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Foreword

The National Health Service is entering a new era. Over the past 5 years quality has moved up the health care agenda and we are now told 'quality is the only organising principle of the NHS'. If we measure quality then working together we can make that ambitious statement a reality. The dimensions of quality have been described; in health care quality is safe, timely, effective, efficient, equitable and patient centred. To these original 6 dimensions the Royal College of Physicians, prompted by the UK renal community, added sustainability in 2010. The challenge for the kidney community is therefore to define quality across the kidney care pathways in these terms and to identify indicators that are robust, easy to measure and will help teams to deliver better value care.

Our UK Renal Registry has a central role in improving the care and outcomes for people with advanced kidney disease. The data generated from individual patient clinical encounters, collated into information returns by kidney units, then analysed and displayed by the Registry staff have enabled the kidney community to understand many biomedical and epidemiological aspects of renal replacement therapy better. This knowledge has been the basis of many quality improvement initiatives over the last decade whilst also generating new questions and research. The Renal Registry has fostered a culture of healthy competition between units and sharing of best practice between teams.

Looking back, the UK Renal Registry with the Renal Association guidelines, then referred to as standards, and the Kidney Alliance bringing patients and professionals together were the corner stones of our 21st century strategy. The Registry provided the data, highlighted the inequalities and by demonstrating variance stimulated improvements. These trends are documented in this report.

Looking forward, our Registry remains at the vanguard. The infrastructure and where-with-all to extend the scope of the Renal Registry wider than renal replacement therapy to encompass additional aspects of advanced kidney care and also to move beyond biometrics to other aspects of kidney care quality and patient experience is in place. Quality is the only organising principle for kidney care; we need to measure and act on all 7 dimensions.

Dr Donal O'Donoghue
Renal Tsar for England

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UK Renal Registry 13th Annual Report (December 2010): Introduction

Terry Feest, Damian Fogarty

UK Renal Registry, Bristol, UK

The UK Renal Registry (UKRR) provides independent audit and analysis of renal replacement therapy (RRT) in the UK. The Registry is part of the UK Renal Association and is funded directly by participating renal centres through an annual capitation fee per patient per annum. The UKRR remains unique amongst renal registries in publishing both centre-specific analyses of indicators of quality of care, such as haemoglobin and also age-adjusted survival statistics for each renal centre.

Data are provided from all renal centres in the UK. For adult patients the Registry receives quarterly electronic data extracts from information systems used for clinical and administrative purposes within each renal centre in England, Wales and Northern Ireland and receives data from Scotland via the Scottish Renal Registry. Details of how the Registry extracts, analyses and reports on data for patients on RRT have been described previously [1].

The UKRR has also taken on the role of collecting paediatric data. This task is somewhat different from the collection of data from adult centres as many paediatric centres do not have clinical information systems which are used for day-to-day patient care. This is a major project as it is necessary to prepare and amalgamate the existing paediatric data for inclusion in the Registry database and to develop methods of obtaining data from the paediatric centres: this project is well under way.

This report contains analyses of data related to patient care in 2009. The inclusion of laboratory data permits analyses not only of the incidence, prevalence and outcomes of RRT in the UK, but also the achievement of clinical performance measures as defined by the Renal Association's Clinical Practice Guidelines. These guidelines have been recently reviewed and thus present new audit targets for forthcoming years for centres and challenges for the software extraction routines (see www.renal.org).

Personnel changes

There were significant changes of personnel within the Registry in 2010. After 15 years service Dr David Ansell ceased working for the Registry. David had worked for the Registry from its early days and made an enormous contribution to the work of the Registry, to its publications and to its goal of improving patient care.

The deputy director, Prof Chris Maggs, retired early in 2011. Prof Terry Feest has returned to the Registry as Acting Director pending the appointment of a permanent Director before the end of 2011.

Completeness of data returns from UK renal centres

Data are still incomplete, particularly those data items that require clinical input, including primary renal disease and comorbidity at the start of RRT.

These deficiencies limit the Registry's ability to perform analyses that are fully adjusted for case-mix and it is of major importance that returns of these data items are improved.

Table 1 gives completeness of data returns on ethnic origin, primary renal diagnosis, date first seen by a nephrologist and comorbidity at the start of RRT, from each centre in the UK for 2009.

It is disappointing that whilst there have been some changes in the performance of individual centres this has been variable and there has been no significant improvement in the last year.

Data collection and validation

The Registry is conducting a major review of the processes used for collection and validation of data and of its communications with renal centres. This review has demonstrated that the processes used until now had not kept abreast of developments in technology and were no longer fully fit for purpose. For some 4 months these have been examined in detail and new more automated processes developed which will reduce the time taken to collect and validate data, will provide more consistency in data validation and should therefore facilitate provision of more accurate data. Communications with renal centres concerning the data files obtained have been revised and it is hoped that centres will now find the feedback helpful and informative.

Inevitably this review has led to some delay in starting to process the data files for 2010 but this delay was necessary in order to produce a process which will enable faster data collection and validation and timely production of the Registry Reports in the future.

The Registry is also planning a pilot project of radical new ways of retrieving data from renal centres, perhaps on a daily basis. This project will work with Renal Patient

Table 1. Percentage completeness of data returns for ethnicity, primary renal diagnosis, date first seen by a nephrologist and comorbidity at the start of RRT (incident patients 2009)

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Comorbidity	Average completeness	Country
Newry	100.0	100.0	100.0	100.0	100.0	N Ireland
Ulster	100.0	100.0	100.0	100.0	100.0	N Ireland
L Kings	96.1	100.0	98.4	100.0	98.6	England
Wolve	98.5	98.5	98.5	98.5	98.5	England
Nottm	100.0	100.0	98.3	94.4	98.2	England
Bradfd	90.7	98.1	90.6	96.3	93.9	England
Oxford	97.1	94.1	91.0	91.2	93.4	England
Derby	84.6	100.0	97.4	91.0	93.3	England
Stevng	100.0	100.0	96.9	74.2	92.8	England
Wrexm	100.0	100.0	89.5	79.0	92.1	Wales
Tyrone	100.0	100.0	100.0	68.4	92.1	N Ireland
Dorset	100.0	100.0	88.4	80.0	92.1	England
Carlis	95.8	100.0	83.3	83.3	90.6	England
Middlbr	89.5	89.5	96.8	85.3	90.3	England
Leeds	94.9	84.0	92.9	86.5	89.6	England
Kent	88.3	99.2	97.7	60.2	86.3	England
Bristol	96.8	88.5	71.3	79.6	84.1	England
Derry	93.8	100.0	[a]	56.3	83.3	N Ireland
Donc	95.0	100.0	95.0	42.5	83.1	England
Antrim	100.0	100.0	100.0	31.6	82.9	N Ireland
Ports	86.8	99.3	96.0	40.4	80.6	England
Leic	95.0	87.8	68.8	66.7	79.6	England
Chelms	76.3	97.4	97.4	44.7	79.0	England
York	93.5	71.7	82.6	67.4	78.8	England
Shrew	93.6	95.7	100.0	17.0	76.6	England
Sheff	52.1	97.9	97.9	52.1	75.0	England
Swanse	100.0	100.0	0.9	97.4	74.6	Wales

Table 1. Continued

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Comorbidity	Average completeness	Country
Belfast	75.5	100.0	81.1	37.7	73.6	N Ireland
Sund	98.4	100.0	0.0	95.3	73.4	England
Basldn	96.2	96.1	[c] 0.0	88.5	70.2	England
Bangor	10.0	100.0	93.1	76.7	69.9	Wales
L Barts	97.0	96.6	0.0	81.6	68.8	England
Glouc	16.5	98.7	93.4	64.6	68.3	England
M RI	94.7	87.3	41.2	44.0	66.8	England
Sthend	82.6	100.0	0.0	82.6	66.3	England
Norwch	54.2	100.0	85.4	22.9	65.6	England
Carsh	85.0	95.2	1.0	68.1	62.3	England
Camb	95.7	[b] 99.3	38.4	0.7	58.5	England
L St.G	83.3	79.6	6.5	54.6	56.0	England
Prestn	75.5	93.9	0.0	49.0	54.6	England
B Heart	99.0	99.0	1.0	16.2	53.8	England
Liv RI	58.8	[b] 100.0	0.0	45.6	51.1	England
Redng	100.0	99.0	[c] 0.0	2.0	50.3	England
Ipswi	2.6	97.4	92.1	2.6	48.7	England
M Hope	100.0	94.1	0.0	0.0	48.5	England
B QEH	98.8	92.9	0.4	0.8	48.2	England
Dudley	92.4	100.0	0.0	0.0	48.1	England
Newc	100.0	91.0	[c] 0.0	0.0	47.8	England
Wirral	98.4	17.7	71.7	0.0	46.9	England
Plymth	11.7	91.7	3.3	76.7	45.8	England
Covnt	89.9	92.4	0.0	0.0	45.6	England
Liv Ain	22.2	91.7	0.0	66.7	45.1	England
Clwyd	23.5	100.0	0.0	52.9	44.1	Wales
L Guys	62.0	98.9	4.0	3.4	42.1	England
Exeter	95.7	47.1	19.4	0.7	40.7	England
Truro	45.1	45.1	23.5	45.1	39.7	England
Stoke	19.3	99.1	37.6	0.0	39.0	England
Brightn	58.3	95.8	0.0	0.0	38.5	England
Hull	10.8	68.6	0.0	71.6	37.7	England
Cardff	48.3	82.8	0.0	0.6	32.9	Wales
L West	3.1	100.0	0.0	2.0	26.3	England
L Rfree	89.7	0.6	0.0	0.0	22.6	England
Colchr	13.3	6.7	0.0	0.0	5.0	England
Airdrie	2.1	100.0				Scotland
D & Gall	0.0	100.0				Scotland
Dundee	0.0	100.0				Scotland
Dunfn	0.0	100.0				Scotland
Edinb	0.0	100.0				Scotland
Inverns	0.0	100.0				Scotland
Klmarnk	0.0	100.0				Scotland
Glasgw	0.6	97.7				Scotland
Abrdn	0.0	98.1				Scotland

[a]Centre excluded due to small patient numbers
[b]Data from these centres included a high proportion of patients whose primary renal diagnosis was 'uncertain'. This appears to have been largely because software in these centres was defaulting missing values to 'uncertain'
[c]As in previous Reports, all 'first seen' dates have been set to 'missing' because at least 10% of the dates returned were identical to the date of start of RRT. Whilst it is possible to start RRT on the day of presentation, comparison with the data returned from other centres raises the possibility, requiring further investigation, of incorrect data entry or extraction from these centres

View. If successful this would facilitate the production of timely interim audit reports pending publication of the detailed annual analysis of the present.

Interpretation of centre-specific comparisons

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

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

Furthermore all differences between centres need to be interpreted in light of measured and unmeasured variables that may account for these differences, the clinical impact of the differences and trend in these variables over time. For instance the 1 year survival of a centre may be in the lowest quartile of centres but be improving faster than others and may reflect excellent care given the case-mix and socio-demographic population base of the region.

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

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

Information governance

The UKRR operates within a comprehensive governance framework which concerns data handling, reporting and research, including data linkages and sharing agreements. The Chair of the UKRR Management Board is appointed as the Lead for Governance, with the UKRR Director responsible for day to day management of governance compliance. The Framework is based on good practice, as described in the Information Governance Framework:

(http://www.connectingforhealth.nhs.uk/systemsandservices/infogov/igap/igaf)

and the Research Governance Framework for Health and Social Care (2005):

(http://www.dh.gov.uk/en/Aboutus/Researchanddevelopment/A-Z/Researchgovernance/DH_4002112).

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

The Registry and the National Renal Dataset

The National Renal Dataset (NRD) was designed to enable a detailed description and audit of renal services. It was developed at a time when it was envisaged that hospitals would be acquiring clinical information systems which would then send data to the Secondary Users Service (SUS) through Connecting for Health. It was 'mandated' for use, which means that the suppliers of clinical information systems are obliged to provide the capacity for these data to be recorded in those systems.

The NRD dataset was to be collected from a variety of sources including hospital theatre systems, renal centre IT systems, primary care IT systems, pathology IT systems and many others. It was not envisaged that it would be the responsibility of renal centres to assemble and enter all these data into their own systems.

Sadly the investment envisaged in hospital clinical information systems and the development of Connecting for Health has not taken place and the NRD does not have the envisaged support. This leaves a situation whereby most renal centres do not have IT systems capable of collecting the whole dataset and have not received the investment to purchase such systems or to provide staff to assemble the data.

In many quarters there is an expectation that the UK Renal Registry, together with UK Transplant, will be collecting these data, as is shown in the following extract from the NHS Information Centre website:

'The dataset extends the existing collections of the UK Renal Registry, UK Transplant and the British Association of Paediatric Nephrologists. Data collection and submission of the NRD will be included within these existing collection mechanisms'.

This is not strictly correct, as it is not the primary responsibility of the Renal Registry to collect these data and it is certainly not the role of the Registry to pass such data on to any other body. The Registry can easily provide the capacity within its database to store the data items from the NRD for subsequent audit, but the Registry has not been resourced for the enormous workload of validating and cleaning such data and furthermore, it can only collect data which are being stored on renal centre IT systems; most of these data items are not yet available on these systems.

Nevertheless the NRD is a valuable potential tool for good audit and the Registry will be working with the renal community to evaluate which items will be most important for critical audits and will then work with renal centres to find ways of assembling those data, extracting them and performing the chosen audits.

Vascular access

The problems of the NRD are well demonstrated by the recent Vascular Access Audit exercise. The Registry installed a large number of data items onto its database which were related to vascular access and were derived from the NRD. It soon became evident that relatively few renal centres had IT systems with the capacity to store the relevant vascular access data items from the NRD. Extraction routines were developed and the Registry did extract data from those centres with the capacity to store the data in their systems, but it was soon clear that in many of those centres only very few vascular access data items were actually in their systems and available. As a result the NHS Information Centre had to resort to sending spreadsheets to renal centres to fill in information, which provided useful cross-sectional access information but did not move forward existing means for the continuing collection of vascular access audit data. The Registry is working with renal centres, NHS Kidney Care and the Department of Health to define which items are both important and available for collection for audit of vascular access and then to find ways of resourcing and enabling centres to collect the data.

Linkage with Hospital Episode Statistics (HES) database

To date, the Registry's analyses of the quality of care have largely been confined to clinical and surrogate outcomes and have not included costs or hospitalisation. The UKRR is working with academic colleagues in Sheffield on a major two year project to explore the benefits of linkage with the Hospital Episode Statistics

database, which holds information not only on hospital admissions but on discharge diagnoses and procedure codes. This project was funded by Kidney Research UK and the DH Research Capability Programme and will help understanding of the health care burden and variation thereof for patients in receipt of renal replacement therapy.

Peer-reviewed publications since the last annual report

The UKRR's primary role is to use data to develop high-quality analyses to drive a cycle of continuous improvement in the care of patients with kidney disease in the UK. Research is an important part of improving the quality of existing analyses and developing new ones. Research from the Registry appears in peer-reviewed journals [2–12] in addition to articles published in collaboration with the EDTA-ERA Registry [13–17]. A list of publications involving analyses of UKRR data is available on the UKRR website at www.renalreg.org.

The future

With the progressive improvement in survival of patients on RRT documented in this report it seems inevitable that the prevalence of RRT will continue to increase, even with continuing improvements in preventive care, earlier referral of patients with advanced CKD and where appropriate, provision of supportive care in place of RRT for those who wish for it. RRT is a high cost therapy and this will pose a challenge to the NHS and to the UK renal community. This will make it more important than ever to submit high quality data on the outcomes of RRT and to develop reliable analyses of the epidemiology and outcomes of conservative management of advanced CKD.

Conflicts of interest: none

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Chapter 1
UK RRT Incidence in 2009: national and centre-specific analyses

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

Summary

- In 2009 the incidence rate in the UK was stable at 109 per million population (pmp).
- From 2007 to 2009, acceptance rates pmp have fallen in Northern Ireland (88), Scotland (104) and Wales (120) whilst they have risen slightly in England (109).
- The median age of all incident patients was 64.8 years and for non-Whites 57.1 years.
- Diabetic renal disease remains the single most common cause of renal failure (25%).
- By 90 days, 69.1% of patients were on haemodialysis, 17.7% on peritoneal dialysis, 6.7% had had a transplant and 6.5% had died or stopped treatment.
- The mean eGFR at the start of RRT was 8.6 ml/min/1.73 m^2 which has been stable for the last three years.
- There was no relationship between social deprivation and presentation pattern.
- Late presentation (<90 days) has fallen from 27% in 2004 to 19% in 2009.

Introduction

This chapter includes analyses of adult patients starting renal replacement therapy (RRT) in the UK in 2009. It describes regional and national variations in acceptance rates onto RRT in the UK, the demographics and clinical characteristics of all patients starting RRT in the UK and late presentation to a renal centre for initiation of RRT. The methodology and the results for these analyses are discussed in three separate sections.

Definitions

The definition of incident patients is given in detail in appendix B: definitions and analysis criteria (www.renalreg.com/Report-Area/Report2010/appendix-B.pdf). In brief, it is all patients over 18 who commenced RRT in the UK in 2009 and who did not recover renal function within 90 days: this does not include those with a failed renal transplant who return to dialysis as they started RRT with or before the transplant.

Small differences may be seen in the 2004 to 2008 figures now quoted when compared with previous publications because of retrospective updating of data in collaboration with renal centres, in particular for patients who were initially thought to have acute renal failure. As last year, rather than allocating all pre-emptive transplants to the transplanting centre, an attempt was made to allocate these patients to their work up centre. This was not possible for all such patients and consequently some patients probably remained incorrectly allocated to the transplanting centre.

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

UK Renal Registry coverage

The UK Renal Registry (UKRR) received individual patient level data from all adult renal centres in the UK (5 renal centres in Wales, 6 in Northern Ireland, 9 in Scotland and 52 in England). Data from centres in Scotland were obtained from the Scottish Renal Registry. Data on children and young adults can be found in chapter 5: Demography of the UK Paediatric Renal Replacement Therapy population in 2009.

1 Geographical variation in acceptance rates

Over the years, there have been wide variations in acceptance trends between renal centres. Equity of access to RRT is an important aim but the need for RRT depends on many variables including age, gender, social deprivation, ethnicity and medical, social and demographic factors such as underlying conditions. Thus comparison of crude acceptance rates by geographical area can be misleading. This year's report again uses age and gender standardisation as well as showing crude rates. It also gives the ethnic minority percentage of each area as this influences acceptance rates. More detailed investigations into variation in acceptance rates are continuing at the UKRR.

Methods

Crude acceptance rates were calculated per million population (pmp) and standardised acceptance ratios were calculated as detailed in appendix D: methodology used for analyses of PCT/HBs (www.renalreg.com/Report-Area/Report2010/appendix-D.pdf). Briefly, data from all areas covered by the Registry for the relevant year were used to calculate overall age and gender specific acceptance rates. The age and gender breakdown of the population in each Primary Care Trust (PCT) area in England, Local Health Board (HB) in Wales, Scottish Health Board (HB) and the Health and Social Care Trust Areas in Northern Ireland (HSC) was obtained from the Office for National Statistics (ONS) [1]. These will be referred to by the umbrella term 'PCT/HB' in this report. This population breakdown was extrapolated by the ONS from the 2001 census data to mid-2009 estimates. For Wales and Northern Ireland the population data were aggregated from local authority to health board level. The population breakdown and the overall acceptance rates were used to calculate the expected age and gender specific acceptance numbers for each PCT/HB. The age and gender standardised acceptance ratio was the observed acceptance numbers divided by the expected acceptance numbers. A ratio below 1 indicated that the observed rate was less than expected given the area's age structure. This was statistically significant if the upper confidence limit was less than 1. Analyses were undertaken for each of the last 6 years and, as the incident numbers for one year can be small for smaller areas, a combined 6 years analysis was also done. The proportion of non-Whites in each PCT/HB area was obtained from the ONS from the 2001 Census for Northern Ireland, Scotland and Wales and from the ONS revised estimates for 2007 for England.

As part of continuing quality control, checks on the accuracy of data received are repeatedly carried out. A small degree of under-reporting of patients has been identified for 2009 in the following centres: Belfast (9), Dorset (9), Basildon (3), Antrim (3), Derry (3), Norwich (3), Doncaster (1), Tyrone (1), Ulster (1), Newry (1), Chelmsford (1), total 35. These patients have been added to tables 1.1 and 1.3 and figure 1.1 but are not included in any other analyses in this chapter.

Table 1.1. Number of new adult patients starting RRT in the UK in 2009

	England	Wales	Scotland	N Ireland	**UK**
All UK centres	5,673	359	540	158	**6,730**
*Total estimated population mid-2009 (millions)	51.8	3.0	5.2	1.8	**61.8**
Acceptance rate (pmp)	109	120	104	88	**109**
(95% CI)	(107–112)	(107–132)	(95–113)	(75–102)	**(106–112)**

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

Results

In 2009 the number of adult patients starting RRT in the UK was 6,730 equating to an acceptance rate of 109 pmp (table 1.1), slightly higher than in 2008. Wales remained the country with the highest acceptance rate (figure 1.1). For England, acceptance rates have been stable for the last 4 years. There continued to be very marked gender differences in take-on rates, 137 pmp (95% CI 133–141) in males and 82 pmp (95% CI 78–85) in females.

Table 1.2 shows acceptance rates and standardised ratios for PCT/HBs. The ratios calculated using combined data from up to six years have been used in determining significantly high and low areas. Provided that the area has been covered by the Registry for at least three years (all but one PCT/HB) significantly high areas have been shaded with bold text and significantly low areas shaded with italicised text in table 1.2. There were wide variations between areas, with 49 being significantly high and 47 being significantly low out of a total of 178 areas. As would be expected, urban areas with high percentages of non-White residents tended to have high acceptance rates. Figure 1.2 shows the positive correlation between the standardised ratios and the percentage of the PCT/HB that is non-White.

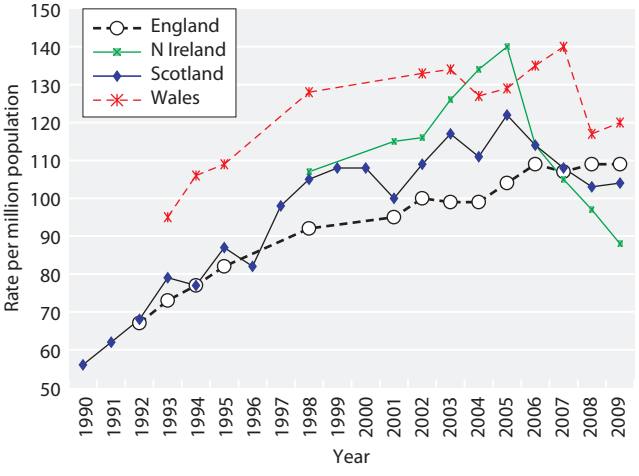

Fig. 1.1. RRT incident rates in the countries of the UK 1990–2009

Confidence intervals are not presented for the crude rates per million population but figures D1 and D2 in appendix D (www.renalreg.com/Report-Area/Report2010/appendix-D.pdf) show the confidence limits around the national average rate for different sized areas and allow an individual area's rate to be compared to the average to ascertain if it is higher or lower than expected.

The number of new patients accepted by each renal centre from 2004 to 2009 is shown in table 1.3, along with the percentage change in incident number between these years for those centres with full reporting during that period. Some centres have had an increase in new patients over time and others have fallen. The variation may reflect chance fluctuation, the introduction of new centres, completeness of reporting, changing incidence of established renal failure, changes in referral patterns, changes in catchment populations and areas or the introduction of conservative care programmes. For the first time this year the rate per million population has been presented for each centre. This has previously not been possible as accurate catchment populations were not available. For a full description of the methodology used see appendix E: methodology for estimating catchment populations (www.renalreg.com/Report-Area/Report2010/appendix-E.pdf). In brief, the patient postcode for each prevalent dialysis patient in 2007 was used to create a series of overlapping areas corresponding to each renal centre. These small areas were then assigned to a Census Area Statistics ward using geographical information system technology and the population in each area assigned to its respective renal centre. This methodology was used for England only. Estimates of the catchment populations in Wales and Northern Ireland were supplied by personal communication from Dr K Donovan, Dr A Williams and Dr D Fogarty. No data were available from Scotland. These estimates will not be accurate for new centres and centres with changes in catchment populations since 2007 (e.g. Bristol, Cambridge and Ipswich, which have lost catchment population since 2007 and Dorset

Table 1.2. Crude adult acceptance rates (pmp) and standardised ratios 2004–2009

Blank cells – no data returned to the Registry for that year
Areas with data for minimum 3 years and with significantly low acceptance ratios over 6 years are italicised in greyed areas, those with significantly high ratios are bold in greyed areas.
O/E = standardised acceptance rate ratio.
% non-White = percentage of the PCT/HB population that is non-White, from 2001 census (revised by ONS to 2007 for England)
PCT/HB = Primary Care Trust (England), Local Health Board (Wales), Scottish Health Board (Scotland), Health and Social Care areas (N Ireland)
For those areas not covered by the Registry for the entire period 2004–2009, the combined years standardised acceptance rate ratios and the acceptance rates are averages for the years covered by the Registry
pmp = per million population
LCL = lower 95% confidence limit
UCL = upper 95% confidence limit

UK Area	PCT/HB	Tot pop (2009)	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 pmp	2004–2009 O/E	2004–2009 LCL	2004–2009 UCL	2004–2009 pmp	% non-White
North East	*County Durham*	*506,600*	*0.89*	*0.91*	*0.86*	*0.66*	*0.68*	*0.78*	*89*	*0.79*	*0.71*	*0.89*	*90*	*2.5*
	Darlington	100,600	0.78	0.36	0.69	1.14	0.96	0.97	109	0.82	0.63	1.07	91	3.3
	Gateshead	190,500	0.96	0.94	0.90	0.86	0.55	0.87	100	0.85	0.70	1.02	95	3.8
	Hartlepool	90,800	1.11	0.94	1.38	0.50	1.30	0.71	77	0.99	0.77	1.28	106	2.6
	Middlesbrough	140,300	1.01	1.01	1.44	1.18	1.25	0.63	64	1.09	0.89	1.34	109	8.6
	Newcastle	284,300	1.16	1.12	0.85	1.18	1.03	0.87	84	1.03	0.89	1.20	99	9.7
	North Tyneside	*197,000*	*0.94*	*0.78*	*0.78*	*0.84*	*0.49*	*0.89*	*102*	*0.78*	*0.65*	*0.95*	*88*	*3.6*
	Northumberland	*311,200*	*0.86*	*0.61*	*0.73*	*0.72*	*0.67*	*0.62*	*77*	*0.70*	*0.60*	*0.82*	*86*	*2.2*
	Redcar and Cleveland	137,600	1.15	0.76	0.84	0.98	0.67	0.86	102	0.87	0.71	1.08	102	3.0
	South Tyneside	152,600	0.95	0.89	1.07	1.03	0.51	1.27	144	0.95	0.78	1.16	107	4.8
	Stockton-on-Tees Teaching	*191,100*	*1.04*	*0.81*	*0.82*	*0.63*	*0.78*	*0.69*	*73*	*0.79*	*0.65*	*0.97*	*83*	*4.7*
	Sunderland Teaching	*281,700*	*0.68*	*0.83*	*0.69*	*1.05*	*0.83*	*0.97*	*106*	*0.84*	*0.72*	*0.99*	*92*	*3.3*
North West	*Ashton, Leigh and Wigan*	*306,400*	*0.79*	*0.95*	*0.70*	*0.94*	*0.83*	*0.60*	*65*	*0.80*	*0.69*	*0.94*	*86*	*2.9*
	Blackburn with Darwen Teaching	139,900	1.19	1.50	1.42	1.29	0.45	0.93	86	1.13	0.91	1.39	104	22.7
	Blackpool	*140,000*	*0.27*	*0.69*	*0.59*	*0.96*	*0.96*	*1.03*	*121*	*0.76*	*0.60*	*0.95*	*88*	*3.7*
	Bolton	265,600	0.79	0.70	0.87	0.92	0.92	0.90	94	0.85	0.72	1.01	88	12.3
	Bury	*182,800*	*0.85*	*0.80*	*0.55*	*0.71*	*0.76*	*0.83*	*88*	*0.75*	*0.61*	*0.92*	*78*	*8.5*
	Central and Eastern Cheshire	*456,000*				*0.65*	*0.60*	*0.75*	*88*	*0.67*	*0.55*	*0.80*	*78*	*3.4*
	Central Lancashire	*457,800*	*0.66*	*0.74*	*0.56*	*0.79*	*0.93*	*0.94*	*103*	*0.77*	*0.68*	*0.88*	*83*	*6.7*
	Cumbria Teaching	*494,900*	*0.61*	*0.86*	*0.65*	*0.61*	*0.69*	*0.60*	*75*	*0.67*	*0.59*	*0.76*	*82*	*2.0*
	East Lancashire Teaching	*380,900*	*0.70*	*0.73*	*0.92*	*0.77*	*0.67*	*0.83*	*89*	*0.77*	*0.67*	*0.89*	*82*	*9.4*
	Halton and St Helens	295,900	0.82	1.18	1.15	1.01	0.61	0.94	101	0.96	0.83	1.10	103	2.1
	Heywood, Middleton and Rochdale	204,900				0.94	0.94	1.10	112	1.00	0.78	1.27	102	12.6
	Knowsley	149,300	0.99	0.86	0.75	1.08	0.45	0.77	80	0.81	0.65	1.02	84	2.8
	Liverpool	**442,400**	**1.13**	**1.33**	**1.24**	**1.05**	**1.17**	**1.21**	**120**	**1.19**	**1.06**	**1.33**	**117**	**8.3**
	Manchester Teaching	**483,500**				**1.26**	**1.38**	**1.47**	**118**	**1.37**	**1.17**	**1.60**	**112**	**23.4**
	North Lancashire Teaching	*327,000*	*0.41*	*0.43*	*0.51*	*0.61*	*0.52*	*0.72*	*89*	*0.54*	*0.45*	*0.64*	*65*	*4.2*
	Oldham	*219,200*	*0.70*	*0.65*	*0.84*	*0.85*	*1.12*	*0.73*	*73*	*0.82*	*0.68*	*0.99*	*81*	*12.2*
	Salford	*225,300*	*0.53*	*0.36*	*0.99*	*0.52*	*1.13*	*0.84*	*84*	*0.74*	*0.60*	*0.90*	*73*	*7.7*
	Sefton	*273,400*	*0.50*	*0.90*	*0.82*	*0.57*	*0.84*	*0.78*	*95*	*0.74*	*0.63*	*0.87*	*88*	*2.6*
	Stockport	*283,600*				*0.77*	*0.77*	*0.53*	*60*	*0.69*	*0.55*	*0.88*	*79*	*6.4*
	Tameside and Glossop	249,100				1.35	0.68	0.92	96	0.98	0.79	1.23	104	5.9
	Trafford	215,400				1.02	0.55	1.12	121	0.90	0.70	1.15	97	11.2
	Warrington	*197,900*	*0.98*	*0.72*	*0.73*	*0.55*	*0.60*	*1.03*	*111*	*0.76*	*0.63*	*0.93*	*82*	*3.5*
	Western Cheshire	*232,900*	*1.08*	*0.56*	*0.85*	*0.86*	*0.58*	*0.94*	*112*	*0.81*	*0.68*	*0.96*	*94*	*3.1*
	Wirral	308,600	1.20	1.18	0.76	0.75	0.78	0.78	91	0.90	0.78	1.04	103	2.8

