	99.2	620	90.1	563	87.5	547	0.0	0
Prestn	91.6	272	84.9	252	89.6	266	0.0	0
Redng	100.0	119	98.3	117	98.3	117	99.2	118
Sheff	99.3	445	98.0	439	98.7	442	98.4	441
Shrew	100.0	60	100.0	60	100.0	60	5.0	3
Stevng	100.0	190	52.1	99	66.3	126	1.1	2
Sthend	82.5	33	77.5	31	92.5	37	0.0	0
Sund	96.3	105	95.4	104	99.1	108	0.0	0
Swanse	100.0	124	99.2	123	98.4	122	18.6	23
Truro	80.2	69	76.7	66	96.5	83	95.4	82
Tyrone	100.0	58	58.6	34	39.6	23	1.7	1
Wolve	100.0	92	97.8	90	97.8	90	84.8	78
York	80.3	49	78.7	48	90.2	55	98.4	60
Eng	**86.9**	**11,609**	**76.8**	**10,255**	**86.8**	**11,597**	**33.0**	**4,404**
Wls	**49.9**	**414**	**48.2**	**400**	**96.5**	**801**	**83.3**	**691**
NI	**100.0**	**539**	**89.0**	**471**	**81.4**	**431**	**23.4**	**124**
UK	**85.2**	**12,562**	**75.5**	**11,132**	**87.1**	**12,837**	**35.4**	**5,219**

*Centres with <20 patients are not shown. Scotland and London Barts are not included as they do not provide biochemical data.

For laboratory results, the last value in quarter 3 or quarter 4 of 2005 was used (last 6 months). For blood pressure recordings the latest value from 2005 was used.

eGFR

For the purpose of eGFR calculation, the 4-variable MDRD formula was used, although serum creatinine has not been standardised to that of the assay used at the MDRD laboratory, or taken into account the different creatinine assay methods in use in the UK.

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 without ethnicity information were excluded from the eGFR analysis.

One year post transplant data

Whilst comparing data relating to transplant patients from different renal units it is important to recognise that in addition to individual centre clinical practice, the results may be affected by a number of factors such as differences in local transplant repatriation policies and the relative numbers of patients with recent as opposed to long established grafts. To minimise such bias, for the first time the UKRR has analysed the outcome in patients at one year after transplantation.

Patients who received a renal transplant between 01 January 2000 and 31 December 2004 were assigned according to the renal unit in which they were transplanted. Transplant units were only included if they had submitted data throughout the 5 year period. Patients who had died or experienced graft failure within 12 months post transplantation were excluded from analysis.

For each patient, the last laboratory or BP value in the 4th quarter or the first value in the 5th quarter after renal transplantation was taken to be representative of the 'one year post transplant outcome'. For the purpose of eGFR calculation (4-variable MDRD formula), 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 11.2 to 11.4. Only

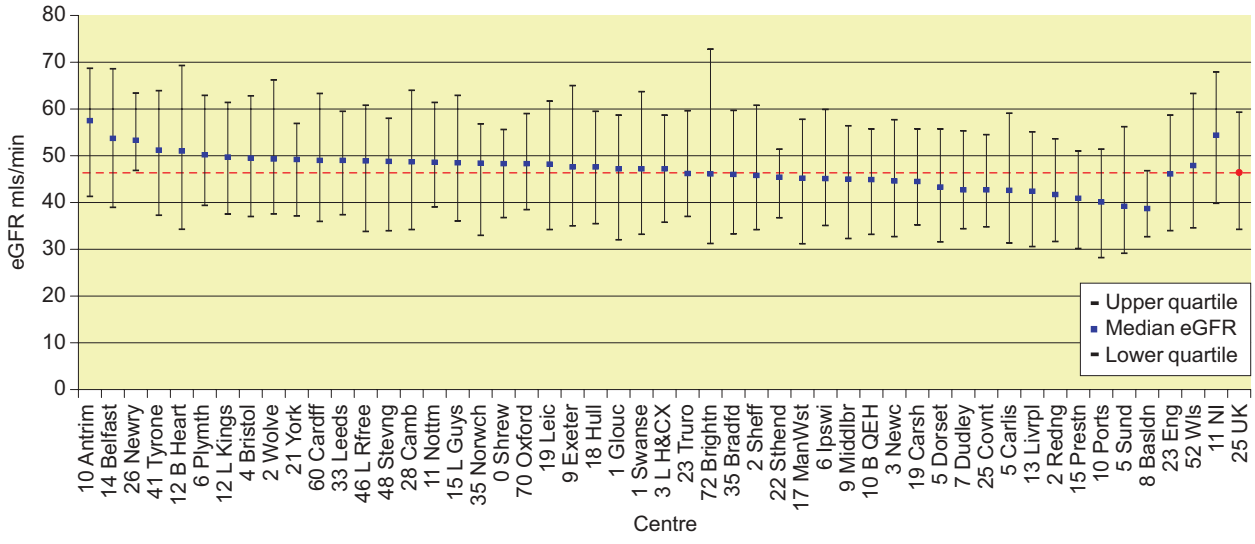

Figure 11.2: Median eGFR of prevalent patients by centre

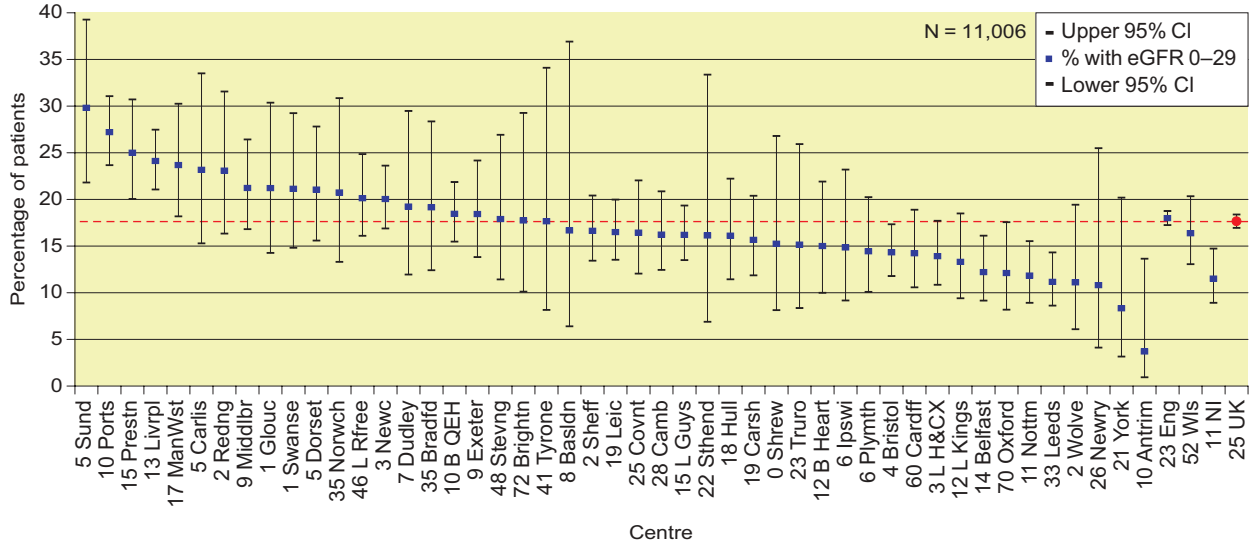

Figure 11.3: Percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2

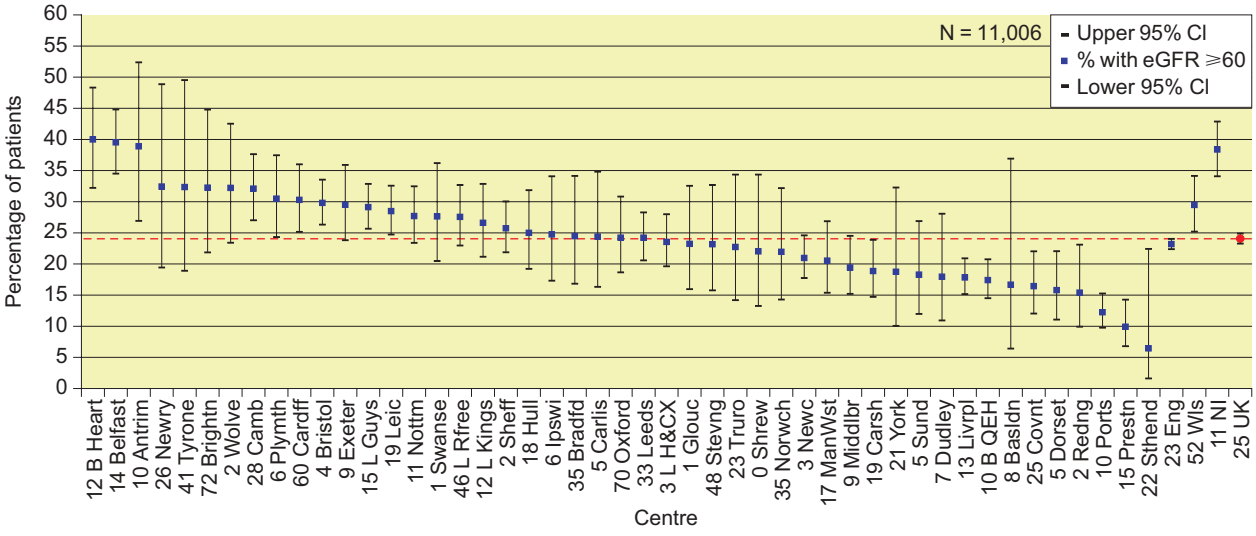

Figure 11.4: Percentage of prevalent transplant patients with eGFR ⩾60 ml/min/1.73 m^2

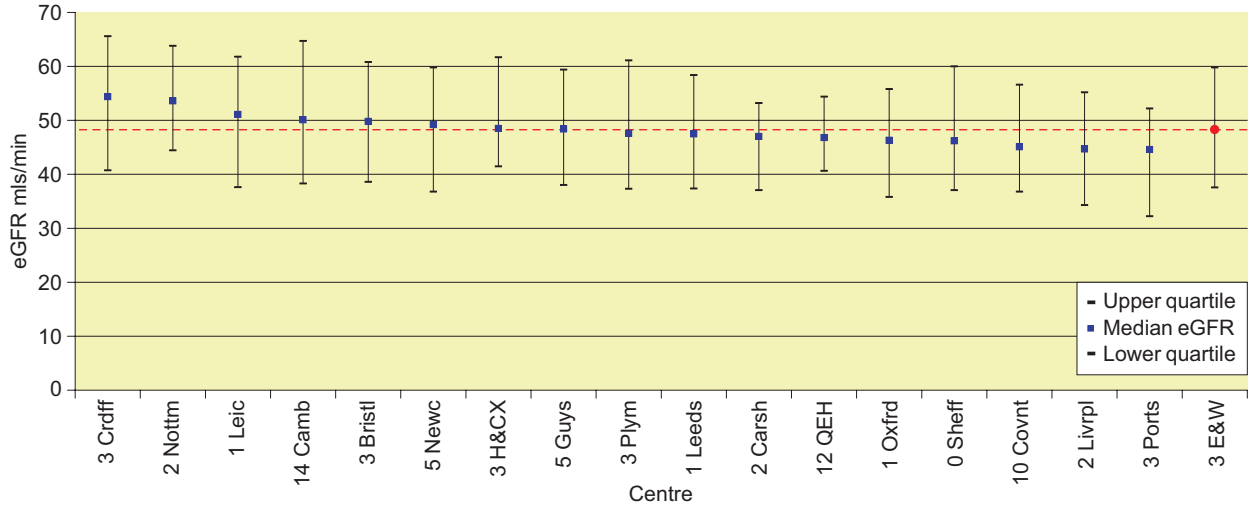

Figure 11.5: Median eGFR one year after date of transplant by transplant centre for cohort 2000–2004

centres with >20 patients are shown in these figures. The median eGFR was 46.1 ml/min/1.73 m^2, with 18% of prevalent transplant recipients having an eGFR <30 ml/min/1.73 m^2. Some centres may have a higher proportion of patients with eGFR <30 ml/min/1.73 m^2 because of local repatriation policies in which patients are only transferred back to the referring renal unit from the transplant centre when the need for dialysis is imminent. Patients with low eGFR, will require substantial resource allocation to prepare for dialysis or to be managed conservatively.

eGFR in patients one year after transplantation

Renal function one year after transplantation is believed to be predictive of future graft performance[1]. Figure 11.5 shows that median eGFR one-year post transplant for patients transplanted between 2000–2004 was 48.3 ml/min/1.73 m^2. All transplants (deceased and live kidney donors) from each unit were included in this analysis.

Haemoglobin in prevalent transplant patients

Transplant patients are to be under the RA CKD guidelines that all patients should have a haemoglobin above 10g/dl.

A number of factors including immunosuppressive medication, graft function, EPO use, IV/oral iron use as well as centre practices/protocols for management of anaemia affect haemoglobin levels in transplant patients. Figure 11.6 gives median Hb values from UK centres whilst Figure 11.7 shows the percentage of transplant patients with Hb <10 g/dl. Only centres with >20 patients and also >50% data returns are shown in these figures.

The median Hb was 12.9 g/dl, with 10% of patients having a Hb <10 g/dl. 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 11.3) are not the same as the five centres with the highest percentage of patients with Hb <10 g/dl.

Haemoglobin in patients one year after transplantation

Figure 11.8 shows that the median Hb at 1 year post transplant was 13.0 g/dl. Some centres with above average eGFR also have above average haemoglobin results at one year after transplantation.

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 ie systolic BP <130 and diastolic BP <80.

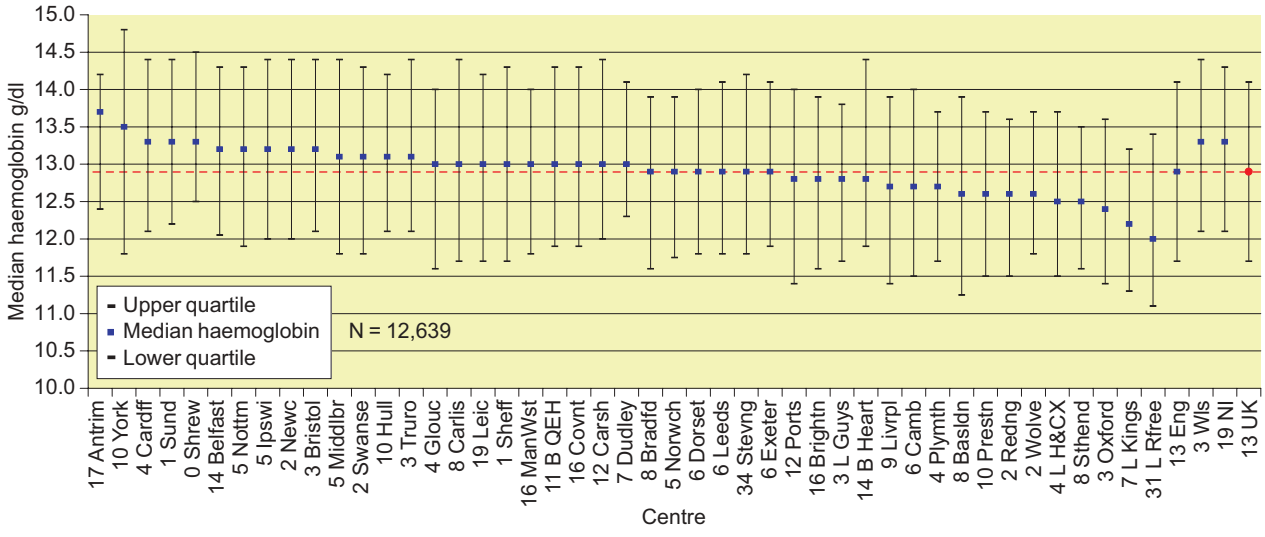

Figure 11.6: Median Hb of prevalent transplant patients by centre

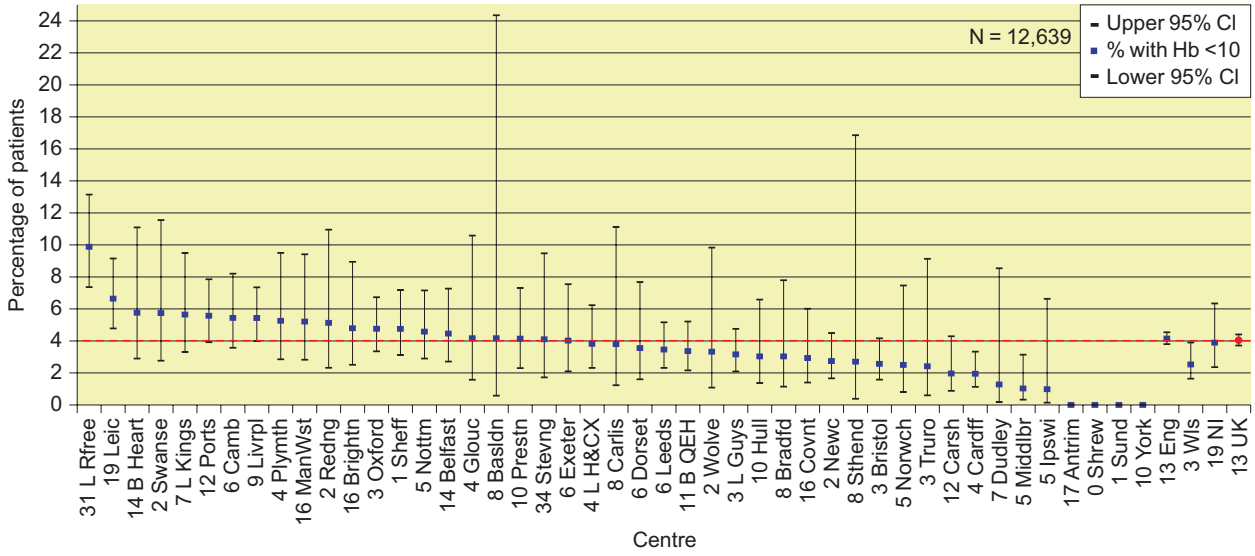

Figure 11.7: Percentage of prevalent patients with Hb <10 g/dl

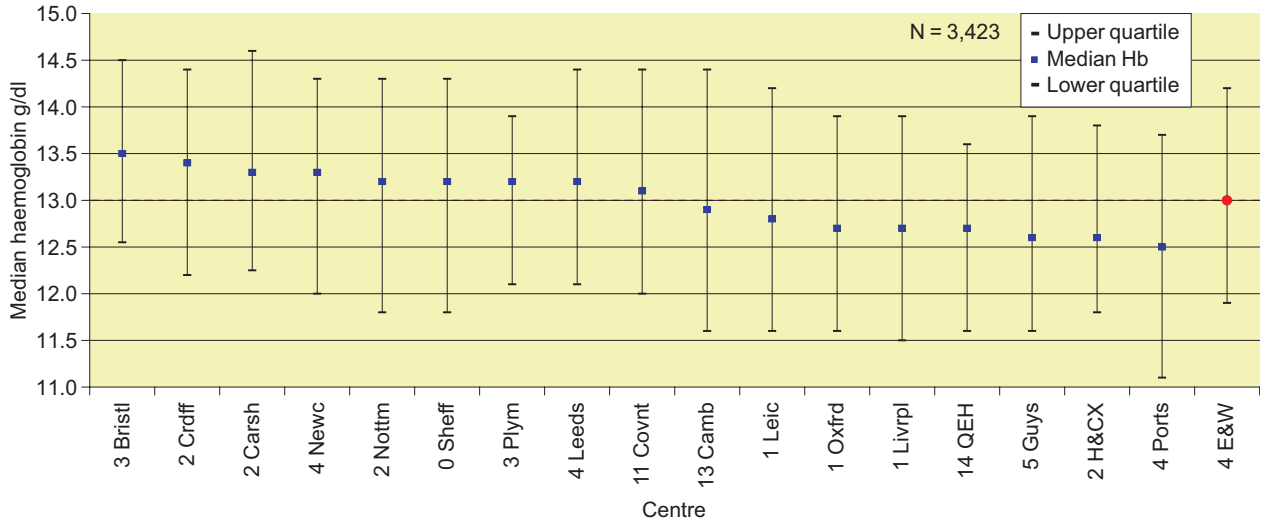

Figure 11.8: Median Hb one year post transplant for patients transplanted between 2000–2004, by centre

Although some centres provide BP data for the majority of their patients many centres provide little if any. Median systolic BP (Figure 11.9), median diastolic BP (Figure 11.10) and the percentage of patients who achieve RA standards (Figure 11.11) are shown. The median systolic and diastolic BP was 136 and 79 mm Hg respectively, with only 25% of patients within guidelines. Only centres with >20 patients and also >50% data returns are shown in these figures.

Blood pressure in patients one year after transplantation

The number of patients who had valid returns for systolic (Figure 11.12) and diastolic BP (Figure 11.13) one year post transplant are substantially less than the numbers available for eGFR and Hb. Since the completeness of data for this variable is very poor, comparison between units is open to criticism.

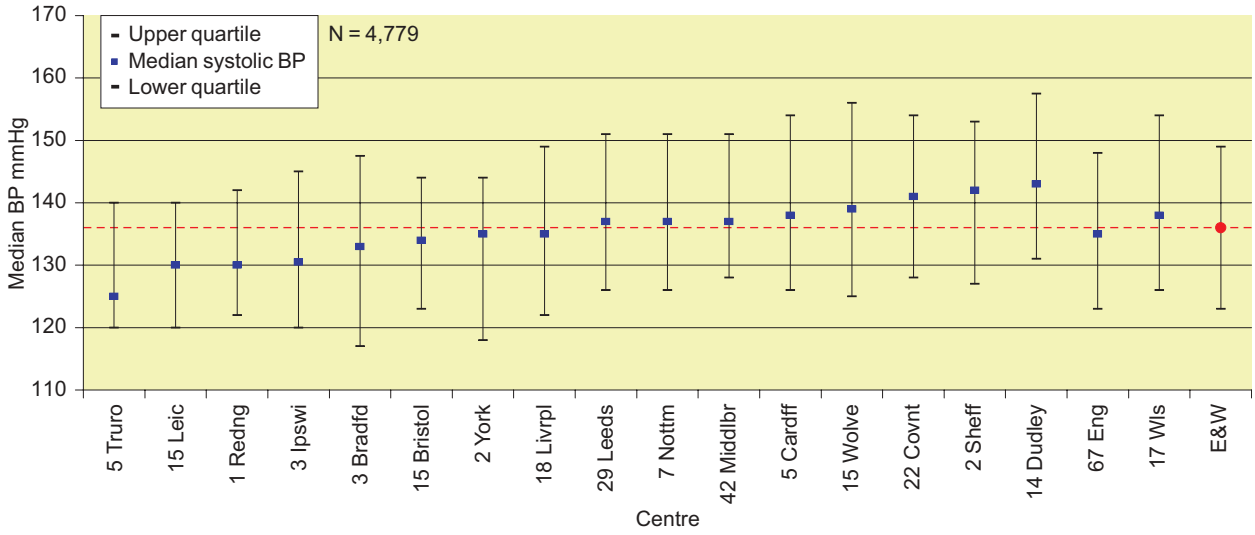

Figure 11.9: Median systolic BP in patients with renal transplants from different renal units

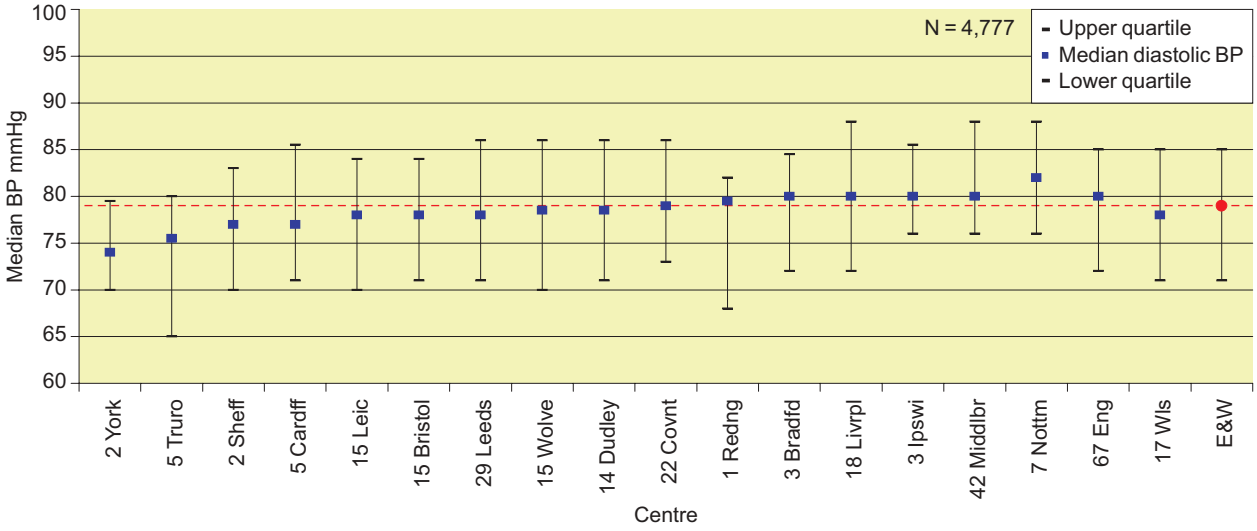

Figure 11.10: Median diastolic BP in patients with renal transplants from different renal units

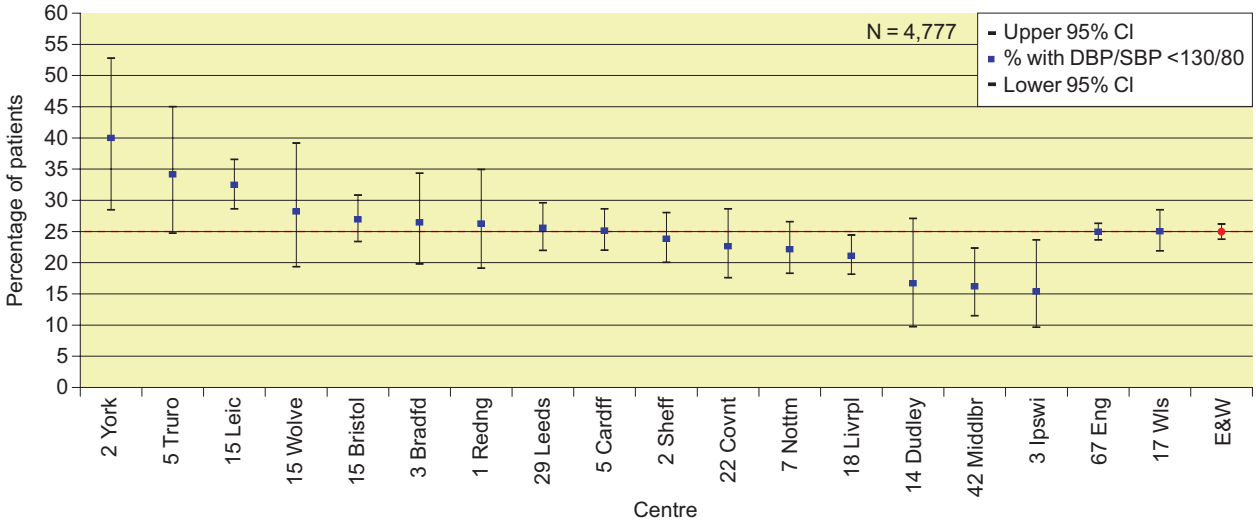

Figure 11.11: Percentage of patients with renal transplants in different renal units who achieve the RA standards for BP