Table 1.2. Continued

UK Area	PCT/HB	Tot pop (2009)	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 pmp	2004–2009 O/E	2004–2009 LCL	2004–2009 UCL	2004–2009 pmp	% non-White
Yorkshire and the Humber	Barnsley	226,500	0.88	0.74	0.89	0.83	1.10	0.92	102	0.89	0.75	1.06	98	2.7
	Bradford and Airedale Teaching	**506,900**	**1.27**	**1.33**	**0.90**	**1.55**	**1.15**	**0.94**	**89**	**1.19**	**1.07**	**1.32**	**111**	**25.0**
	Calderdale	201,500	1.13	0.86	0.86	0.87	0.87	1.02	109	0.93	0.78	1.12	98	9.8
	Doncaster	*290,200*	*0.95*	*0.70*	*0.78*	*0.61*	*0.82*	*1.08*	*121*	*0.82*	*0.70*	*0.96*	*91*	*4.3*
	East Riding of Yorkshire	*337,100*	*0.73*	*1.09*	*0.62*	*0.70*	*0.98*	*0.94*	*119*	*0.84*	*0.74*	*0.97*	*105*	*3.0*
	Hull Teaching	262,700	1.28	1.20	0.83	1.00	1.00	1.01	99	1.05	0.90	1.22	102	5.8
	Kirklees	406,800	1.36	0.77	1.15	0.69	0.76	1.16	118	0.98	0.86	1.11	98	16.0
	Leeds	787,600	1.05	1.18	0.92	0.80	0.98	0.84	81	0.96	0.88	1.06	92	11.8
	North East Lincolnshire	158,600	1.12	1.22	1.10	1.11	1.11	0.85	95	1.08	0.90	1.30	120	3.1
	North Lincolnshire	157,100	1.26	1.01	1.01	0.75	0.81	0.76	89	0.93	0.77	1.13	107	3.2
	North Yorkshire and York	*796,300*	*1.01*	*0.94*	*0.88*	*0.78*	*0.73*	*0.82*	*97*	*0.86*	*0.78*	*0.94*	*100*	*3.7*
	Rotherham	253,900	1.18	1.18	0.90	1.02	1.38	0.97	106	1.10	0.95	1.27	120	5.2
	Sheffield	**547,100**	**1.18**	**1.05**	**1.10**	**1.15**	**1.10**	**1.20**	**122**	**1.13**	**1.02**	**1.25**	**114**	**12.2**
	Wakefield District	*323,800*	*0.99*	*0.69*	*1.04*	*0.67*	*0.72*	*0.62*	*68*	*0.79*	*0.68*	*0.92*	*85*	*4.3*
East Midlands	Bassetlaw	111,900	0.58	1.01	0.59	1.57	0.60	0.76	89	0.86	0.67	1.09	100	3.1
	Derby City	**244,300**	**1.10**	**1.31**	**1.17**	**0.99**	**1.54**	**1.44**	**147**	**1.26**	**1.09**	**1.45**	**128**	**15.0**
	Derbyshire County	*726,400*	*0.70*	*0.65*	*0.68*	*0.75*	*1.03*	*0.75*	*88*	*0.76*	*0.69*	*0.84*	*89*	*3.2*
	Leicester City	**304,800**	**1.41**	**1.46**	**1.61**	**1.84**	**1.47**	**1.57**	**138**	**1.56**	**1.38**	**1.77**	**136**	**38.2**
	Leicestershire County and Rutland	*683,200*	*0.67*	*0.74*	*0.85*	*0.85*	*0.70*	*0.75*	*85*	*0.76*	*0.69*	*0.84*	*86*	*7.7*
	Lincolnshire Teaching	*700,200*	*0.71*	*1.03*	*0.83*	*0.80*	*0.68*	*0.74*	*91*	*0.80*	*0.72*	*0.88*	*98*	*3.3*
	Northamptonshire Teaching	684,000	0.69	0.84	0.88	0.98	1.20	0.82	86	0.91	0.82	1.00	95	7.4
	Nottingham City	**300,800**	**1.20**	**1.39**	**1.33**	**0.96**	**1.34**	**1.09**	**93**	**1.22**	**1.06**	**1.41**	**103**	**18.7**
	Nottinghamshire County Teaching	665,000	1.01	1.20	1.12	1.08	0.91	1.01	116	1.06	0.97	1.16	120	5.1
West Midlands	**Birmingham East and North**	**407,400**	**1.63**	**1.97**	**1.87**	**1.49**	**1.67**	**1.46**	**140**	**1.68**	**1.52**	**1.86**	**160**	**23.8**
	Coventry Teaching	**312,600**	**0.97**	**0.98**	**1.09**	**1.36**	**1.58**	**1.71**	**166**	**1.29**	**1.13**	**1.46**	**124**	**19.6**
	Dudley	306,500	1.12	0.96	0.88	0.92	0.84	1.42	163	1.02	0.89	1.17	116	8.5
	Heart of Birmingham Teaching	**280,500**	**2.41**	**2.14**	**2.46**	**2.62**	**3.04**	**2.87**	**214**	**2.60**	**2.33**	**2.89**	**193**	**61.8**
	Herefordshire	179,000	1.01	0.81	0.72	0.78	0.91	1.13	145	0.89	0.74	1.06	113	2.4
	North Staffordshire	211,500				0.55	0.91	1.12	132	0.86	0.67	1.09	102	3.5
	Sandwell	**291,100**	**1.98**	**1.47**	**1.43**	**1.55**	**2.11**	**1.74**	**179**	**1.71**	**1.53**	**1.91**	**174**	**21.8**
	Shropshire County	291,900	1.11	0.76	0.93	0.76	1.14	0.74	92	0.91	0.79	1.04	112	3.0
	Solihull	205,200	1.26	1.13	1.28	0.84	1.01	1.35	156	1.14	0.98	1.34	130	9.0
	South Birmingham	**341,200**	**1.82**	**1.32**	**1.05**	**1.30**	**1.54**	**1.38**	**135**	**1.39**	**1.24**	**1.57**	**135**	**17.9**
	South Staffordshire	609,300				0.93	0.93	0.84	97	0.90	0.78	1.03	104	4.7
	Stoke on Trent	246,900				1.23	0.97	1.40	150	1.20	0.98	1.46	130	7.1
	Telford and Wrekin	162,300	1.25	0.80	1.10	1.71	1.00	1.20	123	1.18	0.98	1.41	120	6.6
	Walsall Teaching	**255,800**	**1.54**	**1.18**	**1.36**	**1.24**	**1.31**	**1.11**	**121**	**1.29**	**1.12**	**1.47**	**139**	**14.7**
	Warwickshire	535,100	0.86	0.97	1.06	1.03	0.95	0.99	114	0.98	0.88	1.09	111	6.7
	Wolverhampton City	**238,500**	**1.80**	**1.68**	**1.22**	**1.00**	**1.43**	**1.13**	**122**	**1.37**	**1.19**	**1.57**	**145**	**23.8**
	Worcestershire	*556,600*	*0.90*	*0.78*	*0.69*	*0.80*	*0.96*	*1.09*	*129*	*0.87*	*0.78*	*0.97*	*102*	*4.4*
East of England	*Bedfordshire*	*411,100*	*0.86*	*0.66*	*1.11*	*0.56*	*0.72*	*0.87*	*92*	*0.80*	*0.70*	*0.91*	*84*	*9.3*
	Cambridgeshire	607,200	0.93	0.93	1.06	0.85	0.82	1.06	114	0.94	0.85	1.05	100	7.4
	East and North Hertfordshire	*545,600*	*0.64*	*0.75*	*0.88*	*0.65*	*0.76*	*0.77*	*81*	*0.74*	*0.66*	*0.84*	*77*	*8.8*
	Great Yarmouth and Waveney	214,000	1.29	1.21	1.25	1.20	1.20	0.48	61	1.10	0.95	1.28	139	3.5
	Luton	**194,600**	**0.87**	**1.50**	**1.26**	**1.44**	**1.05**	**1.07**	**98**	**1.20**	**1.01**	**1.43**	**109**	**31.5**
	Mid Essex	*371,300*	*1.07*	*0.88*	*0.85*	*0.94*	*0.82*	*0.71*	*78*	*0.87*	*0.76*	*1.00*	*96*	*5.1*
	Norfolk	757,200	0.86	1.14	1.00	1.06	0.91	0.61	77	0.93	0.85	1.01	115	3.9

Table 1.2. Continued

UK Area	PCT/HB	Tot pop (2009)	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 pmp	2004–2009 O/E	2004–2009 LCL	2004–2009 UCL	2004–2009 pmp	% non-White
East of England	North East Essex	324,800					1.60	0.59	71	1.10	0.89	1.36	132	6.4
	Peterborough	171,000	0.85	1.16	1.16	1.05	1.11	1.31	129	1.11	0.92	1.34	108	13.0
	South East Essex	336,500	1.17	0.86	1.28	1.08	0.90	0.61	71	0.98	0.86	1.12	114	5.7
	South West Essex	405,000	1.24	0.89	1.10	0.90	1.11	0.70	72	0.99	0.87	1.12	100	7.6
	Suffolk	*596,200*	*0.78*	*0.94*	*0.80*	*0.92*	*0.78*	*0.87*	*102*	*0.85*	*0.76*	*0.94*	*99*	*5.7*
	West Essex	*282,400*	*1.00*	*0.70*	*0.79*	*0.70*	*0.42*	*0.75*	*81*	*0.72*	*0.61*	*0.86*	*78*	*7.9*
	West Hertfordshire	*549,900*	*0.63*	*0.74*	*0.97*	*0.81*	*1.13*	*0.94*	*98*	*0.87*	*0.78*	*0.98*	*90*	*11.1*
London	Barking and Dagenham	176,000	1.26	0.83	0.92	0.99	1.72	1.41	119	1.19	0.98	1.44	99	23.7
	Barnet	**343,200**		**0.71**	**1.52**	**1.86**	**1.39**	**1.17**	**114**	**1.34**	**1.17**	**1.52**	**131**	**29.4**
	Bexley	225,800	**0.83**	**0.99**	**1.14**	**1.08**	**1.16**	**1.34**	**142**	**1.09**	0.93	1.28	**114**	13.0
	Brent Teaching	**255,200**			**1.66**	**2.09**	**2.17**	**2.59**	**243**	**2.13**	**1.86**	**2.44**	**203**	**53.5**
	Bromley	310,200	**0.96**	**1.05**	**0.82**	**0.74**	**1.24**	**0.96**	**103**	**0.96**	0.83	1.11	**102**	11.9
	Camden	231,600		**0.92**	**1.19**	**1.19**	**1.09**	**1.43**	**117**	**1.17**	0.97	1.40	**96**	24.9
	City and Hackney Teaching	**227,100**			**1.21**	**1.38**	**1.38**	**2.09**	**163**	**1.51**	**1.25**	**1.82**	**120**	**35.7**
	Croydon	**342,800**	**1.28**	**1.69**	**1.01**	**1.65**	**1.59**	**1.73**	**166**	**1.49**	**1.33**	**1.67**	**141**	**34.5**
	Ealing	**316,300**	**2.15**	**1.78**	**1.93**	**1.98**	**1.56**	**2.41**	**215**	**1.96**	**1.76**	**2.19**	**174**	**40.7**
	Enfield	**291,400**		**1.03**	**1.54**	**1.13**	**1.35**	**1.26**	**120**	**1.26**	**1.09**	**1.46**	**121**	**28.0**
	Greenwich Teaching	**226,200**	**0.85**	**2.10**	**1.09**	**1.61**	**1.70**	**1.48**	**128**	**1.48**	**1.27**	**1.72**	**127**	**26.1**
	Hammersmith and Fulham	**169,800**	**1.75**	**1.20**	**1.15**	**1.36**	**0.61**	**1.31**	**112**	**1.22**	**1.01**	**1.48**	**103**	**21.0**
	Haringey Teaching	**225,400**		**1.36**	**1.46**	**1.47**	**1.73**	**1.02**	**84**	**1.41**	**1.19**	**1.67**	**118**	**33.1**
	Harrow	**228,600**			**1.33**	**0.65**	**1.78**	**2.03**	**201**	**1.45**	**1.22**	**1.72**	**145**	**44.7**
	Havering	*234,500*			*0.94*	*0.76*	*0.76*	*0.65*	*72*	*0.78*	*0.63*	*0.97*	*87*	*8.8*
	Hillingdon	**262,500**	**1.47**	**1.08**	**1.49**	**1.03**	**1.51**	**1.25**	**118**	**1.30**	**1.13**	**1.50**	**122**	**25.9**
	Hounslow	**234,200**	**2.10**	**1.45**	**1.72**	**1.54**	**1.25**	**1.81**	**158**	**1.64**	**1.42**	**1.88**	**142**	**37.8**
	Islington	**192,100**		**1.73**	**1.59**	**1.47**	**1.15**	**1.44**	**115**	**1.47**	**1.23**	**1.77**	**119**	**22.9**
	Kensington and Chelsea	169,900			**0.81**	**0.64**	**1.16**	**0.59**	**59**	**0.80**	0.61	1.04	**81**	22.6
	Kingston	166,900				**0.90**	**1.28**	**0.91**	**84**	**1.03**	0.78	1.37	**96**	19.9
	Lambeth	**283,400**	**1.43**	**1.87**	**1.57**	**2.06**	**1.62**	**2.02**	**159**	**1.77**	**1.55**	**2.01**	**138**	**32.0**
	Lewisham	**264,300**	**1.92**	**1.78**	**1.69**	**2.02**	**1.57**	**2.38**	**197**	**1.89**	**1.67**	**2.14**	**155**	**34.4**
	Newham	**241,200**	**2.16**	**2.22**	**2.33**	**1.75**	**2.01**	**2.63**	**195**	**2.18**	**1.92**	**2.48**	**161**	**57.0**
	Redbridge	**267,700**	**1.34**	**0.96**	**0.99**	**1.39**	**1.55**	**1.74**	**161**	**1.33**	**1.16**	**1.53**	**121**	**40.9**
	Richmond and Twickenham	189,400				0.75	0.70	0.82	79	0.75	0.56	1.02	74	11.7
	Southwark	**285,600**	**1.25**	**1.69**	**1.49**	**2.27**	**2.05**	**1.53**	**123**	**1.72**	**1.52**	**1.96**	**137**	**34.1**
	Sutton and Merton	**398,900**				**1.30**	**1.51**	**1.22**	**115**	**1.35**	**1.15**	**1.58**	**129**	**20.8**
	Tower Hamlets	**234,800**	**1.26**	**1.59**	**1.47**	**1.71**	**1.88**	**1.88**	**132**	**1.64**	**1.41**	**1.91**	**115**	**22.8**
	Waltham Forest	**224,500**			**1.47**	**2.46**	**1.49**	**1.52**	**129**	**1.74**	**1.47**	**2.05**	**150**	**36.6**
	Wandsworth	**286,900**				**1.87**	**1.48**	**2.03**	**164**	**1.79**	**1.50**	**2.13**	**146**	**19.7**
	Westminster	**249,200**			**1.41**	**0.71**	**1.36**	**1.58**	**140**	**1.26**	**1.05**	**1.52**	**114**	**27.8**
South East Coast	Brighton and Hove City	256,200	1.02	0.91	0.82	0.95	1.19	1.17	113	1.01	0.86	1.19	97	8.7
	East Sussex Downs and Weald	*333,700*	*1.15*	*0.64*	*0.92*	*0.83*	*0.64*	*0.55*	*72*	*0.78*	*0.68*	*0.90*	*100*	*4.9*
	Eastern and Coastal Kent	**732,100**				**1.30**	**1.19**	**1.06**	**123**	**1.19**	**1.06**	**1.33**	**138**	**5.3**
	Hastings and Rother	178,400	1.00	0.72	1.06	0.56	0.77	0.95	123	0.84	0.70	1.01	107	5.2
	Medway	254,900				1.50	0.73	0.90	90	1.05	0.84	1.30	106	7.5
	Surrey	*1,100,500*	*0.80*	*0.61*	*0.80*	*0.83*	*0.95*	*0.97*	*106*	*0.83*	*0.77*	*0.90*	*90*	*8.3*
	West Kent	678,600				1.03	1.00	0.97	108	1.00	0.88	1.14	112	6.8
	West Sussex	*792,900*	*0.56*	*0.78*	*0.84*	*0.86*	*0.89*	*0.71*	*86*	*0.78*	*0.71*	*0.85*	*93*	*5.8*

Table 1.2. Continued

UK Area	PCT/HB	Tot pop (2009)	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 pmp	2004–2009 O/E	2004–2009 LCL	2004–2009 UCL	2004–2009 pmp	% non-White
South Central	**Berkshire East**	**399,600**	**1.07**	**1.23**	**1.27**	**1.36**	**1.29**	**1.25**	**120**	**1.25**	**1.11**	**1.40**	**118**	**18.9**
	Berkshire West	466,600	1.03	1.25	1.04	0.92	1.15	0.93	92	1.05	0.94	1.18	103	10.1
	Buckinghamshire	*508,700*	*0.76*	*0.63*	*0.67*	*0.77*	*0.79*	*0.94*	*102*	*0.76*	*0.67*	*0.86*	*82*	*10.4*
	Hampshire	*1,289,100*	*0.62*	*0.67*	*0.81*	*0.77*	*0.79*	*0.82*	*94*	*0.75*	*0.69*	*0.81*	*85*	*4.2*
	Isle of Wight National Health Service	*140,200*	*0.65*	*0.39*	*0.47*	*0.21*	*0.27*	*0.16*	*21*	*0.36*	*0.26*	*0.49*	*46*	*3.6*
	Milton Keynes	242,300	0.84	0.73	0.78	1.09	0.92	0.94	87	0.88	0.74	1.06	81	12.7
	Oxfordshire	*615,900*	*0.81*	*0.88*	*0.83*	*0.69*	*0.68*	*1.00*	*104*	*0.81*	*0.73*	*0.91*	*84*	*8.1*
	Portsmouth City Teaching	*203,400*	*0.69*	*0.65*	*0.72*	*0.93*	*0.88*	*0.68*	*64*	*0.76*	*0.62*	*0.94*	*70*	*8.0*
	Southampton City	237,000	0.71	0.66	0.77	0.86	1.18	0.79	72	0.83	0.69	1.00	75	11.4
South West	Bath and North East Somerset	177,500	1.30	1.06	0.90	1.02	0.71	1.28	141	1.04	0.87	1.24	113	5.8
	Bournemouth and Poole Teaching	*306,000*	*0.71*	*0.69*	*0.71*	*0.67*	*0.83*	*0.59*	*69*	*0.70*	*0.60*	*0.82*	*81*	*5.0*
	Bristol	**433,000**	**1.30**	**1.14**	**1.33**	**1.02**	**1.48**	**1.31**	**120**	**1.26**	**1.13**	**1.42**	**115**	**11.6**
	Cornwall and Isles of Scilly	532,900	1.36	0.70	1.06	0.88	0.87	1.01	128	0.98	0.88	1.08	122	2.8
	Devon	747,500	0.99	1.03	0.92	1.03	1.09	0.97	124	1.01	0.93	1.09	127	3.3
	Dorset	*404,200*	*0.73*	*0.56*	*0.52*	*0.77*	*0.86*	*0.68*	*94*	*0.69*	*0.60*	*0.78*	*93*	*3.5*
	Gloucestershire	588,700	0.90	0.85	1.00	0.88	0.64	1.14	132	0.90	0.81	1.00	103	4.7
	North Somerset	209,400	1.17	1.09	0.84	0.78	1.20	0.90	110	0.99	0.85	1.17	119	3.6
	Plymouth Teaching	**256,700**	**1.09**	**1.09**	**1.85**	**1.72**	**1.01**	**1.18**	**121**	**1.33**	**1.16**	**1.52**	**135**	**4.4**
	Somerset	*523,600*	*0.81*	*0.63*	*0.75*	*0.66*	*0.79*	*1.04*	*130*	*0.78*	*0.70*	*0.87*	*96*	*3.2*
	South Gloucestershire	262,300	1.01	1.23	0.96	0.90	0.90	0.63	69	0.94	0.80	1.09	100	5.0
	Swindon	203,700	1.07	0.70	0.80	0.53	1.10	1.11	113	0.88	0.73	1.06	88	7.1
	Torbay	133,900	1.26	0.95	0.73	0.85	1.65	0.69	90	1.02	0.84	1.23	131	3.1
	Wiltshire	*456,000*	*0.57*	*0.79*	*0.65*	*0.62*	*0.83*	*0.78*	*90*	*0.71*	*0.62*	*0.81*	*80*	*3.4*
Wales	Betsi Cadwaladr University	679,000	1.04	1.38	1.11	1.13	0.97	0.87	105	1.08	0.99	1.18	128	1.0
	Powys Teaching	131,700	0.82	1.19	0.79	1.09	0.92	1.04	137	0.97	0.80	1.18	127	0.9
	Hywel Dda	374,800	1.02	1.06	0.86	1.11	1.15	0.80	99	1.00	0.89	1.12	122	1.0
	Abertawe Bro Morgannwg Univ.	**502,300**	**1.25**	**1.06**	**1.41**	**1.50**	**1.23**	**1.57**	**179**	**1.34**	**1.22**	**1.47**	**151**	**1.6**
	Cwm Taf	**290,500**	**1.77**	**1.46**	**1.72**	**1.59**	**1.09**	**1.36**	**148**	**1.50**	**1.33**	**1.68**	**161**	**1.1**
	Aneurin Bevan	560,600	1.03	1.19	1.11	1.34	0.96	0.92	103	1.09	0.99	1.20	121	1.9
	Cardiff and Vale University	**461,000**	**1.39**	**1.16**	**1.27**	**1.40**	**1.07**	**1.24**	**121**	**1.25**	**1.13**	**1.39**	**121**	**6.7**
Scotland	Ayrshire & Arran	367,000	0.91	1.16	1.30	0.84	0.87	0.86	101	0.99	0.88	1.12	116	0.7
	Borders	113,100	1.41	0.73	0.83	1.12	1.06	1.00	124	1.02	0.82	1.26	125	0.6
	Dumfries and Galloway	148,200	1.03	1.23	1.06	0.82	1.08	1.04	135	1.04	0.87	1.25	134	0.7
	Fife	363,400	1.00	1.41	1.00	0.92	0.97	1.08	121	1.06	0.94	1.20	118	1.3
	Forth Valley	291,400	0.69	1.00	0.88	1.30	0.78	1.07	117	0.96	0.83	1.11	104	1.1
	Grampian	545,400	1.19	1.03	0.84	0.89	0.90	0.83	92	0.94	0.85	1.05	103	1.6
	Greater Glasgow & Clyde	**1,199,000**	**1.27**	**1.17**	**1.11**	**1.06**	**0.95**	**0.99**	**103**	**1.09**	**1.02**	**1.17**	**112**	**3.4**
	Highland	311,000	1.13	1.47	0.87	0.88	0.76	0.71	87	0.96	0.84	1.10	116	0.8
	Lanarkshire	*562,500*	*0.95*	*0.77*	*0.95*	*0.87*	*0.74*	*0.87*	*92*	*0.86*	*0.76*	*0.96*	*91*	*1.2*
	Lothian	826,200	1.01	1.03	1.03	0.84	0.96	0.82	84	0.95	0.87	1.04	96	2.8
	Orkney	20,000	0.45	1.27	0.80	0.41	1.22	1.24	150	0.90	0.52	1.55	108	0.4
	Shetland	22,000	1.35	0.42	0.00	1.61	0.00	0.82	91	0.69	0.37	1.28	76	1.1
	Tayside	**399,600**	**1.31**	**1.38**	**1.00**	**1.27**	**1.14**	**1.28**	**150**	**1.23**	**1.10**	**1.36**	**142**	**1.9**
	Western Isles	26,100	1.30	0.00	0.87	1.76	0.29	0.89	115	0.85	0.53	1.37	109	0.6
N Ireland	**Belfast**	**334,600**		**1.58**	**1.59**	**1.28**	**1.01**	**0.70**	**69**	**1.23**	**1.07**	**1.41**	**123**	**1.1**
	Northern	**458,300**		**1.59**	**1.21**	**1.29**	**1.10**	**0.75**	**76**	**1.19**	**1.06**	**1.34**	**121**	**0.6**
	Southern	354,000		1.25	0.62	0.60	1.02	0.83	76	0.86	0.73	1.01	80	0.4
	South Eastern	344,200		1.25	0.96	0.89	0.84	0.62	64	0.91	0.78	1.06	94	0.7
	Western	297,900		0.96	1.26	1.06	0.81	1.19	111	1.06	0.90	1.24	99	0.5

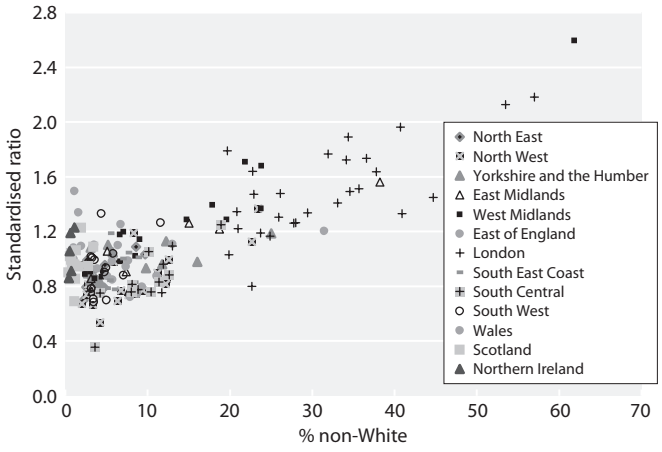

Fig. 1.2. Standardised ratio (2004–2009) by percentage non-White

which gained catchment population); there are also some pre-emptive transplant patients who have been allocated to the transplant centre. Estimation of a centre's catchment population therefore remains an inexact science and these figures should be regarded as indicative only.