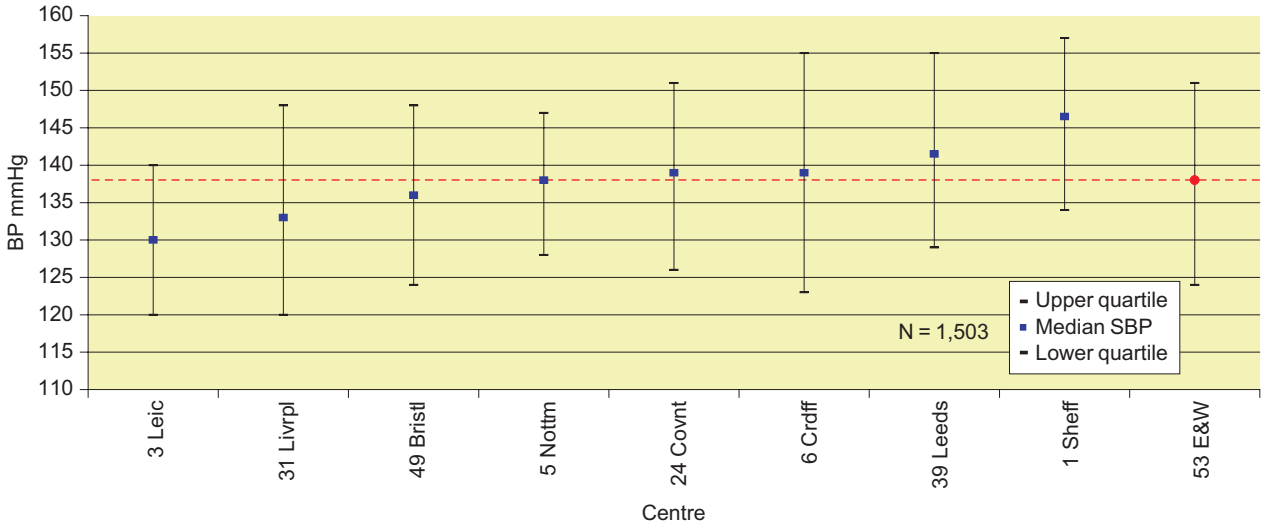

Figure 11.12: Median systolic BP one year post transplant by centre

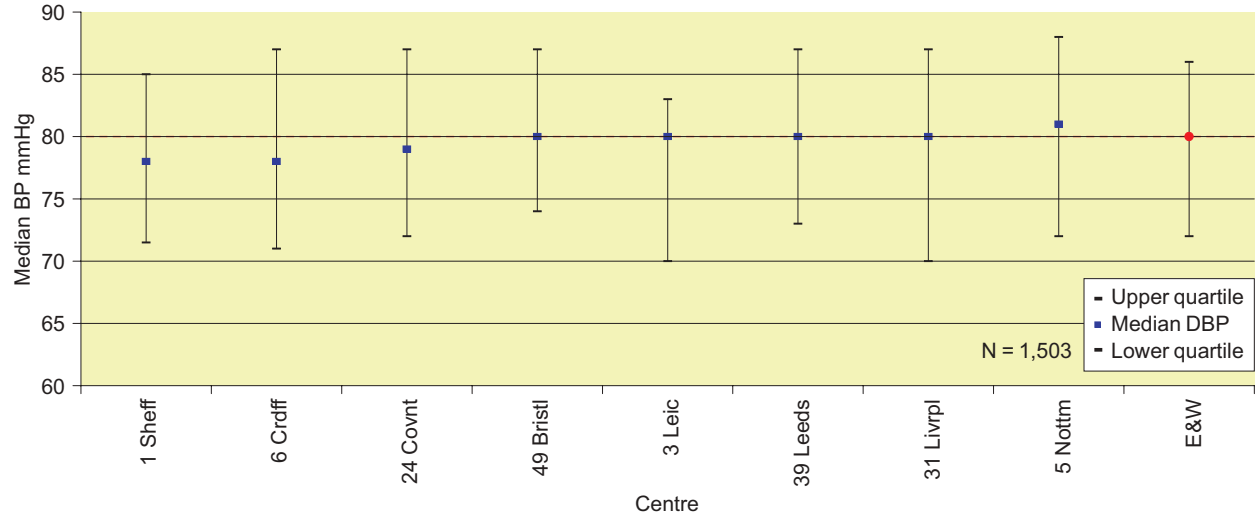

Figure 11.13: Median diastolic BP one year post transplant by centre

Analysis of prevalent transplant patients by CKD stage

About 3% of prevalent transplant patients return to dialysis each year. Patients with failing transplants are similar to other patients with CKD stage 5 in that they contribute substantially to the work load of the multi-disciplinary renal team in order to ensure a safe and seamless transition to dialysis or conservative care. While centre practices vary, in most UK renal units such patients are routinely followed up in transplant out-patient clinics which may not be designed to address the needs of patients with stage 5T transplant function. The results of an analysis to establish the number of patients in each CKD stage T group and to determine if the common biochemical targets for patients on dialysis are comparable to patients post-transplantation are shown in Table 11.11. Approximately 18% of transplant recipients have CKD stage 4T or 5T. While the numbers of patients in the stage 5T group are small, the data suggests that fewer patients in this category achieve the clinical and biochemical targets when compared with patients on dialysis. Whether these results are substantially different to patients with stage 5 CKD prior to commencement of RRT is not known, but in contrast there are no 'late referrals' in the transplant group as they have all been under long term follow up.

Table 11.11: Analysis by CKD stage for prevalent transplant patients compared with dialysis patients

	Stage 1–2T (⩾60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
Number of patients	3,028	7,537	1,971	321	13,715
% of patients	23.6	58.6	15.3	2.5	
eGFR ml/min/1.73 m^2					
mean ± SD	73.0 ± 12.5	44.9 ± 8.3	24.0 ± 4.0	11.4 ± 2.6	
Median	69.6	44.8	24.6	12.1	
Systolic BP					
mean ± SD	134.5 ± 18.7	137.4 ± 19.2	141.6 ± 20.7	143.2 ± 22.1	131.4 ± 25.6
% ⩾130 mmHg	58.6	65.7	74.4	70.8	50.3
Diastolic BP					
mean ± SD	77.7 ± 10.8	78.6 ± 10.6	79.1 ± 11.6	80.7 ± 13.3	71.4 ± 14.5
% ⩾80 mmHg	46.8	49.4	51.6	54.2	28.2
Cholesterol					
mean ± SD	4.7 ± 1.0	4.8 ± 1.0	4.8 ± 1.1	4.8 ± 1.4	4.1 ± 1.1
% ⩾5 mmol/L	35.8	38.4	40.5	35.3	18.4
Haemoglobin					
mean ± SD	13.8 ± 1.6	12.9 ± 1.6	11.7 ± 1.6	11.0 ± 1.7	11.7 ± 1.6
% <10 g/dl	1.1	3.1	11.4	27.4	13.3
Ferritin					
median	103.5	126.0	171.5	230.7	388.0
% ⩽100 µg/L	49.5	41.9	30.9	22.2	6.2
Phosphate*					
mean ± SD	0.9 ± 0.2	1.0 ± 0.2	1.2 ± 0.3	1.6 ± 0.4	1.6 ± 0.5
% ⩾1.8 mmol/L	0.1	0.3	3.0	26.0	30.0
Corrected calcium					
mean ± SD	2.4 ± 0.1	2.4 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.4 ± 0.2
% >2.6 mmol/L	9.5	9.8	5.9	7.2	10.5
% <2.1 mmol/L	3.9	5.6	11.5	24.7	13.8
iPTH					
median	8.4	9.9	16.6	31.5	23.4
% ⩾32 pmol/L	7.1	6.5	21.9	49.7	39.2
Albumin g/L**					
mean ± SD	41.9 ± 3.8	41.4 ± 3.8	39.9 ± 4.1	38.1 ± 5.3	38.4 ± 4.8
Bicarbonate mmol/L					
mean ± SD	26.4 ± 3.0	25.6 ± 3.4	23.4 ± 3.6	21.5 ± 4.0	24.0 ± 3.8

* Only PD patients included in stage 5D, n = 2,697.
** Only patients with BCG assay included: transplant patients n = 10,640, only HD patients included n = 7,421.
Note: prevalent transplant patients with no ethnicity data were classed as White.
Laboratory data from last 2 quarters in 2005 used for this analysis. For stage 5D, incident dialysis patients in 2005 were excluded.

Reference

1. Hariharan S, McBride MA, Cherikh WS *et al.* Post transplant renal function in the first year predicts long term kidney transplant survival. *Kidney International* 2002;61(2):311–318.

Chapter 12: Survival of Incident RRT Patients in the UK

David Ansell, Paul Roderick, Uday Udayaraj, Dirk van Schalkwyk and Charlie Tomson

Summary

- This analysis presents the survival of patients starting RRT in UK renal units ('centres'), and includes an analysis of survival by centre. Data from 59 of the 70 UK centres are included. This is the first year that UK centre anonymity has been removed from analysis of patient survival by centre. Survival after adjustment for co-morbidity is also reported for the first time although this analysis is restricted to those centres returning data on co-morbidity in at least 85% of incident patients.

- The importance of adjusting for co-morbidity can be seen in that for one centre, after adjustment of survival for age and diagnosis, the adjusted 1 year after 90 day survival was 84.6%. After adjusting to the average co-morbidity present across centres, survival increased to 90.4%. Improved co-morbidity data returns by renal units may require investment in informatics staff and creating structural process at renal unit level for clinicians to support these data returns.

- From the date of first RRT, the 1 year survival of all patients (unadjusted for age) is 79%. From the 90th day of RRT (to allow comparison with other countries' 1 year survival), the 1 year survival is 83%. The age adjusted (60 years) survival for the 1 year after 90 day period is 86%. There is 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 (including deaths within the first 90 days) rates are 58%, 53%, 44%, 28%, 19% and 12% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and >75 years.

- The 'vintage effect' of increasing hazard of death with length of time on RRT, prominent in data from the US, is only noted in older age groups (65–75 and 75+ years) at 5–6 years after starting RRT.

- Six 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 three cases this was better survival, and in three, poorer survival, than expected. Poor reporting by renal units 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.

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 since its inception, including the 21% who start on peritoneal dialysis and the 3% who receive a pre-emptive transplant and are 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[1] (which only includes a haemodialysis cohort). Additionally, 1st year UK survival data includes patients that have died within the first 90 days of starting RRT, a period excluded from most other countries' registry data.

As shown in Chapters 3 and 6[2,3], patients starting haemodialysis in the UK have higher levels of co-morbidity and tend to be older than those starting RRT on PD or those pre-emptively transplanted.

The dataset includes patients from England, Scotland and Wales. Northern Ireland has only recently joined the Registry and so there is not sufficient follow-up data available to enable survival analyses to be done. Patients returning to dialysis after a failed transplant are not included in this cohort.

Many of the survival figures quoted in this chapter are from the first day of renal replacement therapy. In many instances survival from day 90 is also presented, as this allows comparison with many other registries, including the US, which record data only from day 90 onwards. The distinction is important, as there is a high death rate in the first 90 days which would distort comparisons; in many other countries, patients are not reported to the 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 patients who develop acute irreversible renal failure in the context of an acute illness, for instance.

To allow comparisons between centres with differing age distributions, survival analyses are 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 8 years ago at the start of the Registry's data collection. The average age of patients commencing RRT in the UK in 2005 is now closer to 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 and this year, with the agreement of all UK clinical directors, centre anonymity has been removed. These are raw data that require very cautious interpretation if legitimate centre comparisons are to be attempted. The Registry can adjust for the effects of the different age distributions of the 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 is difficult to interpret any apparent difference in survival between centres. Using data only from those centres with greater than 85% complete data returns on 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.

Statistical methodology

The take-on population in a year included patients who recover from ERF after 90 days from the start of RRT, but excludes 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 restarting 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 soon after starting RRT treatment were counted at the original centre.

For patients who recovered renal function for a period of time 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 were censored on the day they transferred out if there was no further information in the timeline.

The one year incident survival for patients in 2004 were for those who had all been followed for 1 full year through 2005. The 2005 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 2004, were censored in the analysis, as 2006 data on these patients were not yet available. Analyses in previous UK Registry Reports have used the previous year's patient cohort (eg 2003) starting 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 the Registry will now use, will be the previous year's data with censoring.

Adjustment of 1 year after 90 day survival for co-morbidity was undertaken using the combined incident cohort from 2000–2004. Twelve 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 12 centres. The individual centre data were then further adjusted for average co-morbidity mix present at these centres.

Survival of new patients on RRT

Comparison with Audit Standards

The 2002 UK Renal Standards document (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.

Table 12.1: One-year patient survival, patients aged 18–54, 2004 cohort

First treatment	Standard primary renal disease	All primary renal diseases except diabetes
All %	95.7	94.3
95% CI	*94.3–97.1*	*92.9–95.6*
HD %	94.1	92.6
95% CI	*92.1–96.1*	*90.7–94.5*
PD %	98.6	97.6
95% CI	*97.2–99.9*	*96.1–99.1*

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 figures are included in this report to allow comparison with reports from other registries. The results are shown in Table 12.1 and are similar to the previous year.

Between country

Two years incident data have been combined to increase the size of the patient cohort, so that any differences between the three UK countries are more likely to be identified (Table 12.2). These data have not been adjusted for primary renal diagnosis, ethnicity or comorbidity.

Modality

The age-adjusted one year survival estimates on HD and PD are 85.3% and 90.2% respectively with the improvement in HD survival from 2002 to 2003 appearing to have been maintained. There appears to be better survival on

Table 12.2: Incident patient percentage survival across the UK, combined 2 year cohort (2003–2004), adjusted to age 60

	England	Wales	Scotland	UK
% 90 day	93.7	93.4	93.8	93.7
95% CI	*92.9–94.5*	*91.3–95.5*	*92.1–95.5*	*92.9–94.5*
% 1 year after 90 days	87.2	85.1	83.6	86.6
95% CI	*86.1–88.4*	*81.6–88.7*	*80.6–86.7*	*85.5–87.8*

Table 12.3: One-year after day 90 survival by first established treatment modality (adjusted to age 60)

Year		HD	PD
2004	Adjusted 1 year after 90 days %	85.3	90.2
	95% CI	*83.9–86.6*	*88.6–92.0*
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 %	83.8	89.6
	95% CI	*82.0–85.5*	*87.6–91.7*

PD compared with HD (Table 12.3) 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 selection for the modalities and the patients in the two groups are not comparable[2,3].

Age

Tables 12.4 to 12.9 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 data show a steep age related decline in survival over all time periods (see also Figures 12.1, 12.2).

If the survival data in Tables 12.7 to 12.9 are calculated from day 90 (1 year after day 90 survival, 2 year after day 90 survival, etc) the survival in all cases increases 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[4,5] (see Chapter 17 on international comparisons).

Table 12.4: Unadjusted 90 day survival of new patients, 2004 cohort, by age

Age	KM* survival (%)	KM 95% CI	N
18–64	96.3	95.6–97.1	2,653
⩾65	85.5	84.2–86.8	2,707
All ages	90.8	90.1–91.6	5,360

*KM = Kaplan-Meier.

Table 12.5: Unadjusted 1 year after day 90 survival of new patients, 2004 cohort, by age

Age	KM survival (%)	KM 95% CI	N
18–64	90.8	89.7–92.0	2,533
⩾65	75.1	73.3–77.0	2,298
All ages	83.4	82.3–84.4	4,831

Table 12.6: 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	1.58	1.50–1.66
1 year after first 90 days	1.47	1.41–1.53

The 8-year KM survival from the start of renal replacement therapy (from day 0) is shown in Figure 12.2. The 5 year survival (including deaths within the first 90 days) is 58%, 53%, 44%, 28%, 19% and 12% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and >75 years.

It should be noted that any 50% life expectancy estimates obtained from this graph will include diabetic patients. Also, if these estimates were to be compared with other countries, deaths in the first 3 months should be excluded and this would add approximately 6 months to the average life expectancy figures. It is also important to remember that the Figure shows survival from the start of renal replacement therapy and so cannot be used for example, to estimate the life expectancy of a patient aged 50 who has been on dialysis for 10 years.

When the monthly hazard of death (for the following month) is analysed by age (Figure 12.3), a rapid fall in monthly hazard of death is seen in the first 3–4 months specifically in the older age groups.

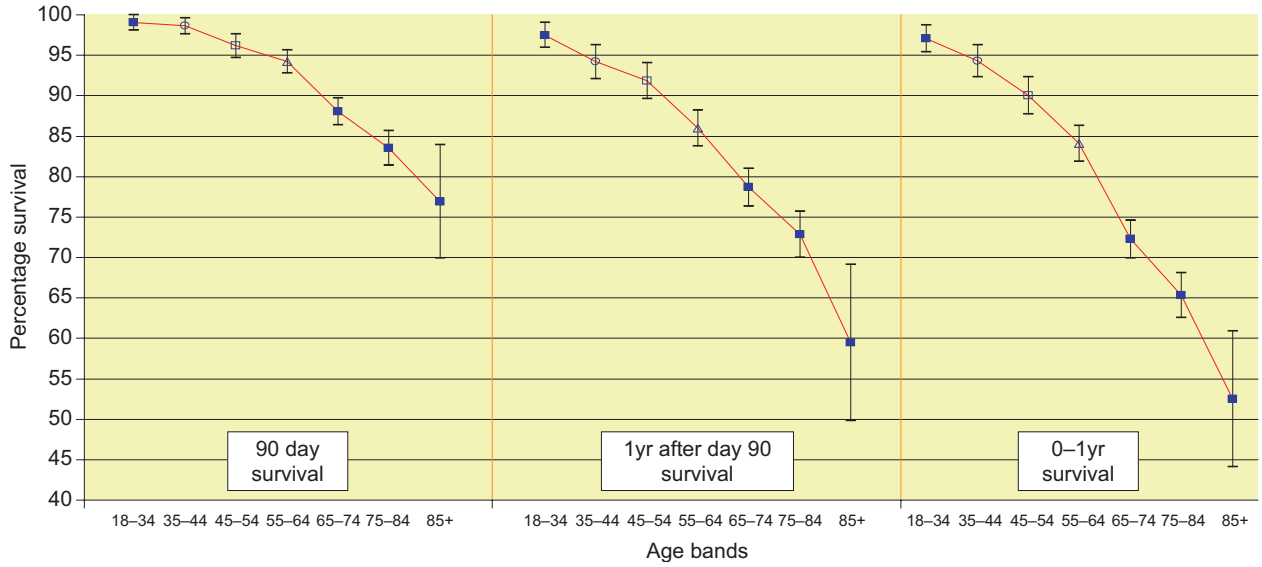

Figure 12.1: Unadjusted survival of all incident patients 2004 by age band

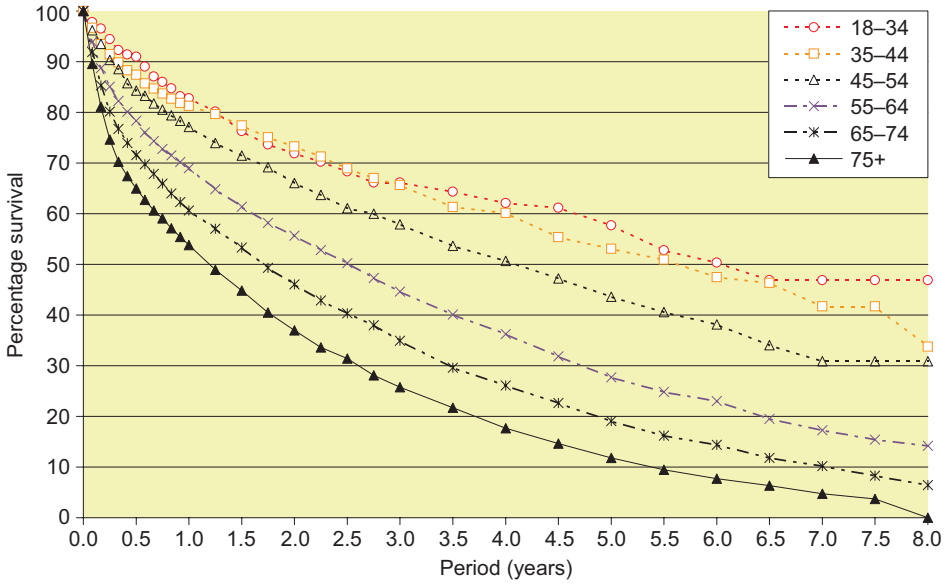

Figure 12.2: Kaplan-Meier 8-year survival of incident patients 1997–2004 cohort (from day 0)

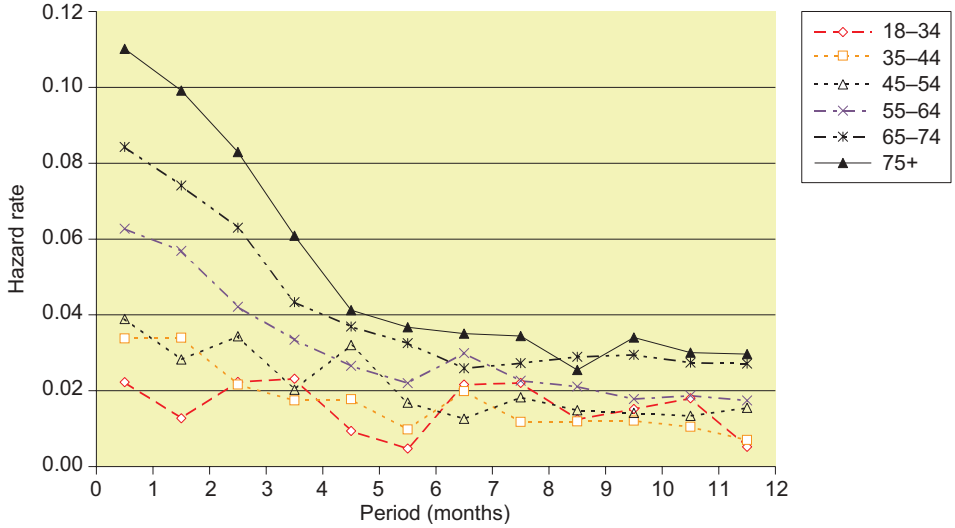

Figure 12.3: 1st-year monthly hazard of death, by age band 1997–2004 cohort

Table 12.7: Unadjusted KM survival of new patients 1997–2004 cohort for patients aged 18–64

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	95% CI for last available year	N
2004	89.5	–	–	–	–	–	–	–	88.3–90.7	2,653
2003	89.1	81.9	–	–	–	–	–	–	80.3–83.4	2,361
2002	88.2	81.0	75.5	–	–	–	–	–	73.6–77.4	2,079
2001	87.4	79.8	74.1	68.5	–	–	–	–	66.4–70.7	1,866
2000	89.4	81.7	75.1	70.3	65.1	–	–	–	62.7–67.4	1,578
1999	87.6	81.3	73.9	67.9	62.9	58.8	–	–	56.1–61.4	1,350
1998	86.7	79.4	72.8	67.6	61.2	56.2	52.3	–	49.5–55.1	1,286
1997	85.9	78.2	70.9	65.3	60.2	55.3	52.0	50.0	46.5–53.5	793

Table 12.8: Unadjusted KM survival of new patients 1997–2004 cohort for patients aged >65

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	95% CI for last available year	N
2004	68.1	–	–	–	–	–	–	–	66.4–69.9	2,707
2003	68.4	52.6	–	–	–	–	–	–	50.6–54.7	2,362
2002	65.5	50.4	39.8	–	–	–	–	–	37.7–41.8	2,174
2001	67.1	51.8	39.5	30.5	–	–	–	–	28.4–32.6	1,871
2000	66.8	53.2	39.9	28.8	22.6	–	–	–	20.5–24.7	1,514
1999	66.1	50.5	38.3	28.8	21.4	15.0	–	–	13.1–17.0	1,272
1998	63.9	46.9	36.3	27.4	20.6	14.8	10.6	–	8.8–12.4	1,140
1997	63.8	46.1	33.3	23.9	16.6	11.8	8.1	6.2	4.2–8.2	583

Table 12.9: Unadjusted survival of new patients 1997–2004 cohort for patients of all ages

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	95% CI for last available year	N
2004	78.7	–	–	–	–	–	–	–	77.6–79.8	5,360
2003	78.7	67.2	–	–	–	–	–	–	65.8–68.5	4,723
2002	76.5	65.3	57.1	–	–	–	–	–	55.6–58.6	4,253
2001	77.2	65.8	56.7	49.4	–	–	–	–	47.8–51.1	3,737
2000	78.3	67.7	57.9	50.1	44.3	–	–	–	42.5–46.1	3,092
1999	77.2	66.3	56.6	48.9	42.8	37.6	–	–	35.7–39.4	2,622
1998	76.0	64.1	55.7	48.7	42.1	36.8	32.7	–	30.8–34.5	2,426
1997	76.6	64.7	55.0	47.8	41.8	36.9	33.5	31.5	29.0–33.9	1,376

Table 12.6 demonstrates that the age related increase in hazard of death is different between the two time periods.

It should be noted that the data in Tables 12.7 to 12.9 are not adjusted for age. The median age of incident patients has increased over the period 1997–2004 and so an apparent decrease in patient survival could have been expected.

Change in survival on renal replacement therapy by vintage

Data from the USA[4] (USRDS Report 2006) has demonstrated a worsening prognosis on renal replacement therapy with increase in years on dialysis (vintage) and this effect has not been demonstrated in previous analyses of UK data[6].

Survival analysis of younger patients that have been censored at the time of transplantation, censors out those with better prognosis, leaving a biased subgroup of patients on dialysis. The analysis has therefore not been censored at transplantation.

The hazard of death was calculated for 6 monthly periods as the hazard at the mid point within that time period. The first 3 month period has been excluded from this analysis.

Analysis of patients in older age groups (65–75 and 75+ years) shows an increasing 6 monthly hazard of death at 5–6 years after starting renal replacement therapy (Figure 12.4). This contrasts with data from the USA where this increasing hazard is seen beyond 2 years for all age groups. Previous Registry analyses have demonstrated that survival on RRT in the UK is better than in the USA[7] across all age ranges even though there are similar rates of co-morbidity[8]. The reasons for this are unknown, but may also partly explain why there are also differences seen in the effect of vintage.

Analysis of the same data after excluding diabetic patients shows an even clearer trend (Figure 12.5). Figure 12.6 for diabetic patients shows no vintage effect and this may be related to the higher risk of death in this group of patients, overwhelming small changes from a vintage effect.

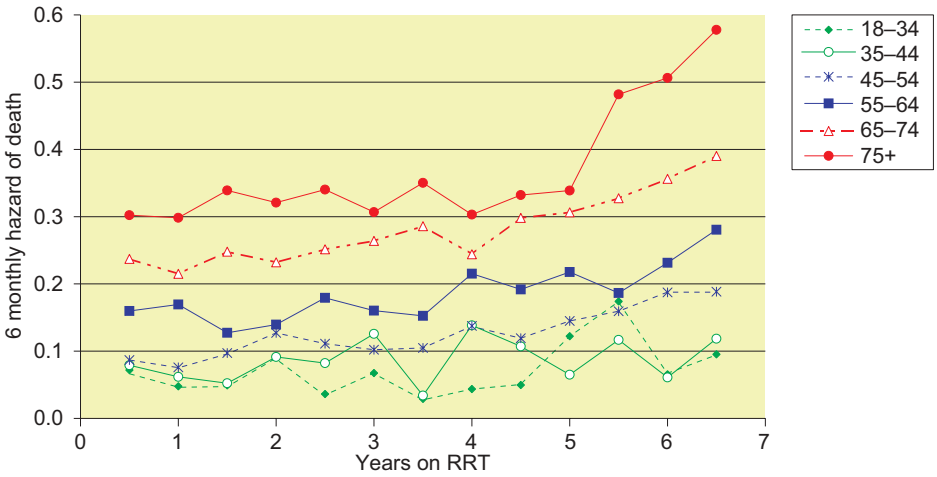

Figure 12.4: Six monthly hazard of death, by vintage and age band, 1997–2004 incident cohort after day 90

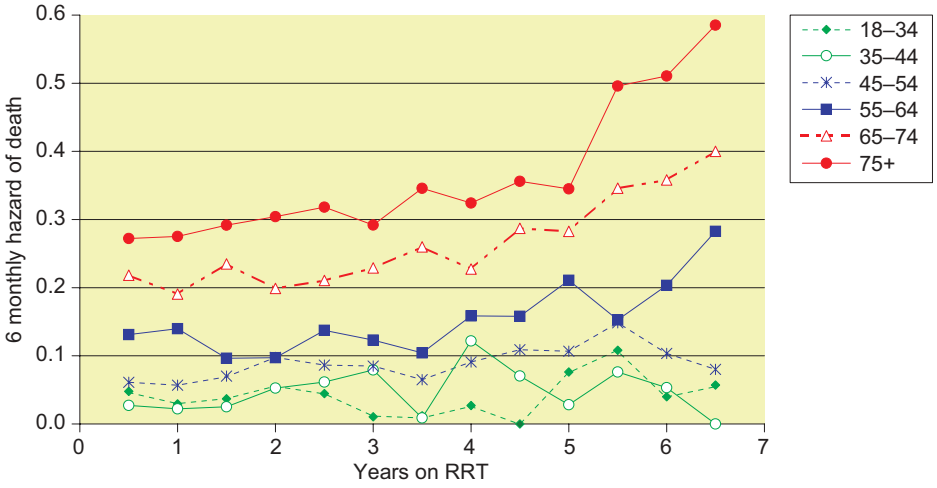

Figure 12.5: Six monthly hazard of death, by vintage and age band, 1997–2004 non-diabetic incident cohort

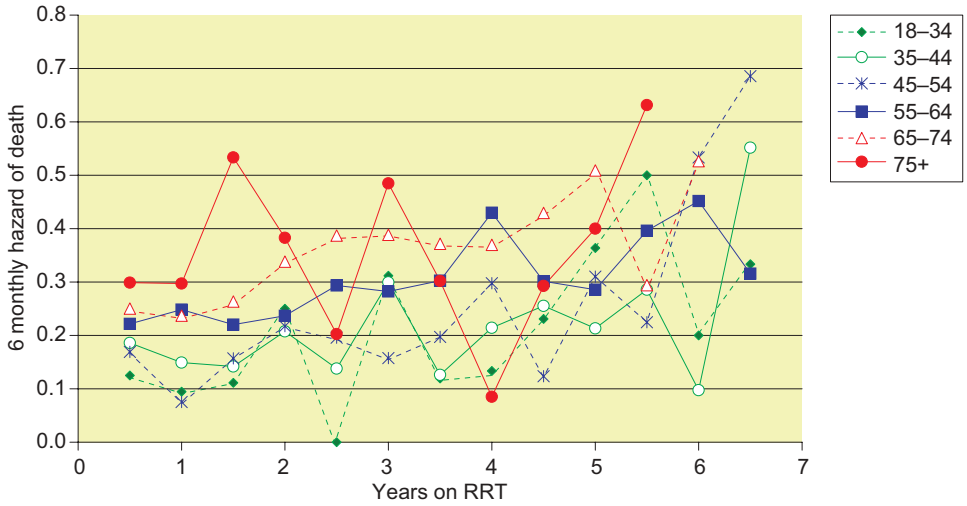

Figure 12.6: Six monthly hazard of death, by vintage and age band, 1997–2004 diabetic incident cohort

Time trend changes in incident patient survival, 1999–2004

Figure 12.7 shows the change over 5 years in incident patient survival. As the Registry does not currently cover the whole of the UK, any improvement in survival could be confounded by the effect of newer centres with lower mortality, reporting data for the first time. To allow for this, the left hand graph shows survival for the original 1999 Registry sites, which very closely follow the 'all sites' UK change in survival. This also indicates that the 1999 Registry data was very representative of the UK as a whole. All previous UK Registry reports have compared survival using the much smaller 1997 cohort.

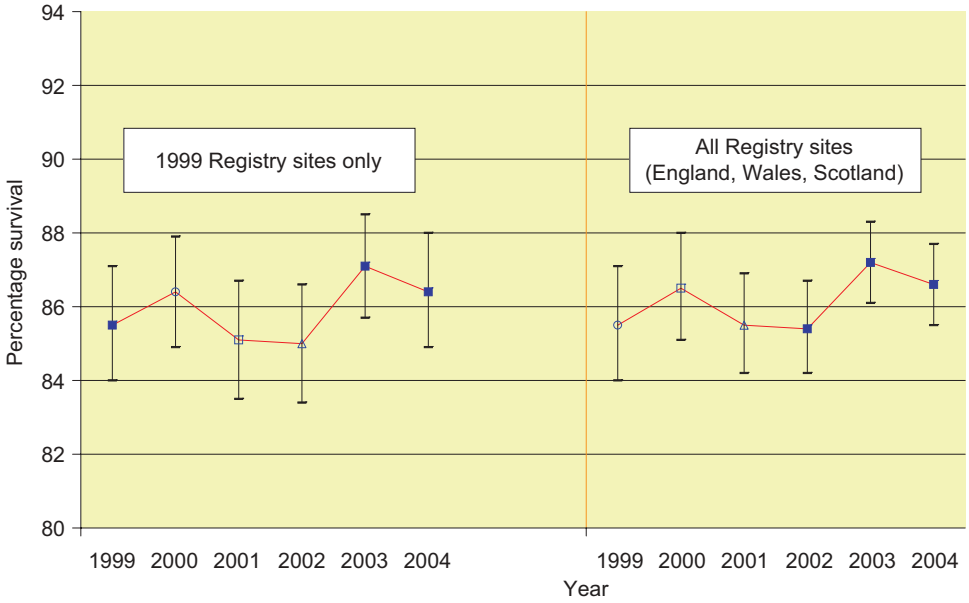

Figure 12.7: Change in one-year after 90 day adjusted (age 60) survival, 1999–2004
Showing 95% confidence intervals

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2004 incident cohort is shown in Figure 12.8 for each renal unit. The tables for these data and for 90 day survival are in Appendix 1 at the end of this chapter (Tables 12.12 and 12.13).

In the analysis of 2004 survival data, some of the smaller centres have wide confidence intervals (Figure 12.8). This can be addressed by including a larger cohort, from all patients starting RRT 2001–2004, which also assesses sustained performance. A few centres have been contributing data to the Renal Registry for only part of this period so will have fewer years included. The survival results are shown for this larger cohort, using funnel plots to identify possible outliers (Figure 12.9). From Figure 12.9, for any size of incident cohort (X axis) one can identify whether any given survival rate

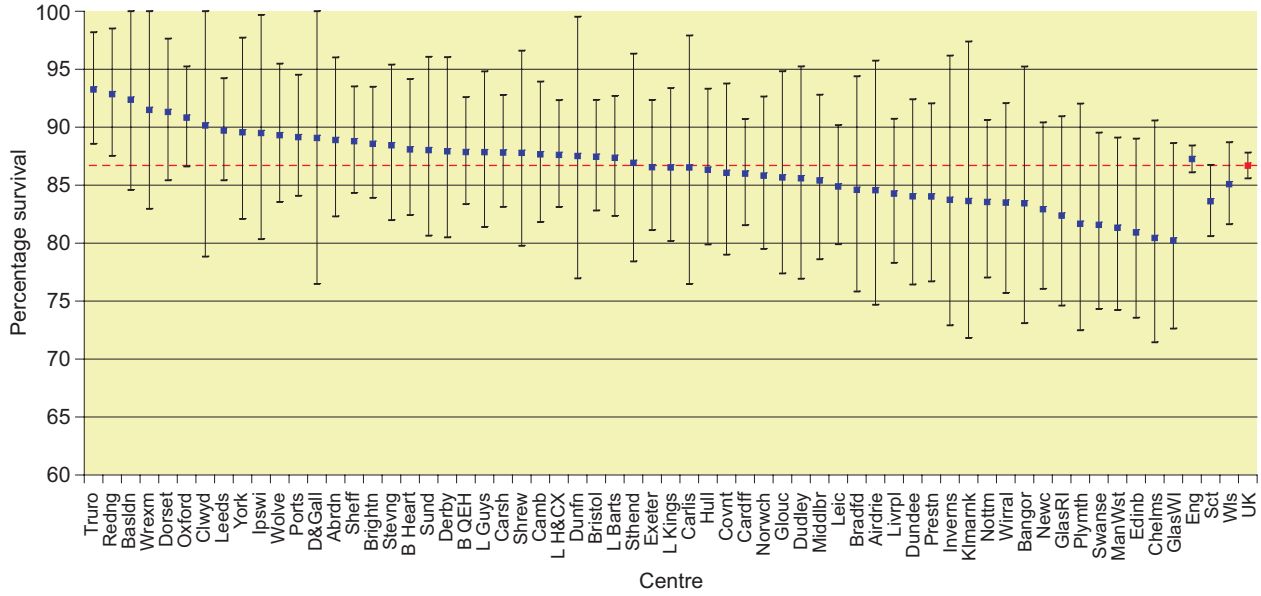

Figure 12.8: Survival one-year after 90 days, adjusted to age 60, 2004 cohort

Showing 95% confidence intervals

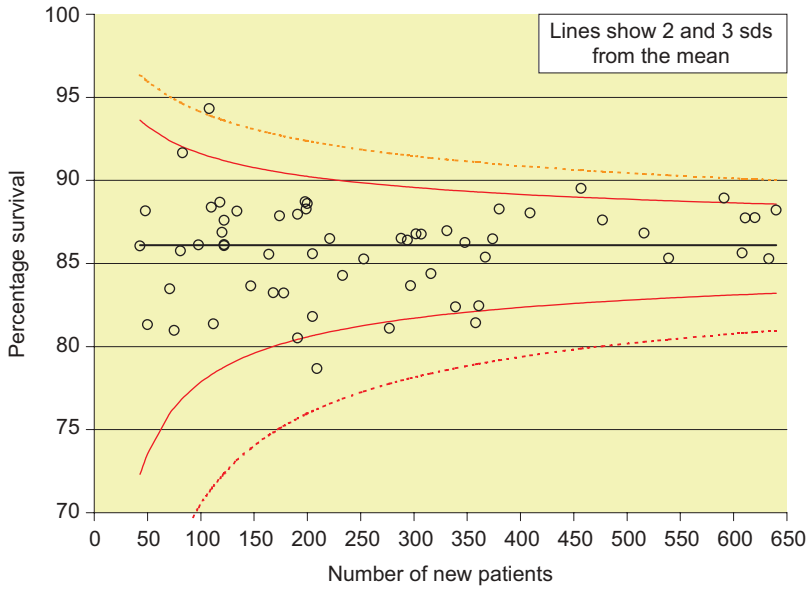

Figure 12.9: Funnel plot for age adjusted 1 year after 90 days survival; 2001–2004 cohorts

(patients who died within the first 90 days have been excluded)

From 2000, the Glasgow Western Infirmary and Glasgow Royal Infirmary have been a single NHS Trust operating on two sites. To date, statistics from these units have been reported separately. The 1-year after day 90 survival rate for the combined Glasgow units (n = 655) was 82.5%

Table 12.10: Adjusted 1 year after 90 day survival 2001–2004

Centre	No of incident pts	1 year after 90 day survival	Centre	No of incident pts	1 year after 90 day survival
Abrdn	199	88.3	Klmarnk	122	86.1
Airdrie	205	81.8	L Barts	174	87.9
B Heart	294	86.4	L Guys	409	88.0
B QEH	191	88.0	L H&CX	457	89.5
Bangor	71	83.5	L Kings	307	86.8
Basldn	83	91.7	Leeds	640	88.2
Bradfd	221	86.5	Leic	620	87.8
Brightn	118	88.7	Livrpl	539	85.3
Bristol	516	86.8	ManWst	233	84.3
Camb	331	87.0	Middlbr	339	82.4
Cardff	633	85.3	Newc	253	85.3
Carlis	98	86.1	Norwch	81	85.8
Carsh	608	85.6	Nottm	374	86.5
Chelms	50	81.3	Oxford	611	87.7
Clwyd	43	86.1	Plymth	209	78.7
Covnt	288	86.5	Ports	477	87.6
D&Gall	75	81.0	Prestn	367	85.4
Derby	164	85.6	Redng	198	88.7
Dorset	110	88.4	Sheff	591	88.9
Dudley	134	88.2	Shrew	48	88.2
Dundee	205	85.6	Stevng	380	88.3
Dunfn	112	81.4	Sthend	122	86.1
Edinb	277	81.1	Sund	191	80.5
Exeter	348	86.3	Swanse	361	82.5
GlasRI	297	83.7	Truro	200	88.6
GlasWI	358	81.4	Wirral	147	83.7
Glouc	178	83.2	Wolve	316	84.4
Hull	302	86.8	Wrexm	122	87.6
Inverns	120	86.9	York	168	83.2
Ipswi	108	94.3			

(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 12.10 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 2–3 sds below average (Plymouth, Glasgow Western and Edinburgh), one centre outside 3 sds above average (Ipswich) and 2 other centres between 2–3 sds above average (Sheffield and Hammersmith & Charing Cross). These data have not been adjusted for any patient related factor except age (not co-morbidity or primary renal disease or ethnicity) with both Plymouth and the Scottish centres returning no data on co-morbidity. There is no censoring at transplantation, so the effect of differing unit rates of transplantation is not taken into account.

As discussed in an earlier Report[8], the general population of Scotland is known to have more ill health than England & Wales, reflected in 16% higher all cause mortality[9] and particularly cardio-vascular disease mortality[10,11,13]. Table 12.11 below shows differences in life expectancy between the UK countries[12]. Thus a slightly higher dialysis mortality in Scotland may reflect the increased mortality in the population from which the dialysis patients are drawn. This emphasises the need to consider the characteristics of the general population from which patients come when considering or comparing outcomes of treatment.

Table 12.11: 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 been slowly increasing (Chapter 6). With the de-anonymisation of centre names in this Report, it is essential to show what the importance is of adjusting patient survival for co-morbidity.

Using the combined incident cohort from 2000–2004, 12 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 12 centres. Further adjustment was then made to the average co-morbidity mix present at these centres (Figure 12.10).

The importance of adjusting for co-morbidity can be seen for Swansea. After adjustment of survival for age and diagnosis, the 1 year after 90 day survival increased from 77% to 84.6%; after adjusting to the average co-morbidity present in the 12 centres, survival increased to 90.4%. This indicates that patients starting RRT at the Swansea renal unit have more co-morbidities present than average for E&W. This contrasts with Wolverhampton where there is little change (85.5% to 85.6%). In both Dorset and Chelmsford the adjusted survival falls indicating that patients at these centres have fewer co-morbidities present.

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

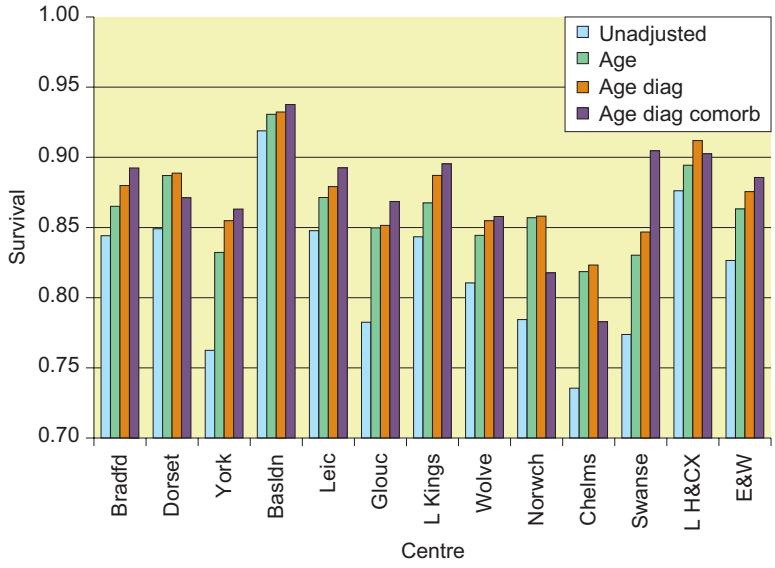

Figure 12.10: Change in 1 year after 90 day survival after adjustment for age, diagnosis and co-morbidity

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Appendix 1: Survival tables

Table 12.12: 1 year after 90-day survival by centre for 2004 unadjusted and adjusted to age 60

Centre	Unadjusted 1yr + 90d survival	Adjusted 1yr + 90d survival	Adjusted 1yr + 90d 95% CI
Abrdn	85.0	88.9	82.3–96.0
Airdrie	83.3	84.6	74.7–95.7
B Heart	83.3	88.1	82.4–94.1
B QEH	86.5	87.9	83.4–92.6
Bangor	74.4	83.4	73.1–95.2
Basldn	91.4	92.4	84.6–100
Bradfd	82.1	84.6	75.8–94.4
Brightn	82.5	88.6	83.9–93.5
Bristol	83.0	87.5	82.8–92.4
Camb	85.9	87.7	81.8–93.9
Cardff	81.3	86.0	81.5–90.7
Carlis	82.1	86.5	76.5–97.9
Carsh	85.4	87.8	83.1–92.8
Chelms	71.7	80.4	71.4–90.6
Clwyd	83.3	90.2	78.8–100
Covnt	83.1	86.1	79.0–93.8
D&Gall	85.7	89.1	76.5–100
Derby	85.4	87.9	80.5–96.0
Dorset	87.4	91.3	85.4–97.6
Dudley	82.9	85.6	76.9–95.2
Dundee	76.3	84.0	76.4–92.4
Dunfn	84.3	87.5	77.0–99.5
Edinb	78.5	80.9	73.6–89.0
Exeter	79.3	86.6	81.1–92.3
GlasRI	77.9	82.4	74.6–90.9
GlasWI	78.2	80.2	72.6–88.6
Glouc	78.1	85.7	77.4–94.8
Hull	81.6	86.3	79.9–93.3
Inverns	81.8	83.7	72.9–96.2
Ipswi	87.2	89.5	80.3–99.7
Klmarnk	79.2	83.6	71.8–97.4
L Barts	88.0	87.4	82.3–92.7
L Guys	88.4	87.8	81.4–94.8
L H&CX	84.8	87.6	83.1–92.3
L Kings	85.2	86.5	80.2–93.4
Leeds	87.3	89.7	85.4–94.2
Leic	81.3	84.9	79.9–90.2
Livrpl	83.0	84.3	78.3–90.7
ManWst	80.0	81.3	74.2–89.1
Middlbr	82.8	85.4	78.6–92.8
Newc	80.8	82.9	76.1–90.4
Norwch	78.1	85.8	79.5–92.6
Nottm	78.6	83.6	77.0–90.6
Oxford	89.1	90.8	86.6–95.2
Plymth	76.1	81.7	72.5–92.0
Ports	85.9	89.1	84.1–94.5
Prestn	80.7	84.0	76.7–92.1
Redng	91.0	92.9	87.5–98.5
Sheff	86.0	88.8	84.3–93.5
Shrew	84.0	87.8	79.8–96.6
Stevng	86.7	88.4	82.0–95.4
Sthend	79.4	86.9	78.4–96.3
Sund	83.7	88.0	80.6–96.1
Swanse	73.6	81.6	74.3–89.5
Truro	89.3	93.3	88.6–98.2
Wirral	78.5	83.5	75.7–92.1
Wolve	86.6	89.3	83.6–95.5
Wrexm	88.0	91.5	83.0–100
York	83.8	89.6	82.1–97.7
Eng	**84.1**	**87.3**	**86.1–88.4**
Scot	**80.1**	**83.6**	**80.6–86.7**
Wls	**79.4**	**85.1**	**81.6–88.7**
UK	**83.4**	**86.7**	**85.6–87.8**

Table 12.13: 90-day survival by centre for 2004 unadjusted and adjusted to age 60

Centre	90 day unadjusted survival	90 day adjusted survival	90 day adjusted 95% CI
Abrdn	94.1	96.2	92.7–99.9
Airdrie	92.2	93.9	88.4–99.7
B Heart	84.9	90.9	86.5–95.5
B QEH	89.5	92.1	88.9–95.4
Bangor	84.9	92.3	86.1–98.9
Basldn	79.6	85.1	76.7–94.5
Bradfd	92.9	94.9	90.2–99.9
Brightn	94.3	96.9	94.7–99.2
Bristol	87.0	91.9	88.6–95.3
Camb	92.8	94.6	91.0–98.3
Cardff	91.5	94.7	92.1–97.3
Carlis	100.0	n/a	n/a
Carsh	90.2	93.0	89.8–96.3
Chelms	90.2	94.8	90.4–99.3
Clwyd	85.7	93.6	85.7–100
Covnt	93.8	95.7	92.0–99.4
D&Gall	87.5	92.5	83.6–100
Derby	85.9	89.9	83.8–96.4
Dorset	93.3	96.0	92.2–99.9
Dudley	87.0	90.7	84.5–97.4
Dundee	88.9	93.9	89.7–98.4
Dunfn	93.1	95.5	89.8–100
Edinb	91.8	94.0	90.1–98.1
Exeter	90.3	94.8	91.8–97.9
GlasRI	87.7	91.6	86.7–96.7
GlasWI	88.2	91.2	86.5–96.1
Glouc	88.0	93.4	88.4–98.6
Hull	77.5	86.2	80.9–91.7
Inverns	94.3	95.8	90.3–100
Ipswi	88.1	91.1	84.1–98.7
Klmarnk	100.0	n/a	n/a
L Barts	92.3	92.8	89.2–96.5
L Guys	95.1	95.6	91.9–99.4
L H&CX	92.4	94.6	91.8–97.4
L Kings	93.3	94.7	90.9–98.6
Leeds	86.9	91.0	87.5–94.7
Leic	94.1	95.9	93.4–98.4
Livrpl	94.8	96.0	93.2–99.0
ManWst	97.2	97.7	95.2–100
Middlbr	86.0	89.7	84.8–95.0
Newc	87.9	90.8	86.2–95.7
Norwch	92.7	96.1	93.1–99.2
Nottm	86.5	91.2	86.8–95.7
Oxford	94.9	96.4	94.0–98.9
Plymth	75.8	85.6	79.0–92.8
Ports	94.8	96.4	93.6–99.3
Prestn	94.9	96.3	92.9–99.9
Redng	98.5	98.9	96.9–100
Sheff	95.2	96.7	94.5–99.0
Shrew	84.6	90.0	83.7–96.8
Stevng	96.2	97.1	93.9–100
Sthend	89.5	94.5	89.4–99.9
Sund	96.1	97.8	94.7–100
Swanse	84.3	91.0	86.6–95.7
Truro	98.5	99.2	97.7–100
Wirral	91.2	94.3	89.9–98.8
Wolve	85.4	89.6	84.6–95.0
Wrexm	92.6	95.6	89.9–100
York	84.4	91.9	86.3–97.8
Eng	**90.8**	**93.8**	**93.0–94.6**
Scot	**91.0**	**93.8**	**92.1–95.6**
Wls	**88.9**	**93.4**	**91.3–95.6**
UK	**90.7**	**93.8**	**93.0–94.6**

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 13: Demography and Management of Childhood Established Renal Failure in the UK

Malcolm Lewis, Joanne Shaw, Chris Reid, Jonathan Evans, Nicholas Webb and Kate Verrier-Jones

Summary

- The incidence and prevalence of ERF in children in the UK is relatively static at 8.0 and 47.7 per million population under the age of 15 years respectively.

- The prevalence of ERF in children from the South Asian community is almost 3 times that of the White population whilst the incidence is over 3 times that of the White population and similar to the increase seen in the adult population. The high incidence and prevalence are related to the high incidence of inherited diseases which cause ERF in the South Asian community.

- ERF in children is more common in males than females (male to female ratio 1.54:1). This is due to a preponderance of males with renal dysplasia and obstructive uropathy causing ERF. For the South Asian patients, the gender ratio is 1:1 as the inherited diseases are mainly autosomal recessive.

- Renal dysplasia is the single most common cause of ERF in childhood, followed closely by glomerular disorders and then obstructive uropathy.

- The majority of prevalent paediatric ERF patients (76%) have a renal allograft. Of these, 28% are from living donations.

- The proportion of patients from ethnic minority groups with a functioning allograft is significantly smaller than that in the White population ($p < 0.0001$). Despite this, the rate of living related donation is no higher in the ethnic minority population.

- In prevalent patients PD is twice as commonly used as HD with the majority managed with automated PD. For patients at one year from starting RRT, 49% are on PD, 10% on HD and 41% have a transplant.

Introduction

Knowledge of the demography of the ERF population is important both for the planning of service provision and for the development of preventative treatment programmes. This article covers the demography of ERF in children in the UK and their current modality of ERF treatment.

Paediatric ERF population

The paediatric arm of the Renal Registry currently holds data on some 1,800 patients who had ERF in childhood. A number of these patients have died and many have been transferred to adult units. The population of ERF patients being treated in paediatric units on 1st April 2005 stood at 768. This is a small fall on the number from 2004. The reasons for this probably lie with incomplete data returns from 3 units, together with variability of the population with the transfer of teenage patients to adult units.

Table 13.1 shows the prevalent population by gender and ethnicity together with the numbers who were under 18 years of age and 15 years of age on 1st April 2005. As in previous Reports, there are about 20 young people over the age of 18 years remaining in paediatric units. These patients are transferred between the age of 18 and 20 years. There are no patients over the age of 20 years in the current cohort. Reasons for delayed transfer include the management of specific paediatric co-morbidities and concerns over growth, development and education. The distribution of the population with regard to gender and ethnicity was unchanged from

Table 13.1: Prevalent patient population according to gender and ethnicity

	Patients	Male	Female	Ratio	% Total
Total	768	466	302	1.54:1	100.0
White	632	395	237	1.66:1	82.3
Asian	109	53	56	0.95:1	14.2
Black	14	9	5	1.80:1	1.8
Other	13	9	4	2.25:1	1.7
<18 years	748	456	292	1.56:1	97.4
<15 years	515	321	194	1.65:1	67.1

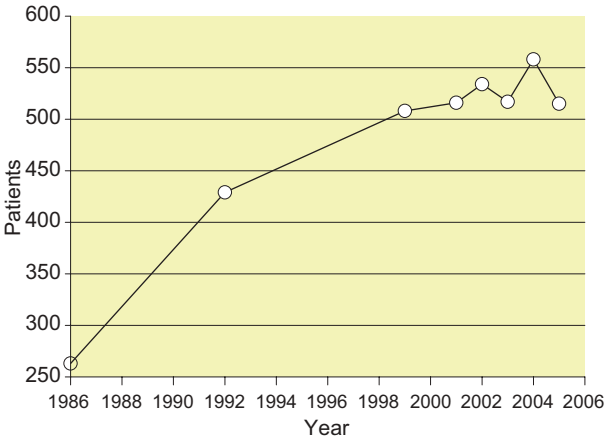

Figure 13.1: ERF patients below 15 years of age, by year of data collection

previous reports. There remains a predominance of males and just over 17% come from ethnic minority backgrounds.