For those centres reporting continuously since 2004, only England has seen an increase in numbers of accepted patients (9.6%), whilst there was a fall for Scotland. For Wales there was an increase and then a fall again resulting in a negligible overall change since 2004. Northern Ireland could not be included in the analysis as the UKRR only received data from 2005 onwards. The overall number of accepted patients in the UK remained relatively stable between 2008 and 2009.

Table 1.3. Number of new patients accepted by individual renal centres reporting to the UK Renal Registry 2004–2009

		Year						Catchment population (millions)	2009 rate pmp	(95% CI)
Country	Centre	2004	2005	2006	2007	2008	2009			
England	B Heart	106	121	115	101	106	99	0.72	137	(110–164)
	B QEH	197	199	187	225	268	253	1.62	156	(137–175)
	Basldn	46	32	45	39	40	29	0.41	71	(45–97)
	Bradfd	61	67	50	88	63	54	0.58	93	(68–118)
	Brightn	119	112	130	119	121	125	1.20	105	(86–123)
	Bristol	164	175	176	157	176	157	1.57	100	(84–116)
	Camb	107	111	155	127	113	138	1.27	109	(91–127)
	Carlis	29	31	27	26	30	24	0.31	76	(46–107)
	Carsh	173	183	186	196	216	207	1.92	108	(93–123)
	Chelms	50	40	49	52	34	39	0.47	84	(57–110)
	Colchr*	n/a	n/a	n/a	n/a	60	15	*	*	*
	Covnt	80	85	105	112	115	119	0.87	137	(112–161)
	Derby	67	72	69	63	92	78	0.65	120	(94–147)
	Donc	n/a	n/a	n/a	18	26	41	*	*	*
	Dorset	61	49	53	64	85	79	0.73	109	(85–133)
	Dudley	54	38	45	39	47	66	0.42	159	(121–197)
	Exeter	109	111	106	125	135	140	1.03	136	(114–159)
	Glouc	54	61	72	58	47	79	0.58	137	(107–168)
	Hull	108	127	105	99	113	102	0.99	103	(83–123)
	Ipswi*	46	59	42	41	38	38	0.56	68*	(46–89)
	Kent				175	140	128	1.16	110	(91–129)
	L Barts	186	185	189	214	206	234	1.68	139	(121–157)
	L Guys	122	146	153	165	166	179	1.15	155	(132–178)
	L Kings	114	134	112	125	151	127	0.97	131	(108–154)
	L Rfree		132	194	184	173	156	1.50	104	(87–120)
	L St.G				96	100	108	0.59	184	(150–219)
	L West	286	308	314	279	318	359	2.23	161	(145–178)
	Leeds	185	171	180	129	161	156	1.65	95	(80–110)
	Leic	163	226	243	245	242	222	2.32	96	(83–108)
	Liv Ain	n/a	29	35	36	42	36	0.29	124	(84–165)
	Liv RI	128	138	141	112	102	114	1.20	95	(78–113)
	M Hope	112	112	131	121	141	118	1.42	83	(68–98)

Table 1.3. Number of new patients accepted by individual renal centres reporting to the UK Renal Registry 2004–2009

Country	Centre	Year						Catchment population (millions)	2009 rate pmp	(95% CI)
		2004	2005	2006	2007	2008	2009			
England	M RI				161	134	150	1.47	102	(86–118)
	Middlbr	101	84	109	99	93	95	1.01	94	(75–113)
	Newc	107	112	106	106	98	100	1.11	90	(73–108)
	Norwch	94	118	112	111	89	51	0.79	64	(47–82)
	Nottm	107	145	137	129	116	124	1.14	109	(90–128)
	Oxford	170	154	160	144	148	171	1.68	102	(87–117)
	Plymth	63	60	93	76	69	60	0.48	126	(94–158)
	Ports	119	149	175	157	170	151	2.00	75	(63–87)
	Prestn	85	124	122	132	113	147	1.51	97	(82–113)
	Redng	67	89	86	95	105	98	0.80	122	(98–146)
	Sheff	167	158	168	166	180	142	1.49	95	(80–111)
	Shrew	55	42	54	58	61	47	0.39	120	(86–154)
	Stevng	84	92	122	89	103	97	1.09	89	(71–107)
	Sthend	41	34	50	35	36	23	0.32	73	(43–103)
	Stoke				87	82	109	0.90	122	(99–144)
	Sund	52	59	58	62	45	64	0.59	109	(82–135)
	Truro	68	32	52	45	40	51	0.41	124	(90–158)
	Wirral	67	60	52	53	42	62	0.52	119	(89–149)
	Wolve	105	95	85	68	88	66	0.61	109	(83–135)
	York	50	45	48	38	37	46	0.51	91	(65–117)
N Ireland	Antrim		42	33	37	40	22	0.30	73	(43–104)
	Belfast		130	119	89	69	62	0.55	112	(84–140)
	Derry			3	8	6	19	0.18	108	(59–156)
	Newry		28	13	15	21	21	0.28	74	(42–106)
	Tyrone		24	29	22	25	20	0.18	113	(64–163)
	Ulster		9	8	16	14	14	0.30	47	(22–71)
Scotland	Abrdn	69	62	53	56	56	53			
	Airdrie	51	39	55	50	39	47			
	D & Gall	16	21	21	17	19	17			
	Dundee	62	75	51	62	64	69			
	Dunfn	29	44	37	37	30	28			
	Edinb	97	99	106	95	103	94			
	Glasgw	186	200	187	189	159	177			
	Inverns	33	44	27	26	25	19			
	Klmarnk	29	44	57	36	34	36			
Wales	Bangor	36	40	42	36	41	30	0.25	120	(77–163)
	Cardff	183	184	206	222	152	180	1.45	124	(106–142)
	Clwyd	13	26	18	22	15	17	0.20	85	(45–125)
	Swanse	95	100	116	126	124	113	0.80	141	(115–167)
	Wrexm	29	42	26	27	21	19	0.30	63	(35–92)
England		**4,532**	**4,907**	**5,199**	**5,541**	**5,717**	**5,673**			
N Ireland			**233**	**205**	**187**	**175**	**158**			
Scotland		**572**	**628**	**594**	**568**	**529**	**540**			
Wales		**356**	**391**	**407**	**433**	**352**	**359**			
UK		**5,460**	**6,159**	**6,405**	**6,729**	**6,773**	**6,730**			
Including only centres reporting continuously 2004–2009								**% change since 2004**		
England		**4,532**	**4,774**	**5,004**	**4,820**	**5,001**	**4,966**	**9.6**		
Scotland		**572**	**628**	**594**	**568**	**529**	**540**	**−5.6**		
Wales		**356**	**392**	**408**	**433**	**353**	**359**	**0.8**		
UK		**5,460**	**5,794**	**6,006**	**5,821**	**5,883**	**5,865**	**7.4**		

Blank cells–no data returned to the registry for that year
n/a – renal centre not yet operational
* Colchester and Doncaster were still expanding and so catchment populations could not be calculated

2 Demographics and clinical characteristics of patients accepted onto RRT

Methods

Age, gender, primary renal disease, ethnic origin and modality were examined for patients starting RRT.

Some centres electronically upload ethnicity coding to their renal information technology (IT) system from the hospital Patient Administration Systems (PAS). Ethnicity coding in these PAS systems is based on self-reported ethnicity and uses a different coding system [2]. For the remaining centres, ethnicity coding is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks, Chinese and Others. The details of regrouping of the PAS codes into the above ethnic categories are provided in appendix H: ethnicity and ERA-EDTA coding (www.renalreg.com/Report-Area/Report2010/appendix-H.pdf). Chi-squared, Fisher's exact, ANOVA and Kruskal Wallis tests were used as appropriate to test for significant differences between groups.

Estimated glomerular filtration rate (eGFR) at the start of RRT was studied amongst patients with eGFR data within 14 days before the start of RRT. The eGFR was calculated using the abbreviated 4 variable MDRD study equation [3]. For the purpose of the eGFR calculation, patients who had missing ethnicity but a valid serum creatinine measurement were classed as Whites. The eGFR values were log transformed in order to normalise the data. Patients with an eGFR >20ml/min/1.73 m^2 were excluded from the eGFR analyses due to concerns about possible data extraction errors.

Results

Age

Incidence rates within the UK have levelled off in the last three years. (figure 1.3).

Figure 1.4 shows RRT incidence rates for 2009 by age band. For men, the peak is in the 80–84 age band, for women 75–79, and overall 75–79 (the high male peak at 80–84 does not shift the overall figure as there are relatively few people in this age band).

In 2009, the median age of patients starting renal replacement therapy was 64.8 years (table 1.4) and this has changed little over the last six years (data not shown). The median age of patients starting in England was lower than that of the other three countries of the United Kingdom possibly reflecting the larger ethnic minority population in England. The median age of incident UK non-White patients was considerably lower at 57.1 years. This reflects the younger age distribution of ethnic minority populations in general compared with the White population (5.1% of ethnic minorities were over 65 years old compared to 16.9% of whites) [4] and the higher rates of diabetes in South Asian and Black populations.

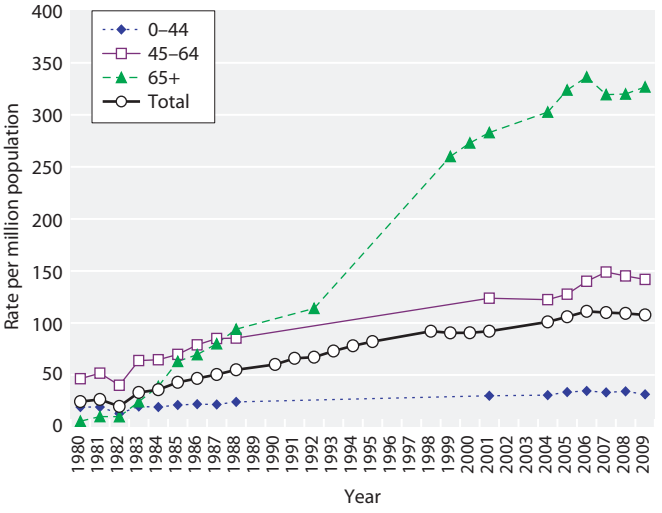

Fig. 1.3. UK incident RRT rates between 1980 and 2009

Figure 1.5 shows that the 55–64 age band contained the most patients starting on peritoneal dialysis whereas the 65–74 age band contained the most patients starting on haemodialysis.

There were large differences between centres in the median age of incident patients (figure 1.6). In part this reflects differences in the age and ethnic structure of the catchment populations and chance fluctuations, particularly in small centres. The median age of patients treated at transplant centres was 63.0 years (IQR 49.0, 74.2) and at non-transplanting centres 66.3 years (IQR 52.6, 75.9) ($p < 0.0001$).

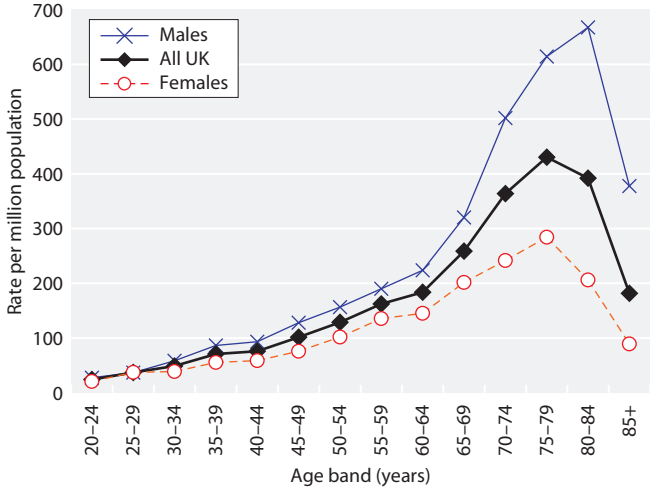

Fig. 1.4. Incidence rates by age and gender in 2009

Table 1.4. Median age of patients starting renal replacement therapy in 2009 by country

Country	Lower quartile	Median	Upper quartile
England	50.5	64.3	74.8
N Ireland	49.7	68.3	75.4
Scotland	51.5	65.5	74.9
Wales	54.8	68.6	77.0
UK	**50.8**	**64.8**	**75.1**

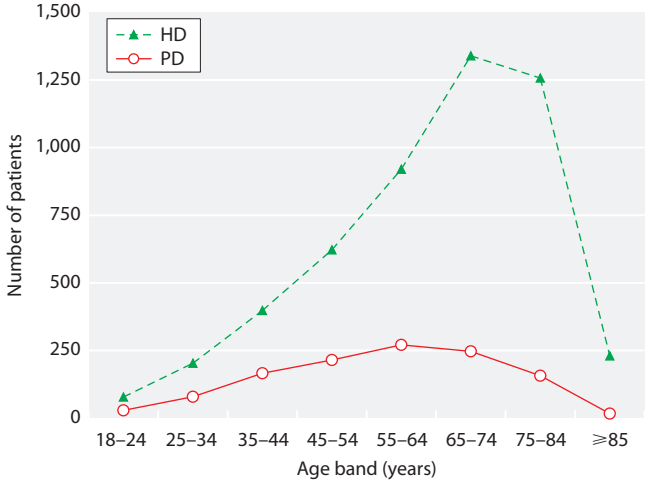

Fig. 1.5. Number of incident patients in 2009, by age band and initial dialysis modality

Gender

As in previous years, more men than women started RRT in all age groups and this became more prominent with older age (figures 1.4 and 1.7).

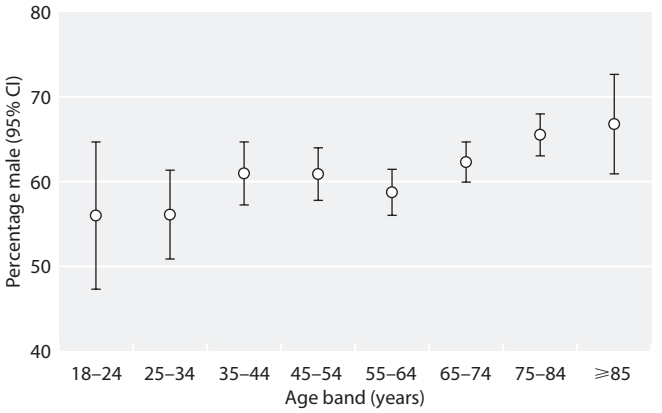

Fig. 1.7. Percentage of total patients starting RRT who are male, by age band in 2009

In the UK as a whole, 61.7% of the 2009 incident cohort were male.

Ethnicity

This year, 51 centres returned ethnicity data that were 50% or more complete (table 1.5). Only 27 of these centres provided ethnicity data for 90% or more of their incident patients. Ethnicity is not a mandatory data item for the Scottish Renal Registry and Scotland has not been included in the table. The low completeness for some centres means results should be interpreted with caution. There was great variation between centres with respect to the ethnic mix of incident patients ranging from 0% ethnic minorities in Dorset, Wirral, Carlisle, Southend, Tyrone, Ulster, Derry and Wrexham to over 50% in London Barts and London Royal Free.

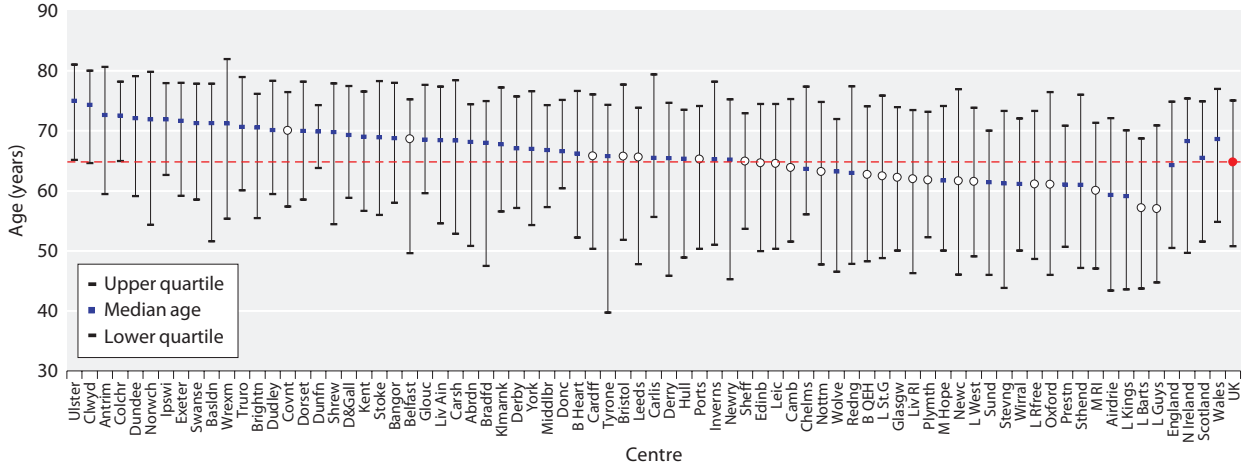

Fig. 1.6. Median age of new patients in each centre in 2009
A white point indicates a transplant centre

Table 1.5. Percentage of incident patients (2009) in different ethnic groups by centre

Country	Centre	% completion	N with data	Percentage in each ethnic group				
				White	Black	South Asian	Chinese	Other
England	Dorset	100.0	70	100.0				
	Newc	100.0	100	94.0	2.0	1.0		3.0
	Nottm	100.0	124	90.3	4.0	4.0		1.6
	M Hope	100.0	118	86.4	0.8	11.0		1.7
	Stevng	100.0	97	74.2	12.4	12.4		1.0
	Redng	100.0	98	70.4	6.1	22.4		1.0
	B Heart	99.0	98	74.5	7.1	18.4		
	B QEH	98.8	250	66.0	10.0	20.4		3.6
	Wolve	98.5	65	73.8	6.2	20.0		
	Sund	98.4	63	95.2	1.6	3.2		
	Wirral	98.4	61	100.0				
	Oxford	97.1	166	81.3	4.8	9.0	2.4	2.4
	L Barts	97.0	227	37.0	25.6	28.2	2.6	6.6
	Bristol	96.8	152	87.5	3.3	3.9	2.0	3.3
	Basldn	96.2	25	92.0	8.0			
	L Kings	96.1	122	58.2	31.1	8.2		2.5
	Carlis	95.8	23	100.0				
	Exeter	95.7	134	99.3	0.7			
	Camb	95.7	132	95.5	1.5	0.8	0.8	1.5
	Leic	95.0	211	74.9	4.7	18.5	0.9	0.9
	Donc	95.0	38	94.7		5.3		
	Leeds	94.9	148	83.8	4.7	10.8		0.7
	M RI	94.7	142	83.1	6.3	10.6		
	Shrew	93.6	44	97.7	2.3			
	York	93.5	43	97.7		2.3		
	Dudley	92.4	61	86.9	1.6	11.5		
	Bradfd	90.7	49	75.5	2.0	22.4		
	Covnt	89.9	107	81.3	5.6	13.1		
	L Rfree	89.7	140	49.3	17.1	21.4		12.1
	Middlbr	89.5	85	97.6		2.4		
	Kent	88.3	113	92.0	0.9	3.5	1.8	1.8
	Ports	86.8	131	91.6	2.3	2.3	0.8	3.1
	Carsh	85.0	176	80.1	6.3	8.5	2.8	2.3
	Derby	84.6	66	87.9	9.1	3.0		
	L St.G	83.3	90	61.1	22.2	8.9	1.1	6.7
	Sthend	82.6	19	100.0				
	Chelms	76.3	29	86.2	3.4		3.4	6.9
	Prestn	75.5	111	91.9	0.9	6.3		0.9
	L Guys	62.0	111	57.7	42.3			
	Liv RI	58.8	67	85.1	6.0	1.5	7.5	
	Brightn	58.3	28	96.4	3.6			
	Norwch	54.2	26	96.2	3.8			
	Sheff	52.1	74	91.9	2.7	5.4		
N Ireland	Tyrone	100.0	19	100.0				
	Ulster	100.0	13	100.0				
	Newry	100.0	20	95.0				5.0
	Antrim	100.0	19	94.7		5.3		
	Derry	93.8	15	100.0				
	Belfast	75.5	40	97.5				2.5
Wales	Wrexm	100.0	19	100.0				
	Swanse	100.0	113	98.2		1.8		
England		**77.6**	**4,331**	**79.8**	**7.8**	**9.6**	**0.8**	**2.0**
N Ireland		**90.0**	**126**	**97.6**		**0.8**		**1.6**
Wales		**63.0**	**226**	**94.2**	**0.9**	**4.0**	**0.9**	
UK		**70.8**	**4,685**	**80.9**	**7.3**	**9.1**	**0.7**	**1.9**

Centres with less than 50% data completeness are not shown, but are included national averages

Primary renal diagnosis

The distribution of primary renal disease (PRD) by centre is shown in table 1.6. Data for PRD were missing in 9.9% of patients and there remained a marked difference between centres in completeness of data returns. Thirty centres provided data on all incident patients, whilst seven centres had more than 25% data missing for PRD. For the centres with >25% missing data, the percentages in the other diagnostic categories have not been shown in table 1.6.

The Registry continues to be concerned about centres with apparently very high data completeness for PRD but also very high rates of 'uncertain' diagnoses (EDTA codes 00 and 10). It is accepted that there will inevitably be a number of patients with uncertain aetiology and that the proportion of these patients will vary between clinicians and centres as the definitions of renovascular disease, hypertensive nephropathy and chronic glomerulonephritis without tissue diagnosis remain relatively subjective. The situation has improved from last year when diagnosis data for five centres was not used. This year data was not used from two centres which had diagnosis 'unknown' for over 50% of their incident patients with non-missing data. As the numbers with the specific PRDs are likely to be falsely low in these centres, the breakdown into these categories has not been shown in table 1.6. These centres have also been excluded from the other analyses where PRD is used to stratify analyses. A third centre had just over 50% with diagnosis 'unknown' but as this was a smaller centre it was possible that this was a chance finding and that centre has been kept in the analyses.

For the non-excluded centres, the overall UK percentage with uncertain aetiology (20.7%) is the same as for 2008 incident patients and again, there is great variation between centres. Some of this variation is likely to reflect the lack of a clear definition of certain diagnostic categories e.g. hypertensive renal disease and renal vascular disease; some may result from differences between

Table 1.6. Percentage distribution of primary renal diagnosis by centre in the 2009 incident cohort

Country	Centre	Data not available	N with data	Uncertain aetiology*	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
England	B Heart	1.0	98	33.7	29.6	8.2	2.0	15.3	4.1	5.1	2.0
	B QEH	7.1	235	12.3	26.8	14.9	9.8	16.2	6.8	6.4	6.8
	Basldn	3.9	25	16.0	16.0	16.0	0.0	16.0	4.0	12.0	20.0
	Bradfd	1.9	53	13.2	22.6	17.0	15.1	13.2	3.8	3.8	11.3
	Brightn	4.2	46	41.3	19.6	10.9	2.2	10.9	4.4	4.4	6.5
	Bristol	11.5	139	24.5	18.7	15.1	6.5	20.9	6.5	6.5	1.4
	Camb	0.7	137	52.6							
	Carlis	0.0	24	8.3	20.8	8.3	4.2	20.8	12.5	0.0	25.0
	Carsh	4.8	197	33.0	13.2	7.6	8.6	16.8	6.1	6.6	8.1
	Chelms	2.6	37	35.1	16.2	8.1	2.7	16.2	8.1	5.4	8.1
	Colchr	93.3	1								
	Covnt	7.6	110	16.4	25.5	9.1	10.9	11.8	4.6	9.1	12.7
	Derby	0.0	78	18.0	29.5	11.5	3.9	24.4	2.6	5.1	5.1
	Donc	0.0	40	35.0	20.0	5.0	10.0	12.5	5.0	5.0	7.5
	Dorset	0.0	70	15.7	24.3	12.9	7.1	7.1	11.4	12.9	8.6
	Dudley	0.0	66	33.3	21.2	4.6	7.6	19.7	6.1	4.6	3.0
	Exeter	52.9	66								
	Glouc	1.3	78	30.8	9.0	15.4	2.6	19.2	6.4	10.3	6.4
	Hull	31.4	70								
	Ipswi	2.6	37	40.5	21.6	10.8	0.0	8.1	16.2	2.7	0.0
	Kent	0.8	127	25.2	21.3	12.6	3.9	12.6	3.9	12.6	7.9
	L Barts	3.4	226	16.8	31.9	11.5	14.2	12.4	5.3	6.2	1.8
	L Guys	1.1	177	9.0	26.0	18.6	11.9	18.6	4.0	8.5	3.4
	L Kings	0.0	127	11.0	36.2	10.2	15.8	13.4	5.5	5.5	2.4
	L Rfree	99.4	1								
	L St.G	20.4	86	14.0	30.2	15.1	8.1	16.3	9.3	2.3	4.7
	L West	0.0	359	17.0	39.8	11.4	3.9	13.9	5.3	4.7	3.9
	Leeds	16.0	131	21.4	20.6	12.2	9.2	19.1	3.8	6.9	6.9

Table 1.6. Continued

Country	Centre	Data not available	N with data	Uncertain aetiology*	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
England	Leic	12.2	195	26.2	21.0	9.7	4.6	9.7	10.8	12.3	5.6
	Liv Ain	8.3	33	51.5	27.3	3.0	3.0	9.1	0.0	3.0	3.0
	Liv RI	0.0	114	54.4							
	M Hope	5.9	111	27.9	33.3	11.7	2.7	5.4	6.3	9.9	2.7
	M RI	12.7	131	17.6	22.9	6.1	10.7	23.7	9.9	6.1	3.1
	Middlbr	10.5	85	25.9	22.4	12.9	7.1	21.2	5.9	1.2	3.5
	Newc	9.0	91	17.6	19.8	11.0	5.5	20.9	7.7	12.1	5.5
	Norwch	0.0	48	25.0	18.8	12.5	6.3	14.6	4.2	6.3	12.5
	Nottm	0.0	124	19.4	18.6	8.1	5.7	27.4	10.5	6.5	4.0
	Oxford	5.9	161	23.0	21.1	13.0	3.7	16.8	5.6	11.2	5.6
	Plymth	8.3	55	10.9	30.9	16.4	1.8	12.7	12.7	10.9	3.6
	Ports	0.7	150	17.3	24.7	6.0	14.7	19.3	8.0	8.0	2.0
	Prestn	6.1	138	11.6	27.5	17.4	12.3	13.0	5.1	8.7	4.4
	Redng	1.0	97	15.5	30.9	14.4	3.1	20.6	6.2	4.1	5.2
	Sheff	2.1	139	25.9	19.4	8.6	5.8	13.7	11.5	10.1	5.0
	Shrew	4.3	45	28.9	22.2	2.2	6.7	17.8	13.3	4.4	4.4
	Stevng	0.0	97	28.9	29.9	12.4	3.1	9.3	5.2	8.3	3.1
	Sthend	0.0	23	21.7	26.1	13.0	4.4	8.7	0.0	13.0	13.0
	Stoke	0.9	108	8.3	19.4	16.7	14.8	14.8	5.6	9.3	11.1
	Sund	0.0	64	9.4	26.6	10.9	17.2	14.1	12.5	0.0	9.4
	Truro	54.9	23								
	Wirral	82.3	11								
	Wolve	1.5	65	20.0	27.7	13.9	6.2	16.9	1.5	6.2	7.7
	York	28.3	33								
N Ireland	Antrim	0.0	19	42.1	21.1	15.8	0.0	10.5	0.0	0.0	10.5
	Belfast	0.0	53	18.9	24.5	9.4	7.6	13.2	5.7	9.4	11.3
	Derry	0.0	16	12.5	12.5	6.3	12.5	18.8	12.5	12.5	12.5
	Newry	0.0	20	30.0	30.0	0.0	5.0	20.0	10.0	0.0	5.0
	Tyrone	0.0	19	5.3	36.8	5.3	5.3	21.1	15.8	10.5	0.0
	Ulster	0.0	13	0.0	30.8	23.1	7.7	0.0	0.0	15.4	23.1
Scotland	Abrdn	1.9	52	3.9	25.0	17.3	3.9	25.0	3.9	19.2	1.9
	Airdrie	0.0	47	19.2	21.3	19.2	0.0	19.2	8.5	8.5	4.3
	D&Gall	0.0	17	11.8	35.3	5.9	23.5	5.9	5.9	5.9	5.9
	Dundee	0.0	69	13.0	23.2	11.6	8.7	10.1	8.7	13.0	11.6
	Dunfn	0.0	28	21.4	32.1	10.7	0.0	7.1	3.6	10.7	14.3
	Edinb	0.0	94	19.2	21.3	10.6	5.3	19.2	8.5	5.3	10.6
	Glasgw	2.3	173	19.7	27.2	10.4	0.6	17.9	9.3	5.8	9.3
	Inverns	0.0	19	26.3	15.8	15.8	5.3	26.3	0.0	10.5	0.0
	Klmarnk	0.0	36	19.4	22.2	11.1	16.7	11.1	5.6	5.6	8.3
Wales	Bangor	0.0	30	36.7	23.3	0.0	6.7	13.3	3.3	6.7	10.0
	Clwyd	0.0	17	35.3	23.5	5.9	5.9	11.8	0.0	11.8	5.9
	Cardff	17.2	149	31.5	30.9	12.8	2.7	8.7	7.4	4.7	1.3
	Swanse	0.0	113	16.8	21.2	6.2	0.9	16.8	8.9	9.7	19.5
	Wrexm	0.0	19	21.1	21.1	10.5	0.0	21.1	0.0	10.5	15.8
England		**11.2**	**4,982**	**20.7**	**25.3**	**11.7**	**7.5**	**15.6**	**6.6**	**7.2**	**5.5**
N Ireland		**0.0**	**140**	**19.3**	**25.7**	**9.3**	**6.4**	**14.3**	**7.1**	**7.9**	**10.0**
Scotland		**0.9**	**535**	**17.2**	**24.7**	**12.2**	**4.7**	**16.8**	**7.5**	**8.6**	**8.4**
Wales		**8.6**	**328**	**26.5**	**25.9**	**8.8**	**2.4**	**12.8**	**6.7**	**7.3**	**9.5**
UK		**9.9**	**5,985**	**20.7**	**25.3**	**11.5**	**6.9**	**15.5**	**6.7**	**7.3**	**6.1**

* includes presumed glomerulonephritis not biopsy proven
The percentage in each category has been calculated after excluding those patients with data not available
For those centres with >25% missing primary diagnoses, the percentages in the other diagnostic categories have not been calculated
For those centres judged to have high % uncertain aetiology, the percentages in the other diagnostic categories have not been calculated and the centres have not been included in the country and UK averages

Table 1.7. Percentage distribution of primary renal diagnosis by age, plus gender ratio, in the 2009 incident cohort

Diagnosis	Age <65	Age ⩾65	All patients	M:F
Diabetes	27.3	23.2	25.3	1.5
Glomerulonephritis	16.0	6.9	11.5	2.2
Pyelonephritis	7.1	7.6	7.3	1.4
Hypertension	6.0	7.9	6.9	2.0
Polycystic kidney	10.2	3.1	6.7	0.8
Renal vascular disease	2.0	10.4	6.1	2.0
Other	16.5	14.4	15.5	1.4
Uncertain aetiology*	15.0	26.6	20.7	1.8

* includes presumed glomerulonepritis not biopsy proven
Percentages are of all patients with data for PRD, however 9.5% of under 65 year olds and 10.4% of over 65 year olds had no data for PRD and are therefore not included in this table

centres in attitudes to the degree of certainty required to record other diagnoses.