Figure 13.1 shows the size of the population under the age of 15 years from 1986 to 2005. The apparent growth in this population seen in 2004 has not been maintained but this will be due to some missing data from units with incomplete submissions together with some variability year on year in presentation rates. The overall trend has been that of a slowing of the initially sharp increase in the population. This is supported by the data on incidence and prevalence presented below.

The age distribution of the population over a number of years is shown in Tables 13.2 and 13.3. The former gives the customary divisions by age and the latter shows the population divided into four year age bands for ease of comparison. Though there is year to year variability, the numbers have been fairly static of late, clearly showing a cessation of the rapid population growth seen after paediatric ERF treatment became available. Figure 13.2 shows the data in Table 13.3 graphically and clearly shows that over recent years there has been no significant change in the age distribution of the population.

Table 13.3: ERF population in 4 year age bands

	Patient population for the years of			
Age group (yrs)	2002	2003	2004	2005
0–3	49	39	41	36
4–7	94	103	112	108
8–11	185	176	173	152
12–15	294	291	297	321
16–19	171	164	179	151

Table 13.2: ERF population by age and year of data collection

	Patient population data for the years of							
Age group (yrs)	1986	1992	1999	2001	2002	2003	2004	2005
0–1		16	18	13	14	10	12	14
2–4		55	46	56	58	56	51	45
5–9		150	151	146	147	141	166	157
10–14		208	293	301	315	310	329	299
15–19			253	274	259	256	244	253
Total <15	263	429	508	516	534	517	558	515
Total <20			761	790	793	773	802	768

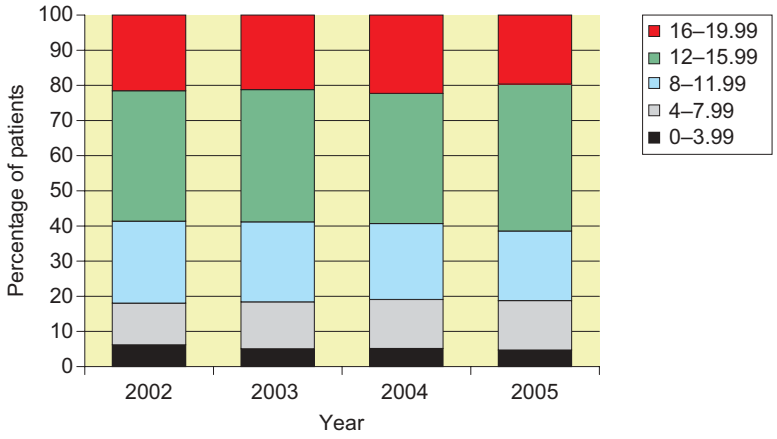

Figure 13.2: ERF population in 4 year age bands

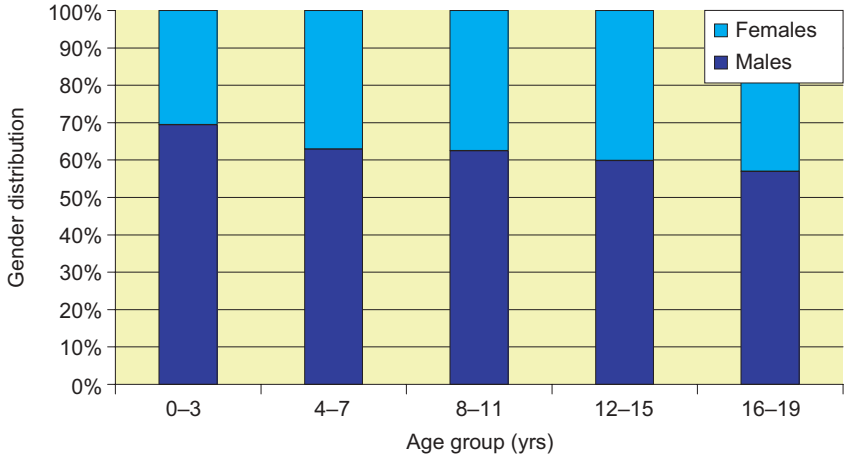

Figure 13.3: Gender distribution of the ERF population according to age

The gender distribution of the paediatric ERF population is shown in Figure 13.3. Throughout the age range, males predominate but there is a steady rise in the proportion of females in the population with increasing age.

Of the ethnic minority patients, the vast majority are of South Asian origin. The age and gender distributions of this cohort are somewhat different to that of the White population. This is secondary to the different causes of ERF in the South Asian community and is dealt with in detail below. Table 13.4 shows the age distribution of the population according to ethnicity. Although the difference in age distribution between the White and ethnic minority populations does not reach statistical significance the pattern is demonstrated in Figure 13.4.

The difference in gender distribution between the White and South Asian paediatric ERF populations is shown in Figure 13.5 which contrasts the proportion of the population in each age group who are male. In the under the age of 4 years group, 77% of White patients in this group are male. Thereafter, there is a fall in the proportion of males in the White population, with an increase in the proportion of males in the South Asian population, until in the young adults, both lie between 55 and 60%. There

Table 13.4: Age and ethnic distribution of the ERF prevalent population

Age group (yrs)	Ethnicity			
	White	South Asian	Black	Other
0–3	30	5	1	0
4–7	82	16	5	5
8–11	120	26	3	3
12–15	270	44	3	4
16–19	130	18	2	1
All <20	632	109	14	13

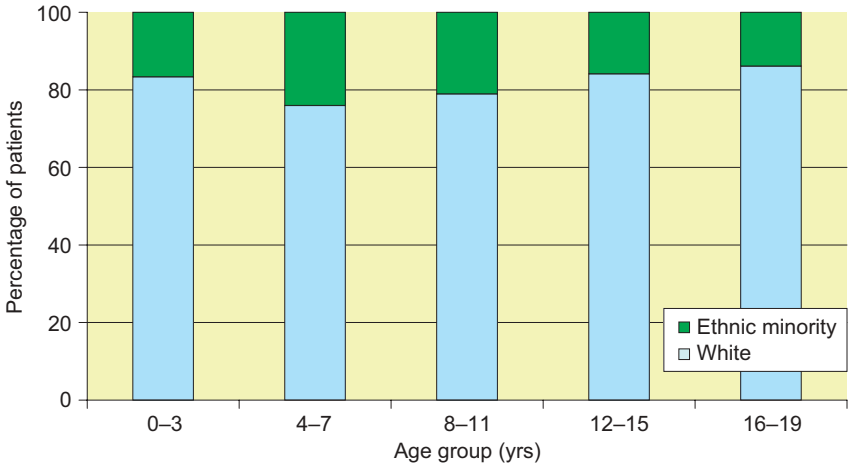

Figure 13.4: Age distribution of the White and Ethnic minority patients

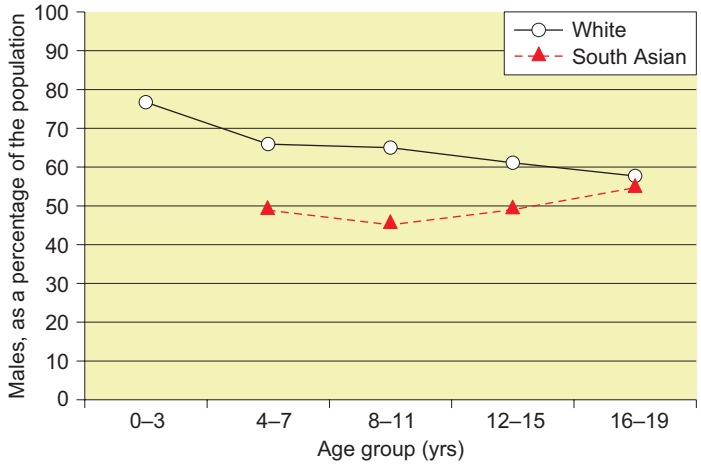

Figure 13.5: Gender distribution and ethnicity in the paediatric population

were only five Asian patients under age 4 so these have been removed from the graph.

Prevalence and take-on rate

Data on the UK population divided according to age and ethnic background was taken from the Office for National Statistics' Website (www.statistics.gov.uk). Data for this report is based upon current population estimates which themselves are extrapolated from the United Kingdom Census of 2001. Table 13.5 shows the prevalence of ERF per million childhood population for each age group. These figures have changed little since previous Reports[1–6] as one might expect from the stable population numbers. Figure 13.6 shows this graphically, clearly demonstrating the steady rise in prevalence with patient age until the fall in the over 16 year old

Table 13.5: Prevalence of ERF per million childhood population

	All patients		Males		Females	
Age group (yrs)	Patients	Prevalence	Patients	Prevalence	Patients	Prevalence
0–3	36	13.3	25	18.0	11	8.3
4–7	108	38.2	68	46.9	40	29.0
8–11	152	51.2	95	62.5	57	39.4
12–15	321	102.2	192	119.1	129	84.4
16–19	151	48.1	86	53.2	65	42.6
<15	515	47.4	321	57.6	194	36.6

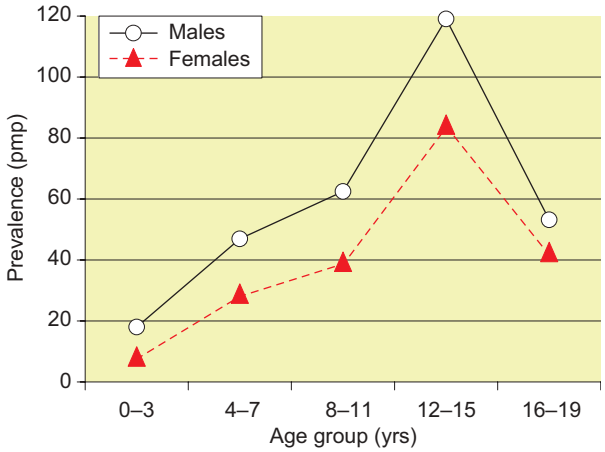

Figure 13.6: Prevalence of ERF according to gender

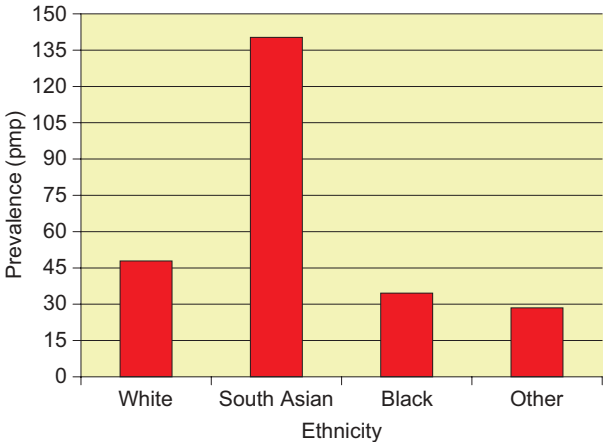

Figure 13.7: Prevalence of ERF according to ethnicity

group, secondary to transfer to adult units. The figures for prevalence of ERF in the UK are comparable with those presented in the USRDS and ANZDATA registries[7,8].

Whilst there is no mention of ethnicity in the most recent ANZDATA report the USRDS report does give an ethnic breakdown but not one which is specific to the paediatric age range. As the majority of the patients are adult and there are varying rates of glomerulonephritis, hypertensive and diabetic nephropathies amongst the different adult ethnic groups, it is impossible to extrapolate this published data to look at prevalence and ethnicity in children. As with previous reports from the UK paediatric registry the prevalence of ERF is much higher in the South Asian community, being almost three times that of the White population, whilst the prevalence of ERF in the Black population and those of other ethnic origins is a little below that of the White community. This is demonstrated in Figure 13.7. The reasons for this distribution lie in the varying causes of ERF with ethnicity and are discussed below.

The take on rates of patients starting RRT has been assessed looking at a 5 year period to even out the peaks and troughs seen with annual data collection when relatively small numbers are being analysed. This is demonstrated well by the undulant picture shown by the ANZDATA incidence chart. Looking at take on rate as a mean of consecutive 5 year periods, there is clearly little change in the incidence of ERF in children. Overall, the incidence of ERF in children in the UK is very similar to that of the Australian, New Zealand and US cohorts. These data are shown in 4 year age bands in Table 13.6 and graphically in Figure 13.8. There is a nadir of presentation of ERF in the 4 to 8 year old group following a peak in the first four years of life with the presentation of many children with obstructive uropathy and renal dysplasia. Following this there is a steady rise in incidence as the number of patients with glomerular diseases increases. As with the prevalence data, the take on rate of new patients with ERF in the South Asian community far outweighs that of the White community with an incidence per million childhood population 3.7 times that of the White population (Figure 13.9). This incidence figure will, over a number of years, lead to the proportion of the total population of children with

Table 13.6: Average 5 year incidence rate for patients with ERF per million childhood population

	All patients		Males		Females	
Age group (yrs)	Patients	Take on rate	Patients	Take on rate	Patients	Take on rate
0–3	22	8.0	13	9.4	9	6.7
4–7	15	5.2	8	5.2	7	5.1
8–11	24	8.0	13	8.4	11	7.6
12–15	35	11.3	19	11.8	16	10.7
<15	87	8.0	47	8.5	40	7.5

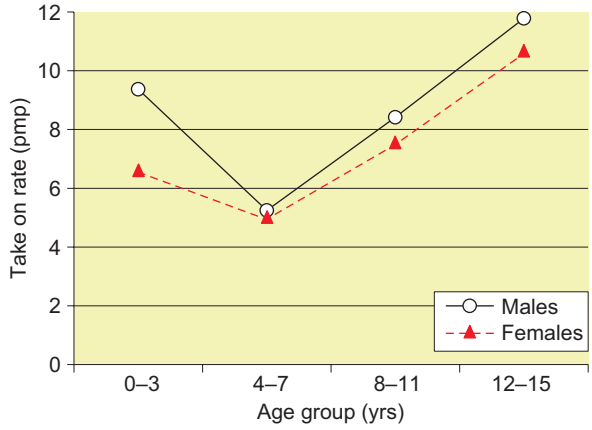

Figure 13.8: Average 5 year take on rate of children with ERF by gender

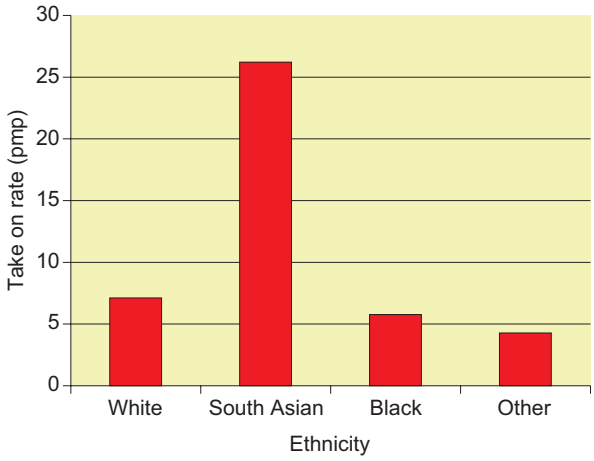

Figure 13.9: Average 5 year take on rate of children with ERF by ethnicity

ERF coming from the South Asian community rising still further. The distribution of the ethnic minority population (and consequently the ethnic minority children with ERF) around the UK is not evenly spread[6]. This has significant implications for resource management.

Causes of ERF in children

The causes of ERF have been analysed by looking at a total of 913 incident patients presenting with ERF before the age of 16 years, since the inception of the registry in 1996, for whom a primary diagnosis was stated. Diagnoses have been grouped into 12 bands. These are shown in Table 13.7 with a further breakdown of each of the groupings in Tables 13.8 to 13.17. Renal dysplasia remains the single most common diagnostic group comprising almost a quarter of the total cohort. There is a male predominance in patients with renal dysplasia, and this together with the male contingent with obstructive uropathy from posterior urethral valves, accounts for the overall gender distribution of the paediatric ERF population. The gender distribution of each diagnostic group is shown in Figure 13.10. Although there is no explanation for this, a high incidence of renal dysplasia in males has not only been noted in the UK registry reports but also in the NAPRTCS report[9]. Glomerular disease follows closely behind renal dysplasia, accounting for 22% of patients. Obstructive uropathy is the third most common cause accounting for 15%.

The nature and distribution of the diseases causing ERF in childhood have not changed significantly over the years that reports have been generated by the Registry. However, this will be due to the fact that a complete and

Table 13.7: ERF diagnostic grouping for 913 patients presenting after 1st April 1996

Diagnostic group	Patients	% of total	Males	Females	Ratio
Dysplasia	221	24.2	138	83	1.66:1
Glomerular diseases	205	22.5	91	114	0.80:1
Obstructive uropathy	136	14.9	121	15	8.06:1
Tubulo-interstitial diseases	73	8.0	36	37	0.97:1
Reflux nephropathy	69	7.6	34	35	0.97:1
Congenital nephrotic syndrome	46	5.0	18	28	0.64:1
Metabolic diseases	44	4.8	25	19	1.32:1
Renovascular problems	34	3.7	18	16	1.13:1
ERF of uncertain aetiology	29	3.2	12	17	0.71:1
Polycystic kidney disease	27	3.0	9	18	0.50:1
ERF from drug nephrotoxicity	19	2.1	13	6	2.17:1
Malignancy & associated disease	10	1.1	5	5	1.00:1

Table 13.8: Diagnoses for patients with renal dysplasia

Diagnoses in renal dysplasia group	Patients	Males	Females	Ratio
Renal dysplasia	184	114	70	1.63:1
Multicystic dysplastic kidneys	11	5	6	0.83:1
Prune belly syndrome	10	10	0	
Renal hypoplasia	8	3	5	0.75:1
Branchio-oto-renal syndrome	3	3	0	
Lawrence Moon Bardet Biedl syndrome	3	1	2	0.50:1
Megacystis megaureter	2	2	0	

Table 13.9: Diagnoses for patients with glomerular disease

Diagnoses in glomerular diseases group	Patients	Males	Females	Ratio
Primary focal segmental glomerulosclerosis	87	40	47	0.85:1
Diarrhoea positive HUS	18	8	10	0.80:1
Henoch Schoenlein nephritis	14	5	9	0.56:1
Diarrhoea negative HUS	12	3	9	0.33:1
GN (unspecified)	10	6	4	1.50:1
Alport's syndrome	9	8	1	8.00:1
IgA nephropathy	9	5	4	1.25:1
Mesangio-capillary GN type 1	9	4	5	0.80:1
Mesangio-capillary GN type 2	6	2	4	0.50:1
Crescentic GN	8	4	4	1.00:1
Proliferative GN	6	2	4	0.50:1
Systemic lupus erythematosis	6	1	5	0.20:1
Anti GBM disease	3	0	3	
Microscopic polyarteritis nodosa	3	1	2	0.50:1
Wegner's granulomatosis	3	2	1	2.00:1
Macroscopic polyarteritis nodosa	1	0	1	
Vasculitis (unspecified)	1	0	1	

Table 13.10: Diagnoses for patients with obstructive uropathy

Diagnoses in obstructive uropathy group	Patients	Males	Females	Ratio
Posterior urethral valves	103	103	0	
Neuropathic bladder	13	3	10	0.30:1
Bladder outlet obstruction (Not PUV)	11	9	2	4.50:1
Congenital obstructive uropathy (Not BOO)	7	4	3	1.25:1
Acquired obstructive uropathy	2	2	0	

(PUV = posterior urethral valves, BOO = bladder outlet obstruction)

Table 13.11: Diagnoses for patients with tubulo-interstitial disease

Diagnoses in tubulo-interstitial group	Patients	Males	Females	Ratio
Nephronophthisis	59	28	31	0.90:1
Primary interstitial nephritis	9	5	4	1.25:1
Bartter's syndrome	2	1	1	1.00:1
Nephrocalcinosis	1	0	1	
Renal tubular acidosis	1	1	0	
Tubular disorders (other)	1	1	0	

Table 13.12: Diagnoses for patients with congenital nephrotic syndrome

Diagnoses in congenital nephrotic syndrome group	Patients	Males	Females	Ratio
CNS unspecified	21	5	16	0.31:1
Finnish type	17	8	9	0.89:1
Diffuse mesangial sclerosis	5	4	1	4.00:1
Focal segmental glomerulosclerosis	3	1	2	0.50:1

Table 13.13: Diagnoses for patients with metabolic diseases

Diagnoses in metabolic diseases group	Patients	Males	Females	Ratio
Cystinosis	34	19	15	1.27:1
Primary hyperoxaluria type I	5	3	2	1.50:1
Mitochondrial cytopathy	4	2	2	1.00:1
Metabolic disease (other)	1	1	0	

Table 13.14: Diagnoses for patients with renovascular disease

Diagnoses in renovascular disease group	Patients	Males	Females	Ratio
Cortical necrosis	22	10	12	0.83:1
Renal vein thrombosis	8	6	2	3.00:1
Renal artery stenosis	2	1	1	1.00:1
Renal trauma	2	1	1	1.00:1

Table 13.15: Diagnoses for patients with polycystic kidney disease

Diagnoses in polycystic kidney disease group	Patients	Males	Females	Ratio
Recessive polycystic kidney disease	20	6	14	0.43:1
Polycystic kidney disease (other)	5	2	3	0.67:1
Dominant polycystic kidney disease	1	1	0	
Tuberous sclerosis with polycystic kidney disease	1	0	1	

Table 13.16: Diagnoses for patients with ERF from drug nephrotoxicity

ERF from drug nephrotoxicity group	Patients	Males	Females	Ratio
Calcineurin inhibitor nephrotoxicity	14	11	3	3.67:1
Cytotoxic drug nephrotoxicity	5	2	3	0.67:1

Table 13.17: Diagnoses for patients with malignant disease

Diagnoses in malignant disease group	Patients	Males	Females	Ratio
Wilms' tumour	7	3	4	0.75:1
Wilms' nephropathy	3	2	1	2.00:1

expanding cohort has been used to look at this distribution. Certainly the information provided by ANZDATA suggests a similar distribution of causes if one excludes the 15 to 20 year age group, which appears to be a complete cohort in ANZDATA and therefore dramatically expands the band of patients with glomerulonephritides. The USRDS data available does not give a specific diagnostic breakdown for children. The NAPRTCS report is more difficult

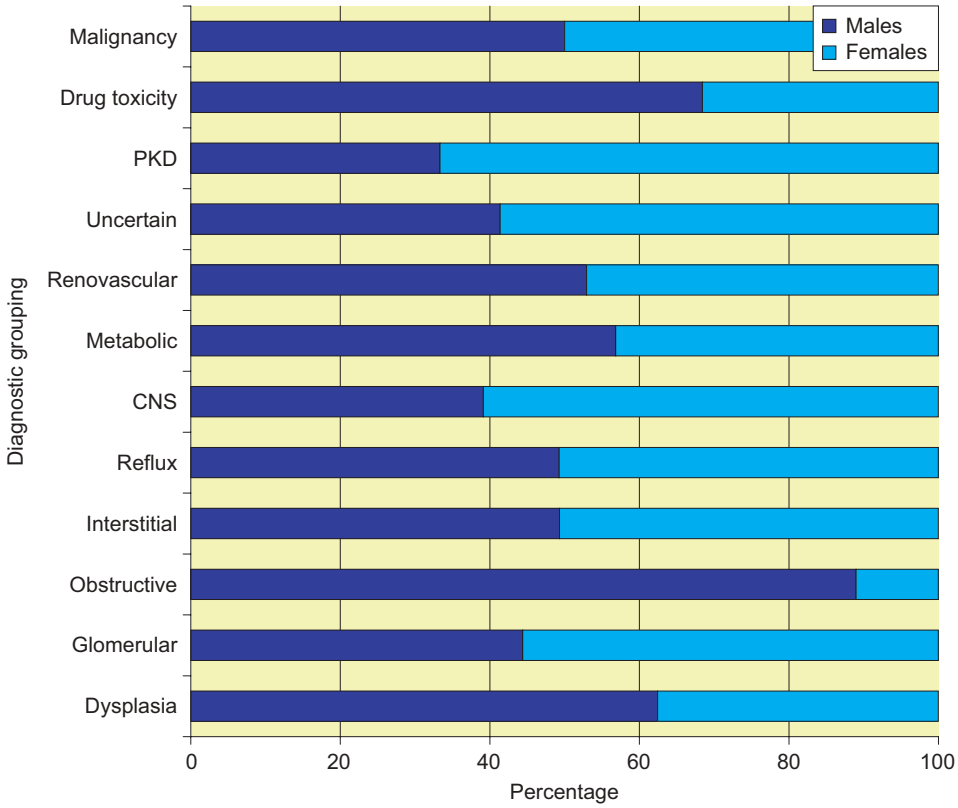

Figure 13.10: Gender distribution of the ERF population according to diagnostic group

to interpret as the analysis of transplant and dialysis patients is separate. Certainly it appears that for White and Hispanic patients, renal dysplasia leads in conjunction with obstructive uropathy. Unlike the UK data, glomerular diseases causing ERF appear less frequent in this population. This however, is offset by the high incidence of glomerular diseases causing ERF in the Black population. Differences in the patterns of primary pathology with ethnicity in the UK population are dealt with below.

To investigate whether there has been any change in the pattern of primary pathology causing ERF in children over the period the Registry has been collecting data, the distribution of diagnoses have been compared within the 12 main classifications in those patients presenting between 1996 (when data collection began) and 1999, with those patients presenting between 2002 and 2005. These data are shown in Table 13.18. There is no significant difference in the patterns of disease. The incidence of

Table 13.18: Comparison of diagnostic distributions 1996–1999 and 2002–2005

	Percentage of patients presenting	
Diagnostic group	**1996–1999**	**2002–2005**
Dysplasia	25.2	26.1
Glomerular diseases	21.1	21.2
Obstructive uropathy	17.1	13.8
Tubulo-interstitial diseases	6.7	9.9
Reflux nephropathy	9.4	5.7
Congenital nephrotic syndrome	6.0	4.2
Metabolic diseases	4.0	3.5
Renovascular problems	3.7	3.5
ERF of uncertain aetiology	2.3	5.3
Polycystic kidney disease	2.7	3.5
ERF from drug nephrotoxicity	1.0	1.4
Malignancy & associated disease	0.7	1.8

obstructive uropathy has fallen slightly and time will tell whether this is an ongoing trend. Reflux nephropathy has fallen and there has been a parallel rise in the incidence of ERF of uncertain aetiology. Knowing the difficulty in categorising patients who present with small kidneys, either in or near ERF, it is possible that this simply represents variability in classification. The incidence of tubulo-interstitial diseases has risen. Again, only time will tell whether this is a true trend, however, it is something that may be expected given the rising South Asian population and the increased frequency of these pathologies in this ethnic group.