There were no missing data for Northern Ireland and only 0.9% for Scotland, whilst England and Wales had 11.2% and 8.6% respectively. This was a change from last year when Scotland had 13.5% missing data and Wales had 1.5%. The overall percentage missing is down from 10.8 for 2008 incident patients to 9.9% for 2009.

The overall distribution of PRDs is shown in table 1.7. Diabetic nephropathy was the most common specific renal diagnosis in both the under and over 65 year age groups, accounting for 25% of all (non-missing) incident diagnoses. Biopsy proven glomerulonephritis and autosomal dominant polycystic kidney disease (ADPKD) made up higher proportions of the younger than the older incident cohorts (16% vs. 7% and 10% vs. 3% repectively), whilst renal vascular disease was much more common in older incident patients (10% vs. 2%). It was perhaps not surprising that uncertainty about the underlying diagnosis was also more common in the older cohort (27% vs. 15%). The proportion of each major diagnosis has changed little in the last few years.

For all primary renal diagnoses except ADPKD, the male to female ratio was 1.4 or greater. This gender difference may relate to factors such as hypertension, atheroma and renal vascular disease, which are more common in males and more common with increasing age. These factors may influence the rate of progression of renal failure.

Table 1.8 shows the incidence rates for each PRD per million population in the 2009 cohort by country. As there are some missing data, the rates for each diagnosis will be underestimates.

First established treatment modality

The first treatment recorded, irrespective of any later change, was haemodialysis (HD) in 76.3% of patients, peritoneal dialysis (PD) in 17.9% and pre-emptive

Table 1.8. Primary renal diagnosis incidence rates per million population (unadjusted) 2009

Diagnosis	England	N Ireland	Scotland	Wales	UK
Diabetes	24.2	20.1	25.4	28.3	24.4
Glomerulonephritis	11.2	7.3	12.5	9.7	11.1
Pyelonephritis	6.9	6.1	8.9	8.0	7.1
Hypertension	7.2	5.0	4.8	2.7	6.7
Polycystic kidney	6.3	5.6	7.7	7.3	6.4
Renal vascular disease	5.3	7.8	8.7	10.3	5.9
Other	14.9	11.2	17.3	14.0	15.0
Uncertain aetiology*	19.9	15.1	17.7	29.0	20.0
Data not available	12.1	0.0	1.0	10.3	10.7
All	**108****	**78****	**104**	**120**	**107**

* includes presumed glomerulonephritis not biopsy proven
** as mentioned earlier there are 35 patients who were only included in tables 1.1 and 1.3. As a result the rates here are slightly too low for England and markedly too low for N Ireland

transplant in 5.9%. The proportion with HD as the first treatment modality has remained relatively stable over the last few years, though it has increased considerably since the late 1990s (58% of incident patients in 1998). The frequency of PD usage has fallen whilst pre-emptive transplantation has risen. This may be as a consequence of national initiatives to encourage live donation and pre-emptive transplantation thus improving pre-emptive transplant rates in the same group of younger, less comorbid patients approaching ERF who traditionally started on PD.

Many patients, especially those presenting late, undergo a brief period of HD before switches to other modalities are, or can be, considered. Hence, the established modality at 90 days is more representative of the elective first modality. By 90 days, 6.3% of the 2009 incident patients had died and a further 0.2% had stopped treatment, leaving 93.5% of the original cohort on RRT. Table 1.9 shows the percentages on each treatment at 90 days both as percentages of all of those starting and then of those still on treatment at 90 days. For this analysis, the incident cohort from 1/10/2008 to 31/09/2009 was used so that follow up to 90 days was available for all patients. Expressed as a percentage of the whole incident cohort, 69.1% were on HD at 90 days, 17.7% were on PD and 6.7% had received a transplant. Expressed as a percentage of those still receiving RRT at 90 days, 73.9% were on HD, 18.9% on PD and 7.2% had received a transplant. Figure 1.8 shows these percentages with the HD patients further subdivided. Of those still on RRT at 90 days, only 0.7% were receiving home haemodialysis, with the vast majority of HD patients on centre-based treatment either in main hospital centres (47.4% of total) or satellite units (25.8%). Although Northern Ireland continued to have a lower percentage of all patients on PD at 90 days compared with other parts of the UK, the percentages in the 3 other countries have all continued to fall, most dramatically in Wales (24.6% in 2007 to 20.9% in 2008 to 15.9% in 2009) and Scotland (21.3% to 18.1% to 13.5%). This comes at a time when the Department of Health is trying to increase the proportion of patients on home therapies.

Table 1.9. RRT modality at 90 days by centre (incident cohort 1/10/2008 to 31/09/2009)

			Percentage of patients who started RRT					Percentage of patients still on RRT at 90 days		
Country	Centre	N	HD	PD	Tx	Stopped treatment	Died	HD	PD	Tx
England	B Heart	96	79.2	12.5	3.1	0.0	5.2	83.5	13.2	3.3
	B QEH	260	71.9	17.3	7.3	0.0	3.5	74.5	17.9	7.6
	Basldn	33	72.7	12.1	3.0	6.1	6.1	82.8	13.8	3.5
	Bradfd	58	65.5	24.1	0.0	0.0	10.3	73.1	26.9	0.0
	Brightn*	85	54.1	31.8	8.2	0.0	5.9	57.5	33.8	8.8
	Bristol	158	65.8	17.1	7.6	0.0	9.5	72.7	18.9	8.4
	Camb	144	75.0	6.3	13.9	0.0	4.9	78.8	6.6	14.6
	Carlis	21	76.2	19.1	4.8	0.0	0.0	76.2	19.1	4.8
	Carsh	213	73.7	16.0	1.4	0.0	8.9	80.9	17.5	1.6
	Chelms	35	65.7	31.4	0.0	2.9	0.0	67.7	32.4	0.0
	Colchr	29	89.7	3.5	0.0	0.0	6.9	96.3	3.7	0.0
	Covnt	124	63.7	25.0	4.8	0.0	6.5	68.1	26.7	5.2
	Derby	75	64.0	30.7	0.0	0.0	5.3	67.6	32.4	0.0
	Donc	35	65.7	20.0	0.0	0.0	14.3	76.7	23.3	0.0
	Dorset	85	65.9	18.8	5.9	0.0	9.4	72.7	20.8	6.5
	Dudley	65	60.0	24.6	0.0	0.0	15.4	70.9	29.1	0.0
	Exeter	136	72.1	16.9	2.2	0.0	8.8	79.0	18.6	2.4
	Glouc	79	72.2	20.3	1.3	0.0	6.3	77.0	21.6	1.4
	Hull	100	75.0	14.0	2.0	0.0	9.0	82.4	15.4	2.2
	Ipswi	39	71.8	23.1	5.1	0.0	0.0	71.8	23.1	5.1
	Kent	138	66.7	16.7	8.7	1.5	6.5	72.4	18.1	9.5
	L Barts	227	66.5	26.4	5.3	0.0	1.8	67.7	26.9	5.4
	L Guys	163	69.3	6.8	20.9	0.0	3.1	71.5	7.0	21.5
	L Kings	134	75.4	15.7	5.2	0.0	3.7	78.3	16.3	5.4
	L Rfree	167	74.3	10.2	12.6	0.0	3.0	76.5	10.5	13.0
	L St.G	118	63.6	19.5	12.7	0.0	4.2	66.4	20.4	13.3

Table 1.9. Continued

Country	Centre	N	Percentage of patients who started RRT					Percentage of patients still on RRT at 90 days		
			HD	PD	Tx	Stopped treatment	Died	HD	PD	Tx
England	L West	344	79.4	3.2	12.2	0.0	5.2	83.7	3.4	12.9
	Leeds	158	62.0	21.5	7.6	0.0	8.9	68.1	23.6	8.3
	Leic	230	66.5	16.1	11.7	0.0	5.7	70.5	17.1	12.4
	Liv Ain	45	68.9	11.1	0.0	0.0	20.0	86.1	13.9	0.0
	Liv RI	120	68.3	22.5	7.5	0.0	1.7	69.5	22.9	7.6
	M Hope	143	63.6	30.1	2.1	0.0	4.2	66.4	31.4	2.2
	M RI	148	58.8	23.7	16.9	0.0	0.7	59.2	23.8	17.0
	Middlbr	88	73.9	10.2	9.1	0.0	6.8	79.3	11.0	9.8
	Newc	102	59.8	19.6	12.8	1.0	6.9	64.9	21.3	13.8
	Norwch	48	68.8	29.2	2.1	0.0	0.0	68.8	29.2	2.1
	Nottm	134	63.4	24.6	5.2	0.0	6.7	68.0	26.4	5.6
	Oxford	159	49.7	27.0	12.0	0.0	11.3	56.0	30.5	13.5
	Plymth	60	51.7	28.3	15.0	0.0	5.0	54.4	29.8	15.8
	Ports	155	60.7	26.5	7.1	0.0	5.8	64.4	28.1	7.5
	Prestn	138	71.7	18.1	4.4	0.0	5.8	76.2	19.2	4.6
	Redng	103	53.4	30.1	5.8	0.0	10.7	59.8	33.7	6.5
	Sheff	148	71.6	17.6	5.4	0.7	4.7	75.7	18.6	5.7
	Shrew	51	74.5	19.6	3.9	0.0	2.0	76.0	20.0	4.0
	Stevng	90	75.6	8.9	11.1	0.0	4.4	79.1	9.3	11.6
	Sthend	29	62.1	31.0	3.5	0.0	3.5	64.3	32.1	3.6
	Stoke	116	72.4	14.7	6.9	0.0	6.0	77.1	15.6	7.3
	Sund	57	71.9	21.1	1.8	0.0	5.3	75.9	22.2	1.9
	Truro	41	73.2	17.1	2.4	0.0	7.3	79.0	18.4	2.6
	Wirral	56	66.1	21.4	1.8	3.6	7.1	74.0	24.0	2.0
	Wolve	77	76.6	19.5	0.0	0.0	3.9	79.7	20.3	0.0
	York	45	64.4	17.8	0.0	0.0	17.8	78.4	21.6	0.0
N Ireland	Antrim	24	83.3	8.3	0.0	4.2	4.2	90.9	9.1	0.0
	Belfast	65	76.9	15.4	4.6	0.0	3.1	79.4	15.9	4.8
	Derry	14	92.9	7.1	0.0	0.0	0.0	92.9	7.1	0.0
	Newry	21	81.0	9.5	0.0	4.8	4.8	89.5	10.5	0.0
	Tyrone	21	71.4	23.8	0.0	0.0	4.8	75.0	25.0	0.0
	Ulster	10	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Scotland	Abrdn	54	72.2	20.4	0.0	0.0	7.4	78.0	22.0	0.0
	Airdrie	36	75.0	13.9	0.0	0.0	11.1	84.4	15.6	0.0
	D & Gall	21	85.7	4.8	4.8	0.0	4.8	90.0	5.0	5.0
	Dundee	67	76.1	6.0	1.5	0.0	16.4	91.1	7.1	1.8
	Dunfn	23	69.6	13.0	0.0	0.0	17.4	84.2	15.8	0.0
	Edinb	102	59.8	21.6	7.8	0.0	10.8	67.0	24.2	8.8
	Glasgw	178	77.0	9.0	3.9	0.0	10.1	85.6	10.0	4.4
	Inverns	16	75.0	12.5	0.0	0.0	12.5	85.7	14.3	0.0
	Klmarnk	30	73.3	23.3	0.0	0.0	3.3	75.9	24.1	0.0
Wales	Bangor	34	61.8	23.5	0.0	2.9	11.8	72.4	27.6	0.0
	Cardff	176	72.7	15.3	8.0	0.0	4.0	75.7	16.0	8.3
	Clwyd	20	90.0	5.0	0.0	0.0	5.0	94.7	5.3	0.0
	Swanse	115	75.7	14.8	1.7	0.0	7.8	82.1	16.0	1.9
	Wrexm	20	65.0	25.0	5.0	0.0	5.0	68.4	26.3	5.3
England		**5,703**	**68.2**	**18.4**	**7.3**	**0.2**	**5.9**	**72.7**	**19.6**	**7.8**
N Ireland		**155**	**80.7**	**12.9**	**1.9**	**1.3**	**3.2**	**84.5**	**13.5**	**2.0**
Scotland		**527**	**72.7**	**13.5**	**3.2**	**0.0**	**10.6**	**81.3**	**15.1**	**3.6**
Wales		**364**	**73.4**	**15.9**	**4.4**	**0.3**	**6.0**	**78.3**	**17.0**	**4.7**
UK		**6,749**	**69.1**	**17.7**	**6.7**	**0.2**	**6.3**	**73.9**	**18.9**	**7.2**

* For technical reasons, only 9 months of data are included for Brighton

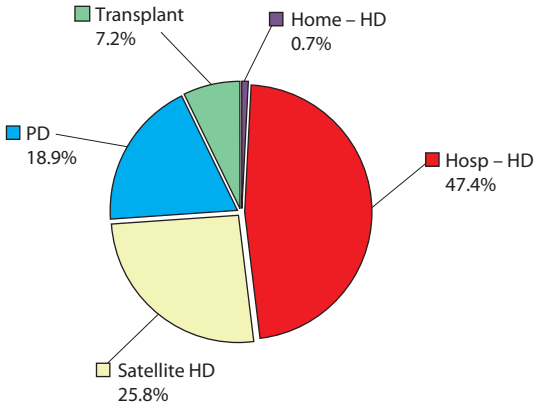

Fig. 1.8. RRT modality at day 90 in the 2009 incident cohort

It is possible that this is in part due to fears about encapsulating peritoneal sclerosis and improvements in haemodialysis provision that is closer to patients' homes.

The percentage of incident patients who had died by 90 days varied considerably between centres (0% to 20%, table 1.9). The definition of whether patients have acute or chronic renal failure may be a factor in this apparent variation.

The proportion with a functioning transplant at 90 days in different centres varied between 0% and 21%. The mean percentage of the incident cohort with a functioning transplant by 90 days was significantly greater in transplanting compared to non-transplanting centres (9.3% vs. 4.2%: $p < 0.0001$). One possible reason could be that some patients transplanted pre-emptively were attributed to the incident cohort of the transplanting centre rather than that of the referring centre (as mentioned earlier). Further information and analyses in this area can be found in chapter 13: Centre Variation in Access to Renal Transplantation in the UK.

Table 1.10 shows the HD/PD split for those incident patients on dialysis at 90 days. It also gives this split by age group. The percentage on PD at 90 days was almost twice as high in patients aged <65 years than in older patients (26.9% vs. 14.2%). The median age on HD was 67.1 years compared with 58.7 years for PD and these medians have been stable for 5 years.

Renal function at the time of starting RRT

Some caution should be applied to the analysis of eGFR at the start of RRT. A review of pre-RRT biochemistry in nine renal centres revealed that up to 18%

Table 1.10. Modality split of patients on dialysis at 90 days after starting RRT (1/10/2008 to 31/09/2009)

		Age <65 (%)		Age ⩾65 (%)		All patients (%)	
Centre	N	HD	PD	HD	PD	HD	PD
Abrdn	50	68.0	32.0	88.0	12.0	78.0	22.0
Airdrie	32	82.4	17.6	86.7	13.3	84.4	15.6
Antrim	22	85.7	14.3	93.3	6.7	90.9	9.1
B Heart	88	82.9	17.1	89.4	10.6	86.4	13.6
B QEH	232	78.1	21.9	83.1	16.9	80.6	19.4
Bangor	29	72.7	27.3	72.2	27.8	72.4	27.6
Basldn	28	88.9	11.1	84.2	15.8	85.7	14.3
Belfast	60	83.3	16.7	83.3	16.7	83.3	16.7
Bradfd	52	69.0	31.0	78.3	21.7	73.1	26.9
Brightn*	73	63.0	37.0	63.0	37.0	63.0	37.0
Bristol	131	65.0	35.0	91.5	8.5	79.4	20.6
Camb	117	85.2	14.8	98.4	1.6	92.3	7.7
Cardff	155	71.4	28.6	91.8	8.2	82.6	17.4
Carlis	20	70.0	30.0	90.0	10.0	80.0	20.0
Carsh	191	71.6	28.4	91.3	8.7	82.2	17.8
Chelms	34	66.7	33.3	68.4	31.6	67.6	32.4
Clwyd	19	100.0	0.0	92.3	7.7	94.7	5.3
Colchr	27	100.0	0.0	95.0	5.0	96.3	3.7
Covnt	110	67.9	32.1	75.4	24.6	71.8	28.2
D & Gall	19	100.0	0.0	91.7	8.3	94.7	5.3
Derby	71	57.1	42.9	74.4	25.6	67.6	32.4
Derry	14	100.0	0.0	85.7	14.3	92.9	7.1
Donc	30	64.3	35.7	87.5	12.5	76.7	23.3
Dorset	72	74.1	25.9	80.0	20.0	77.8	22.2

Table 1.10. Continued

		Age <65 (%)		Age ⩾65 (%)		All patients (%)	
Centre	N	HD	PD	HD	PD	HD	PD
Dudley	55	54.2	45.8	83.9	16.1	70.9	29.1
Dundee	55	84.2	15.8	97.2	2.8	92.7	7.3
Dunfn	19	100.0	0.0	76.9	23.1	84.2	15.8
Edinb	83	76.7	23.3	70.0	30.0	73.5	26.5
Exeter	121	77.8	22.2	82.9	17.1	81.0	19.0
Glasgw	153	85.6	14.4	95.2	4.8	89.5	10.5
Glouc	73	67.7	32.3	85.7	14.3	78.1	21.9
Hull	89	81.6	18.4	87.5	12.5	84.3	15.7
Inverns	14	83.3	16.7	87.5	12.5	85.7	14.3
Ipswi	37	64.3	35.7	82.6	17.4	75.7	24.3
Kent	115	69.6	30.4	87.0	13.0	80.0	20.0
Klmarnk	29	71.4	28.6	80.0	20.0	75.9	24.1
L Barts	211	70.5	29.5	73.2	26.8	71.6	28.4
L Guys	124	87.0	13.0	97.9	2.1	91.1	8.9
L Kings	122	80.0	20.0	86.5	13.5	82.8	17.2
L Rfree	141	85.5	14.5	90.3	9.7	87.9	12.1
L St.G	98	69.2	30.8	84.8	15.2	76.5	23.5
L West	284	94.1	5.9	98.0	2.0	96.1	3.9
Leeds	132	66.2	33.8	82.1	17.9	74.2	25.8
Leic	190	73.4	26.6	87.5	12.5	80.5	19.5
Liv Ain	36	78.9	21.1	94.1	5.9	86.1	13.9
Liv RI	109	65.6	34.4	87.5	12.5	75.2	24.8
M Hope	134	55.1	44.9	85.7	14.3	67.9	32.1
M RI	122	63.6	36.4	80.4	19.6	71.3	28.7
Middlbr	74	81.3	18.8	92.9	7.1	87.8	12.2
Newc	81	65.2	34.8	88.6	11.4	75.3	24.7
Newry	19	88.9	11.1	90.0	10.0	89.5	10.5
Norwch	47	47.6	52.4	88.5	11.5	70.2	29.8
Nottm	118	64.5	35.5	80.4	19.6	72.0	28.0
Oxford	122	46.8	53.2	83.3	16.7	64.8	35.2
Plymth	48	55.6	44.4	76.2	23.8	64.6	35.4
Ports	135	64.6	35.4	74.3	25.7	69.6	30.4
Prestn	124	81.2	18.8	78.2	21.8	79.8	20.2
Redng	86	50.0	50.0	83.3	16.7	64.0	36.0
Sheff	132	77.6	22.4	82.4	17.6	80.3	19.7
Shrew	48	61.1	38.9	90.0	10.0	79.2	20.8
Stevng	76	84.1	15.9	96.9	3.1	89.5	10.5
Sthend	27	50.0	50.0	90.9	9.1	66.7	33.3
Stoke	101	73.8	26.2	89.8	10.2	83.2	16.8
Sund	53	63.3	36.7	95.7	4.3	77.4	22.6
Swanse	104	73.2	26.8	90.5	9.5	83.7	16.3
Truro	37	69.2	30.8	87.5	12.5	81.1	18.9
Tyrone	20	75.0	25.0	75.0	25.0	75.0	25.0
Ulster	10	100.0	0.0	100.0	0.0	100.0	0.0
Wirral	49	72.7	27.3	81.3	18.8	75.5	24.5
Wolve	74	77.5	22.5	82.4	17.6	79.7	20.3
Wrexm	18	66.7	33.3	77.8	22.2	72.2	27.8
York	37	76.5	23.5	80.0	20.0	78.4	21.6
England	**4,938**	**72.0**	**28.0**	**85.5**	**14.5**	**78.8**	**21.2**
N Ireland	**145**	**86.2**	**13.8**	**86.3**	**13.8**	**86.2**	**13.8**
Scotland	**454**	**81.5**	**18.5**	**87.2**	**12.8**	**84.4**	**15.6**
Wales	**325**	**73.0**	**27.0**	**88.8**	**11.2**	**82.2**	**17.8**
UK	**5,862**	**73.1**	**26.9**	**85.8**	**14.2**	**79.6**	**20.4**

* For technical reasons, only 9 months of data are included for Brighton

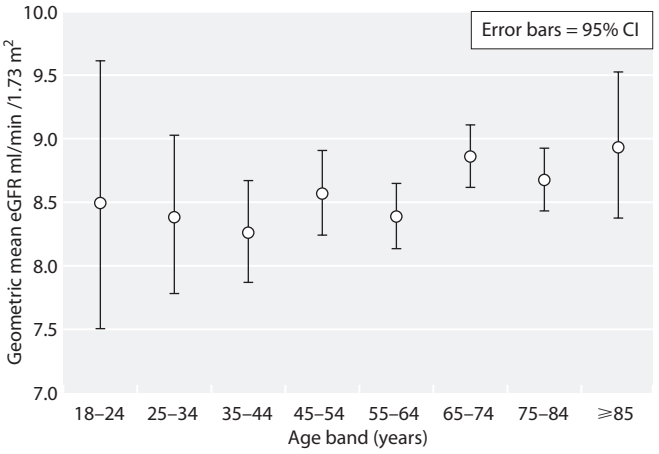

Fig. 1.9. Geometric mean eGFR at start of RRT (2009) by age band

of patients may have an incorrect date of start of RRT allocated (by up to 5 weeks). In these patients, the eGFR used for analysis in some patients may have been taken whilst they were already receiving RRT and thus be artificially high. The details of this analysis and a subsequent validation study were described in detail in the 12th Annual Report chapter 13: The UK Renal Registry Advanced CKD Study 2009 [5].

The mean eGFR at initiation of RRT in 2009 was 8.6 ml/min/1.73 m^2. This was highest in patients who were aged 85 and over, at 8.9 ml/min/1.73 m^2 (figure 1.9). By contrast the mean eGFR at initiation of RRT in the United States was 11.1 in 2008 and 12.2 for those aged over 75 years [6].

Figure 1.10 shows serial data from centres reporting annually to the UKRR since 1999. It demonstrates a continued pattern over the last 5 years of a higher mean eGFR at start of RRT for PD than HD patients.

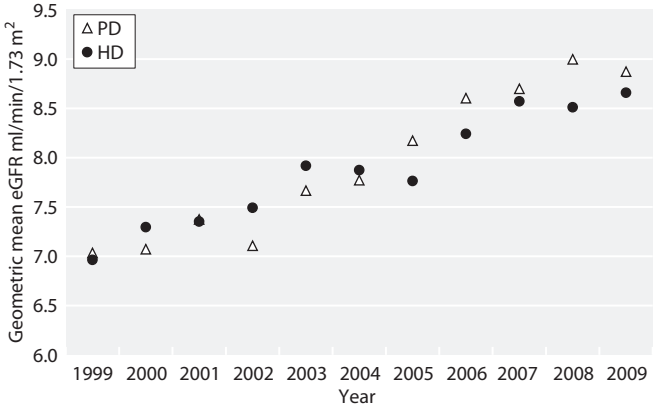

Fig. 1.10. eGFR on starting RRT 1999–2009; PD and HD. Restricted to centres reporting since 1999

In patients starting HD, there may be some plateauing of this level around an eGFR of 8.5 ml/min/1.73 m^2.

3 Late presentation and delayed referral of incident patients

Introduction

Late presentation to a nephrologist has many definitions and a range of possible causes. There are many patients with chronic kidney disease who are regularly monitored in primary or secondary care, and whose referral to nephrological services is delayed (delayed or late referral). In contrast other patients present late to medical services. Chronic kidney disease may be asymptomatic until very advanced stages resulting in no contact with medical services or patients may present with a variety of rapidly progressive kidney diseases: these patients are the true 'late presenters'. The analyses presented here do not differentiate between these groups and include any patient first seen by renal services within 90 days of requiring RRT as 'late presentation'.