As alluded to above and published in previous reports from the Registry, there is a significant difference in the pattern of diseases causing ERF in different ethnic groups. This is shown in Table 13.19. Whilst for the White population renal dysplasia predominates followed closely by glomerular diseases. In the South Asian population glomerular diseases predominate with a lower incidence of renal dysplasia. Tubulo-interstitial disorders, metabolic diseases and congenital nephrotic syndrome are much more common in the South Asian community. The overall difference in the distribution of diseases between the White and South Asian populations is highly significant ($\chi^2 = 40.2,\ p < 0.0001$). Interpretation of the distribution of diseases in the Black population and those from other ethnic backgrounds is more difficult because of the small numbers. Black patients with glomerular diseases contribute over 50% of the cohort and renal dysplasia is much less common with only occasional cases of other disorders appearing. Certainly data from NAPRTCS would suggest that this is not an unrepresentative pattern of disease.

Much of the difference between the patterns of disease in the South Asian patients compared to the White cohort can be explained by the high incidence of autosomal recessive inherited disorders in this population. Table 13.20 shows the pattern of inheritance of the primary cause of ERF in 913 patients presenting after 1996 and starting ERF before the age of 16 years for whom both details of primary diagnosis and ethnicity were available. Overall, 190 patients (20.8%) had diseases with a clear inheritance link, showing the major contribution of genetic

Table 13.19: Ethnic distribution of ERF diagnostic groups

Diagnostic group	White No (%)	South Asian No (%)	Black No (%)	Other No (%)
Dysplasia	193 (26.2)	23 (16.4)	5 (25.0)	0 (0.0)
Glomerular diseases	161 (21.8)	29 (20.7)	11 (55.0)	4 (26.7)
Obstructive uropathy	117 (15.9)	17 (12.1)	0 (0.0)	2 (13.3)
Tubulo-interstitial diseases	52 (7.1)	17 (12.1)	0 (0.0)	4 (26.7)
Reflux nephropathy	60 (8.1)	6 (4.3)	1 (5.0)	2 (13.3)
Congenital nephrotic syndrome	30 (4.1)	16 (11.4)	0 (0.0)	0 (0.0)
Metabolic diseases	31 (4.2)	13 (9.3)	0 (0.0)	0 (0.0)
Renovascular problems	31 (4.2)	2 (1.4)	1 (5.0)	0 (0.0)
ERF of uncertain aetiology	17 (2.3)	9 (6.4)	1 (5.0)	2 (13.3)
Polycystic kidney disease	20 (2.7)	5 (3.6)	1 (5.0)	1 (6.7)
ERF from drug nephrotoxicity	17 (2.3)	2 (1.4)	0 (0.0)	0 (0.0)
Malignant disease	9 (1.2)	1 (0.7)	0 (0.0)	0 (0.0)

Table 13.20: Ethnic distribution of inherited diseases

Disease inheritance	White	South Asian	Black	Other
Autosomal recessive	120	47	1	4
Autosomal dominant	5	0	0	0
Sex linked	6	2	1	0
Mitochondrial disease	3	1	0	0
Not directly inherited	604	90	18	11

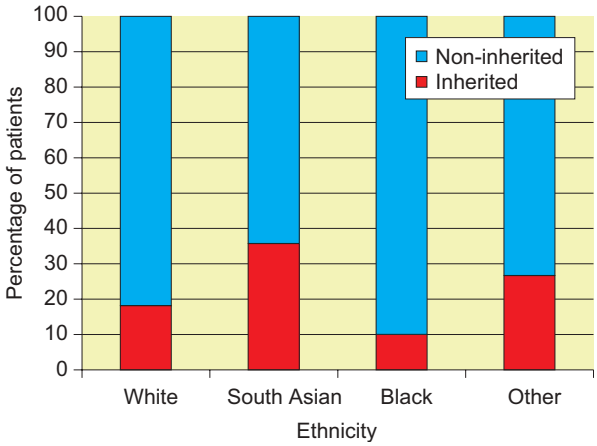

Figure 13.11: Percentage of inherited disease, by ethnicity

problems to childhood ERF. Of these, the vast majority (90.5%) were autosomal recessive diseases with just a small number of dominant, sex linked and mitochondrial disorders. These of course do not include patients with diseases that probably do have a strong genetic component that has not yet been clearly defined, such as isolated renal dysplasia. The proportion of each ethnic group with inherited disease as a cause of ERF is shown in Figure 13.11. This clearly shows the excess of inherited disease both in those of South Asian origin and in those of "Other" origin. Consanguineous marriage is more common in both of these groups compared to the White population. Although the small numbers of patients in the "Other" group make valid statistical analysis difficult, the increased proportion of inherited disease in the South Asian group compared to the White population is very significant ($p < 0.0001$, Fisher's exact test).

The age distribution of the paediatric ERF population is determined by both the survival of patients and the age of presentation with ERF. This in turn is often dependent upon the aetiology of ERF. The effect of diagnosis upon the population age distribution is shown in Figures 13.12, 13.13 and 13.14 below. For each of these figures the (a) pane shows the percentage of patients in a designated diagnostic group presenting in each age group, whilst the (b) pane shows the percentage of patients in each age group belonging to that diagnostic group. Thus, for patients with renal dysplasia, 32% present with ERF in the first 4 years of life and 32% present between the ages of 12 and 16 years whilst the remaining third present in the intervening 8 years.

The proportion of patients with renal dysplasia as a cause of ERF in each age group, account for 34% of those in the first four years of life but only 20% of those between the ages of 12 and 16 years because other causes of ERF have become more frequent in this latter age group. The pattern for obstructive uropathy is virtually identical to that for renal dysplasia. As with renal dysplasia, virtually all patients will have been born with their problem. The distributions of both these groups show the combined effect of the severity of the initial problem and the subsequent rate of decline of GFR with the stresses of growth and hyper-perfusion glomerulopathy. Reflux nephropathy rarely causes ERF

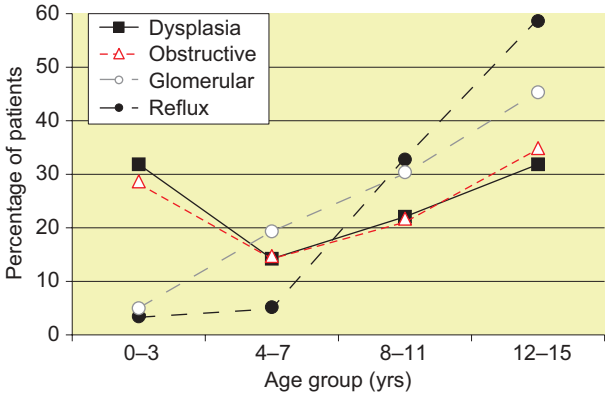

Figure 13.12a: Percentage of incident patients with renal dysplasia, obstructive uropathy, glomerular diseases and reflux nephropathy presenting in each age band

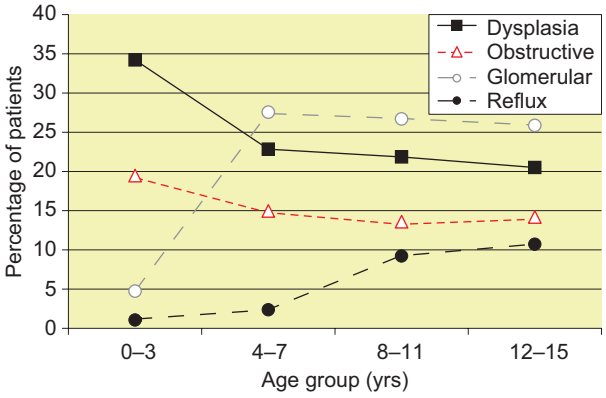

Figure 13.12b: Percentage of incident patients by age with renal dysplasia obstructive uropathy, glomerular disease or reflux nephropathy as the cause

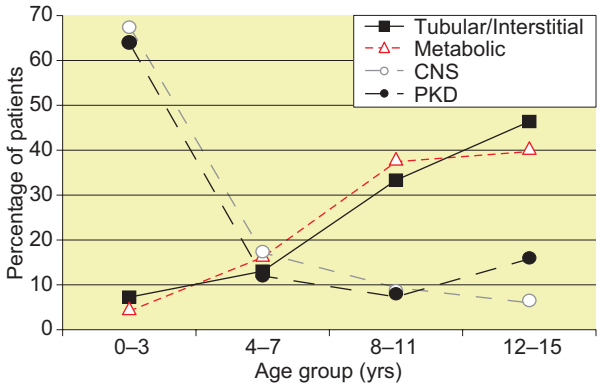

Figure 13.13a: Percentage of incident patients with tubulo-interstitial diseases, metabolic diseases, congenital nephrosis and polycystic disease by age band

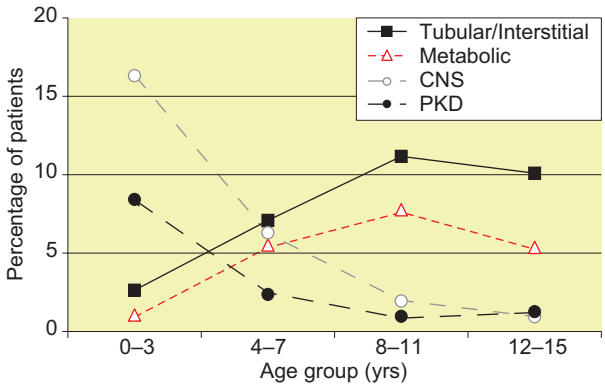

Figure 13.13b: Percentage of incident patients by age band with tubulo-interstitial or metabolic disease, congenital nephrosis or polycystic kidneys as the cause

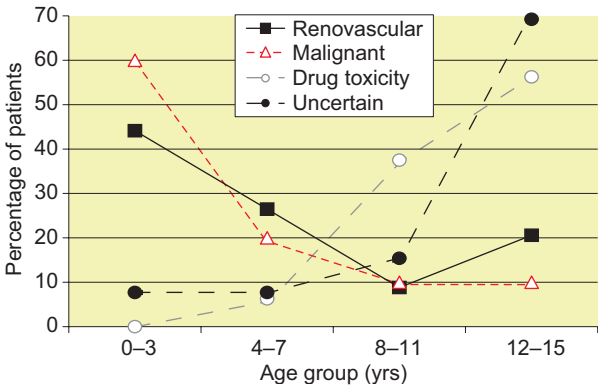

Figure 13.14a: Percentage of patients with renovascular diseases, malignant diseases, drug nephrotoxicity and uncertain aetiology presenting in each age band

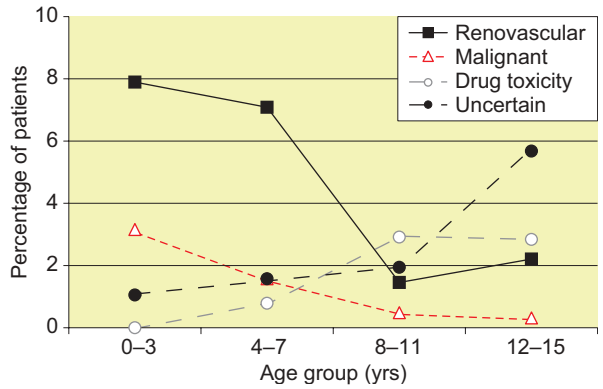

Figure 13.14b: Percentage of incident patients in each age band with renovascular or malignant disease, drug nephrotoxicity as the cause or uncertain aetiology

in the first 8 years of life and just over one third present between 8 and 12 years of life with almost 60% entering ERF between the age of 12 and 16 years. Even so reflux nephropathy only accounts for 11% of patients between the ages of 12 and 16 years with ERF. The addition of patients with renal dysplasia and reflux nephropathy together leads to a block accounting for a little under or over 30% of patients in each age group. In both conditions there is a high incidence of vesico-ureteric reflux and in both conditions there is likely to be congenital renal dysplasia. In view of the reduced frequency of urinary tract infections and clinical pyelonephritis in the older age groups, hyper-perfusion glomerulopathy is likely to play a major part in both conditions in determining the speed and timing of the decline into ERF. It is most likely therefore that reflux nephropathy and renal dysplasia share common origins. Glomerular diseases are rare in early childhood and 75% of children with these diseases will enter ERF beyond the age of 8 years. As glomerular diseases are the most common cause of ERF in Black children this explains the age distribution of this cohort. Whilst this is a small group within the UK, this observation is important with regard to the development of services in developing countries. Those with a predominantly Black population where consanguineous marriage is rare can expect their paediatric ERF population to come from the older childhood groups. This will limit the potential size of the paediatric unit, particularly if transfer to adult services is at a much younger age than is the norm in the UK and Europe.

The same data for the main disease groups with inherited diseases are shown in Figures 13.13(a) and (b). As one might expect, diseases

such as congenital nephrotic syndrome and polycystic kidney disease peak in the first 4 years of life, whilst the tubular and metabolic disorders peak later in childhood.

The final four groups are shown in Figures 13.14(a) and (b). Numerically these very different conditions account for only a small percentage of patients, both overall and in any one age band.

Current treatment of paediatric ESRF patients

Of the 768 patients, data on modality on the 1st April 2005 were available for 684 (89%). The distribution of modalities has changed little since previous reports with 76% of patients having a functioning allograft and for the remainder, peritoneal dialysis being a more common treatment than haemodialysis. For those with allografts, over two thirds have cadaveric grafts with 21% of the total population (28% of those with allografts) having a graft from a living donor. For those on peritoneal dialysis the vast majority are receiving automated PD with few centres using CAPD (Figure 13.15).

The proportion of engrafted patients, whose graft has come from a living (usually related) donor, rather than a cadaveric donor, is slowly but steadily increasing (Figure 13.16). This, in the face of a stable ERF population with a stable proportion whose management is with an allograft, highlights the shortage of suitable

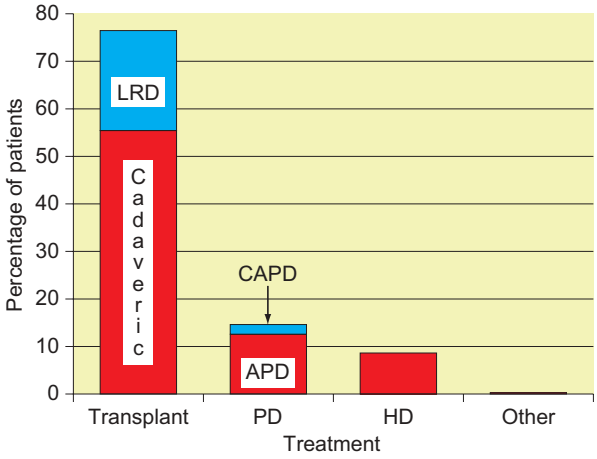

Figure 13.15: Distribution of RRT modality in paediatric patients on 1st April 2005

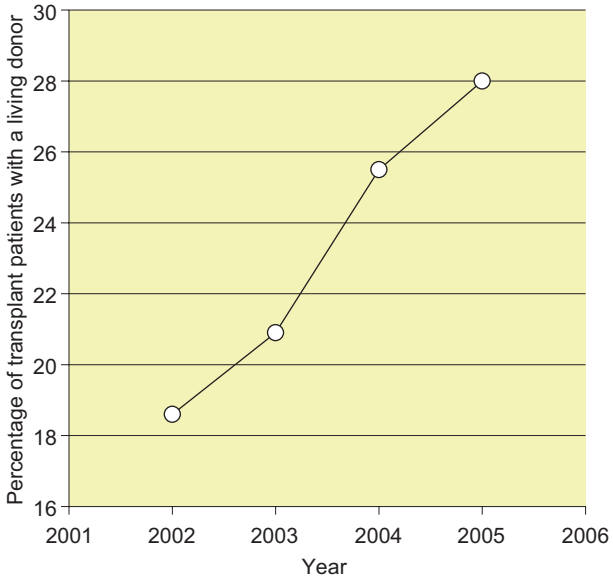

Figure 13.16: Percentage of patients with renal allografts whose graft came from a living rather than cadaveric donor

cadaveric organs, the need to use living donation to maintain the proportion of engrafted patients and the change in medical practice in the UK with a greater emphasis being placed upon the benefits of living donation.

The distribution of RRT modalities divided according to ethnic origin is shown in Figure 13.17. Whilst 80% of White patients have a functioning allograft only 63% of South Asian patients and 42% of Black patients have one. These populations therefore have proportionately larger numbers on dialysis. For all groups, peritoneal dialysis is the most frequent dialysis modality employed. The difference between ethnic groups in the distribution of treatment modalities is significant ($p < 0.0001$, $\chi^2 = 22.2$). Part of the explanation for the lower transplantation rates in ethnic minority groups is the lower rate of living donation. Certainly the proportion of South Asian patients with an allograft from a living donor is significantly lower than the proportion of White patients with one ($p = 0.0466$). This difference loses its significance if all ethnic minorities are compared to the White population. The ethnic minority population have a different distribution of tissue types and blood groups to the White population who form the vast majority of the donor pool. In these circumstances it is inevitable that there will be fewer offers of well matched cadaveric allografts for ethnic minority patients than White patients. In these

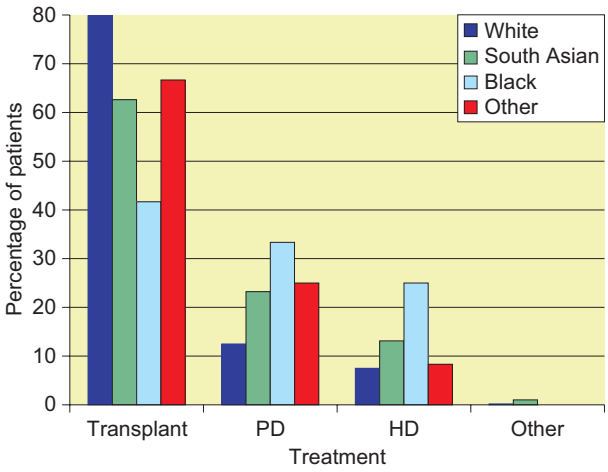

Figure 13.17: Distribution of RRT modalities according to ethnicity

circumstances only an increase in the number of live donors in the ethnic minority groups will allow the proportion with a functioning allograft in these groups to rise to that of the White population.

An important aspect of ERF management is treatment modality change with time. Figure 13.18 shows the distribution of patients according to whether or not their treatment modality had changed since the previous data collection in 2004. Clearly for the majority there was no change. Just under 11% of the cohort had had a change in treatment modality during the year whilst 77% did not. The remainder were new patients with no previous annual record.

For those who had had no change over the previous year, the vast majority (84%) had a functioning allograft. Nine percent were maintained on peritoneal dialysis and 7% on haemodialysis (Figure 13.19).

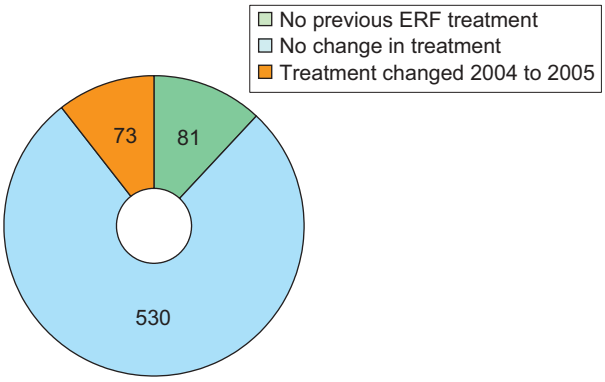

Figure 13.18: ERF modality changes from 2004 to 2005

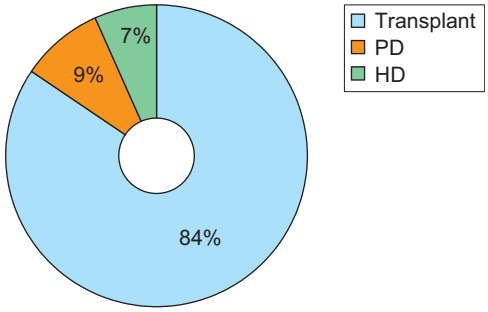

Figure 13.19: Distribution of modalities in those unchanged from 2004 to 2005

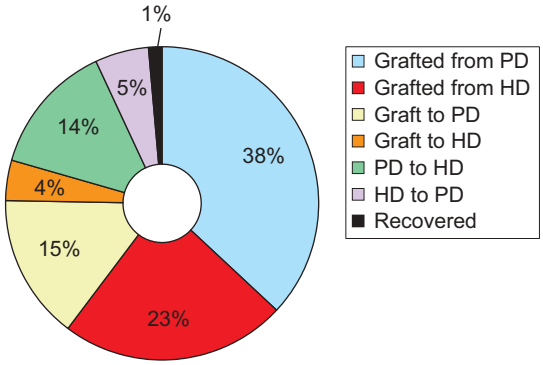

Figure 13.20: ERF modality changes from 2004 to 2005

For those who changed treatment modality over the course of the year the reason in most was because they were transplanted. 61% of this cohort received an allograft and the distribution of these between patients on peritoneal and haemodialysis was appropriate for the numbers on each modality. 19% lost grafts and started dialysis, 75% of these started peritoneal dialysis. 14% of the cohort moved from peritoneal to haemodialysis whilst only 5% of the cohort moved in the opposite direction. One patient recovered enough renal function to stop dialysis (Figure 13.20).

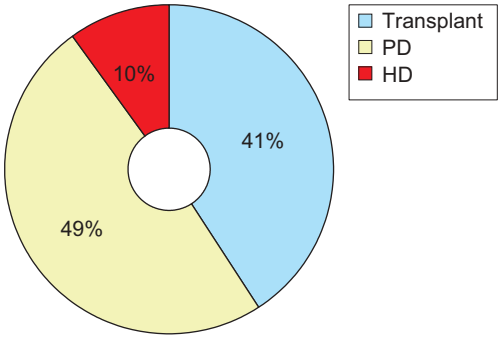

Figure 13.21: ERF modality in April 2005 for those starting after April 2004

The distribution of RRT modalities in April 2005 of the 81 patients starting ERF management during that year is shown in Figure 13.21. As expected, the single largest group accounting for 49% of the cohort were those on peritoneal dialysis. Just 10% were on haemodialysis whilst 41% had a functioning allograft. A proportion of this latter group would have had pre-emptive grafts whilst others will have received an allograft during the first year as a second treatment modality.

Conclusions

The incidence and prevalence of ERF in children in the UK has changed little over recent years. Similarly, analyses of the causes of ERF in childhood shows little change over the past decade. After an initial steep growth following the commencement of RRT services for children in the UK, the size of the paediatric ERF population is now relatively static. As with most paediatric and adult RRT studies there is a male predominance. In the paediatric population this is secondary to both the large proportion of patients with posterior urethral valves as a cause of ERF and the predominance of males with renal dysplasia as a cause of ERF.

The striking data is the high incidence and prevalence of ERF in the South Asian community in the UK. This is in part due to a high incidence of autosomal recessive inherited diseases causing ERF in this population. This could potentially lead not only to further growth of the ERF population over the next two decades, but also to a change in the pattern of disease causing ERF in the UK childhood population in addition to equalisation of the gender distribution of ERF.

The commonest RRT modality for children with ERF is transplantation, with 76% of the population having a functioning allograft. The paucity of cadaveric organs has led to an increase in the proportion of these patients with an allograft from a living donor. Living donation is less frequent in the South Asian community who by virtue of their tissue types and that of the cadaveric donor pool, are also less likely to receive a graft. This could lead to a growing number of patients on dialysis as the ethnic minority population grows. For those on dialysis the majority are managed with peritoneal dialysis and the vast majority of these patients receive APD rather than CAPD.

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Chapter 14: Growth in Children with Established Renal Failure – a Registry Analysis

Malcolm Lewis, Joanne Shaw, Chris Reid, Jonathan Evans, Nicholas Webb and Kate Verrier-Jones

Summary

- Short stature is a major problem in paediatric ERF patients with 29% of transplant patients and 41% of dialysis patients below the 2nd percentile for height.
- Only 6.5% of transplant patients and 15.5% of dialysis patients are receiving rhGH.
- There is no significant difference in the height distribution of patients commencing RRT and those who have had a functioning allograft for at least one year.
- In patients with at least 2 years between presentation and RRT, there is a significant fall in height Z score. This overall statistic is strongly influenced by the very poor growth of patients with glomerular disease.

Introduction

Achieving reasonable growth in children with chronic kidney disease and particularly those with ERF remains one of the greatest challenges for the paediatric nephrologist. Even with control of acidosis, electrolyte balance, renal osteodystrophy and supplemental nutrition, many children grow poorly and this is a major problem to the patients and their families. The recent Cochrane review[1] suggested that the use of recombinant human growth hormone (rhGH) was effective for patients regardless of their pubertal or treatment status. Since the initial studies of rhGH in patients with CKD in the early 1990s it has been licensed for use in the UK for over 10 years and certainly for the whole period the paediatric registry has been collecting data. In a recent review Mahan and Warady[2] found that there was reluctance amongst US paediatric nephrologists to use rhGH. They set out an algorithm, developed by members of a consensus committee, for the use of rhGH. In the light of this it seemed important to examine the UK practice through the data available in the paediatric registry.

Analysis

The Registry collects anthropometric data at presentation, ERF commencement and annually thereafter. For the follow up records a note is also made as to whether rhGH has been used over the previous year. Data on rhGH usage over the past 5 years in patients where a complete data set is available is shown in Table 14.1. These data are divided according to whether patients had a functioning allograft or were on dialysis. In the dialysis population just 15.9% of patients on average, are receiving rhGH. These data show that there is certainly no upward trend in rhGH usage and if anything, the trend is downward. For transplant patients the trend is towards increasing usage, but the proportion receiving rhGH is much less, averaging just 4.3%.

These findings would be expected in a patient population that was growing well with little consequent need for rhGH. However, cross-sectional analysis shows this not to be the case. The cumulative frequency distribution of height in 273 patients with a functioning allograft for at least one year in 2005 and between the ages of 2 and 16 years at the time is shown with the data from 105 dialysis patients in that same age range in Figure 14.1. Although the transplant patients are significantly taller than those on dialysis (Figure 14.2, $p = 0.004$), both groups are well below the normal range. For the transplant patients, 48% were below the 10th percentile with 39% being below the 5th percentile and 27% below the second percentile. The corresponding figures for dialysis patients were 61% below the 10th percentile, 54% below the 5th percentile and 44% below the 2nd percentile. Thus, based on this cross-sectional analysis, it appears that rhGH is being

Table 14.1: Usage of growth hormone in dialysis and transplant patients

	Transplant patients			Dialysis patients		
Year	Patients	No on GH	% on GH	Patients	No on GH	% on GH
2001	358	14	3.9	122	23	18.9
2002	501	16	3.2	159	28	17.6
2003	479	15	3.1	134	17	12.7
2004	481	22	4.6	168	25	14.9
2005	400	26	6.5	142	22	15.5
Average	444	19	4.3	145	23	15.9

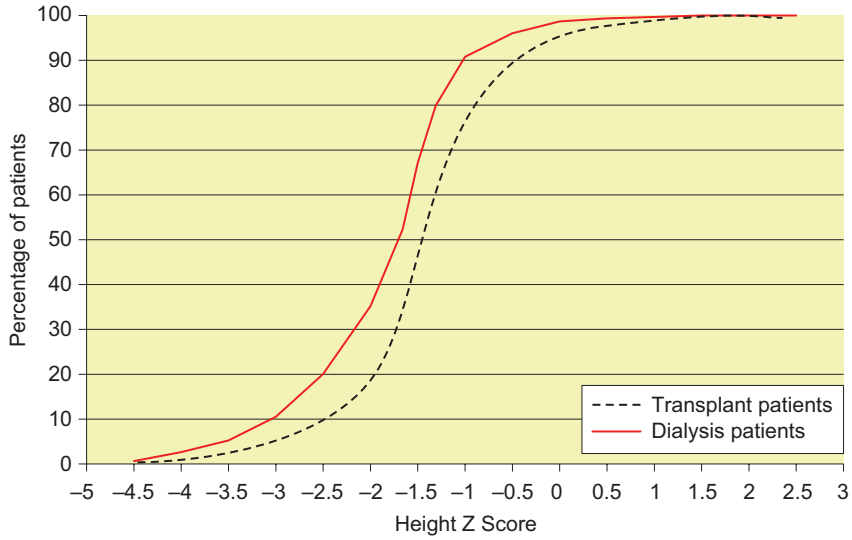

Figure 14.1: Height Z scores cumulative frequency distribution for ERF patients aged 2 to 16 years in 2005

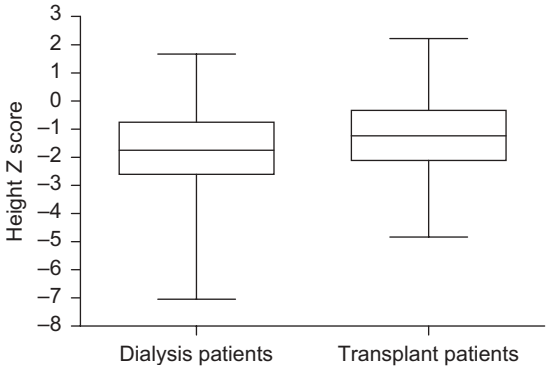

Figure 14.2: Height Z scores (median, quartiles, range) for ERF patients aged 2 to 16 years in 2005

under-used in the paediatric ERF population. This analysis was based upon those between the ages of 2 and 16 years of age as this is the group one would expect to potentially most benefit from rhGH. Analysis of all patients from the age of 2 to 20 years of age showed no difference and indeed, though the usage of rhGH was low, overall the frequency of usage was the same in those over the age of 16 as under the age of 16 years. The lower usage of rhGH in transplant patients compared to dialysis patients could in part be secondary to the fear of rhGH stimulating the growth of renal cell carcinomas as described by Tyden *et al*[3]. However, wider analysis of these data available by Mehls *et al.*[4] and the Cochrane review have suggested that this risk is low and should not prevent the usage of rhGH where indicated by growth parameters.

These data on height in the paediatric ERF population are clearly disappointing but not dissimilar to the findings of Mahan and Warady analysing the NAPRTCS dataset. Clearly the two most influential factors, after control of biochemical and nutritional status, are growth after transplantation and before commencing RRT as for the majority of paediatric patients, the longest periods of treatment are either conservative before RRT or with a functioning allograft. At present, the Registry does not collect data on pre-ERF CKD patients but analyses of data at presentation to nephrology services together with data

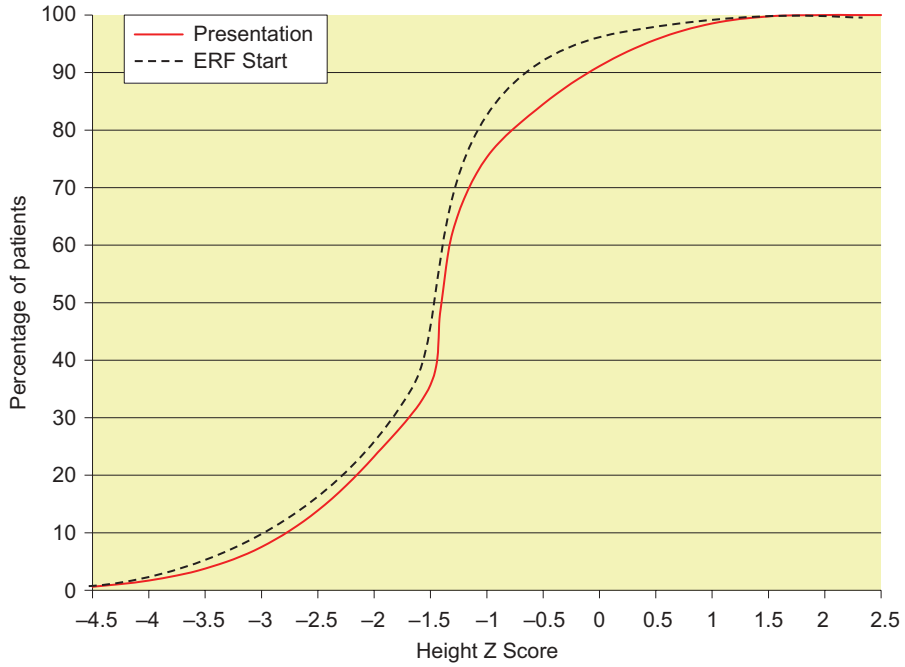

Figure 14.3: Height Z scores cumulative frequency distribution for patients at presentation and ERF commencement

at ERF commencement gives some insight into the CKD phase.

For this analysis 236 patients with complete anthropometric data, presenting between 2 and 16 years of age between 1996 and 2005, who had a minimum of two years between presentation and commencement of ERF were selected. These selection criteria allowed study of a population who had a reasonable period of time in the paediatric CKD clinic and for whom all interventions, including the use of rhGH would have been available. The height distribution of this population at presentation to nephrology services and at ERF commencement is shown in Figure 14.3. The population is clearly significantly smaller than normal with 50% being below the 10th percentile, 42% below the 5th percentile and 33% below the 2nd percentile at presentation. Overall, by the time these children entered ERF their height Z score had fallen rather than risen with 53% being below the 10th percentile, 45% below the 5th percentile and 34% below the 2nd percentile ($p = 0.0015$, Figure 14.4).

There are numerous factors that could affect growth in children with chronic kidney disease. One powerful factor is underlying diagnosis. Some conditions are associated with biochemical disequilibrium that is difficult to control or are likely to be treated with steroid containing immunosuppressive regimes that will impair growth. Others, like nephropathic cystinosis, have been shown to respond well to rhGH in all phases of CKD management[5]. The series of figures below, show the change in height Z score from presentation to ERF commencement and the distribution of height Z scores at these two points in the main diagnostic groups. For patients with renal dysplasia, obstructive uropathy, reflux nephropathy and tubulo-interstitial disease (Figures 14.5 to 14.8), there is no significant difference in height Z score from presentation to ERF commencement. Tubulo-interstitial disease is in fact the only one of these four diagnostic groups where the

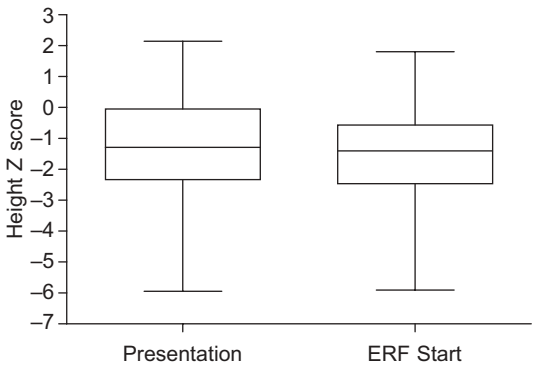

Figure 14.4: Median, quartiles and range of height Z scores for patients at presentation and ERF commencement

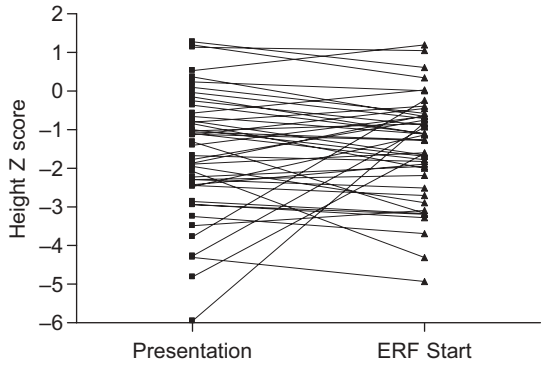

Figure 14.5a: Change in height Z score from presentation to ERF commencement in patients with renal dysplasia

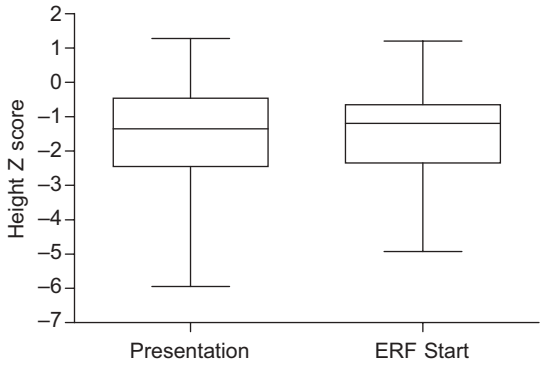

Figure 14.5b: Distribution of height Z score from presentation to ERF commencement in patients with renal dysplasia

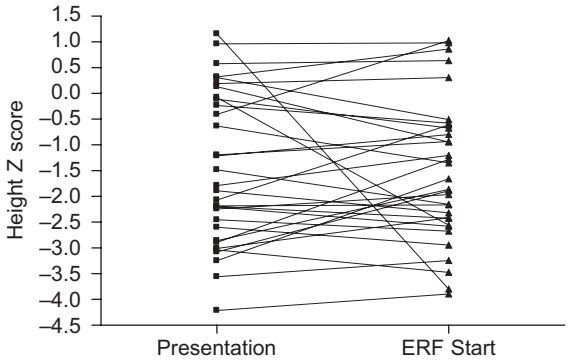

Figure 14.6a: Change in height Z score from presentation to ERF commencement in patients with obstructive uropathy

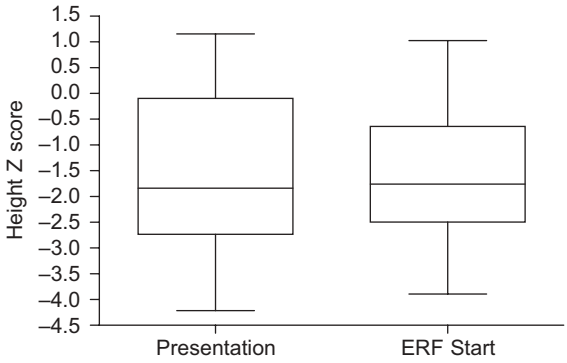

Figure 14.6b: Distribution of height Z score at presentation and ERF commencement in patients with obstructive uropathy

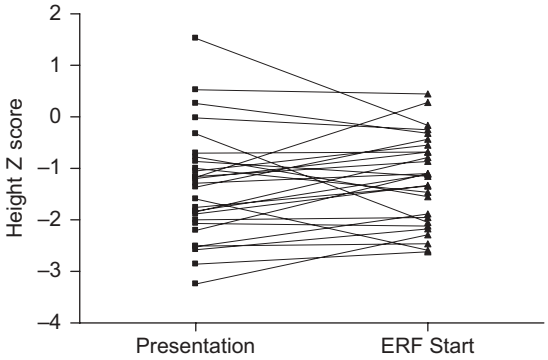

Figure 14.7a: Change in height Z score from presentation to ERF commencement in patients with reflux nephropathy

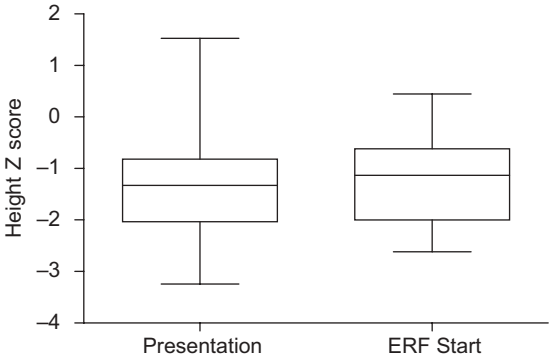

Figure 14.7b: Distribution of height Z score at presentation and ERF commencement in patients with reflux nephropathy

median height Z score at presentation is higher than at ERF commencement. For the large number of patients with glomerular disorders however, there is a significant fall in height Z score from presentation to ERF commencement ($p < 0.0001$, Figure 4.9).

The data for the 20 patients who had metabolic disease as a cause of ERF are shown below in Figure 14.10. All these patients had cystinosis as the cause of their renal failure. Despite the data from Wuhl *et al.*[5] suggesting that patients with cystinosis grow well with rhGH, there is no significant difference in the height Z score of these patients from presentation to ERF. To check that this was not just secondary to the small numbers of patients studied, the selection criteria rules were relaxed

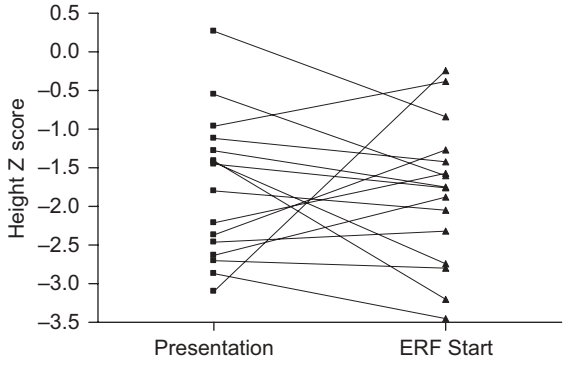

Figure 14.8a: Change in height Z score from presentation to ERF commencement in patients with tubulo-interstitial disease

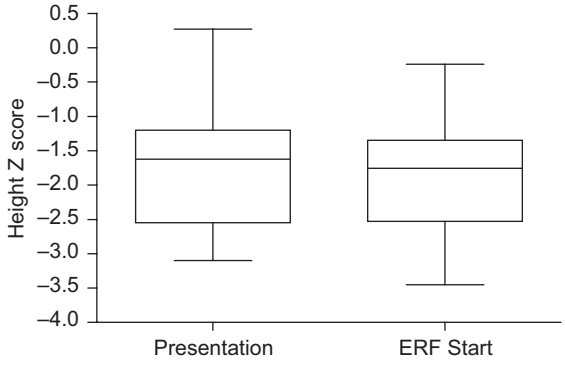

Figure 14.8b: Distribution of height Z score at presentation and ERF commencement in patients with tubulo-interstitial disease

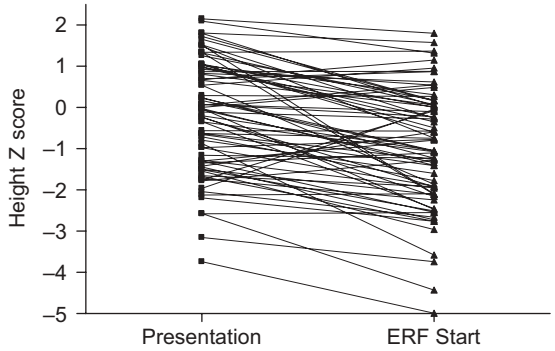

Figure 14.9a: Change in height Z score from presentation to ERF commencement in patients with glomerular disease

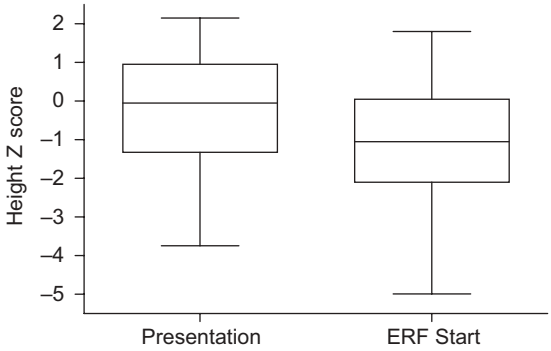

Figure 14.9b: Distribution of height Z score at presentation and ERF commencement in patients with glomerular disease

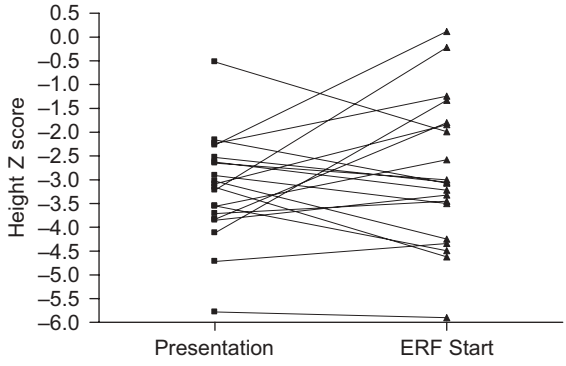

Figure 14.10a: Change in height Z score from presentation to ERF commencement in patients with cystinosis

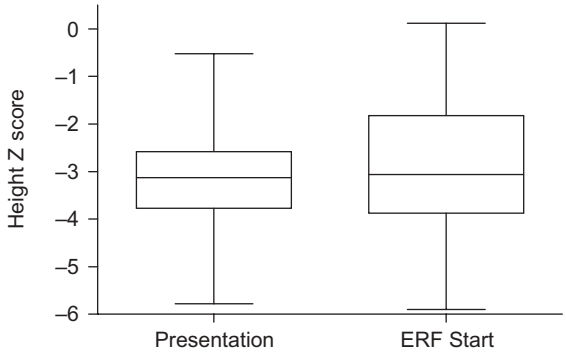

Figure 14.10b: Distribution of height Z score at presentation and ERF commencement in patients with cystinosis

to allow inclusion of patients presenting below the age of two years. This allowed the patient group to be almost doubled to 37. The result however, was identical. It is clear that whilst some patients are doing very well, others do badly. Unfortunately, no data are available on the detailed management of these patients so it is not possible to determine whether this is simply because some patients are not being offered rhGH or whether there were other factors leading to poor growth in many of the patients.

Comparing the height distribution of the cohort of patients studied above when they start ERF management with the height distribution of the patients studied who were at least 1 year post transplant, there is no significant difference (Figure 14.11).

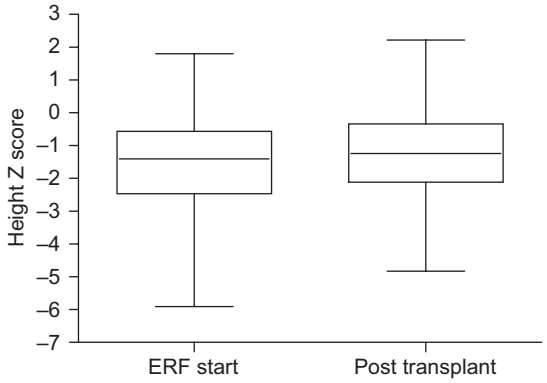

Figure 14.11: Height Z score at ERF start and at least 1 year post transplantation

Conclusions

Clearly, there are many factors that cannot be studied with the data available from the Registry dataset. However, it seems clear that growth in children with ERF is suboptimal. Growth acceleration is not being achieved in either the pre-ERF stage or after transplantation. Patients on dialysis are poorly grown. One factor that may be contributing to this is the relatively infrequent use of rhGH. Other factors that need to be considered are the control of acidosis, renal osteodystrophy and nutrition. Finally it is important to tease out the role of corticosteroids, both in patients post transplant and pre ERF patients with glomerulonephritis. Further studies using specific data collections from a Registry cohort would be valuable in this regard.

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This report was reviewed, revised and approved by the Paediatric Renal Registry subcommittee comprising:

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Chapter 15: Aspects of Anaemia Management in Children with Established Renal Failure

Malcolm Lewis, Joanne Shaw, Chris Reid, Jonathan Evans, Nicholas Webb and Kate Verrier-Jones

Summary

- Despite the universal availability of erythropoietin and intravenous iron, 14% of transplant patients and 30% of dialysis patients have a haemoglobin below 10.5 g/dl. Only 11% of anaemic transplant patients were receiving erythropoietin.
- There was a linear relationship between eGFR and haemoglobin with the risk of anaemia occurring at a much higher eGFR than would be expected in the CKD population.
- There was also a significant association between the use of Mycophenolate and anaemia. 95% of dialysis patients were receiving erythropoietin and 47% intravenous iron.
- It is speculated that raising the target haemoglobin for this population to 13 g/dl could shift the whole distribution curve to the left, reducing the proportion with anaemia. Doing this would require careful monitoring to steepen the distribution curve and limit the upper tail if complications of high haematocrits are to be avoided.

Introduction

The control of anaemia is an important factor in the reduction of morbidity and mortality in the ERF population[1]. The Renal Association standards suggest that, outside of infancy, the haemoglobin of patients should be maintained at above 10.5 g/dl with a combination of erythropoietin and haematinics[2]. More recently the National Institute for Clinical Excellence suggested a higher target with the aim of maintaining the haemoglobin between 11 and 12 g/dl and taking action when the haemoglobin is outside of this range, or appeared to be moving outside this range on trend analysis[3]. Whilst great attention is paid to this in the dialysis and CKD population, it is easy to overlook haemoglobin parameters in those with renal allografts as concentration within the clinic is usually on other factors such as eGFR and immunosuppression. However, the paediatric transplant population is the largest cohort of patients being reviewed regularly with CKD. Moreover, their reduced renal function, together with the effects of some immunosuppressants upon the bone marrow and the effects of antihypertensives such as ACE inhibitors and ARB's, make them prone to anaemia.

The cumulative frequency distribution of Hb levels for 135 dialysis patients with a full data set available and 386 transplant patients who had been grafted at least 12 months before the collection of the data set are shown in Figure 15.1. There is clearly a difference in the distributions with the transplanted patients doing better. However, 14% of transplant patients and 30% of dialysis patients had a Hb below the NICE guidelines of 10.5 g/dl. Using the European Best Practice guidelines of maintaining the Hb above 11 g/dl, 20% of transplant patients and 47% of dialysis patients were below this figure. For transplant patients, 47% had a Hb above the 12 g/dl whilst 33% of dialysis patients were above this level. This left just 33% of transplant patients and 20% of dialysis patients within the desired range. The difference between the distributions was significant ($p < 0.0001$). The median Hb in transplant patients was 12.1 g/dl whilst the median in dialysis patients was 1 g/dl lower at 11.1 g/dl (Figure 15.2).

For the transplanted patients, erythropoietin was recorded as being utilised in just 14 patients, eight of whom had a satisfactory Hb and six of whom were amongst the 55 patients with a Hb <10.5 g/dl. Intravenous iron was only recorded as having been given to 1 patient

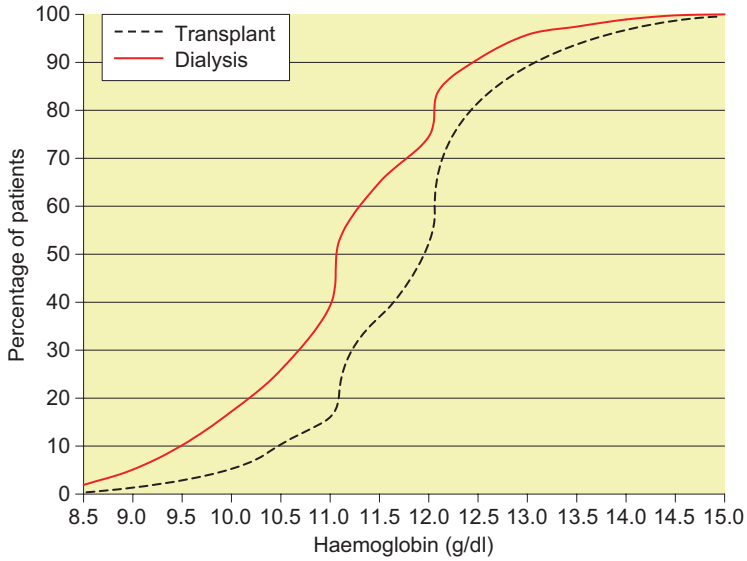

Figure 15.1: Cumulative frequency distribution of haemoglobin values in dialysis and transplant patients

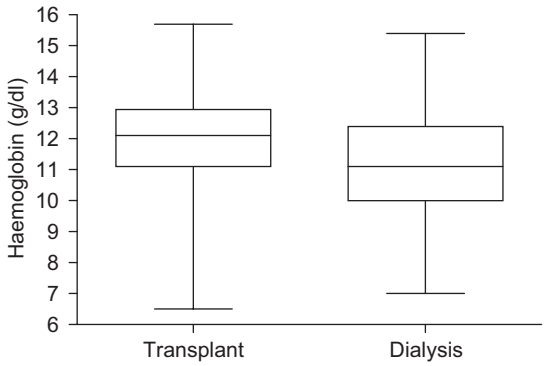

Figure 15.2: Median, quartiles and range of haemoglobin in paediatric RRT patients

and that patient did have a low haemoglobin. Four patients were recorded as having had transfusions in the previous 12 months of whom two were in the low Hb group. This of course, may not be a true marker for anaemia as transfusions may have been given following surgical or other procedures.

There was a significant linear correlation between eGFR as calculated by the Schwartz formula ($40 \times$ height {cm}/creatinine {µmol/L}) and Hb ($r^2 = 0.10$, $p < 0.0001$, Figure 15.3). It is noteworthy that the regression line crosses a Hb of 10.5 g/dl at an eGFR of 56 ml/min/1.73 m^2. This is a much higher eGFR figure than might be expected for the potential development of anaemia, particularly as a low value has been used for the constant for eGFR calculation, based upon the findings in previous reports. Comparing the Hb distributions of those with an eGFR below and above 56 ml/min/1.73 m^2, they are significantly different

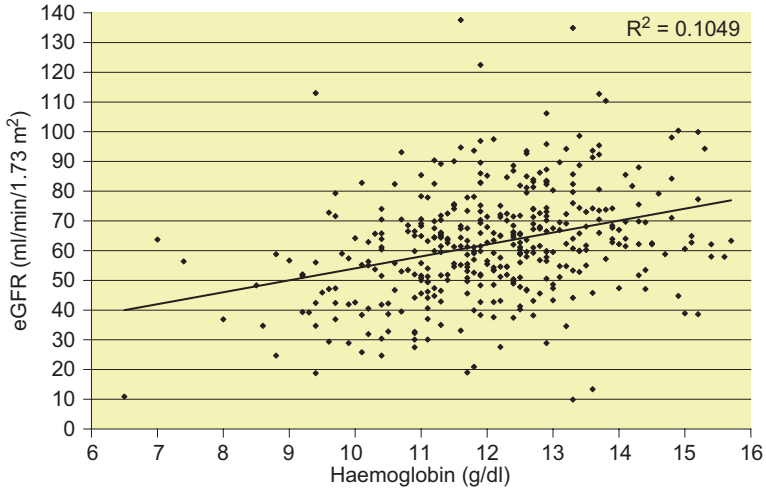

Figure 15.3: Correlation of haemoglobin against eGFR in paediatric allograft recipients

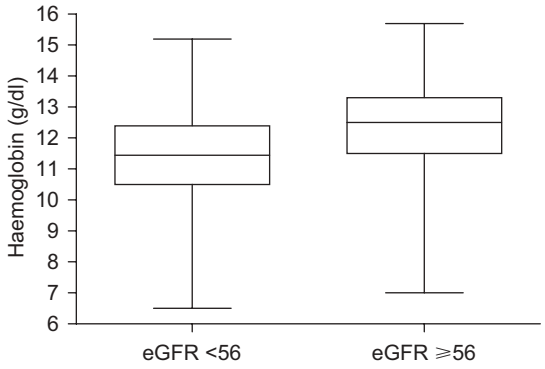

Figure 15.4: Median, quartiles and range of haemoglobin by eGFR

($p = 0.0001$, Figure 15.4). Thus, special attention needs to be paid to the Hb of patients with renal allografts at a level at which problems would not be expected in the ordinary childhood CKD population.