Methods

Data were included from all incident patients in the years 2004 to 2009. The date first seen in a renal centre and the date of starting RRT were used to define the late presenting cohort. Around 5% of data were excluded because of actual or potential inconsistencies, it is hoped to address this before next year's report. Only data from those centres with 75% or more completeness were used. Data were excluded for centres in the years where 10% or more of the patients were reported to have started RRT on the same date as the first presentation, as investigation has shown that this is due to misunderstanding on the part of the renal centres resulting in incorrect recording of data. After these exclusions, data on 11,206 patients were available for analysis. Presentation times of 90 days or more were defined as early presentation and times of less than 90 days were defined as late presentation.

Results

Table 1.11 shows the percentage completeness of data from 2004 to 2009 excluding centres with 10% or more start dates for RRT being on the same day as first presentation. Whilst some centres have made improvements to the reporting of late presentation data several centres have shown no improvement.

Late presentation by centre and year

Late presentation ranged by centre from 5–37% in patients commencing RRT in 2009 (table 1.12). The

Table 1.11. Percentage completeness of late presentation data (2004 to 2009) by centre

	Year					
Centre	2004	2005	2006	2007	2008	2009
Antrim		0.0	66.7	67.6	80.0	100.0
B Heart	0.0	0.0	0.9	1.0	1.0	1.0
B QEH	0.0	0.5	0.0	1.4	0.0	0.4
Bangor	97.1	92.3	*	*	*	93.1
Basldn	97.8	90.6	100.0	100.0	100.0	*
Belfast		56.9	63.6	78.7	68.1	81.1
Bradfd	95.1	98.5	98.0	94.3	84.1	90.6
Brightn	0.8	0.0	0.0	0.0	0.0	0.0
Bristol	77.6	81.6	92.0	72.4	83.3	71.3
Camb	65.4	69.7	51.6	65.4	69.9	38.4
Cardff	0.5	1.1	0.0	1.8	0.0	0.0
Carlis	*	*	61.5	*	83.3	83.3
Carsh	0.6	0.6	0.0	0.0	0.0	1.0
Chelms	80.0	55.0	89.8	90.4	97.1	97.4
Clwyd	0.0	0.0	0.0	4.5	0.0	0.0
Colchr	n/a	n/a	n/a	n/a	3.3	0.0
Covnt	0.0	0.0	1.9	3.7	0.0	0.0
Derby	*	54.9	73.5	81.0	94.6	97.4
Donc	n/a	n/a	n/a	100.0	96.2	95.0
Dorset	98.4	100.0	100.0	96.9	100.0	88.4
Dudley	*	*	*	0.0	0.0	0.0
Exeter	64.2	50.0	55.2	25.2	18.7	19.4
Glouc	15.1	95.1	86.1	96.6	87.0	93.4
Hull	0.9	3.2	0.0	1.0	0.0	0.0
Ipswi	*	94.7	92.9	*	97.3	92.1
Kent				*	97.1	97.7
L Barts	0.5	0.0	19.6	0.5	0.5	0.0
L Guys	*	*	*	3.1	2.4	4.0
L Kings	15.9	16.4	10.7	18.5	96.0	98.4
L Rfree		0.0	0.0	1.1	0.6	0.0
L St.G				6.3	0.0	6.5
L West	*	*	*	*	*	0.0
Leeds	88.0	88.2	86.0	82.0	79.1	92.9
Leic	91.9	64.3	58.9	68.4	75.1	68.8
Liv Ain	n/a	0.0	0.0	0.0	0.0	0.0
Liv RI	0.8	0.0	0.0	0.9	0.0	0.0
M Hope	59.8	75.7	86.3	78.5	41.4	0.0
M RI				15.5	26.9	41.2
Middlbr	87.1	94.0	83.5	89.9	96.7	96.8
Newc	*	*	96.2	100.0	100.0	*
Newry		78.6	*	100.0	100.0	100.0
Norwch	66.0	46.6	54.5	*	59.6	85.4
Nottm	97.1	97.2	97.8	97.6	96.5	98.3
Oxford	90.5	92.2	89.8	99.3	98.6	91.0
Plymth	0.0	3.4	1.1	1.3	3.0	3.3
Ports	93.1	91.8	94.2	89.1	86.3	96.0
Prestn	0.0	0.8	1.7	0.8	0.0	0.0
Redng	41.8	43.2	45.9	*	65.7	*
Sheff	99.4	97.5	95.2	97.5	96.6	97.9
Shrew	*	*	*	*	98.4	100.0
Stevng	89.0	76.1	76.7	88.6	91.2	96.9
Sthend	0.0	0.0	0.0	0.0	2.8	0.0
Stoke				*	*	37.6
Sund	*	*	3.5	3.2	*	0.0
Swanse	64.5	93.9	98.3	97.5	89.9	0.9
Truro	60.3	71.0	51.9	91.1	27.5	23.5
Tyrone		95.8	100.0	90.9	96.0	100.0

Table 1.11. Continued

Centre	Year					
	2004	2005	2006	2007	2008	2009
Ulster		*	100.0	100.0	92.9	100.0
Wirral	47.8	75.0	80.0	82.4	80.5	71.7
Wolve	96.1	97.9	96.3	95.5	97.7	98.5
Wrexm	*	*	61.5	*	100.0	89.5
York	92.0	*	97.9	89.2	89.2	82.6
Total	**40.6**	**40.5**	**44.4**	**37.9**	**45.7**	**39.9**

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

Table 1.12. Percentage of patients presenting to a nephrologist less than 90 days before dialysis initiation

Centre	Year					
	2004	2005	2006	2007	2008	2009
Antrim					9.4	36.8
Bangor	36.4	38.9				25.9
Basldn	35.6	17.2	26.7	20.5	32.5	
Belfast				24.3		4.7
Bradfd	15.5	32.3	16.3	20.5	17.0	14.6
Bristol	29.6	23.2	16.3		24.1	
Carlis					12.0	25.0
Chelms	22.5		29.5	23.4	24.2	16.2
Derby				19.6	18.4	17.1
Derry			0.0	0.0	20.0	12.5
Donc				27.8	20.0	15.8
Dorset	18.3	36.7	17.0	17.7	20.2	21.3
Glouc		19.0	22.6	21.4	17.5	18.3
Ipswi		51.9	33.3		36.1	25.7
Kent					39.0	35.2
L Kings					19.3	21.6
Leeds	29.0	30.0	28.1	21.9	14.4	16.1
Leic	23.6				13.3	
M Hope		20.2	13.3	3.2		
Middlbr	31.8	22.8	18.7	20.2	18.0	21.7
Newc			23.0	19.0	28.6	
Newry		22.7		20.0	14.3	15.0
Norwch						19.5
Nottm	33.3	33.3	24.1	16.9	24.8	21.4
Oxford	26.8	27.7	24.8	20.0	18.8	17.1
Ports	30.6	28.1	30.7	24.5	24.8	18.8
Sheff	22.0	22.2	22.8	19.5	13.5	11.5
Shrew					25.0	29.8
Stevng	21.9	14.3	13.0	19.2	9.7	13.8
Swanse		43.0	38.1	28.6	26.2	
Truro				17.1		
Tyrone		21.7	13.8	15.0	16.7	5.3
Ulster			12.5	31.3	15.4	23.1
Wirral		31.1	57.5	45.2	33.3	
Wolve	30.3	30.4	25.6	26.6	25.0	14.1
Wrexm					19.0	29.4
York	26.1		26.1	27.3	15.2	26.3
Total	**27.0**	**28.3**	**24.1**	**21.0**	**21.0**	**19.4**

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

Table 1.13. Presentation times in 4 groups by year restricted to 11 centres contributing continuous data 2004–2009

Year	% <3 months	% 3–<6 months	% 6–<12 months	% ⩾12 months
2004	27.1	6.6	11.0	55.4
2005	27.4	6.4	10.6	55.6
2006	23.7	6.7	9.5	60.0
2007	20.6	5.6	10.1	63.7
2008	19.0	5.8	9.1	66.1
2009	17.0	7.3	7.3	68.4

overall rate of late presentation was 19.4%, slightly lower than last year.

There has been a steady decline nationally in the proportion of patients presenting late to renal services, with some centres achieving <10% late presentation rates. This may have been as a consequence of the National CKD guidelines published by the Medical and GP Royal Colleges [7], the Quality and Outcomes Framework (QOF) initiative (www.dh.gov.uk) raising awareness of CKD amongst non-nephrologists and the introduction of estimated GFR reporting.

Time referred before dialysis initiation in the 2009 incident cohort

In 2009, 67.1% of incident patients presented over a year before they needed to start dialysis. There were 7.2% of patients presented within 6–12 months, 6.3% within 3–6 months and 19.4% within 3 months. Table 1.13 shows this breakdown by year for those 11 centres supplying data for each of the last 6 years with >75% completeness (Basildon, Bradford, Dorset, Leeds, Middlesbrough, Nottingham, Oxford, Portsmouth, Sheffield, Stevenage and Wolverhampton). The proportion of patients presenting late in these centres has steadily fallen since 2005 (figure 1.11), and there has been an increase in those presenting 12 months or more before starting RRT.

Age and late presentation

In the 2004 to 2009 cohort, patients who presented late were significantly older than patients who presented earlier (>90 days before dialysis initiation) (median age 67.0 vs. 64.7 years: $p < 0.0001$). The median duration of pre-RRT care diminished progressively with increasing age beyond the 45–54 age group (figure 1.12).

Gender and late presentation

There was no significant difference in the proportion of males to females by time of presentation (male:female ratio 1.64 in early presentation, 1.71 in late presentation, $p = 0.37$).

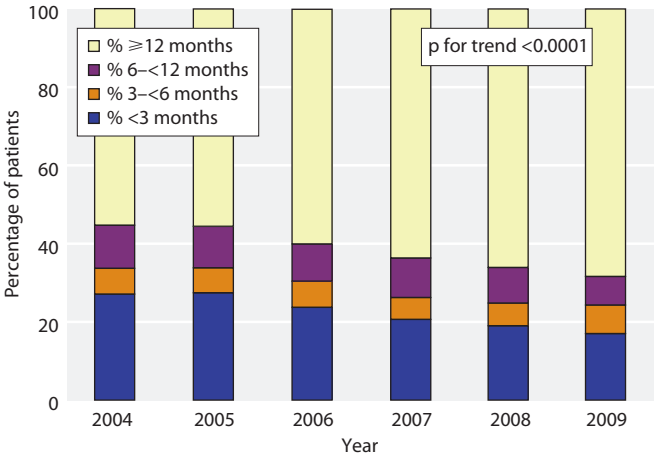

Fig. 1.11. Late presentation rate by year 2004–2009
Restricted to centres reporting continuous data 2004–2009

Ethnicity, social deprivation and late presentation

This analysis of the 2004 to 2009 cohort was limited to patients from centres with >70% ethnicity and >75% presentation time data. Patients from the Chinese and Other ethnic minority groups were excluded due to the small numbers with presentation data. The percentage of non-Whites (South Asian and Black) presenting late (<90 days) was significantly lower than in Whites (18.9% vs. 23.2%: $p = 0.0018$). The high incidence of diabetes in non-Whites (as discussed below, patients with diabetes tended to present earlier) and the older median age of incident Whites may explain this finding. There was no relationship between social deprivation and presentation pattern.

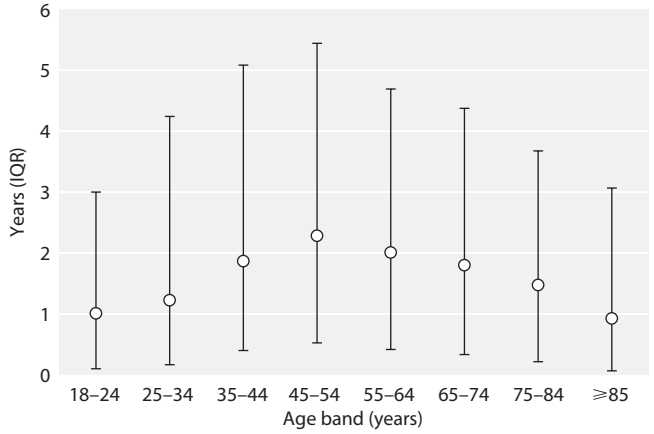

Fig. 1.12. Median duration of pre-RRT care by age

Table 1.14. Late presentation by primary renal diagnosis

	Late presentation	
Diagnosis	N	%
Uncertain aetiology*	625	25.5
Diabetes	270	11.2
Glomerulonephritis	229	19.5
Other identified category	743	44.7
Polycystic kidney	57	7.3
Pyelonephritis	176	20.2
Renal vascular disease	329	23.4
Data not available	96	33.6

* includes presumed glomerulonephritis not biopsy proven

Table 1.15. Percentage prevalence of specific comorbidities amongst patients presenting late (<3 months) compared with those presenting early (⩾3 months)

Comorbidity	<3 months	⩾3 months	p-value
Cerebrovascular disease	9.5	10.8	0.1
COPD	7.0	7.1	0.9
Diabetes (not a cause of ERF)	8.4	8.8	0.5
Ischaemic heart disease	21.3	24.9	0.002
Liver disease	3.5	2.5	0.02
Malignancy	19.8	11.0	<0.0001
Peripheral vascular disease	10.3	13.7	0.0002
Smoking	16.0	14.0	0.03

Primary renal disease and late presentation

In the 2004 to 2009 cohort, late presentation differed significantly between primary renal diagnoses (Chi-squared test $p < 0.0001$) (table 1.14). Patients with a diagnosis of 'other identified category', 'not available' and the aetiology uncertain/glomerulonephritis unproven groups had higher rates of late presentation. Those with diabetes and adult polycystic kidney disease had lower rates. Over these 6 years, there has been a significant downward trend in the proportion of diabetics presenting late (Maentel-Haenszel Chi-squared test $p = 0.0001$). This likely reflects national initiatives to screen patients with diabetes for proteinuria and falling GFR.

Modality and late presentation

In the 2004 to 2009 cohort, late presentation was associated with initial modality. The percentage of patients whose first modality was PD was significantly less in the late presentation group compared to those presenting earlier (10.8% vs. 25.9%: $p < 0.0001$). By 90 days after dialysis initiation this difference was reduced, although still highly significant (15.7% vs. 26.9%: $p < 0.0001$).

Comorbidity and late presentation

In the 2004 to 2009 cohort, a slightly lower percentage of patients who presented late were assessed as having no comorbidity when compared with the group who presented earlier, this just reached statistical significance (39.8% vs. 42.9%: $p = 0.02$). Peripheral vascular disease and ischaemic heart disease were significantly less common in the group presenting late. Malignancy was significantly more common in those presenting late, perhaps because of the potential for rapid decline in renal function in this setting. Liver disease and smoking were also more common in those presenting late although for these the differences were only of borderline statistical significance (table 1.15).

Haemoglobin and late presentation

In the 2004 to 2009 cohort, patients presenting late had a significantly lower haemoglobin concentration at dialysis initiation than patients presenting earlier (9.4 vs. 10.5 g/dl: $p < 0.0001$). This may reflect inadequate pre-dialysis care with limited anaemia management, but alternatively those presenting late may be more likely to have anaemia because of multisystem disease or inter-current illness.

eGFR at start of RRT and late presentation

In the 2004 to 2009 cohort, eGFR at start of RRT was lower in patients presenting late (7.5 vs. 8.4 ml/min/1.73 m^2: $p < 0.0001$).

Survival of incident patients

This analysis is to be found in chapter 7: Survival and Causes of Death of UK Adult Patients on Renal Replacement Therapy in 2009.

International comparisons

Figure 1.13 shows the crude RRT incidence rates for 2004 to 2008 combined for several countries with complete coverage of their populations. The UK incidence rate is similar to many other Northern European countries and Australasia, but remains lower than Belgium, Greece, US, Japan and Taiwan. These differences are

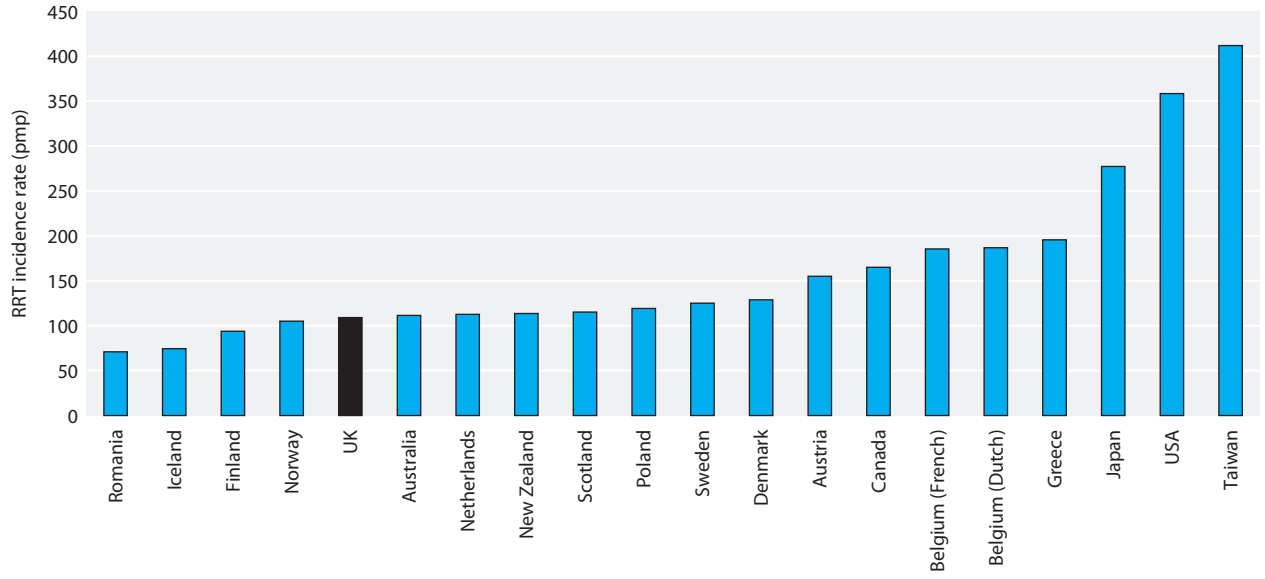

Fig. 1.13 International comparison of RRT acceptance rates (latest available data)

likely to be due to the rate of advanced kidney disease in these populations as well as lower mortality from competing risks for RRT, such as cardiovascular disease in southern Europe and the Far East. The healthcare system in use in these countries may also influence RRT incidence.

numbers of patients continued to present late to renal centres but there was a continuing decline in late presentation rate overall with the most marked difference for those with diabetes.

Conflicts of interest: none

Summary

RRT incidence rates have fallen in Northern Ireland, Scotland and Wales whilst they have risen slightly in England over the last 3 years. Wales continued to have the highest incidence rate. There remained large centre variations in incidence rates for RRT. Significant

Acknowledgements

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Chapter 2
UK RRT Prevalence in 2009: national and centre-specific analyses

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

Summary

- There were 49,080 adult patients receiving RRT in the UK on 31st December 2009, equating to a UK prevalence of 794 pmp, an increase of 3.2%.
- Growth rate from 2008 to 2009 for prevalent patients was 4.2% for haemodialysis (HD), a fall of 7.2% for peritoneal dialysis (PD) and a growth of 4.4% with a functioning transplant.
- The median age of prevalent patients was 57.7 years (HD 65.9 years, PD 61.2 years and transplant 50.8 years).
- Prevalence rates in males exceeded those in females: the peak for males was in the 75–79 year age group at 2,632 per million population (pmp) and for females in the 70–74 year age group at 1,445 pmp.
- The most common identifiable renal diagnosis was biopsy-proven glomerulonephritis (16.0%), followed by diabetes (14.7%).
- Transplantation was the most common treatment modality (48%), HD was used in 44% and PD in 8% of RRT patients.
- There were national, regional and dialysis centre level variations in prevalence rates. A significant factor in this variation was the ethnic mix of local populations, but a large amount of the variation remains unexplained.

Introduction

This chapter presents data on all adult patients on RRT in the UK at the end of 2009. The UK Renal Registry (UKRR) received data returns for 2009 from all 5 renal centres in Wales, all 6 in Northern Ireland and all 52 in England. Data from all 9 centres in Scotland were obtained from the Scottish Renal Registry. Data on children and young adults can be found in chapter 5, Demography of the UK Paediatric Renal Replacement Therapy population in 2009.

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

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

Methods

These analyses relate to the prevalent RRT cohort in the UK in 2009. The cohort was defined as all adult patients receiving RRT on the UKRR database on 31st December 2009. Population estimates were obtained from the UK Office of National Statistics (ONS) [1].

The number of prevalent RRT patients was calculated for the UK as a whole and for each UK country, using UKRR data from all renal centres. Crude prevalence rates were calculated per million population (pmp) and standardised prevalence ratios were calculated as detailed in appendix D: Methodology used for Analyses (http://www.renalreg.com/Report-Area/Report 2010/Appendix-D.pdf) for Primary Care Trusts (PCT) in England, Health and Social Care Areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland. These areas will be referred to in this report as 'PCT/HBs'. Briefly, data from all areas were used to calculate overall age and gender specific prevalence rates. The age and gender breakdown of the population in each PCT/HB were obtained from the mid-2009 population estimate based on 2001 Census data from the ONS [1]. The population breakdown and the overall prevalence rates were used to calculate the expected age and gender specific prevalence numbers for each PCT/HB. The age and gender standardised prevalence ratio was the observed prevalence numbers divided by the expected prevalence number. A ratio below 1 indicated that the observed rate was less than expected given the area's population structure. This was statistically significant at the 5% level if the upper confidence limit was less than 1. Analyses were done for each of the last 6 years and as the prevalent numbers for one year can be small for smaller areas, a combined years' analysis was also done. To enable assessment of whether a centre was an outlier in this regard, funnel plots for smaller and larger populations have been included (appendix D: figures D3, D4) which show the 95% confidence intervals around the national average prevalence. The proportion of non-Whites in each PCT/HB was obtained from the ONS [1].

Prevalent patients on RRT in 2009 were examined by time on RRT, age group, gender, ethnic origin, primary renal disease, presence of diabetes (2009 Report appendix H: Coding (http://www.renalreg.com/Report-Area/Report2010/Appendix-H.pdf) and treatment modality. Some centres electronically upload ethnicity coding to their renal information technology (IT) system from the hospital Patient Administration System (PAS). Ethnicity coding in these PAS systems is based on self-reported ethnicity and uses a different coding system [2]. For the remaining centres, ethnicity coding is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks, Chinese and Others as described in appendix H: Coding (http://www.renalreg.com/Report-Area/Report 2010/Appendix-H.pdf). Time on RRT was defined as median time on treatment and was calculated from the most recent start date. Patients without an accurate start date were excluded from this calculation. Analyses were done for the UK as a whole, by UK country, at centre level and split by treatment modality when appropriate. Chi-squared test, Fisher's exact test, linear regression and Kruskal Wallis tests were used as appropriate to test for significant differences between groups. The data were analysed using SAS 9.2.

Results

Prevalent patient numbers and changes in prevalence

The number of patients calculated for each country (table 2.1) by adding the patient numbers in each renal centre differ marginally from those quoted elsewhere when patients are allocated to geographical areas by their individual post codes, as some centres treat patients across national boundaries.

There were 49,080 adult patients receiving RRT in the UK at the end of 2009, giving a UK population prevalence of 794 pmp (table 2.1) compared with 774 pmp in 2008 [3]. Prevalence rates increased in three of the UK countries in 2009, but in Northern Ireland the prevalence dropped from 806 pmp in 2008 to 802 pmp in 2009 [3]. Prevalence remained significantly lower in

Table 2.1. Prevalence of RRT in the UK on 31/12/2009

	England	N Ireland	Scotland	Wales	UK
All UK centres	40,962	1,434	4,173	2,511	49,080
Total estimated population, mid-2009 (millions)*	51.8	1.8	5.2	3.0	61.8
Prevalence rate HD (pmp)	351	406	356	362	354
Prevalence rate PD (pmp)	65	44	55	76	64
Prevalence rate dialysis (pmp)	416	449	411	438	417
Prevalence rate transplant (pmp)	375	352	392	399	377
Prevalence rate total (pmp)	791	802	803	837	794
95% confidence intervals total (pmp)	783–798	760–843	779–828	805–870	787–801

* estimates from ONS web site
pmp = per million population

England (791 pmp) than in Wales (837 pmp) but there were no other significant differences between the four UK countries. PD prevalence decreased again in all UK countries, with the largest decrease in Northern Ireland (57 pmp in 2008 vs. 44 pmp in 2009), whilst transplant prevalence once more increased in the UK. The prevalence rate for each of the UK countries (figure 2.1) shows that Northern Ireland had a higher prevalence rate for patients aged 65+ compared with the other UK countries.

Prevalent patients by RRT centre

Both the number of prevalent patients in each renal centre and the distribution of their treatment modalities varied widely (table 2.2). Many factors including geography, local population density, age distribution, ethnic composition and the social deprivation index of that population have contributed to this.

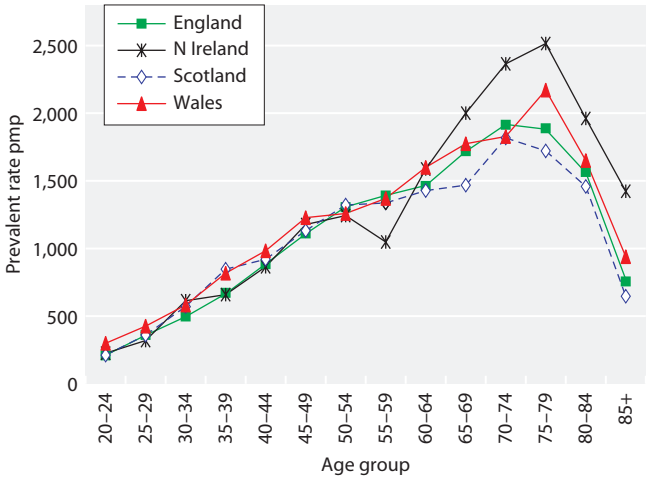

Fig. 2.1. Prevalence rates per million population by age group and UK country on 31/12/2009

Throughout this chapter, haemodialysis refers to all modes of HD treatment, including the 657 patients reported as receiving haemodiafiltration (HDF). Stevenage, Manchester RI, Norwich, London St. George's and Ulster reported significant numbers of patients on HDF, but other centres did not differentiate this treatment type in their UKRR returns.

As part of continuing quality control, checks on the accuracy of data received were repeatedly carried out. A small degree of under-reporting has been identified in the following centres: London Guy's, London St. Bartholomew's, Manchester Hope and Oxford. Whilst this may be significant to each individual centre figures, the overall effect on the national figure is less than 0.001%. Where joint care of renal transplant recipients between the referring centre and the transplant centre occurs, the patient was allocated to the centre which saw the patient most frequently, usually the referring centre. Thus the number of patients allocated to a transplant centre is often lower than that recorded by the centre itself.

Changes in prevalence

Overall growth in the prevalent UK RRT population from 2008 to 2009 was 3.2% (table 2.3) which has been fairly consistent over the last 10–15 years (figure 2.2). Most of the growth in the prevalent RRT population was due to a continued increase in the prevalent RRT population in England and Wales, with a stable prevalent RRT population in Scotland and a slight decline in the RRT population growth in Northern Ireland. Over the period 2005 to 2009, Northern Ireland (2.4%), Scotland (2.3%) and Wales (3.8%) showed slower average yearly growth compared with England (4.7%).