In addition to the poor agreement between eGFR and true GFR in transplant patients, this phenomenon will be related to the use of drugs such as ACE inhibitors and immunosuppressive drugs. One recent change in practice has been a move to using Mycophenolate rather than Azathioprine. To investigate the effect of this upon anaemia, the distributions of the Hb values in 89 of the above cohort who were receiving Mycophenolate were compared with the 297 who were not. As all these patients were at least one year post engraftment, post surgical anaemia should not have played a part. Some of the patients may have been changed onto Mycophenolate because of chronic allograft nephropathy and will also have had lower eGFR's as a consequence. For others however, the use of Mycophenolate would simply have been in line with updated immunosuppressive protocols. The use of Mycophenolate was associated with a significantly greater proportion of patients with a Hb below 10.5 g/dl ($p = 0.0374$, Figure 15.5).

For patients on dialysis, the use of erythropoietin was recorded in 127 of the 135 patients on this modality. Intravenous iron was used in 63 patients (47%). The usage of intravenous iron appeared to be less in those with a low Hb (<10.5 g/dl) though this difference failed to reach statistical significance. Twelve patients were recorded as having received transfusions (9%), 6 of these had a Hb <10.5 g/dl. Despite the potential for blood loss there was no difference in the

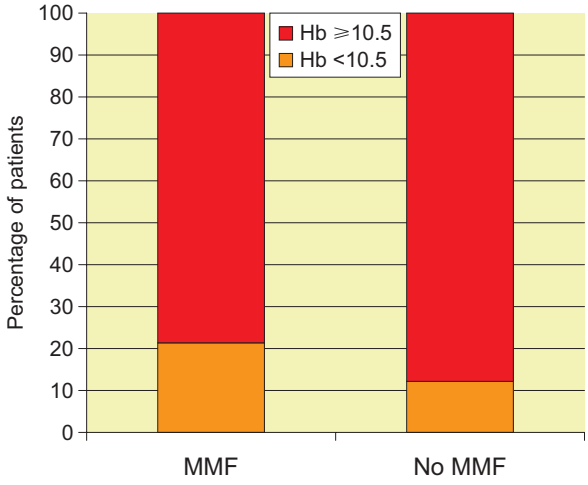

Figure 15.5: Haemoglobin achievement and the use of Mycophenolate (MMF)

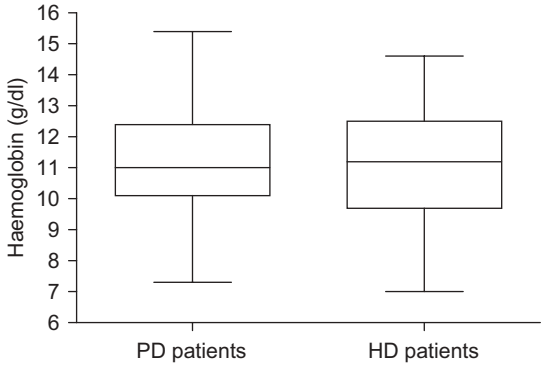

Figure 15.6: Median, quartiles and range of haemoglobin for PD and HD paediatric patients

Hb distribution of those on haemodialysis to those on peritoneal dialysis (Figure 15.6).

Conclusions

These data suggest that whilst the majority of paediatric ERF patients have an acceptable haemoglobin, a significant minority do not. Within the transplant population there needs to be a greater awareness of the risk of anaemia at a relatively high GFR. Screening and treatment with haematinics and erythropoietin need to be part of routine patient assessment. For the dialysis population there may be potential for a greater use of intravenous iron. There are however, other factors, such as control of renal osteodystrophy, that play a major role in the control of anaemia.

These data were collected at a time when the Renal Association Standards were available but

before the publication of the NICE guidelines. It remains to be seen whether changing to these recommendations improves the distribution of haemoglobin in the paediatric ERF population. It may transpire that the range quoted by NICE is too narrow.

Movement of the whole distribution curve to give a median haemoglobin for the population of 13 g/dl would potentially leave 9% of transplant patients and 18% of dialysis patients with a haemoglobin above 15 g/dl. This is potentially undesirable with the reported morbidity associated with higher haemoglobin values[4,5,6,7], though all this data relates to adult studies and there is as yet, no reported morbidity from having a haemoglobin at the high end of the normal range in children. Careful monitoring could limit the numbers in this bracket by creating a steeper distribution curve with a smaller upper tail whilst the movement of the population towards having a higher median haemoglobin would have a major effect on the proportion of significantly anaemic patients. The answer to this question will come from further Registry analyses after the NICE guidelines have been implemented for a period of time.

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This report is presented on behalf of the BAPN.

Chapter 16: The Renal Long Term Care Workforce Survey (in conjunction with the British Renal Society)

Jane Macdonald, Althea Mahon, Donal O'Donoghue, Paul Stevens, Alex Hodsman and Charlie Tomson

The final version of this Workforce survey chapter, including the results, will be available on the web at www.renalreg.org.

Introduction

This survey was commissioned by the Renal Long Term Condition Care Group Workforce Team (LTC CGWT) of the Department of Health for England, to ensure that the workforce implications of the Renal National Service Framework (NSF) had been adequately and appropriately considered. The Renal Association and British Renal Society (BRS) were jointly commissioned to develop the survey and the Renal Association UK Renal Registry subsequently agreed to undertake the survey and collate the results. The findings were compared to the conclusions of the workforce survey undertaken by the BRS in 2001[1]; as well as providing a baseline for the present survey, that survey included detailed projections for the requirements for future staffing of Renal Units in 2006 and 2010 that would allow an adequate standard of care to be provided. Since that survey was completed, the Renal National Service Framework (2004, 2005) and the quality markers and standards they contain have driven the development of new roles and new modes of care delivery, adding to the need for a repeat survey of practice.

Completion of the survey was complicated by the introduction of Agenda for Change, a new approach to job definitions and payment for all directly employed NHS staff except very senior managers and those covered by the Doctors and Dentists Pay Review Body[2]. Implementation of Agenda for Change started on 1st December 2004 and was ongoing at the time of this survey.

References

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Chapter 17: International Comparison of UK Registry Data

Fergus Caskey, Retha Steenkamp and David Ansell

Summary

- In 2005, the incidence of RRT in the United Kingdom was 110 per million of the population (pmp) using the day 0 definition and 103 pmp using the day 90 definition.

- Relative to the 42 countries reporting data to the USRDS, the day 0 and day 90 rates for RRT incidence in the UK are the 32nd and 35th lowest respectively. However, the overall incidence for the UK masks higher rates in Scotland, Wales and Northern Ireland (123, 129 and 140 pmp, respectively).

- Of the six countries with RRT incidence rates comparable to those in the UK (Australia, Finland, Malaysia, New Zealand, Norway and the Netherlands) three had relatively high rates for the age band 20–44 and two had relatively high rates for the age band 45–60.

- The proportion of incident patients with diabetes as the cause of established renal failure also varied considerably between these six comparator countries from 16–40% but rates of peritoneal dialysis utilisation were comparable to that in the UK and generally higher than in countries with higher rates of RRT incidence.

- When transplantation rates were considered alongside prevalence rates for RRT, the UK position appeared relatively high at 46% (11th out of 37 countries), although still considerably lower than in Norway and the Netherlands (72% and 54%, respectively).

- Although variation in RRT incidence rate exists within the four countries of the UK, the overall RRT incidence, reported for the first time this year, appears similar to that observed in a number of demographically similar countries around the world.

- Examining the UK alongside the six comparator countries, different patterns of RRT incidence were observed across the age bands and variation in the RRT incidence secondary to diabetes mellitus raised interesting questions.

- The higher rates of renal transplantation achieved in several of the comparator countries also justifies further analysis.

Introduction

There has been a revival of interest in international comparisons of renal replacement therapy (RRT) in recent years. This has in part been due to the work being done in re-establishing the European Renal Registry in Amsterdam[1,2,3,4], collaborative work with other registries that has become possible as a result (The ESRD Incidence Group 2006[5], Stewart 2006[6]), as well as the prospective international study comparing outcomes and practice patterns in a sample of haemodialysis patients, DOPPS[7,8].

International renal registry comparisons provide an opportunity for benchmarking between countries, providing reassurance when data are consistent and driving further research when differences are seen. The analysis in this chapter aims to define the methodology the UK Renal Registry (UKRR) would need to adopt if it is to report data to the United States Renal Data System's (USRDS) international comparison chapter in future years. It also examines the current position of renal replacement therapy in England, Wales, Scotland and Northern Ireland in relation to the 42 other countries and regions of the world reporting to the USRDS.

The number of national and regional renal registries is increasing. In 2006, age-specific (although not age-standardised) data on RRT

incidence, prevalence, dialysis modality and transplantation rates from 42 registries were included in the USRDS annual data report, with striking results: Taiwan and Jalisco (Mexico) were shown to have higher RRT incidence rates even than the United States with rates of RRT in these countries three times those in a number of predominantly European populations, such as Norway, the Netherlands, Australia and New Zealand[9].

Such comparisons are important in generating hypotheses – defining the research questions for future epidemiological research. To date however, although the UKRR has been publishing such data in its own reports it has not contributed to the USRDS international comparison chapter. There has been the issue of population coverage to address. The USRDS international data collection form asks for the reporting country's population by age band but as the UKRR doesn't cover the whole of the UK, the covered population would have to be very carefully established and its composition by age band estimated. The cross boundary referral of patients (between areas covered and not covered by the UKRR) has complicated these calculations. Secondly, there is the question of whether numbers of all new RRT patients should be used or numbers of patients surviving to 90 days. The USRDS international data collection form does not specify whether numbers should be provided based on day 0 or day 90. Reporting within the United States is based on patients surviving the first 90 days of RRT due to the constraints of financial reimbursement from the government starting from this period with prior data being incomplete. In contrast, many countries collect data on incident RRT patients from day 0 and are also likely to report to the USRDS based on this definition. Although variation in when patients are included in national RRT registries will distort international survival comparisons its effect on RRT incidence rates is likely to be small[10].

In previous years[11], this chapter has concentrated on using the many different data available from other national registry reports and analysing the UK data in a comparable fashion (eg co-morbidity, death rates, haemoglobin achievement etc). This year the analyses will be restricted to defining the methodology for reporting data from the UKRR to the USRDS for inclusion in their international comparison chapter. This will enable timely reporting to the USRDS in future years. The chapter also examines our current position in relation to the 42 other countries and regions of the world reporting to the USRDS.

Methodology

Data on numbers of incident and prevalent RRT patients in England, Northern Ireland, Scotland and Wales for the year 2005 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 renal units in England not reporting data electronically to the UKRR in 2005 were contacted and the number of incident and prevalent patients by RRT modality established. Age band data were not available for these five centres so an assumption was made that their age distribution was similar to that of the reporting centres. A possible small variation from this distribution will not result in any change in these calculations as these five centres contribute to a very small proportion of the total data.

As the numerator for incidence and prevalence rates generated by this approach was based on all incident and prevalent patients in the UK, the general population age band data for the denominator could be based on the entire populations for the four countries (from the Office for National Statistics). As data on the number of incident and prevalent patients were only available for the year 2005 in the five non-reporting centres, UKRR data from 2005 had to be compared with the published USRDS data for the year 2004.

Two definitions of incident RRT patients were used:

1. The UKRR definition which includes patients from the date of their first RRT (excluding those who recovered within 90 days and including patients presenting with acute renal failure who do not recover renal function within 3 months).
2. Patients were included once they have survived the first 90 days of RRT (a definition

more in line with practice in the United States).

In order to review the UKRR's relative position in comparisons of RRT incidence, prevalence, modality use and rates of transplantation, data from tables in the USRDS annual data report 2006 were used. Variation in the UKRR's relative position for RRT incidence, prevalence and transplantation in different age bands was then examined by comparing it with a sub-group of the six countries with overall RRT incidence rates closest to the UKRR incidence rate (excluding countries that did not provide age specific data).

Results

Incidence of RRT

In 2005, the incidence of RRT in the UK was 110 pmp using the UKRR day 0 definition and 103 pmp using the USRDS day 90 definition (Figure 17.1). Depending on which of these rates is taken for the comparison, the UK RRT incidence is either 32nd or 35th out of the 42 countries reporting to the USRDS. However, the overall RRT incidence for the UK masks higher rates in Scotland, Wales and Northern Ireland (123, 129 and 140 pmp, respectively compared with 105 pmp in England).

The six countries with data available by age band that flank the UK at the lower end of the RRT incidence range are Australia, Finland, Malaysia, New Zealand, Norway and the Netherlands. The relative ranking of these countries differs considerably however within the various age bands, with several ranking quite highly in the 20–44 age band (Malaysia, New Zealand and Finland) and the 45–64 band (Malaysia and New Zealand) (Figures 17.2a–e). The UK also ranked relatively highly in the 20–44 age band. Several of the comparator countries also have quite different percentages of their incident RRT patients with diabetes as the cause of treated established renal failure; 17% for the Netherlands and Norway, 30% for Australia, 40% in New Zealand and 55% in Malaysia, compared with 19% in the UK (Figure 17.3). Table 17.1 shows the incidence rates of RRT pmp for diabetes and also compares the percentage of all incident RRT patients. The low diabetes rates in Russia are likely to reflect limited availability for treatment rather than a true low incidence of diabetes.

Prevalence of RRT

The RRT prevalence rate of 694 pmp in the UK is comparable to those of five of the six countries with similar RRT incidence rates (Malaysia being the exception) (Figure 17.4).

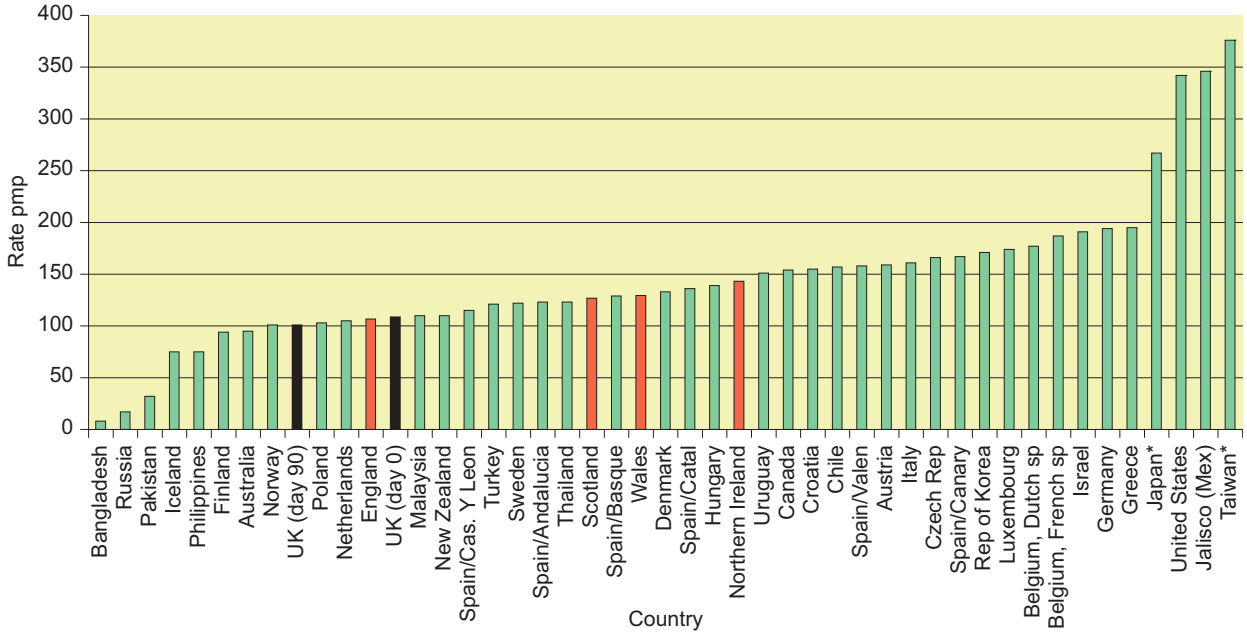

Figure 17.1: Incidence of RRT in different countries (pmp)