The prevalent growth per million population (pmp) disguises the differential growth in RRT modalities

Table 2.2. Number of prevalent RRT patients per treatment modality by centre on 31/12/2009

Centre	HD	PD	Dialysis	Transplant	RRT
England					
Birmingham Heartlands	432	33	465	157	622
Birmingham QEH*	865	159	1,024	797	1,821
Basildon	143	28	171	43	214
Bradford	191	34	225	197	422
Brighton	329	86	415	322	737
Bristol*	444	75	519	704	1,223
Cambridge*	345	39	384	556	940
Carlisle	66	15	81	122	203
Carshalton	666	123	789	513	1,302
Chelmsford	118	37	155	70	225
Colchester	116		116		116
Coventry*	347	82	429	365	794
Derby	247	87	334	85	419
Doncaster	121	33	154	42	196
Dorset	228	58	286	266	552
Dudley	156	56	212	80	292
Exeter	334	70	404	327	731
Gloucester	185	43	228	138	366
Hull	332	74	406	319	725
Ipswich	110	43	153	155	308
Kent & Canterbury	337	69	406	338	744
London Barts*	712	188	900	738	1,638
London Guys*	579	50	629	882	1,511
London Kings	395	85	480	306	786
London Royal Free*	649	70	719	827	1,546
London St. George's*	264	63	327	334	661
London West*	1,277	36	1,313	1,412	2,725
Leeds*	499	106	605	743	1,348
Leicester*	751	166	917	818	1,735
Liverpool Aintree	139	7	146		146
Liverpool RI*	403	89	492	731	1,223
Manchester Hope	347	119	466	318	784
Manchester RI*	433	103	536	900	1,436
Middlesbrough	295	20	315	392	707
Newcastle*	276	54	330	567	897
Norwich	312	58	370	221	591
Nottingham*	408	111	519	437	956
Oxford*	378	104	482	838	1,320
Plymouth*	127	42	169	285	454
Portsmouth*	476	95	571	730	1,301
Preston	480	78	558	381	939
Reading	269	85	354	264	618
Sheffield*	600	72	672	544	1,216
Shrewsbury	195	29	224	113	337
Stevenage	379	29	408	172	580
Southend	127	20	147	60	207
Stoke	301	72	373	267	640
Sunderland	178	28	206	162	368
Truro	153	28	181	139	320
Wirral	187	35	222		222
Wolverhampton	300	51	351	126	477
York	190	16	206	115	321

Table 2.2. Continued

Centre	HD	PD	Dialysis	Transplant	RRT
Northern Ireland					
Antrim	126	14	140	75	215
Belfast*	246	36	282	398	680
Derry	66	3	69	46	115
Newry	103	12	115	52	167
Tyrone	90	11	101	42	143
Ulster	95	2	97	17	114
Scotland					
Aberdeen	197	30	227	225	452
Airdrie	167	13	180	130	310
Dumfries & Galloway	52	12	64	54	118
Dundee	182	28	210	185	395
Dunfermline	114	23	137	96	233
Edinburgh*	274	62	336	364	700
Glasgow*	624	59	683	785	1,468
Inverness	90	22	112	112	224
Kilmarnock	148	38	186	87	273
Wales					
Bangor	79	31	110		110
Cardiff*	508	104	612	828	1,440
Clwyd	76	7	83	61	144
Swansea	349	59	408	190	598
Wrexham	73	27	100	119	219
England	**18,191**	**3,353**	**21,544**	**19,418**	**40,962**
Northern Ireland	**726**	**78**	**804**	**630**	**1,434**
Scotland	**1,848**	**287**	**2,135**	**2,038**	**4,173**
Wales	**1,085**	**228**	**1,313**	**1,198**	**2,511**
UK	**21,850**	**3,946**	**25,796**	**23,284**	**49,080**

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

(HD, PD and transplant) and is shown in table 2.4. From 2008 to 2009, there was a 3.5% growth of prevalent HD patients, a 3.7% growth in those with a functioning transplant and a decline in patients on PD of 7.8%. During the period 2005 to 2009 there was a 5.7% pmp growth in HD, 5.1% pmp fall in PD, and 5.6% pmp growth in prevalent transplant patients in the UK (table 2.4).

There were large variations between centres as well as countries. In 2008–2009 growth increased by more than 20% in only 2 centres (table 2.3); 26.5% in Airdrie and 27.3% in Doncaster largely due to relocation of transplant patients from Glasgow to Airdrie and both relocation of transplant patients and new haemodialysis stations in Doncaster (data shown in chapter 3 Outcomes in Renal Transplant Recipients in 2009, table 5.5). Smaller centres will show relatively large percentage changes in prevalence in either direction due to only small fluctuations in incidence numbers or numbers of deaths, particularly when growth in one year only is examined. There was a large decrease in prevalent patient numbers in 3 centres from 2005 to 2009 (Belfast, Glasgow and Liverpool RI). This was due to reallocation of transplant patients from Glasgow to other Scottish centres, the reallocation of some patients from Belfast to other centres in Northern Ireland and from Liverpool RI to Liverpool Aintree. The decline in prevalent patients on PD was evident at 45 of the 72 renal centres (data not shown) in the UK and PD numbers declined across all the 4 UK countries. The long-term (1982–2009) UK prevalence pattern by treatment modality is shown in figure 2.2. The steady growth in transplant numbers was maintained but the increase in haemodialysis patient numbers was

Table 2.3. Number of prevalent patients on RRT by centre 2005–2009

Centre	Date					% change 2008–2009	% average change 2005–2009
	31/12/2005	31/12/2006	31/12/2007	31/12/2008	31/12/2009		
Abrdn	417	434	452	456	452	−0.9	2.0
Airdrie	171	233	230	245	310	26.5	16.0
Antrim	189	200	200	220	215	−2.3	3.3
B Heart	541	578	578	597	622	4.2	3.5
B QEH	1,518	1,557	1,626	1,714	1,821	6.2	4.7
Bangor	101	103	98	112	110	−1.8	2.2
Basldn	169	187	208	217	214	−1.4	6.1
Belfast	749	751	748	726	680	−6.3	−2.4
Bradfd	367	365	395	414	422	1.9	3.6
Brightn	618	659	686	722	737	2.1	4.5
Bristol	1,165	1,203	1,234	1,247	1,223	−1.9	1.2
Camb	819	906	935	927	940	1.4	3.5
Cardff	1,272	1,333	1,438	1,371	1,440	5.0	3.1
Carlis	185	188	202	205	203	−1.0	2.3
Carsh	1,002	1,102	1,165	1,249	1,302	4.2	6.8
Chelms	136	158	194	207	225	8.7	13.4
Clwyd	92	88	155	146	144	−1.4	11.9
Colchr		84	100	118	116	−1.7	11.4
Covnt	638	675	717	745	794	6.6	5.6
D & Gall	69	77	77	113	118	4.4	14.4
Derby	277	301	301	389	419	7.7	10.9
Derry		40	67	100	115	15.0	42.2
Donc[a]			109	154	196	27.3	34.1
Dorset	383	406	452	513	552	7.6	9.6
Dudley	258	263	259	275	292	6.2	3.1
Dundee	359	365	376	370	395	6.8	2.4
Dunfn	150	156	220	220	233	5.9	11.6
Edinb	670	701	720	695	700	0.7	1.1
Exeter	583	630	664	708	731	3.2	5.8
Glasgw	1,593	1,553	1,605	1,568	1,468	−6.4	−2.0
Glouc	284	319	326	325	366	12.6	6.5
Hull	588	610	672	696	725	4.2	5.4
Inverns	200	200	207	212	224	5.7	2.9
Ipswi	291	284	285	294	308	4.8	1.4
Kent		546	627	714	744	4.2	10.9
Klmarnk	181	215	214	263	273	3.8	10.8
L Barts	1,337	1,416	1,473	1,526	1,638	7.3	5.2
L Guys	1,225	1,324	1,395	1,447	1,511	4.4	5.4
L Kings	636	669	712	784	786	0.3	5.4
L Rfree	1,346	1,383	1,437	1,510	1,546	2.4	3.5
L St.G	544	595	575	624	661	5.9	5.0
L West[b]	2,286	2,156	2,162	2,570	2,725	6.0	4.5
Leeds	1,341	1,380	1,379	1,342	1,348	0.4	0.1
Leic c	1,430	1,500	1,594	1,660	1,735	4.5	5.0
Liv Ain	81	99	115	130	146	12.3	15.9
Liv RI	1,280	1,338	1,274	1,200	1,223	1.9	−1.1
M Hope	631	718	759	758	784	3.4	5.6
M RI	1,420	1,504	1,402	1,424	1,436	0.8	0.3
Middlbr	573	640	687	682	707	3.7	5.4
Newc	867	905	902	901	897	−0.4	0.9
Newry	155	148	148	163	167	2.5	1.9
Norwch	409	437	495	567	591	4.2	9.6
Nottm	894	923	971	954	956	0.2	1.7
Oxford[c]	1,196	1,266	1,328	1,318	1,320	0.2	2.5
Plymth	369	412	421	443	454	2.5	5.3

Table 2.3. Continued

Centre	Date					% change 2008–2009	% average change 2005–2009
	31/12/2005	31/12/2006	31/12/2007	31/12/2008	31/12/2009		
Ports	1,085	1,143	1,182	1,268	1,301	2.6	4.6
Prestn	772	832	857	874	939	7.4	5.0
Redng	409	530	552	578	618	6.9	10.9
Sheff[a]	1,166	1,232	1,175	1,216	1,216	0.0	1.1
Shrew	236	259	285	325	337	3.7	9.3
Stevng	567	606	548	580	580	0.0	0.6
Sthend	181	187	195	204	207	1.5	3.4
Stoke	560	588	590	603	640	6.1	3.4
Sund	278	271	344	343	368	7.3	7.3
Swanse	475	503	545	602	598	−0.7	5.9
Truro	269	291	288	297	320	7.7	4.4
Tyrone	169	160	149	136	143	5.1	−4.1
Ulster	44	61	89	96	114	18.8	26.9
Wirral	192	206	219	216	222	2.8	3.7
Wolve	440	451	449	490	477	−2.7	2.0
Wrexm[d]	225	209	213	223	219	−1.8	−0.7
York	189	223	231	276	321	16.3	14.2
England	**34,031**	**36,505**	**37,731**	**39,540**	**40,962**	**3.6**	**4.7**
N Ireland	**1,306**	**1,360**	**1,401**	**1,441**	**1,434**	**−0.5**	**2.4**
Scotland	**3,810**	**3,934**	**4,101**	**4,142**	**4,173**	**0.7**	**2.3**
Wales	**2,165**	**2,236**	**2,449**	**2,454**	**2,511**	**2.3**	**3.8**
UK	**41,312**	**44,035**	**45,682**	**47,577**	**49,080**	**3.2**	**4.4**

[a] Doncaster previously part of Sheffield centre
[b] Hammersmith and Charing Cross amalgamated with St. Mary's
[c] Oxford transferred Northamptonshire LA to Leicester
[d] Wrexham data suspect from previous renal IT system in 2005 and 2006

associated with a slow contraction in home-based therapies, particularly PD in more recent years. There has been a gradual increase in the number on home haemodialysis since 2007.

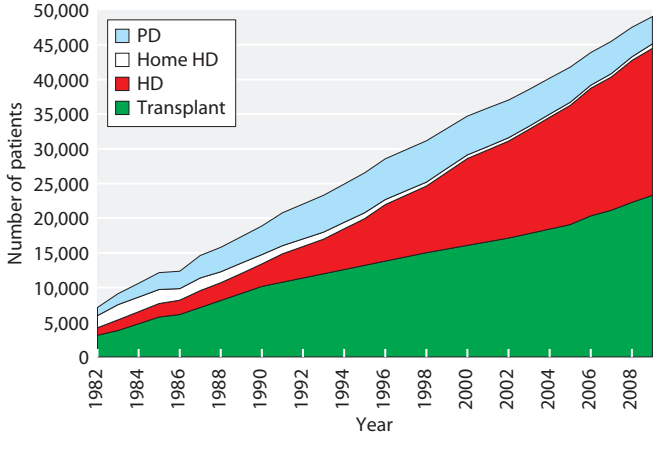

Fig. 2.2. Growth in prevalent patients by treatment modality at the end of each year 1982–2009

Prevalence of RRT in Primary Care Trusts (PCT) in England, Health and Social Care Areas in Northern Ireland (HB), Local Health Boards in Wales (HB) and Health Boards in Scotland (HB)

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

Prevalence rates have been reported in relation to the catchment area populations of PCTs in England. Data by local health areas for the other UK countries have also been reported (called Health and Social Care Areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland) and are described as HBs. There were substantial variations in the crude PCT/HB

Table 2.4. Change in RRT prevalence rates pmp 2005–2009 by modality

Year	HD prevalence pmp	PD prevalence pmp	Dialysis prevalence pmp	Transplant prevalence pmp	RRT prevalence pmp	% growth in prevalence pmp				
						HD	PD	Dialysis	Tx	RRT
2005	293	84	377	317	694	9.2	1.1	7.2	10.1	8.5
2006	311	78	389	336	724	6.0	−7.4	3.1	6.0	4.4
2007	323	76	399	346	746	3.9	−2.1	2.7	3.2	2.9
2008	342	69	411	363	774	5.8	−9.0	2.9	4.9	3.8
2009	354	64	417	377	794	3.5	−7.8	1.6	3.7	2.6
Average annual growth 2005–2009						5.7	−5.1	3.5	5.6	4.5

* Differences in the figures for dialysis and RRT prevalence and the sum of the separate modalities are due to rounding

prevalence rate per million population (pmp), from 478 pmp (Isle of Wight, population 22,000) to 1,708 pmp (Brent, population 255,200). There were similar variations in standardised prevalence ratios from 0.52 (Isle of Wight) to 2.44 (Heart of Birmingham, population 280,500) (table 2.5). Confidence intervals are not presented for the rates per million population for 2009 but figures D3 and D4 in appendix D (http://www.renalreg.com/Report-Area/Report 2010/Appendix-D.pdf) can be used to determine if a PCT/HB falls within the range representing the 95% confidence limit of the national average prevalence rate. The annual standardised prevalence ratios were inherently more stable than the annual standardised incidence ratios (see chapter 1 UK RRT Incidence in 2009).

Factors associated with variation in standardised prevalence ratios in Primary Care Trusts (PCT) in England, Health and Social Care Areas (HB) in Northern Ireland, Local Health Boards in Wales (HB) and Health Boards in Scotland (HB)

Geographical considerations and ethnicity were the major factors underlying the variation in SPRs (table 2.5). In 2009, there were 54 PCT/HBs with a significantly low SPR, 77 with a 'normal' SPR and 47 with a significantly high SPR. This is not strictly comparable to last year's report [3], because local health areas reported on have been changed in Northern Ireland, Scotland and Wales. However in broad terms the areas with high and low SPRs have been consistent over the last few years. They tend to reflect the demographics of the regions in question such that urban, ethnically diverse populations especially when coupled with areas of deprivation have the highest prevalence rates of renal replacement therapy. The geographical distribution is summarised in table 2.6. The East of England had a significantly higher proportion of areas with a low SPR compared with the UK as a whole. In London there was a significantly higher proportion of areas with a high SPR. The West Midlands (41%) and Northern Ireland (40%) had a relatively higher percentage of PCT/HBs with high SPRs but this did not reach significance.

PCT/HBs with high SPRs had significantly higher ethnic minority populations than those with low or normal SPRs ($p < 0.0001$). Mean SPRs were significantly higher in the 59 PCT/HBs with an ethnic minority population greater than 10% than in those with lower ethnic minority populations ($p < 0.0001$). The SPR (correlation coefficient $r = 0.86$) was positively correlated with ethnicity. For each 10% increase in ethnic minority population, the age standardised prevalence ratio increased by 0.21 and this would result in increased prevalent patient numbers. In figure 2.3, the relationship between the ethnic composition of a PCT/HB and its SPR is demonstrated.

Only 6 of the 119 PCT/HBs with ethnic minority populations of less than 10% had high SPRs: Abertawe Bro Morgannwg University, Belfast, Cwm Taf, Greater Glasgow & Clyde, Liverpool and Western Northern Ireland. Forty-one of the 59 PCT/HBs with ethnic minority populations greater than 10% had high SPRs, whereas only 3 had low SPRs (Richmond & Twickenham, Trafford, Leeds). Richmond & Twickenham and Trafford have lower deprivation than many areas with higher than average ethnic minority populations but Leeds has significant deprivation issues (http://www.apho.org.uk). Also some PCT/HBs with high ethnic minority populations did not have a proportionate increase in SPR; Westminster, also affluent, has 27.8% non-White population but with a modest increase in SPR of 1.04 (2004–2009). The factors contributing to these disparities remain unclear, but social deprivation may be an important factor and consideration should also be given to a possible lack of supply of services in some areas.

Table 2.5. Prevalence of RRT and standardised prevalence ratios in PCT/HB areas

PCT/HB = PCT in England, Health and Social Care Areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland
O/E = standardised prevalence ratio
LCL = lower 95% confidence limit
UCL = upper 95% confidence limit
pmp = per million population
Blank cells = no data returned to the UKRR for that year
Areas with significantly low prevalence ratios in 2009 are italicised in greyed areas, those with significantly high prevalence ratios in 2009 are bold in greyed areas
% non-White = percentage of the PCT/HB population that is non-White, from 2001 census (revised by ONS to 2007 for England)

									2009					
UK area	**PCT/HB**	**Total population**	**2004 O/E**	**2005 O/E**	**2006 O/E**	**2007 O/E**	**2008 O/E**	**O/E**	**95% LCL**	**95% UCL**	**Crude rate pmp**	**2004–2009 O/E**	**% non-White**
North East	*County Durham*	*506,600*	*0.93*	*0.95*	*0.91*	*0.89*	*0.87*	*0.86*	*0.78*	*0.96*	*720*	*0.90*	*2.5*
	Darlington	100,600	0.89	0.90	0.76	0.82	0.85	0.87	0.69	1.10	716	0.85	3.3
	Gateshead	190,500	1.06	1.00	0.94	0.90	0.84	0.89	0.75	1.05	735	0.93	3.8
	Hartlepool	90,800	1.03	0.97	0.99	0.90	0.93	0.91	0.71	1.16	727	0.95	2.6
	Middlesbrough	140,300	1.07	1.01	1.06	1.04	1.05	1.06	0.88	1.27	791	1.05	8.6
	Newcastle	284,300	0.92	0.94	0.92	0.96	0.98	0.95	0.82	1.09	679	0.95	9.7
	North Tyneside	197,000	1.06	1.07	1.05	0.99	0.93	0.96	0.82	1.12	792	1.00	3.6
	Northumberland	*311,200*	*0.93*	*0.89*	*0.82*	*0.81*	*0.79*	*0.76*	*0.67*	*0.87*	*681*	*0.83*	*2.2*
	Redcar and Cleveland	137,600	0.99	0.97	1.00	0.99	0.97	0.96	0.80	1.16	814	0.98	3.0
	South Tyneside	152,600	0.97	1.00	1.02	0.99	0.93	1.00	0.84	1.19	826	0.99	4.8
	Stockton-on-Tees Teaching	*191,100*	*0.78*	*0.78*	*0.88*	*0.82*	*0.82*	*0.80*	*0.67*	*0.95*	*628*	*0.81*	*4.7*
	Sunderland Teaching	281,700	1.07	1.00	0.93	0.90	0.93	0.93	0.81	1.06	749	0.96	3.3
North West	*Ashton, Leigh and Wigan*	*306,400*	*0.57*	*0.62*	*0.67*	*0.88*	*0.80*	*0.82*	*0.72*	*0.94*	*666*	*0.74*	*2.9*
	Blackburn with Darwen Teaching	**139,900**	**1.10**	**1.15**	**1.21**	**1.40**	**1.31**	**1.29**	**1.08**	**1.53**	**908**	**1.25**	**22.7**
	Blackpool	140,000	0.77	0.73	0.64	0.78	0.81	0.86	0.71	1.05	729	0.77	3.7
	Bolton	265,600	0.69	0.79	0.81	1.07	1.04	0.96	0.83	1.10	742	0.90	12.3
	Bury	182,800	0.37	0.43	0.46	0.88	0.83	0.91	0.77	1.08	717	0.67	8.5
	Central and Eastern Cheshire	*456,000*				*0.81*	*0.76*	*0.77*	*0.68*	*0.86*	*651*	*0.78*	*3.4*
	Central Lancashire	*457,800*	*0.71*	*0.76*	*0.71*	*0.78*	*0.81*	*0.84*	*0.75*	*0.93*	*675*	*0.77*	*6.7*
	Cumbria Teaching	*494,900*	*0.80*	*0.77*	*0.76*	*0.75*	*0.74*	*0.71*	*0.64*	*0.79*	*630*	*0.75*	*2.0*
	East Lancashire Teaching	380,900	0.90	0.90	0.92	1.07	1.01	0.95	0.85	1.07	761	0.96	9.4
	Halton and St. Helens	295,900	0.86	0.88	0.95	0.97	0.91	0.93	0.81	1.06	747	0.92	2.1
	Heywood, Middleton and Rochdale	204,900				1.01	1.01	1.04	0.89	1.22	796	1.02	12.6
	Knowsley	149,300	1.33	1.24	1.18	1.13	1.07	1.03	0.86	1.23	790	1.15	2.8
	Liverpool	**442,400**	**1.21**	**1.16**	**1.14**	**1.10**	**1.10**	**1.11**	**1.00**	**1.23**	**818**	**1.13**	**8.3**
	Manchester Teaching	**483,500**				**1.07**	**1.14**	**1.17**	**1.05**	**1.30**	**730**	**1.13**	**23.4**
	North Lancashire Teaching	*327,000*	*0.80*	*0.72*	*0.69*	*0.77*	*0.73*	*0.74*	*0.65*	*0.85*	*642*	*0.74*	*4.2*
	Oldham	219,200	0.52	0.50	0.61	0.93	0.94	0.92	0.79	1.08	693	0.76	12.2
	Salford	*225,300*	*0.63*	*0.60*	*0.64*	*0.82*	*0.86*	*0.81*	*0.68*	*0.96*	*604*	*0.74*	*7.7*
	Sefton	*273,400*	*0.92*	*0.93*	*0.91*	*0.88*	*0.85*	*0.83*	*0.72*	*0.96*	*717*	*0.88*	*2.6*
	Stockport	*283,600*				*0.87*	*0.87*	*0.82*	*0.71*	*0.94*	*673*	*0.85*	*6.4*
	Tameside and Glossop	249,100				1.01	0.95	0.94	0.82	1.09	743	0.97	5.9
	Trafford	*215,400*				*0.78*	*0.75*	*0.79*	*0.67*	*0.93*	*627*	*0.77*	*11.2*
	Warrington	197,900	0.87	0.79	0.81	0.89	0.87	0.93	0.79	1.09	753	0.86	3.5
	Western Cheshire	232,900	1.02	0.96	0.93	0.94	0.93	0.97	0.84	1.11	820	0.96	3.1
	Wirral	*308,600*	*1.12*	*1.08*	*1.03*	*0.96*	*0.89*	*0.84*	*0.73*	*0.96*	*693*	*0.97*	*2.8*
Yorkshire and the Humber	Barnsley	226,500	1.24	1.14	1.11	1.05	1.05	1.10	0.96	1.26	896	1.11	2.7
	Bradford and Airedale Teaching	**506,900**	**1.21**	**1.20**	**1.11**	**1.15**	**1.17**	**1.15**	**1.04**	**1.26**	**811**	**1.16**	**25.0**
	Calderdale	201,500	1.07	1.06	1.07	1.08	1.07	1.08	0.93	1.26	864	1.07	9.8
	Doncaster	290,200	1.11	1.03	1.04	0.95	0.95	0.98	0.86	1.11	796	1.00	4.3
	East Riding of Yorkshire	*337,100*	*0.80*	*0.80*	*0.80*	*0.79*	*0.81*	*0.84*	*0.74*	*0.95*	*751*	*0.81*	*3.0*
	Hull Teaching	262,700	0.97	0.98	0.98	1.02	0.94	0.99	0.86	1.14	727	0.98	5.8
	Kirklees	406,800	1.20	1.16	1.18	1.11	1.04	1.07	0.96	1.19	811	1.12	16.0

Table 2.5. Continued

UK area	PCT/HB	Total population	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 95% LCL	2009 95% UCL	2009 Crude rate pmp	2004–2009 O/E	% non-White
Yorkshire and the Humber	*Leeds*	*787,600*	*0.99*	*0.99*	*1.00*	*0.95*	*0.91*	*0.90*	*0.82*	*0.98*	*645*	*0.95*	*11.8*
	North East Lincolnshire	158,600	0.98	0.97	1.01	0.99	1.00	0.99	0.83	1.17	801	0.99	3.1
	North Lincolnshire	*157,100*	*0.98*	*0.92*	*0.97*	*0.93*	*0.89*	*0.77*	*0.64*	*0.94*	*656*	*0.90*	*3.2*
	North Yorkshire and York	*796,300*	*0.80*	*0.80*	*0.78*	*0.78*	*0.78*	*0.80*	*0.73*	*0.87*	*676*	*0.79*	*3.7*
	Rotherham	253,900	1.30	1.22	1.12	1.11	1.15	1.12	0.99	1.28	910	1.16	5.2
	Sheffield	547,100	1.11	1.06	1.08	1.08	1.07	1.08	0.98	1.18	808	1.08	12.2
	Wakefield District	*323,800*	*0.87*	*0.86*	*0.90*	*0.85*	*0.83*	*0.83*	*0.72*	*0.94*	*673*	*0.85*	*4.3*
East Midlands	*Bassetlaw*	*111,900*	*0.78*	*0.82*	*0.79*	*0.94*	*0.87*	*0.79*	*0.63*	*0.99*	*679*	*0.83*	*3.1*
	Derby City	**244,300**	**1.16**	**1.09**	**1.08**	**1.01**	**1.09**	**1.16**	**1.01**	**1.33**	**872**	**1.10**	**15.0**
	Derbyshire County	*726,400*	*0.86*	*0.84*	*0.84*	*0.87*	*0.88*	*0.86*	*0.79*	*0.93*	*735*	*0.86*	*3.2*
	Leicester City	**304,800**	**1.82**	**1.79**	**1.74**	**1.74**	**1.75**	**1.79**	**1.62**	**1.98**	**1201**	**1.77**	**38.2**
	Leicestershire County and Rutland	*683,200*	*0.97*	*0.92*	*0.92*	*0.91*	*0.90*	*0.87*	*0.80*	*0.95*	*726*	*0.91*	*7.7*
	Lincolnshire Teaching	*700,200*	*0.83*	*0.83*	*0.79*	*0.79*	*0.78*	*0.78*	*0.71*	*0.85*	*686*	*0.80*	*3.3*
	Northamptonshire Teaching	*684,000*	*0.74*	*0.91*	*0.89*	*0.89*	*0.90*	*0.89*	*0.82*	*0.98*	*706*	*0.87*	*7.4*
	Nottingham City	**300,800**	**1.30**	**1.24**	**1.22**	**1.17**	**1.18**	**1.17**	**1.03**	**1.33**	**758**	**1.21**	**18.7**
	Nottinghamshire County Teaching	665,000	1.06	1.05	1.02	1.00	0.98	0.94	0.86	1.02	786	1.01	5.1
West Midlands	**Birmingham East and North**	**407,400**	**1.58**	**1.61**	**1.63**	**1.51**	**1.55**	**1.53**	**1.40**	**1.68**	**1085**	**1.57**	**23.8**
	Coventry Teaching	**312,600**	**1.33**	**1.25**	**1.21**	**1.19**	**1.21**	**1.25**	**1.12**	**1.41**	**905**	**1.24**	**19.6**
	Dudley	306,500	0.98	0.94	0.89	0.91	0.88	0.94	0.83	1.07	786	0.92	8.5
	Heart of Birmingham Teaching	**280,500**	**2.39**	**2.39**	**2.39**	**2.37**	**2.39**	**2.44**	**2.21**	**2.69**	**1415**	**2.40**	**61.8**
	Herefordshire	*179,000*	*0.91*	*0.90*	*0.87*	*0.83*	*0.75*	*0.80*	*0.67*	*0.95*	*721*	*0.84*	*2.4*
	North Staffordshire	211,500				0.85	0.86	0.87	0.75	1.02	747	0.86	3.5
	Sandwell	**291,100**	**1.53**	**1.49**	**1.51**	**1.48**	**1.56**	**1.60**	**1.44**	**1.78**	**1213**	**1.53**	**21.8**
	Shropshire County	291,900	0.88	0.90	0.88	0.87	0.93	0.88	0.77	1.00	781	0.89	3.0
	Solihull	205,200	1.06	1.03	1.08	0.97	0.93	0.99	0.85	1.15	824	1.01	9.0
	South Birmingham	**341,200**	**1.49**	**1.47**	**1.38**	**1.31**	**1.32**	**1.34**	**1.20**	**1.49**	**970**	**1.38**	**17.9**
	South Staffordshire	*609,300*				*0.92*	*0.92*	*0.89*	*0.81*	*0.97*	*748*	*0.91*	*4.7*
	Stoke on Trent	246,900				1.13	1.08	1.12	0.98	1.28	879	1.11	7.1
	Telford and Wrekin	162,300	0.89	0.80	0.88	1.03	1.02	1.04	0.88	1.23	807	0.95	6.6
	Walsall Teaching	**255,800**	**1.36**	**1.36**	**1.32**	**1.27**	**1.32**	**1.29**	**1.14**	**1.46**	**1016**	**1.32**	**14.7**
	Warwickshire	535,100	1.10	1.08	1.03	1.02	0.98	1.00	0.91	1.09	833	1.03	6.7
	Wolverhampton City	**238,500**	**1.34**	**1.31**	**1.26**	**1.18**	**1.21**	**1.21**	**1.06**	**1.38**	**943**	**1.25**	**23.8**
	Worcestershire	*556,600*	*0.86*	*0.86*	*0.82*	*0.82*	*0.82*	*0.83*	*0.76*	*0.92*	*715*	*0.83*	*4.4*
East of England	*Bedfordshire*	*411,100*	*0.85*	*0.82*	*0.84*	*0.80*	*0.81*	*0.80*	*0.71*	*0.90*	*637*	*0.82*	*9.3*
	Cambridgeshire	*607,200*	*0.89*	*0.92*	*0.91*	*0.88*	*0.83*	*0.85*	*0.77*	*0.94*	*674*	*0.88*	*7.4*
	East and North Hertfordshire	*545,600*	*0.76*	*0.88*	*0.83*	*0.80*	*0.81*	*0.80*	*0.72*	*0.89*	*627*	*0.81*	*8.8*
	Great Yarmouth and Waveney	*214,000*	*0.43*	*0.41*	*0.43*	*0.51*	*0.77*	*0.85*	*0.73*	*0.99*	*752*	*0.58*	*3.5*
	Luton	**194,600**	**1.10**	**1.23**	**1.22**	**1.26**	**1.31**	**1.29**	**1.12**	**1.50**	**894**	**1.24**	**31.5**
	Mid Essex	*371,300*	*0.82*	*0.81*	*0.85*	*0.89*	*0.85*	*0.85*	*0.75*	*0.96*	*692*	*0.85*	*5.1*
	Norfolk	*757,200*	*0.92*	*0.93*	*0.93*	*0.92*	*0.90*	*0.87*	*0.80*	*0.95*	*766*	*0.91*	*3.9*
	North East Essex	*324,800*					*0.78*	*0.81*	*0.71*	*0.92*	*680*	*0.79*	*6.4*
	Peterborough	171,000	1.00	1.00	1.05	1.05	0.99	1.07	0.91	1.27	795	1.03	13.0
	South East Essex	336,500	0.95	0.92	0.95	0.94	0.95	0.93	0.82	1.05	782	0.94	5.7
	South West Essex	405,000	0.88	0.92	0.93	0.95	0.96	0.97	0.87	1.09	746	0.94	7.6
	Suffolk	*596,200*	*0.84*	*0.83*	*0.83*	*0.83*	*0.81*	*0.82*	*0.74*	*0.90*	*693*	*0.83*	*5.7*
	West Essex	*282,400*	*0.80*	*0.83*	*0.79*	*0.74*	*0.68*	*0.69*	*0.59*	*0.81*	*559*	*0.75*	*7.9*
	West Hertfordshire	549,900	0.40	0.59	0.78	0.83	1.00	0.99	0.90	1.08	771	0.79	11.1
London	**Barking and Dagenham**	**176,000**	**1.09**	**1.12**	**1.14**	**1.16**	**1.16**	**1.24**	**1.05**	**1.46**	**807**	**1.16**	**23.7**
	Barnet	**343,200**		**1.12**	**1.24**	**1.43**	**1.46**	**1.43**	**1.29**	**1.58**	**1049**	**1.34**	**29.4**

Table 2.5. Continued

UK area	PCT/HB	Total population	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 95% LCL	2009 95% UCL	2009 Crude rate pmp	2004–2009 O/E	% non-White
London	**Bexley**	**225,800**	**1.17**	**1.13**	**1.18**	**1.19**	**1.19**	**1.21**	**1.06**	**1.39**	**948**	**1.18**	**13.0**
	Brent Teaching	**255,200**			**1.37**	**2.03**	**2.27**	**2.38**	**2.16**	**2.61**	**1708**	**2.03**	**53.5**
	Bromley	310,200	0.99	1.00	0.99	0.95	0.99	0.94	0.82	1.07	745	0.97	11.9
	Camden	**231,600**		**0.99**	**1.08**	**1.15**	**1.20**	**1.25**	**1.09**	**1.45**	**825**	**1.14**	**24.9**
	City and Hackney Teaching	**227,100**			**1.38**	**1.41**	**1.34**	**1.46**	**1.28**	**1.67**	**925**	**1.40**	**35.7**
	Croydon	**342,800**	**1.14**	**1.18**	**1.16**	**1.32**	**1.32**	**1.37**	**1.23**	**1.52**	**1009**	**1.26**	**34.5**
	Ealing	**316,300**	**1.44**	**1.40**	**1.46**	**1.60**	**1.90**	**1.91**	**1.73**	**2.10**	**1344**	**1.64**	**40.7**
	Enfield	**291,400**		**1.51**	**1.50**	**1.44**	**1.44**	**1.42**	**1.27**	**1.59**	**1036**	**1.46**	**28.0**
	Greenwich Teaching	**226,200**	**0.97**	**1.13**	**1.13**	**1.15**	**1.23**	**1.23**	**1.07**	**1.42**	**836**	**1.15**	**26.1**
	Hammersmith and Fulham	**169,800**	**1.49**	**1.33**	**1.36**	**1.30**	**1.38**	**1.42**	**1.22**	**1.66**	**966**	**1.38**	**21.0**
	Haringey Teaching	**225,400**		**1.52**	**1.54**	**1.54**	**1.62**	**1.62**	**1.43**	**1.83**	**1087**	**1.57**	**33.1**
	Harrow	**228,600**				**1.56**	**1.73**	**1.82**	**1.63**	**2.03**	**1365**	**1.71**	**44.7**
	Havering	*234,500*				*0.79*	*0.78*	*0.80*	*0.68*	*0.94*	*644*	*0.79*	*8.8*
	Hillingdon	**262,500**	**0.87**	**0.96**	**1.01**	**0.98**	**1.30**	**1.31**	**1.16**	**1.49**	**945**	**1.09**	**25.9**
	Hounslow	**234,200**	**1.50**	**1.40**	**1.33**	**1.32**	**1.59**	**1.62**	**1.44**	**1.83**	**1123**	**1.46**	**37.8**
	Islington	**192,100**		**1.38**	**1.49**	**1.41**	**1.37**	**1.36**	**1.17**	**1.58**	**885**	**1.40**	**22.9**
	Kensington and Chelsea	169,900				0.79	0.95	0.95	0.79	1.13	724	0.90	22.6
	Kingston	166,900				1.03	1.12	1.11	0.93	1.31	791	1.09	19.9
	Lambeth	**283,400**	**1.30**	**1.29**	**1.29**	**1.61**	**1.60**	**1.66**	**1.48**	**1.85**	**1076**	**1.47**	**32.0**
	Lewisham	**264,300**	**1.62**	**1.64**	**1.67**	**1.70**	**1.67**	**1.72**	**1.53**	**1.92**	**1158**	**1.67**	**34.4**
	Newham	**241,200**	**1.53**	**1.71**	**1.79**	**1.82**	**1.83**	**1.92**	**1.70**	**2.15**	**1157**	**1.78**	**57.0**
	Redbridge	**267,700**	**1.15**	**1.24**	**1.24**	**1.22**	**1.36**	**1.39**	**1.23**	**1.56**	**982**	**1.27**	**40.9**
	Richmond and Twickenham	*189,400*				*0.62*	*0.71*	*0.76*	*0.63*	*0.91*	*576*	*0.70*	*11.7*
	Southwark	**285,600**	**1.51**	**1.54**	**1.54**	**1.64**	**1.68**	**1.70**	**1.52**	**1.90**	**1113**	**1.61**	**34.1**
	Sutton and Merton	**398,900**				**1.14**	**1.17**	**1.22**	**1.10**	**1.36**	**895**	**1.18**	**20.8**
	Tower Hamlets	**234,800**	**1.04**	**1.09**	**1.13**	**1.22**	**1.28**	**1.39**	**1.21**	**1.61**	**809**	**1.20**	**22.8**
	Waltham Forest	**224,500**			**1.39**	**1.58**	**1.57**	**1.51**	**1.33**	**1.72**	**1020**	**1.52**	**36.6**
	Wandsworth	**286,900**				**1.40**	**1.40**	**1.46**	**1.30**	**1.64**	**952**	**1.42**	**19.7**
	Westminster	249,200				0.97	1.04	1.12	0.97	1.28	787	1.04	27.8
South East Coast	Brighton and Hove City	256,200	0.87	0.86	0.87	0.86	0.86	0.88	0.76	1.03	648	0.87	8.7
	East Sussex Downs and Weald	*333,700*	*0.86*	*0.82*	*0.78*	*0.80*	*0.76*	*0.78*	*0.68*	*0.88*	*698*	*0.80*	*4.9*
	Eastern and Coastal Kent	732,100				0.86	0.91	0.93	0.85	1.01	768	0.90	5.3
	Hastings and Rother	*178,400*	*0.90*	*0.83*	*0.83*	*0.77*	*0.79*	*0.82*	*0.69*	*0.97*	*734*	*0.82*	*5.2*
	Medway	254,900				0.86	0.89	0.88	0.76	1.02	671	0.87	7.5
	Surrey	*1,100,500*	*0.77*	*0.76*	*0.77*	*0.86*	*0.88*	*0.88*	*0.82*	*0.94*	*710*	*0.82*	*8.3*
	West Kent	*678,600*				*0.87*	*0.90*	*0.89*	*0.82*	*0.97*	*725*	*0.89*	*6.8*
	West Sussex	*792,900*	*0.78*	*0.77*	*0.77*	*0.81*	*0.83*	*0.84*	*0.77*	*0.91*	*718*	*0.80*	*5.8*
South Central	**Berkshire East**	**399,600**	**1.04**	**1.00**	**1.08**	**1.19**	**1.19**	**1.18**	**1.06**	**1.31**	**866**	**1.12**	**18.9**
	Berkshire West	466,600	1.03	0.96	1.03	1.12	1.12	1.10	1.00	1.22	825	1.06	10.1
	Buckinghamshire	508,700	0.99	0.98	0.97	0.96	0.93	0.91	0.83	1.01	737	0.95	10.4
	Hampshire	*1,289,100*	*0.79*	*0.76*	*0.78*	*0.77*	*0.78*	*0.79*	*0.74*	*0.84*	*659*	*0.78*	*4.2*
	Isle of Wight National Health Service	*140,200*	*0.75*	*0.63*	*0.61*	*0.57*	*0.55*	*0.52*	*0.41*	*0.66*	*478*	*0.60*	*3.6*
	Milton Keynes	242,300	0.94	0.92	0.86	0.92	0.92	0.90	0.77	1.05	660	0.91	12.7
	Oxfordshire	*615,900*	*1.11*	*1.05*	*1.04*	*0.95*	*0.91*	*0.89*	*0.81*	*0.98*	*687*	*0.98*	*8.1*
	Portsmouth City Teaching	203,400	1.12	1.05	0.99	0.98	0.98	0.94	0.79	1.11	659	1.00	8.0
	Southampton City	237,000	0.95	0.93	0.91	0.92	0.95	0.96	0.82	1.12	658	0.94	11.4
South West	*Bath and North East Somerset*	*177,500*	*0.87*	*0.92*	*0.89*	*0.89*	*0.82*	*0.82*	*0.68*	*0.98*	*648*	*0.86*	*5.8*
	Bournemouth and Poole Teaching	*306,000*	*0.91*	*0.87*	*0.87*	*0.88*	*0.86*	*0.84*	*0.73*	*0.96*	*690*	*0.87*	*5.0*
	Bristol	**433,000**	**1.37**	**1.31**	**1.32**	**1.23**	**1.27**	**1.25**	**1.13**	**1.39**	**871**	**1.29**	**11.6**

Table 2.5. Continued

UK area	PCT/HB	Total population	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2009 95% LCL	2009 95% UCL	2009 Crude rate pmp	2004–2009 O/E	% non-White
South West	Cornwall and Isles of Scilly	532,900	1.12	1.02	1.04	0.98	0.96	0.97	0.88	1.06	863	1.01	2.8
	Devon	*747,500*	*0.85*	*0.81*	*0.83*	*0.85*	*0.87*	*0.87*	*0.80*	*0.95*	*779*	*0.85*	*3.3*
	Dorset	*404,200*	*0.83*	*0.83*	*0.79*	*0.80*	*0.82*	*0.82*	*0.74*	*0.92*	*772*	*0.81*	*3.5*
	Gloucestershire	*588,700*	*0.92*	*0.92*	*0.93*	*0.89*	*0.83*	*0.85*	*0.77*	*0.93*	*710*	*0.88*	*4.7*
	North Somerset	209,400	1.13	1.04	0.98	0.91	0.92	0.87	0.74	1.02	755	0.97	3.6
	Plymouth Teaching	256,700	1.11	1.05	1.16	1.14	1.10	1.11	0.97	1.27	834	1.11	4.4
	Somerset	*523,600*	*0.92*	*0.88*	*0.87*	*0.83*	*0.81*	*0.81*	*0.73*	*0.90*	*712*	*0.85*	*3.2*
	South Gloucestershire	262,300	1.08	1.05	1.04	0.98	0.96	0.90	0.78	1.04	721	1.00	5.0
	Swindon	203,700	0.98	0.92	0.94	0.88	0.85	0.87	0.74	1.03	668	0.90	7.1
	Torbay	133,900	0.98	0.91	0.87	0.81	0.94	0.90	0.75	1.09	814	0.90	3.1
	Wiltshire	*456,000*	*0.66*	*0.69*	*0.70*	*0.72*	*0.74*	*0.71*	*0.63*	*0.81*	*596*	*0.70*	*3.4*
Wales	*Betsi Cadwaladr University*	*679,000*	*1.08*	*1.04*	*0.99*	*0.96*	*0.95*	*0.91*	*0.84*	*0.99*	*779*	*0.98*	*1.0*
	Powys Teaching	131,700	0.95	0.98	0.92	0.90	0.90	0.92	0.77	1.11	850	0.93	0.9
	Hywel Dda	374,800	1.05	1.04	1.02	0.97	1.01	0.94	0.84	1.06	824	1.00	1.0
	Abertawe Bro Morgannwg University	**502,300**	**1.28**	**1.24**	**1.25**	**1.26**	**1.20**	**1.22**	**1.11**	**1.33**	**999**	**1.24**	**1.6**
	Cwm Taf	**290,500**	**1.46**	**1.41**	**1.45**	**1.50**	**1.42**	**1.40**	**1.26**	**1.57**	**1119**	**1.44**	**1.1**
	Aneurin Bevan	560,600	1.24	1.21	1.16	1.17	1.10	1.08	0.99	1.18	883	1.15	1.9
	Cardiff and Vale University	461,000	1.25	1.16	1.16	1.15	1.05	1.07	0.96	1.19	779	1.13	6.7
Scotland	Ayrshire & Arran	367,000	1.09	1.13	1.18	1.12	1.14	1.08	0.97	1.20	926	1.13	0.7
	Borders	113,100	0.85	0.83	0.83	0.94	0.97	1.01	0.83	1.23	902	0.91	0.6
	Dumfries and Galloway	148,200	1.02	1.04	0.97	0.87	0.94	0.93	0.78	1.10	850	0.96	0.7
	Fife	363,400	0.97	0.99	0.95	0.93	0.94	0.93	0.83	1.05	765	0.95	1.3
	Forth Valley	291,400	0.94	0.96	0.91	0.96	0.93	0.91	0.79	1.04	734	0.94	1.1
	Grampian	545,400	1.00	0.99	0.96	0.95	0.94	0.96	0.87	1.05	785	0.96	1.6
	Greater Glasgow & Clyde	**1,199,000**	**1.31**	**1.28**	**1.22**	**1.17**	**1.13**	**1.09**	**1.03**	**1.16**	**851**	**1.19**	**3.4**
	Highland	311,000	1.06	1.06	1.02	1.02	1.00	1.00	0.89	1.13	884	1.02	0.8
	Lanarkshire	562,500	1.14	1.05	1.02	0.97	0.97	0.95	0.87	1.05	763	1.01	1.2
	Lothian	*826,200*	*1.01*	*0.96*	*0.94*	*0.92*	*0.89*	*0.87*	*0.80*	*0.95*	*673*	*0.93*	*2.8*
	Orkney	20,000	1.15	1.14	1.14	0.93	1.12	1.07	0.68	1.68	950	1.09	0.4
	Shetland	22,000	0.74	0.55	0.45	0.66	0.46	0.60	0.33	1.09	500	0.57	1.1
	Tayside	399,600	1.19	1.15	1.14	1.10	1.04	1.08	0.98	1.20	911	1.11	1.9
	Western Isles	26,100	0.92	0.58	0.55	0.88	0.79	0.75	0.47	1.20	690	0.75	0.6
Northern Ireland	**Belfast**	**334,600**		**1.38**	**1.37**	**1.35**	**1.30**	**1.21**	**1.08**	**1.35**	**882**	**1.32**	**1.1**
	Northern	458,300		1.21	1.22	1.16	1.12	1.06	0.96	1.17	803	1.15	0.6
	Southern	354,000		1.15	1.07	1.00	1.02	1.00	0.88	1.13	703	1.04	0.7
	South Eastern	344,200		1.12	1.07	1.02	1.01	0.97	0.86	1.10	747	1.04	0.4
	Western	297,900		1.14	1.18	1.16	1.12	1.16	1.02	1.31	826	1.15	0.5

Case mix in prevalent RRT patients

Time on RRT

Table 2.7 shows the median time, in years, since starting RRT of the prevalent RRT patients on 31/12/2009. Median time on RRT for all prevalent patients was 5.4 years. (For patients who recovered for >90 days and then subsequently restarted RRT the median time from the start of RRT was calculated from the most recent start date.) Patients with functioning transplants had survived a median of 10.3 years on RRT whilst the median time on RRT of HD and PD patients was significantly less (3.1 and 2.0 years respectively $p < 0.001$). The median time on RRT increased for both transplant and haemodialysis patients over the past 5 years (additional 0.7 and 0.4 years respectively) but not for peritoneal dialysis patients.

Age

The median age of prevalent UK patients on RRT at 31st December 2009 was slightly higher (57.7 years) compared with 2008 (57.3 years) (table 2.8), this has changed little in the last few years. There were marked

Table 2.6. Summary of the regional distribution of PCT/HB areas with significantly high, low or normal values of SPR and mean (weighted by PCT/HB size) % non-Whites per region on 31/12/2009

Region	SPR group			Total	Mean % non-White	Weighted mean % non-White
	Low	Normal	High			
NE England	3	9	0	12	4.4	4.2
NW England	10	11	3	24	7.5	7.5
Yorkshire & Humber	5	8	1	14	7.9	9.2
East Midlands	5	1	3	9	11.3	9.0
West Midlands	3	7	7	17	14.1	13.5
East of England	9	4	1	14	9.1	7.9
London	2	4	25	31	28.9	29.3
South Coast of England	5	3	0	8	6.6	6.7
South Central England	3	5	1	9	9.7	8.8
SW England	7	6	1	14	4.7	4.6
England	**52**	**58**	**42**	**152**	**12.6**	**11.3**
N Ireland	**0**	**3**	**2**	**5**	**0.7**	**0.7**
Scotland	**1**	**12**	**1**	**14**	**1.3**	**2.0**
Wales	**1**	**4**	**2**	**7**	**2.0**	**2.1**
UK	**54**	**77**	**47**	**178**	**10.9**	**9.8**

PCT/HB = Primary Care Trust in England, Health and Social Care Areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland
SPR = standardised prevalence ratio

differences between modalities; the median age of HD patients (65.9 years) was greater than those on PD (61.2 years) and substantially higher than those of transplanted patients (50.8 years). These represent slightly older ages compared with 2008. Although the median age for Northern Ireland patients on PD increased by about 3 years from 2008 (59.8 years in 2008 vs. 63.1 years in 2009), the median age for all prevalent RRT patients in Northern Ireland decreased slightly in 2009 (59.2 years in 2008 vs. 58.9 years in 2009). About half of the UK prevalent RRT population were in the age group 40–64 years of age, with Northern Ireland and Wales having a higher proportion (16.9% and 16.4% respectively) of patients older than 75+ years compared with England (14.6%) and Scotland (12.9%) (table 2.9). Furthermore there existed a wide range between centres in the proportion of patients aged over 75 (range 8% to 32%). As a result, prevalent dialysis patients were slightly older in Northern Ireland and Wales compared with the rest of the UK.

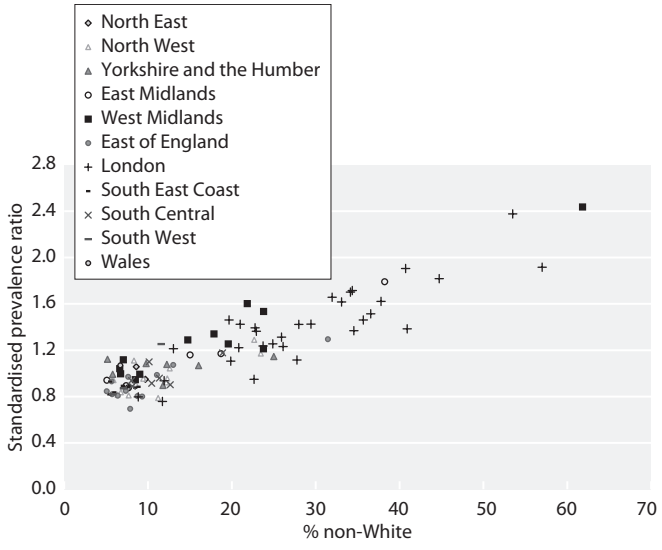

Fig. 2.3. Ethnicity and standardised prevalence ratios for all PCT/HB areas by percentage non-White on 31/12/2009 (excluding areas with <5% ethnic minorities)

Table 2.7. Median time on RRT of prevalent patients on 31/12/2009

Modality	N	Median time treated (years)
Haemodialysis	21,135	3.1
Peritoneal dialysis	3,826	2.0
Transplant	22,159	10.3
All RRT	**47,120**	**5.4**

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

Table 2.8. Median age of prevalent RRT patients by treatment modality by centre on 31/12/2009

Centre	Median age HD	Median age PD	Median age transplant	Median age RRT	Centre	Median age HD	Median age PD	Median age transplant	Median age RRT
Abrdn	65.6	55.8	51.1	56.1	L Rfree	65.2	61.2	49.7	55.4
Airdrie	59.4	54.2	48.6	54.1	L St.G	67.7	63.1	51.3	59.0
Antrim	71.4	68.3	49.6	65.0	L West	66.5	60.8	51.7	57.5
B Heart	67.0	65.0	51.9	63.2	Leeds	66.3	59.1	49.9	55.9
B QEH	65.6	58.7	50.3	56.6	Leic	65.6	64.7	50.6	58.5
Bangor	65.6	69.4		66.3	Liv Ain	62.9	59.7		62.8
Basldn	65.5	70.1	47.5	63.6	Liv RI	62.0	56.9	50.0	53.7
Belfast	63.2	58.4	49.3	53.6	M Hope	62.2	57.8	48.2	55.5
Bradfd	62.2	56.5	49.6	54.5	M RI	61.1	54.0	49.9	53.0
Brightn	71.0	65.4	52.5	62.3	Middlbr	66.6	64.4	50.7	57.7
Bristol	67.2	61.7	52.4	58.6	Newc	63.1	59.0	52.4	56.6
Camb	70.7	57.1	50.9	57.1	Newry	66.6	59.9	51.3	61.9
Cardff	67.8	61.3	50.1	56.2	Norwch	70.2	62.7	49.9	62.9
Carlis	68.2	59.3	51.5	57.7	Nottm	66.3	56.7	48.4	56.4
Carsh	68.8	62.8	50.2	60.5	Oxford	65.9	60.6	50.4	55.7
Chelms	69.4	68.3	56.5	62.8	Plymth	71.4	63.5	53.4	59.0
Clwyd	64.1	53.7	54.7	60.6	Ports	65.7	63.9	51.2	56.7
Colchr	69.4			69.4	Prestn	63.4	59.0	51.8	58.0
Covnt	66.8	64.0	49.3	57.6	Redng	69.5	60.2	55.0	60.7
D & Gall	71.5	58.2	48.2	60.0	Sheff	66.0	62.0	51.1	58.4
Derby	66.2	63.3	53.8	63.3	Shrew	67.4	57.6	51.8	60.8
Derry	65.4	55.7	51.3	60.7	Stevng	66.5	54.8	48.9	59.8
Donc	65.7	60.0	53.8	62.2	Sthend	68.2	60.3	58.0	63.5
Dorset	69.1	69.2	55.7	63.0	Stoke	65.6	59.7	49.6	57.4
Dudley	61.7	61.3	59.1	60.2	Sund	62.7	48.7	50.6	55.9
Dundee	70.6	61.3	53.1	61.5	Swanse	69.3	66.4	52.6	63.4
Dunfn	64.7	65.5	50.8	58.6	Truro	73.4	65.1	54.5	64.1
Edinb	61.0	62.0	50.0	54.9	Tyrone	66.7	64.4	45.4	61.6
Exeter	71.4	63.6	50.5	60.9	Ulster	71.7	54.4	50.1	69.5
Glasgw	63.5	57.2	50.5	55.0	Wirral	64.9	60.3		64.1
Glouc	72.0	55.3	52.8	63.1	Wolve	67.5	58.8	49.2	61.4
Hull	64.9	62.4	50.2	57.3	Wrexm	65.0	68.6	50.6	55.9
Inverns	68.8	70.4	47.4	56.2	York	62.5	57.8	52.2	57.1
Ipswi	65.0	63.8	51.5	57.6	**England**	**65.9**	**61.0**	**50.9**	**57.7**
Kent	68.3	63.2	51.9	60.4	**N Ireland**	**67.3**	**63.1**	**49.5**	**58.9**
Klmarnk	64.7	59.1	48.4	58.9	**Scotland**	**64.4**	**60.0**	**50.2**	**56.4**
L Barts	58.7	58.8	49.4	53.9	**Wales**	**67.6**	**64.8**	**50.9**	**59.3**
L Guys	61.6	57.2	49.9	53.7	**UK**	**65.9**	**61.2**	**50.8**	**57.7**
L Kings	62.8	56.7	51.1	56.1					

Blank cells – no patients for that treatment modality

There were wide inter-centre variations in the median age of patients on RRT (53.0 to 69.5 years). Prevalent dialysis patients in Truro had the highest median age (72.6 years), whilst London Barts and Airdrie had the lowest median ages (58.8 years and 59.2 years respectively) and were the only centres with a prevalent dialysis median age below 60 (table 2.8). The median age of HD patients was slightly less in transplanting than in non-transplanting centres (65.7 vs. 66.6, $p < 0.04$), but there was no significant difference in the median ages of PD and transplant patients. This implies that a major factor accounting for the lower median age of RRT patients in transplanting centres was the large number of transplant patients they follow-up. Transplant centres also tend to be situated in the major cities where a larger proportion of the population are from the ethnic minorities, which are younger. The differing age distributions of the transplant and dialysis populations

Table 2.9. Percentage of prevalent RRT patients in each age group by centre on 31/12/2009

		Percentage of patients			
Centre	N	18–39 years	40–64 years	65–74 years	75+ years
Abrdn	452	17.9	51.8	17.7	12.6
Airdrie	310	19.4	51.3	18.4	11.0
Antrim	215	12.1	37.9	26.6	23.4
B Heart	622	12.7	41.2	26.4	19.8
B QEH	1,821	17.2	49.5	18.3	14.9
Bangor	110	8.2	38.2	24.5	29.1
Basldn	214	15.6	38.7	20.8	25.0
Belfast	680	18.1	53.9	16.2	11.8
Bradfd	422	22.5	47.4	19.2	10.9
Brightn	737	12.9	43.6	23.2	20.4
Bristol	1,223	15.9	50.6	20.8	12.8
Camb	940	17.1	51.3	16.8	14.8
Cardff	1,440	16.5	52.8	17.4	13.3
Carlis	203	13.8	52.2	21.7	12.3
Carsh	1,302	13.4	47.2	20.1	19.3
Chelms	225	11.1	44.9	20.4	23.6
Clwyd	144	9.0	55.6	18.8	16.7
Colchr	116	5.2	35.3	28.4	31.0
Covnt	794	15.0	48.6	21.8	14.6
D & Gall	118	12.7	50.8	16.1	20.3
Derby	419	11.7	43.0	25.1	20.3
Derry	115	15.8	45.6	21.9	16.7
Donc	196	8.7	49.0	22.4	19.9
Dorset	552	12.3	42.2	26.1	19.4
Dudley	292	8.9	51.4	25.0	14.7
Dundee	395	13.7	45.6	23.0	17.7
Dunfn	233	15.9	48.1	23.2	12.9
Edinb	700	16.4	56.1	17.1	10.3
Exeter	731	12.2	47.2	18.9	21.8
Glasgw	1,468	17.2	53.7	17.8	11.3
Glouc	366	10.7	45.1	20.8	23.5
Hull	725	14.9	53.2	18.2	13.7
Inverns	224	18.8	48.2	16.5	16.5
Ipswi	308	13.0	54.5	19.8	12.7
Kent	744	14.1	46.9	22.6	16.4
Klmarnk	273	12.1	54.2	15.4	18.3
L Barts	1,638	18.1	57.3	16.4	8.1
L Guys	1,511	17.7	55.8	15.1	11.4
L Kings	786	15.3	52.7	19.7	12.3
L Rfree	1,546	19.5	50.2	16.9	13.5
L St.G	661	14.1	51.1	20.1	14.7
L West	2,725	13.5	52.7	20.5	13.2
Leeds	1,348	19.3	50.1	17.8	12.8
Leic	1,735	14.4	51.4	19.8	14.5
Liv Ain	146	12.3	42.5	25.3	19.9
Liv RI	1,223	18.6	54.4	16.5	10.5
M Hope	784	17.0	53.3	18.5	11.2
M RI	1,436	19.6	57.2	15.2	8.0
Middlbr	707	14.3	51.2	20.9	13.6
Newc	897	16.7	55.2	16.7	11.4
Newry	167	15.0	41.9	25.7	17.4
Norwch	591	12.8	43.2	21.8	22.3
Nottm	956	18.8	50.9	16.9	13.3
Oxford	1,320	17.6	52.9	18.0	11.5
Plymth	454	13.4	50.0	23.3	13.2

Table 2.9. Continued

Centre	N	Percentage of patients			
		18–39 years	40–64 years	65–74 years	75+ years
Ports	1,301	14.8	54.0	17.4	13.7
Prestn	939	14.1	52.9	19.2	13.8
Redng	618	12.9	46.1	21.0	19.9
Sheff	1,216	13.8	50.0	21.2	15.0
Shrew	337	14.2	45.1	21.7	19.0
Stevng	580	13.4	45.3	23.4	17.8
Sthend	207	10.1	44.4	23.7	21.7
Stoke	640	16.1	48.0	19.8	16.1
Sund	368	15.8	53.8	19.8	10.6
Swanse	598	11.7	41.5	24.6	22.2
Truro	320	11.9	40.9	21.9	25.3
Tyrone	143	20.4	37.3	22.5	19.7
Ulster	114	8.9	27.7	31.3	32.1
Wirral	222	11.3	39.6	24.8	24.3
Wolve	477	10.9	47.0	22.6	19.5
Wrexm	219	18.7	45.7	21.0	14.6
York	321	19.6	44.5	17.8	18.1
England	**40,962**	**15.5**	**50.5**	**19.5**	**14.6**
N Ireland	**1,434**	**16.2**	**45.7**	**21.1**	**16.9**
Scotland	**4,173**	**16.5**	**52.3**	**18.3**	**12.9**
Wales	**2,511**	**14.7**	**49.0**	**19.8**	**16.4**
UK	**49,080**	**15.5**	**50.4**	**19.4**	**14.6**

are illustrated in figure 2.4, demonstrating that the age peak for prevalent dialysis patients is around 25 years later than for prevalent transplant patients.