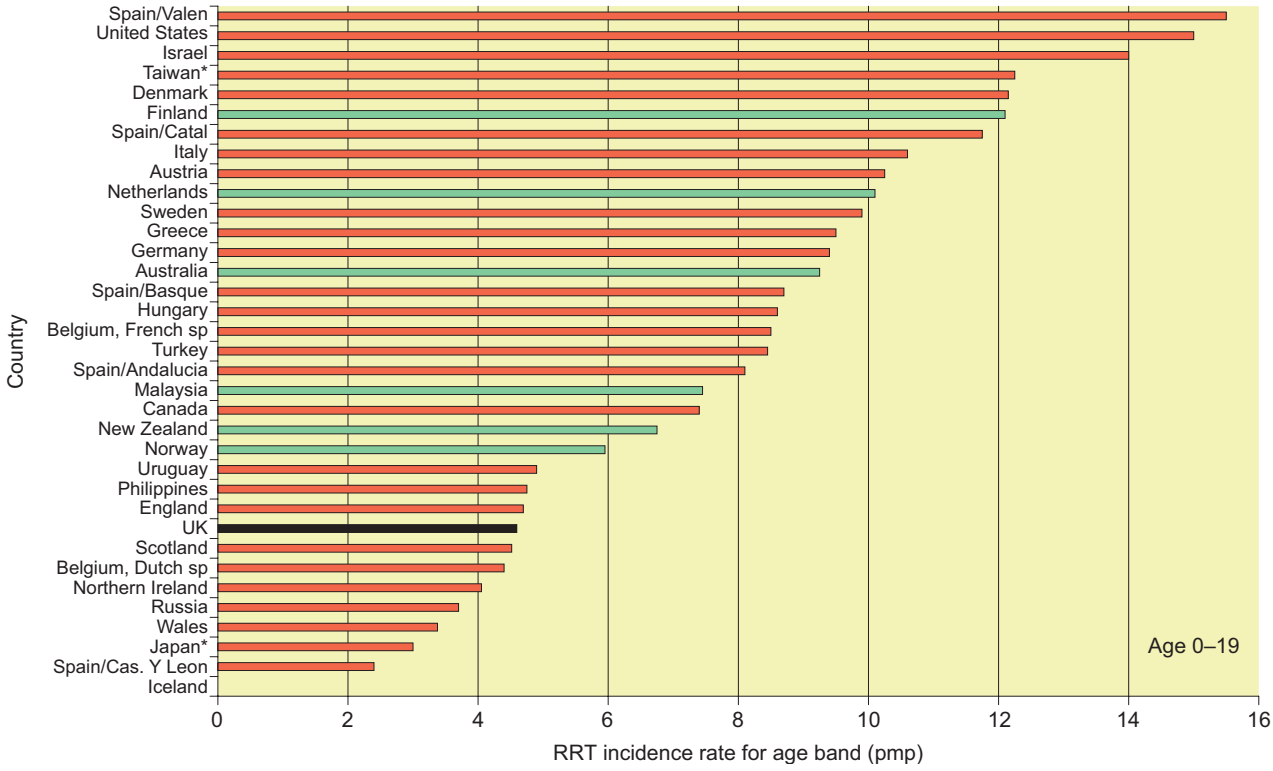

Figure 17.2a: Incidence of RRT pmp, 0–19 years in different countries

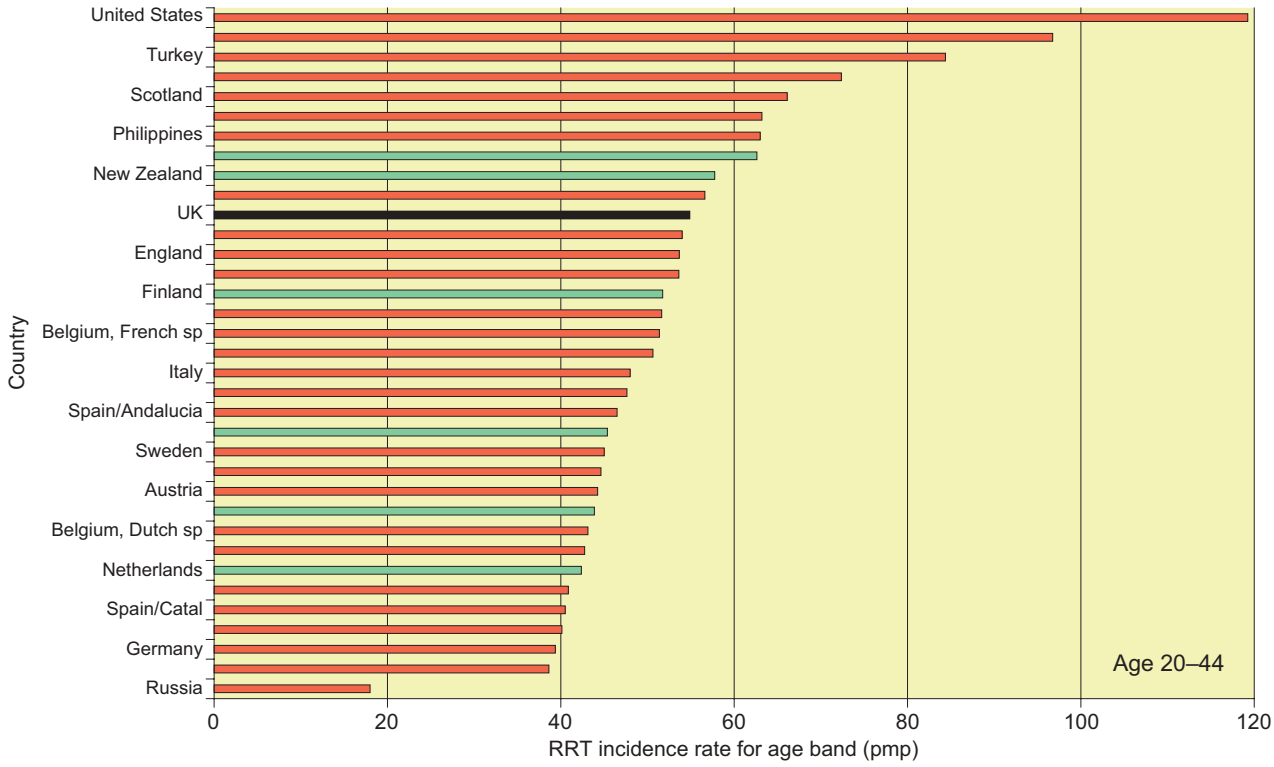

Figure 17.2b: Incidence of RRT pmp, 20–44 years in different countries

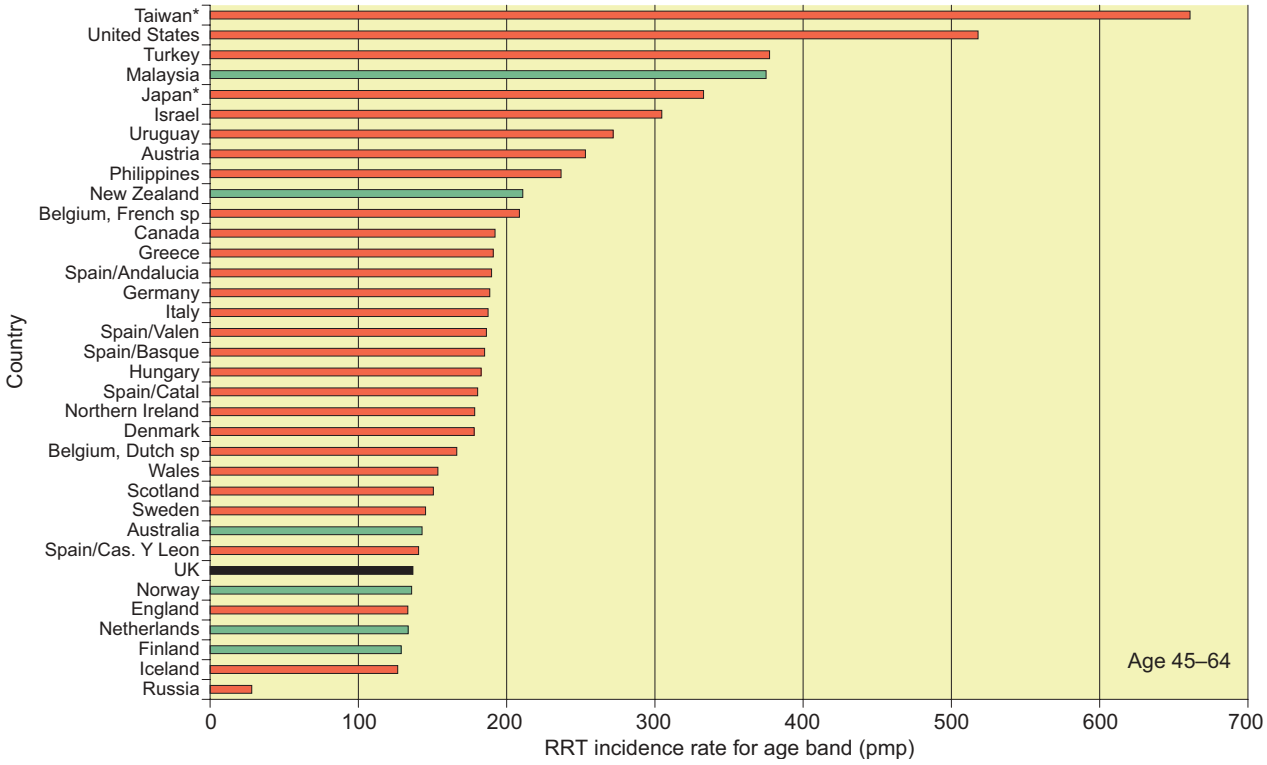

Figure 17.2c: Incidence of RRT pmp, 45–64 years in different countries

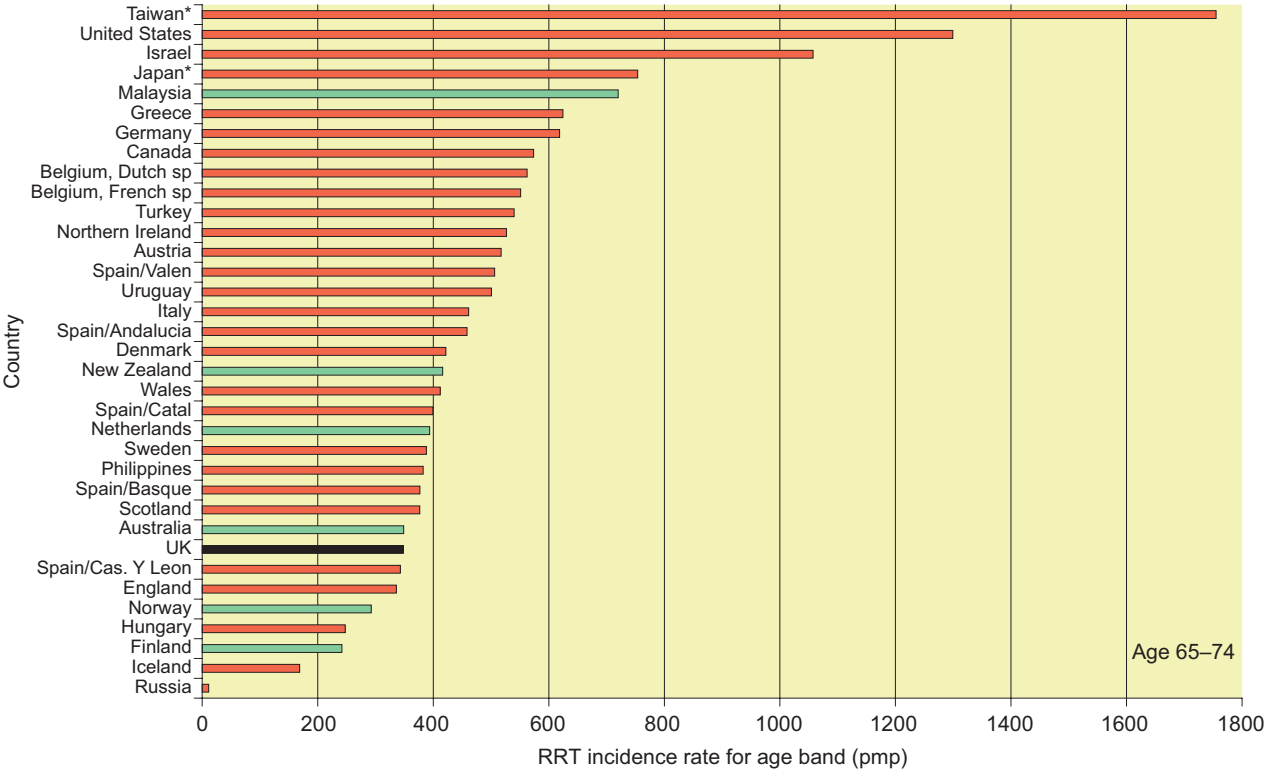

Figure 17.2d: Incidence of RRT pmp, 65–74 years in different countries

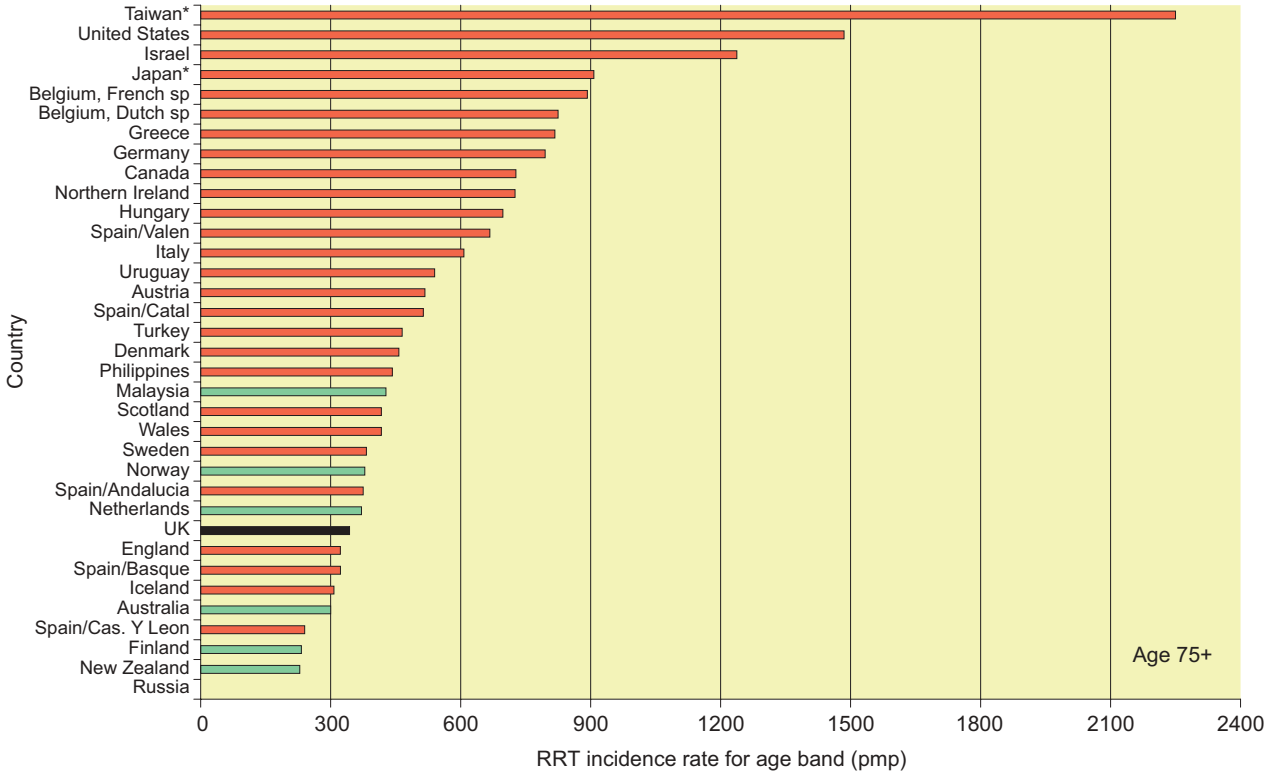

Figure 17.2e: Incidence of RRT pmp, 75+ years in different countries

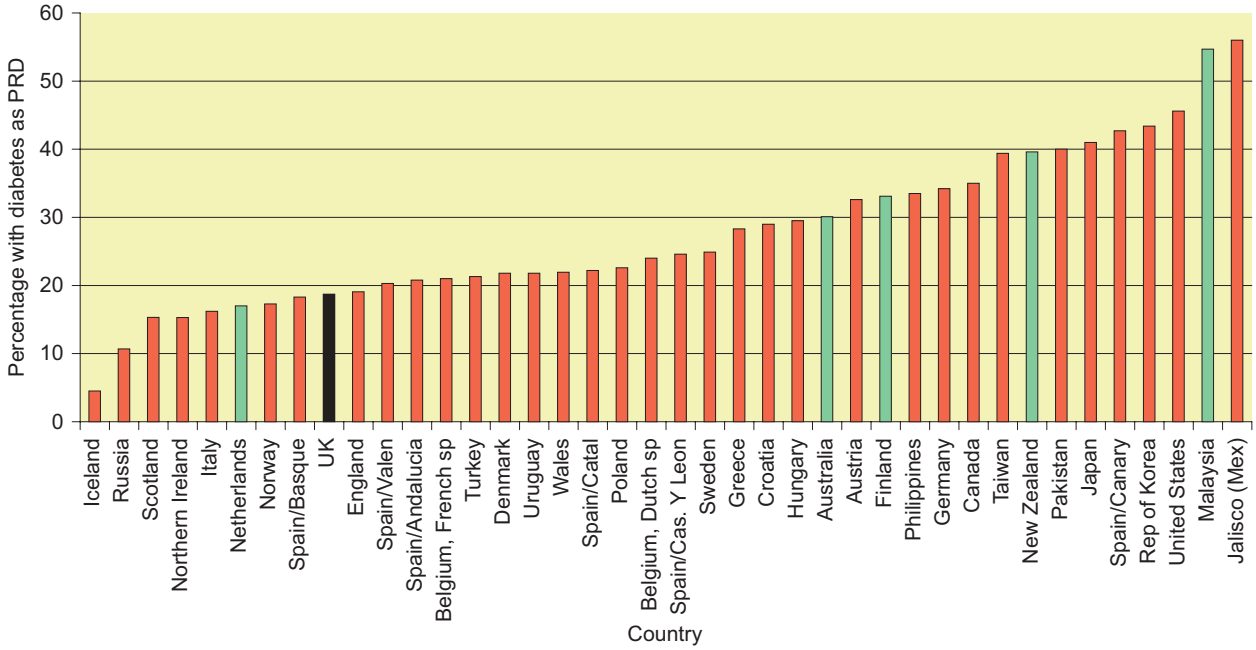

Figure 17.3: Percentage of incident RRT population with diabetes mellitus as cause of established renal failure

These countries (again with the exception of Malaysia) also have relatively high rates of peritoneal dialysis use (between 17 and 42%) compared with countries with higher RRT incidence rates (Figure 17.5).

When considering the number of renal transplants per million of the population (deceased and live donor) performed in each country each year, the UK's rate of 25 pmp places it 28th of 42, considerably lower than Spain, Norway and

Table 17.1: Rates of diabetic nephropathy in the incident RRT population

	Incidence of diabetic nephropathy pmp	% of incident RRT pts with DN
Russia	2	11
Iceland	3	5
Pakistan	13	40
Norway	17	17
Netherlands	18	17
Scotland	19	15
UK	20	19
England	22	19
Northern Ireland	22	15
Poland	23	23
Spain/Basque	24	18
Philippines	25	34
Spain/Andalucia	26	21
Turkey	26	21
Italy	27	16
Spain/Cas. Y Leon	28	25
Australia	29	30
Denmark	29	22
Wales	29	22
Spain/Catal	30	22
Sweden	30	25
Finland	31	33
Spain/Valen	32	20
Uruguay	33	22
Belgium, French sp	39	21
Hungary	41	30
Belgium, Dutch sp	42	24
New Zealand	44	40
Croatia	45	29
Austria	52	33
Canada	54	35
Greece	55	28
Malaysia	60	55
Germany	66	34
Spain/Canary	71	43
Rep of Korea	74	43
Japan	109	41
Taiwan	148	39
United States	156	46

the United States where rates vary between 58 and 64 pmp (Figure 17.6). When transplantation rates are considered alongside the prevalence rates for RRT, the UK position appears relatively high at 46% (13 out of 37 countries), although still considerably lower than in Norway and the Netherlands (72% and 54%, respectively) (Figure 17.7).

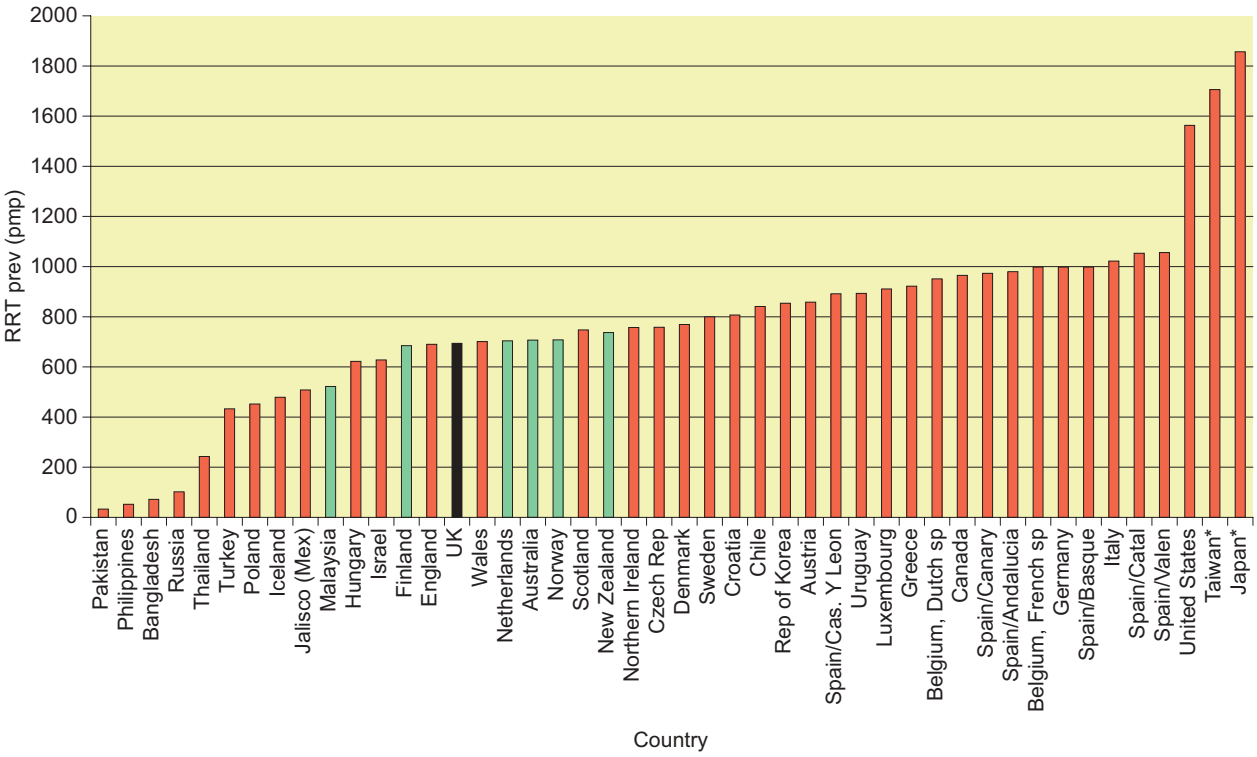

Figure 17.4: Prevalence of RRT by country (pmp)

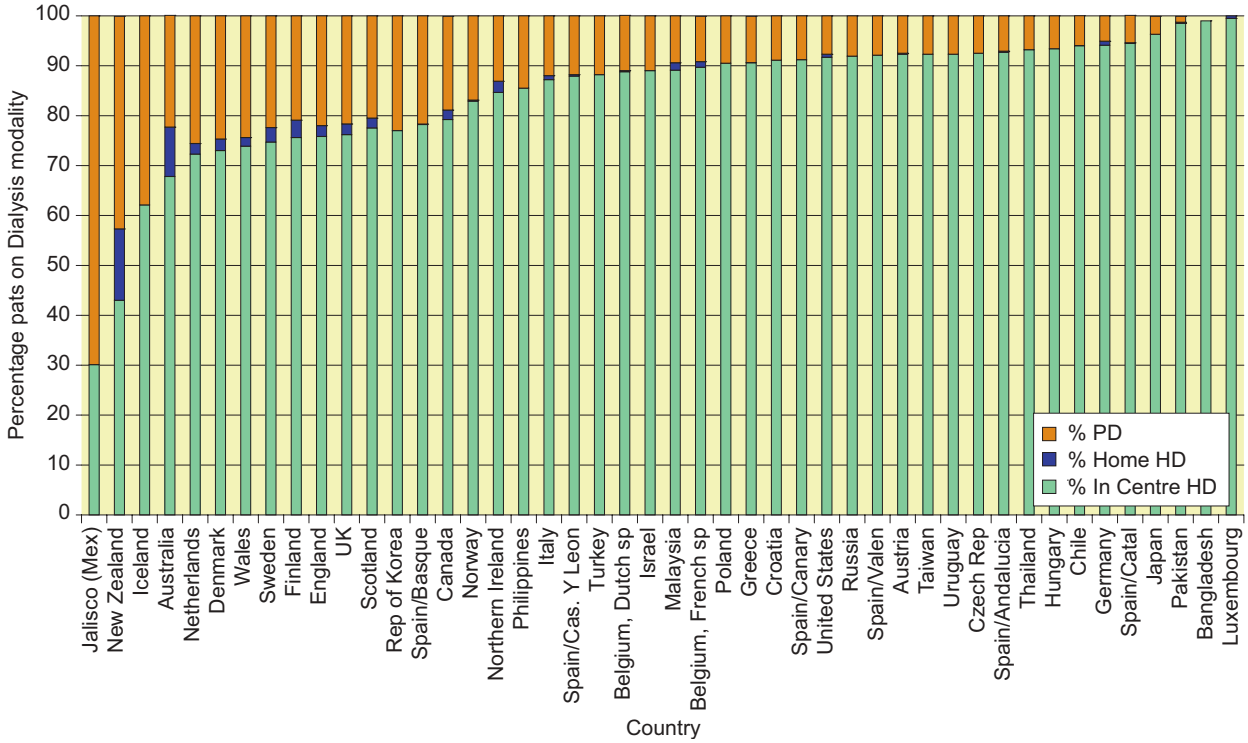

Figure 17.5: Percentage of prevalent dialysis population by dialysis modality

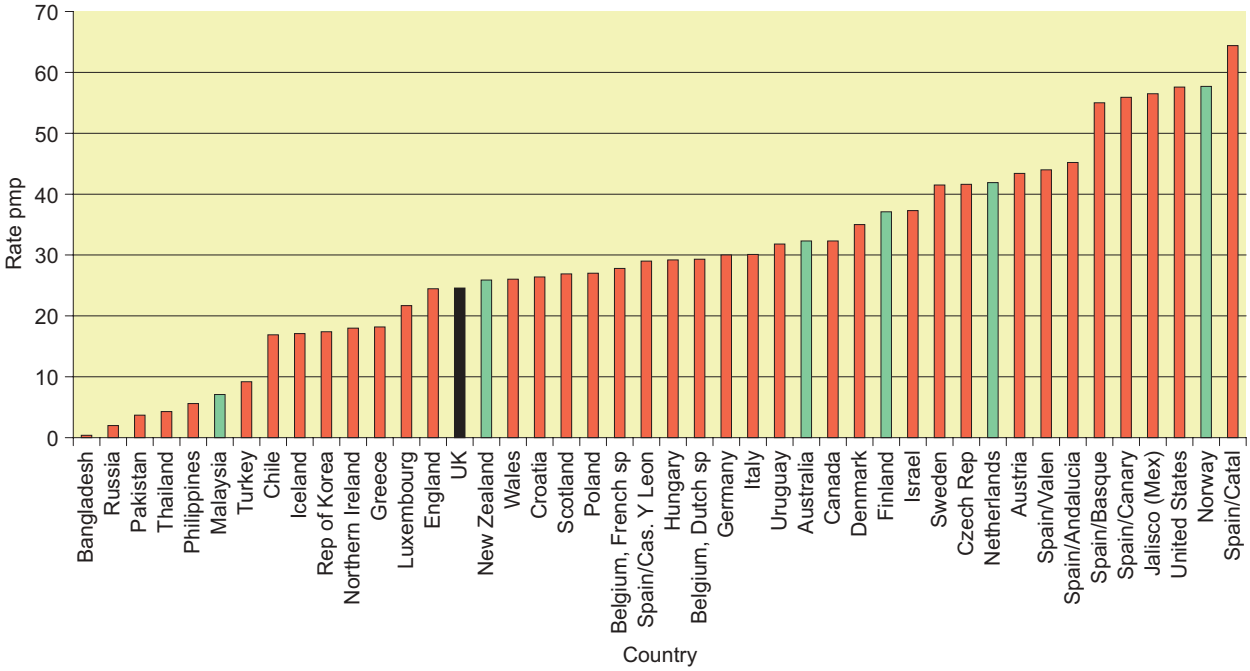

Figure 17.6: Renal transplant rate by country (pmp)

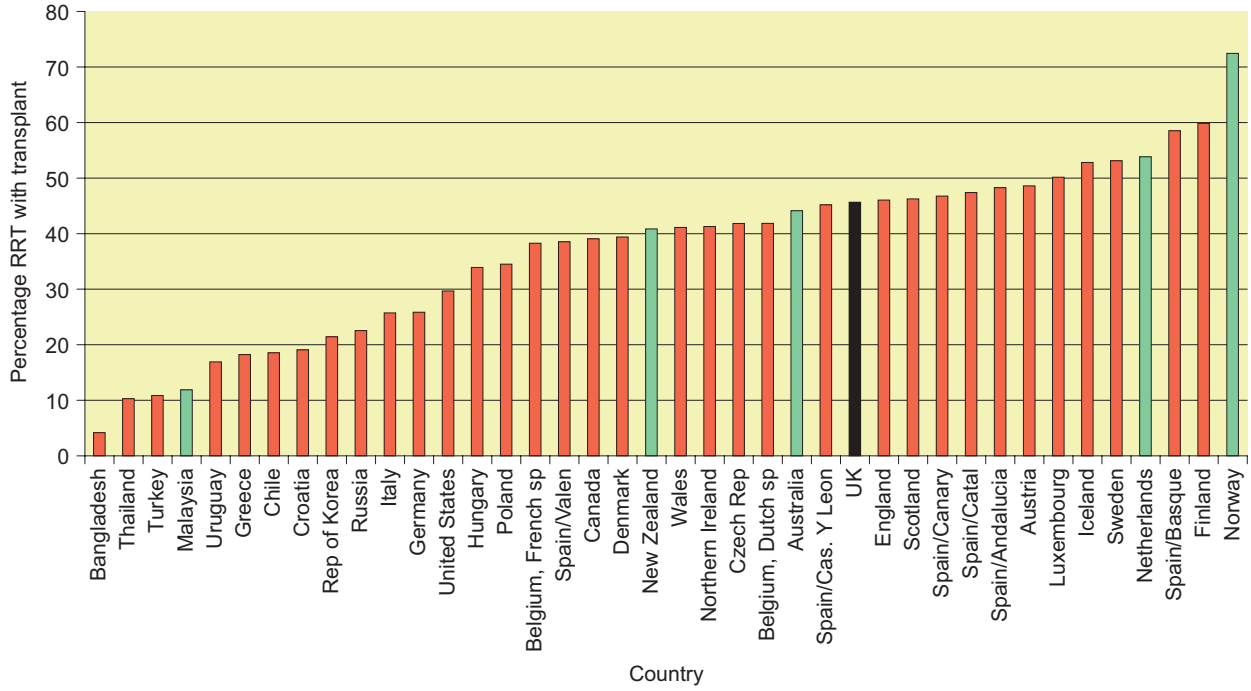

Figure 17.7: Percentage of prevalent RRT population with functioning renal transplant by country

Discussion

It has been recognised for many years that the UK has an RRT incidence rate considerably lower than some other developed countries, especially the United States. International comparisons such as presented in this chapter, show that the RRT incidence rate in the UK is very similar to that observed in a number of similar countries with predominantly European populations, such as Australia, the Netherlands, New Zealand and Norway.

Considering the wide distribution of RRT incidence rates between all the countries reporting to the USRDS, the 7 pmp reduction in RRT incidence (from 110 to 103 pmp) that results from adopting the 90-day rule is relatively small. For the purposes of ensuring consistency and transparency with other data reported by the UKRR, the RRT incidence rates quoted in future in the USRDS annual data reports will be based on patients alive on RRT at day 0.

In the sub group of six countries (with age-specific data) flanking the UK in the RRT incidence chart – Australia, Finland, Malaysia, the Netherlands, New Zealand and Norway – there are interesting differences in relative RRT incidence when considered by age band. Malaysia appears to have relatively high incidence rates for all individual age bands (Figures 17.2a–e), yet is at the low end of the distribution for overall RRT incidence along with the UK. The explanation for this lies in the age distribution of the Malaysian general population. In 2006, Malaysia had a median age of 24 years compared with 38 years in the UK and 34 to 39 years for the other five comparator countries (www.cia.gov accessed 7th January 2007). As the elderly make up a smaller proportion of the general population in Malaysia, the overall crude RRT incidence rate in Malaysia is less influenced by the incidence rate in elderly individuals. As a result of this, their overall crude RRT incidence rate appears low. Age-standardising the RRT incidence rates would overcome such differences in underlying demography and facilitate inter-country comparisons.

Although RRT incidence rates are consistently high in some countries, such as Taiwan and the United States and consistently low in others, such as the Netherlands, some countries have rates which are high in some age bands and low in others. On the basis that in developed countries young patients with established renal failure would not be denied access to RRT, a pattern of low RRT incidence rates across all age bands suggests a truly low rate of established renal failure, not just a low rate of acceptance onto replacement therapy. The UK,

Finland and New Zealand however have relatively high RRT incidence rates for the age band 20 to 44 years (and 45 to 64 years for New Zealand) and then relatively low rates for all older age bands. Access to RRT has been shown not to be a significant factor determining differences in RRT incidence in individuals aged less than 65 years and in most developed countries in those aged less than 75 years[6]. Therefore other explanations, such as differences in age-related risk factors for chronic kidney disease[10] or variation in rates of progression of chronic kidney disease in different countries[12] should be considered and studied.

Comparing dialysis modality use in the six countries with similar RRT incidence rates (excluding Malaysia for the reasons outlined above), it is interesting that rates of peritoneal dialysis use are relatively high in these countries compared to those with higher incidence rates. The similar patterns of dialysis modality use in these countries suggest that there may be similarities between them in terms of organisation of renal services that have influenced RRT incidence rates. Peritoneal dialysis is likely to be favoured where haemodialysis facilities are, or have historically been limited, or where there are geographical barriers to providing local haemodialysis facilities. Improving our understanding of how such organisational factors have shaped RRT provision around the world may prove useful to countries in earlier stages of developing renal services.

Conclusion

This chapter has described the methodology that the UKRR has adopted to provide data for the four countries of the UK individually or collectively on RRT incidence, prevalence, modality use and transplantation rates to the USRDS for the international comparison chapter in their annual data report. It has demonstrated that the RRT incidence rate in the UK is comparable with a number of demographically similar countries around the world. There is some variation in the RRT incidence in different age bands and also variation in RRT incidence secondary to diabetes mellitus which raises interesting questions. There is enormous potential for further collaborative epidemiological work, both at the chronic kidney disease and the RRT level, to improve our understanding of the driving forces behind these observed differences.

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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 G: Vascular Access and Workforce Survey Forms

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
ERA-EDTA	European Renal Association – European Dialysis and Transplant Association
eGFR	Estimated GFR
EPO	Erythropoietin
EPR	Electronic Patient Record
ERA	European Renal Association
ER	Early referral
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 Authorities
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
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
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
PMPO	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 use 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 H: Laboratory Conversion Factors

	Conversion factors from SI units
Albumin	g/dl = g/L × 0.1
Aluminium	μg/L = μmol/L × 27.3
Bicarbonate	mg/dl = mmol/L × 6.1
Calcium	mg/dl = mmol/L × 4
Calcium × phosphate	$mg^2/dl^2 = mmol^2/L^2 \times 12.4$
Cholesterol	mg/dl = mmol/L × 38.6
Creatinine	mg/dl = μmol/L × 0.011
Glucose	mg/dl = mmol/L × 18
Haemoglobin	Hct = g/dl × 3.11 (*NB this factor is variable*)
Phosphate	mg/dl = mmol/L × 3.1
PTH	ng/L = pmol/L × 9.5
Urea	mg/dl = mmol/L × 2.8

Appendix I: Abbreviations used for the renal units 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
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	Royal Liverpool University Hospital	Livrpl	England
London	St Barts and The London Hospital	L Barts	England
London	Guy's & St Thomas' Hospital	L Guys	England
London	Hammersmith & Charing Cross Hospitals	L H&CX	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
Wirral	Arrowe Park Hospital	Wirral	England
Wolverhampton	New Cross Hospital	Wolve	England
York	York District Hospital	York	England

City	Hospital	Abbreviation	Country
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	GlasWI	Scotland
Glasgow	Glasgow Royal Infirmary & Stobhill Hospital	GlasRI	Scotland
Inverness	Raigmore Hospital	Inverns	Scotland
Kilmarnock	Crosshouse Hospital	Klmarnk	Scotland
Antrim	Antrim Hospital	Antrim	Northern Ireland
Belfast	Belfast City Hospital	Belfast	Northern Ireland
Newry	Daisy Hill Hospital	Newry	Northern Ireland
Tyrone	Tyrone County Hospital	Tyrone	Northern Ireland
Ulster	Ulster Hospital	Ulster	Northern Ireland