In the UK on 31st December 2009, 60% of patients aged under 65 years on RRT had a functioning transplant (table 2.15) compared with only 23% aged 65 years and over. This was similar in all four UK countries.

Gender

Standardising the age of the UK RRT prevalent patients by using the age and gender distribution of the UK population by PCT/HB (from ONS mid-2009 population estimates), allowed estimation of crude prevalence rates by age and gender (figure 2.5). This shows a progressive increase in prevalence rate with age, peaking

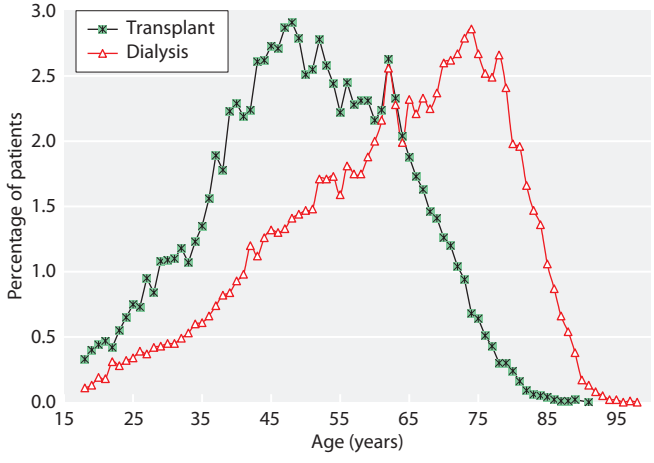

Fig. 2.4. Age profile of prevalent RRT patients by modality on 31/12/2009

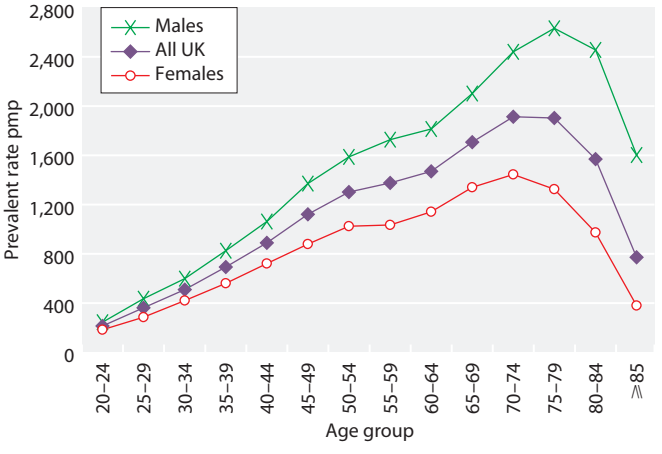

Fig. 2.5. Prevalence rate of RRT patients per million population by age and gender on 31/12/2009

at 1,912 pmp (a slight decrease from 1,925 pmp in 2008) in the age group 70–74 years before showing a reducing prevalence rate in age groups over 80 years. Crude prevalence rates in males exceeded those of females for all age groups, peaking in age group 75–79 years at 2,632 pmp and for females in age group 70–74 years at 1,444 pmp.

Ethnicity

Forty-one of the 72 centres (57%) provided ethnicity data that were at least 90% complete (table 2.10), this was an improvement compared with 2008. Ethnicity completeness for prevalent RRT patients improved in the UK from 81.0% in 2008 to 83.3% in 2009 with a 3.5% improvement in ethnicity completeness in England in 2009. Data from 63 centres had greater than 50% ethnicity returns. Ethnicity completeness is generally slightly worse in prevalent HD patients with the best ethnicity completeness recorded for prevalent transplant patients, this may relate to the fact that the intensive work-up for transplantation may increase the recording of data.

In 2009, 16.1% of the prevalent UK RRT population (with assigned ethnicity) were from ethnic minorities and 18.9% in England were from ethnic minorities. The proportions in Wales, Scotland and Northern Ireland were very small, although there was a high level of missing ethnicity data in Scotland (where ethnicity is not a mandated item). This compared with approximately 12% [1] of the UK general population who were designated as belonging to an ethnic minority. The number of patients reported to the UKRR as receiving RRT and belonging to an ethnic minority has doubled in the last 5 years which may be due to both improvements in coding of ethnicity as well as increasing incidence of ERF in these populations.

Among the centres with more than 50% returns, there was wide variation between centres with respect to the proportion of patients from ethnic minorities, ranging from 0% in one centre (Derry) to over 40% in London Barts (56.5%), London Royal Free (47.8%) and London Kings (45.0%). Centres with an ethnic minority population greater than 10% had the higher number of prevalent patients on RRT, both on dialysis and with functioning transplants. Sixty one percent of transplanting centres had an ethnic minority population greater than 10% compared with 23% of non-transplanting centres.

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

Primary renal diagnosis

Data for primary renal diagnosis (PRD) were not sent in 3.3% of patients (4.4% in 2008) and there remained a marked inter-centre difference in completeness of data returns. Where centres had ⩾50% primary renal diagnosis data not sent they were excluded from the following analyses. The UKRR is also concerned about some centres with very high rates of primary renal diagnosis uncertain (EDTA codes 00 and 10). It is accepted that there will inevitably be a number of patients with uncertain aetiology and that the proportion of these patients will vary between clinicians and centres as the definitions of renovascular disease, hypertensive nephropathy and chronic glomerulonephritis (GN) without tissue diagnosis remain relatively subjective. However, some centres with very high rates of uncertain diagnosis appear to also have fewer patients with the more objective diagnoses such as polycystic kidney disease or biopsy-proven GN. It is believed that the software in these centres defaults any missing data to 'uncertain' (EDTA code 00). This issue has been raised with the centres and software suppliers in 2010 and although not completely resolved for the current data collection, the situation has improved markedly. As a result, only one centre with ⩾40% 'uncertain' diagnosis has been excluded from the inter-centre analysis and the UK and national totals have been adjusted. The two centres with a high rate of primary renal diagnosis uncertain and data not sent have also been excluded from other analyses where PRD is included in the case-mix adjustment.

Biopsy-proven glomerulonephritis remained the most common specific primary renal diagnosis in the 2009 prevalent cohort at 16.0% (table 2.11), although 20.6% of patients had an uncertain diagnostic code. Diabetes accounted for 14.7% of renal disease in the prevalent patients on RRT, although it was more common in the ⩾65-year age group compared to the under 65 age group (16.8% vs. 13.7%). This contrasted with the pattern seen in incident patients where diabetes is the predominant specific diagnostic code in 25% of new RRT patients. This reflects the different ages and survival of patients with these diagnoses; it is the younger fitter patients who survive longest and contribute highly to the prevalent numbers. Younger patients (age <65 years) are more likely to have a specific diagnosis and far less likely to have renal vascular disease or hypertension as the cause of their renal failure.

There was wide inter-centre variation in the proportion of primary renal diagnoses not sent in the RRT prevalent population, with 3 centres having >20% not

Table 2.10. Ethnicity of prevalent RRT patients by centre on 31/12/2009

Centre	N	% White	% Black	% Asian	% Chinese	% Other	% Missing
Abrdn	452	50.0	0.0	0.4	0.4	0.2	48.9
Airdrie	310	37.7	0.0	1.0	0.0	0.0	61.3
Antrim	215	99.1	0.0	0.9	0.0	0.0	0.0
B Heart	622	62.5	7.2	28.6	0.5	1.0	0.2
B QEH	1,821	66.1	9.8	20.8	0.9	2.0	0.4
Bangor	110	55.5	1.8	0.0	0.0	0.0	42.7
Basldn	214	91.5	3.8	2.4	0.5	0.9	0.9
Belfast	680	95.4	0.1	0.4	0.0	0.1	3.8
Bradfd	422	55.5	2.8	35.8	0.0	1.2	4.7
Brightn	737	76.3	1.9	4.3	0.0	0.7	16.8
Bristol	1,223	89.7	4.2	3.2	0.5	1.1	1.3
Camb	940	90.9	1.2	3.5	0.3	0.9	3.3
Cardff	1,440	61.1	0.6	2.2	0.5	0.0	35.6
Carlis	203	98.0	0.0	0.5	0.0	0.0	1.5
Carsh	1,302	71.9	8.1	10.3	1.8	2.7	5.3
Chelms	225	71.1	2.2	1.8	1.8	1.8	21.3
Clwyd	144	60.4	0.0	0.0	0.7	0.0	38.9
Colchr	116	38.8	0.0	1.7	0.9	0.9	57.8
Covnt	794	79.1	3.0	12.5	0.5	0.1	4.8
D & Gall	118	10.2	0.0	0.0	0.0	0.0	89.8
Derby	419	79.5	3.8	10.0	0.5	0.2	6.0
Derry	115	96.5	0.0	0.0	0.0	0.0	3.5
Donc	196	95.9	0.5	2.6	0.5	0.0	0.5
Dorset	552	97.3	0.2	0.7	0.9	0.9	0.0
Dudley	292	86.3	2.7	9.2	0.7	0.0	1.0
Dundee	395	54.9	0.0	0.8	0.0	0.3	44.1
Dunfn	233	23.6	0.0	0.0	0.0	0.4	76.0
Edinb	700	6.6	0.0	0.7	0.1	0.0	92.6
Exeter	731	95.2	0.5	0.3	0.3	0.1	3.6
Glasgw	1,468	7.4	0.0	1.2	0.1	0.0	91.3
Glouc	366	71.9	0.3	0.5	0.5	0.3	26.5
Hull	725	39.6	0.3	0.3	0.1	0.4	59.3
Inverns	224	46.9	0.0	0.4	0.0	0.0	52.7
Ipswi	308	79.9	1.9	2.6	0.3	0.6	14.6
Kent	744	85.8	0.9	1.6	0.1	0.5	11.0
Klmarnk	273	7.0	0.0	0.0	0.4	0.0	92.7
L Barts	1,638	42.7	27.7	25.5	2.0	1.3	0.9
L Guys	1,511	53.4	22.0	2.2	1.1	0.1	21.2
L Kings	786	52.2	32.2	10.7	1.5	0.6	2.8
L Rfree	1,546	50.0	19.6	18.1	1.6	8.5	2.1
L St.G	661	48.1	20.7	7.4	1.7	6.1	16.0
L West	2,725	33.9	12.0	17.7	0.6	7.8	28.0
Leeds	1,348	74.8	3.6	12.2	0.0	1.5	8.0
Leic	1,735	74.1	3.5	16.7	0.2	1.0	4.5
Liv Ain	146	55.5	1.4	0.7	0.7	0.7	41.1
Liv RI	1,223	80.4	1.6	1.1	1.2	0.7	15.0
M Hope	784	82.5	1.4	13.8	0.4	1.7	0.3
M RI	1,436	79.7	5.4	11.1	0.8	0.1	2.9
Middlbr	707	94.1	0.3	2.8	0.1	0.1	2.5
Newc	897	95.1	0.4	2.7	0.6	1.0	0.2
Newry	167	98.8	0.0	0.0	0.6	0.0	0.6
Norwch	591	80.1	0.3	0.7	0.7	0.2	18.0
Nottm	956	87.6	5.1	6.1	0.0	1.2	0.1
Oxford	1,320	80.1	3.0	7.3	0.8	2.0	6.9
Plymth	454	54.2	1.5	0.0	0.2	0.4	43.6
Ports	1,301	92.8	1.2	2.5	0.6	1.0	2.0

Table 2.10. Continued

Centre	N	% White	% Black	% Asian	% Chinese	% Other	% Missing
Prestn	939	79.1	0.9	12.4	0.0	0.6	7.0
Redng	618	73.0	6.1	18.3	0.6	1.9	0.0
Sheff	1,216	78.2	1.4	3.0	0.4	0.8	16.2
Shrew	337	95.3	1.2	2.4	0.0	0.3	0.9
Stevng	580	73.6	8.8	16.4	0.5	0.7	0.0
Sthend	207	86.5	0.5	1.0	1.9	0.0	10.1
Stoke	640	47.0	0.2	2.3	0.3	0.5	49.7
Sund	368	95.4	1.1	1.6	0.5	0.3	1.1
Swanse	598	97.7	0.5	1.0	0.0	0.2	0.7
Truro	320	64.7	1.9	0.0	0.3	0.0	33.1
Tyrone	143	98.6	0.7	0.0	0.0	0.0	0.7
Ulster	114	99.1	0.0	0.0	0.9	0.0	0.0
Wirral	222	95.0	0.5	0.9	1.4	0.9	1.4
Wolve	477	73.0	8.8	16.6	0.4	0.0	1.3
Wrexm	219	98.6	0.0	0.5	0.0	0.5	0.5
York	321	88.2	0.3	0.3	0.0	0.3	10.9
England	**40,962**	**71.1**	**6.9**	**9.6**	**0.7**	**1.7**	**9.9**
N Ireland	**1,434**	**97.1**	**0.1**	**0.4**	**0.1**	**0.1**	**2.2**
Scotland	**4,173**	**21.7**	**0.0**	**0.7**	**0.1**	**0.1**	**77.3**
Wales	**2,511**	**72.8**	**0.6**	**1.6**	**0.3**	**0.1**	**24.7**
UK	**49,080**	**67.8**	**5.8**	**8.2**	**0.6**	**1.5**	**16.2**

(Appendix H ethnicity coding structure http://www.renalreg.com/Report-Area/Report2010/Appendix-H.pdf)

sent (Exeter 21%, London Royal Free 46% and Truro 22%). Uncertain primary renal diagnosis also ranged widely between centres and 5 centres had >30% uncertain diagnosis (Cambridge 31%, Bangor 33%, Liverpool RI 36%, Manchester Hope 37% and Stevenage 31%).

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

In older patients (age ⩾65 years) the transplant rate was generally much lower for all primary renal diagnoses,

Table 2.11. Primary renal diagnosis in prevalent RRT patients by age and gender on 31/12/2009

Primary diagnosis*	N	% all patients	Inter centre range %	N age <65	% age <65	N age ⩾65	% age ⩾65	M:F ratio
Aetiology uncertain/GN (not biopsy proven)**	10,026	20.6	6.3–37.4	5,923	18.4	4,103	24.8	1.6
GN (biposy proven)**	7,812	16.0	7.5–22.3	6,053	18.8	1,759	10.6	2.2
Pyelonephritis	5,782	11.9	3.8–18.7	4,361	13.5	1,421	8.6	1.1
Diabetes	7,184	14.7	6.7–25.2	4,401	13.7	2,783	16.8	1.5
Polycystic kidney	4,676	9.6	4.3–17.0	3,207	10.0	1,469	8.9	1.1
Hypertension	2,799	5.7	0.9–14.1	1,612	5.0	1,187	7.2	2.3
Renal vascular disease	1,652	3.4	0.8–13.2	358	1.1	1,294	7.8	1.9
Other	7,189	14.8	9.5–23.5	5,290	16.4	1,899	11.5	1.3
Not sent	1,622	3.3	0.1–46.1	1,010	3.1	612	3.7	1.5

* See appendix H: ERA-EDTA coding http://www.renalreg.com/Report-Area/Report 2010/Appendix-H.pdf
** GN = glomerulonephritis
Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)

Table 2.12. Transplant:dialysis ratio by age and primary renal diagnosis in the prevalent RRT population on 31/12/2009

	Transplant:dialysis ratio	
Primary diagnosis*	<65	⩾65
Aetiology uncertain/ GN (not biopsy proven)**	1.7	0.3
GN (biopsy proven)**	2.0	0.5
Pyelonephritis	2.3	0.3
Diabetes	0.7	0.1
Polycystic kidney	1.8	1.2
Hypertension	1.0	0.3
Renal vascular disease	0.8	0.1
Other	1.6	0.3
Not sent	1.4	0.2

* See appendix H: ERA-EDTA coding http://www.renalreg.com/Report-Area/Report 2010/Appendix-H.pdf
** GN = glomerulonephritis
Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)

with the exception of polycystic kidney disease with a transplant:dialysis ratio of 1.2. (table 2.12).

Diabetes

Diabetes included all prevalent patients with type 1 or type 2 diabetes as primary renal diagnosis (ERA-EDTA coding) and did not include patients with diabetes as a comorbidity. This analysis did not differentiate between type 1 and type 2 diabetes as this distinction was not made in the data submitted by some centres.

The number of prevalent patients with diabetes as a primary renal diagnosis increased to 7,184 in 2009, representing 14.7% of all prevalent patients (tables 2.13 and 2.14). The median age at start of RRT for patients with diabetes was 9 years higher compared with patients without diabetes, although the median age at the end of 2009 for diabetic patients was only 3 years higher. This reflected reduced survival for patients with diabetes compared with patients without diabetes on RRT. Median time on RRT for patients with diabetes was less compared with patients without diabetes (3.1 years vs. 6.4 years). Patients with diabetes starting RRT in Scotland were 4 years younger and in Northern Ireland 4 years older compared with the UK average.

Table 2.13. Median age, gender ratio and treatment modality in diabetic and non-diabetic prevalent RRT patients on 31/12/2009

	Diabetics	Non-diabetics
Number	7,184	39,936
M:F ratio	1.55	1.52
Median age on 31/12/08	60	57
Median age at start of RRT	56	47
Median years on RRT	3.1	6.4
% HD	62	41
% PD	10	8
% transplant	29	51

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Diabetes as the primary renal diagnosis also influenced the modality distribution. The predominant mode of treatment for patients with diabetes was HD (62%). The percentage of patients with a functioning transplant was much lower in prevalent patients with diabetes than in prevalent patients without diabetes (29% vs. 51%). As would be expected, this difference was even more pronounced for older patients with diabetes (age ⩾65 years) (table 2.14), with only 7.8% of older prevalent patients with diabetes having a functioning transplant compared with 26.3% of their non-diabetic peers. In Northern Ireland, only 22% of prevalent

Table 2.14. Age relationships in diabetic and non-diabetic patients and modality in prevalent RRT patients on 31/12/2009

	<65		⩾65	
	Diabetics	Non-diabetics	Diabetics	Non-diabetics
N	4,401	26,804	2,783	13,132
% HD	48.2	29.4	82.7	64.2
% PD	9.7	6.9	9.5	9.5
% transplant	42.1	63.7	7.8	26.3

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code

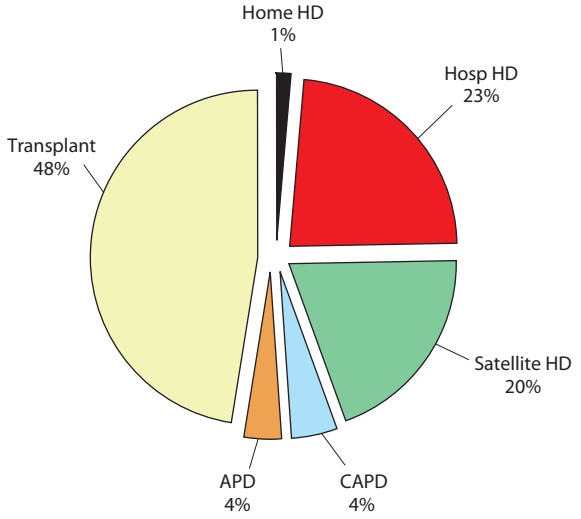

Fig. 2.6. Treatment modality in prevalent RRT patients on 31/12/2009

patients with diabetes had a functioning transplant compared with the UK average of 29% although Northern Ireland diabetic patients were older. More prevalent patients without diabetes were on home dialysis therapies (home HD and PD) compared with prevalent patients with diabetes where the predominant treatment modality was hospital and satellite HD.

Modalities of treatment

Transplantation was the most common treatment modality (48%) for prevalent RRT patients in 2009, followed closely by centre-based HD (43%) in either hospital centre (23%) or satellite unit (20%) (figure 2.6). Home therapies made up the remaining 9% of treatment therapies, largely PD in its different formats (8%). This represented a 1% fall in PD compared with 9% of therapies in 2008. The proportion of PD patients on continuous ambulatory peritoneal dialysis (CAPD) and automated PD (APD) was 4.3% and 3.8% respectively, though the proportion on APD may be an underestimate due to centre coding issues which mean the UKRR cannot always distinguish between these therapies. The term CAPD has been used for patients receiving non-disconnect as well as disconnect CAPD systems, because the proportion of patients using non-disconnect systems was very small. The number of patients on home HD has stopped falling and is beginning to show a slight rise (see below).

As mentioned earlier, treatment modality was related to patient age. Younger patients (age <65 years), were more likely to have a functioning transplant (60.3%) when compared with patients aged over 65 years (22.5%) (table 2.15). HD was the principal modality in the older patients (68.0%). There were differences among the four UK countries with respect to the proportion of prevalent patients on PD according to age. England and Wales had a higher proportion of older prevalent patients on PD.

Figure 2.7 shows the effect of age on modality distribution. With increasing age beyond 64 years, transplant prevalence reduced, whilst HD prevalence increased. The proportion of each age group treated by PD remained fairly stable across the age spectrum.

The proportion of prevalent dialysis patients receiving HD, ranged from 71.8% in Bangor to 100% in Colchester (table 2.16).

The number of centres with no prevalent HD patients reported as treated at satellite units decreased in 2009, although some of these centres were unable to record these data in their renal IT systems. Overall the proportion of dialysis patients treated in a satellite haemodialysis centre has increased to 36% this year compared to 35% in 2008 and 32% in 2007. Although there are satellite units in Scotland, the data are not provided to distinguish between main centre and satellite unit haemodialysis except for the Glasgow renal centre. There was an increase in the number of centres to 25 in 2009 that had more than 50% of their HD activity

Table 2.15. Treatment modalities by age in UK countries on 31/12/2009

	<65 years				⩾65 years			
UK country	N	% HD	% PD	% transplant	N	% HD	% PD	% transplant
England	27,017	32.4	7.5	60.1	13,945	67.7	9.6	22.7
N Ireland	886	35.1	5.1	59.8	548	75.4	6.1	18.6
Scotland	2,871	32.9	6.4	60.7	1,302	69.4	8.0	22.6
Wales	1,601	29.8	7.2	63.0	910	66.8	12.3	20.9
UK	**32,375**	**32.4**	**7.3**	**60.3**	**16,705**	**68.0**	**9.5**	**22.5**

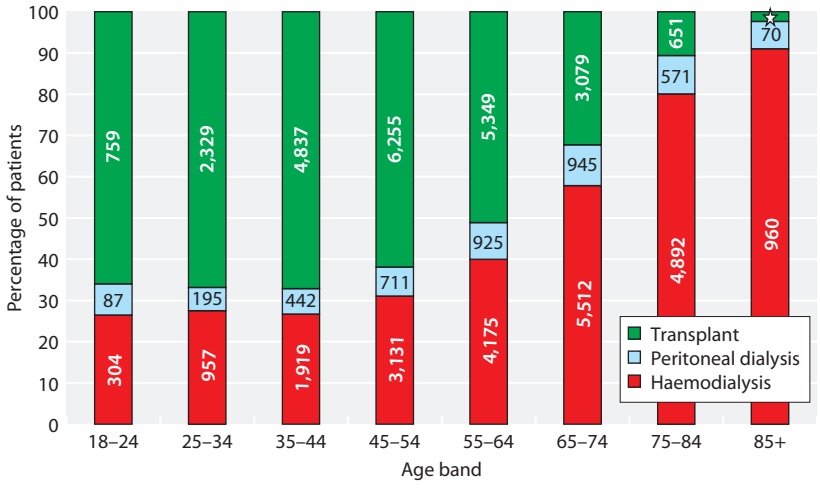

Fig. 2.7. Treatment modality distribution by age in prevalent RRT patients on 31/12/2009
* Transplant in age group 85+, N = 25

taking place in satellite units (table 2.16 and figure 2.8). There was also wide variation between centres in the proportion of PD patients on APD treatment, ranging from 0 to 17.5% (table 2.16). Twelve of the 71 centres with a PD programme had no patients on APD, whilst in four Northern Ireland centres all PD patients were on this form of the modality. Cambridge PD patients (n = 39) were all reported as receiving unknown PD and are not included in table 2.16.

Home haemodialysis

The proportion of prevalent dialysis patients on home HD has been declining since the first recorded prevalence numbers in 1982, when it was 43.0% of all dialysis

Table 2.16. Percentage of prevalent dialysis patients by dialysis modality by centre on 31/12/2009

		Haemodialysis				Peritoneal dialysis	
Centre	N	Total	Home	Hospital	Satellite	CAPD	APD
Abrdn*	227	86.8	3.1	83.7	0.0	6.2	7.1
Airdrie*	180	92.8	0.0	92.8	0.0	3.3	3.9
Antrim**	140	89.9	1.4	88.5	0.0	1.4	8.6
B Heart	465	92.9	2.8	82.8	7.3	6.7	0.4
B QEH	1,024	84.5	2.0	18.4	64.2	6.5	9.1
Bangor	110	71.8	4.6	67.3	0.0	11.8	16.4
Basldn	171	83.4	0.0	83.4	0.0	6.5	10.1
Belfast	282	87.2	4.3	82.9	0.0	2.1	10.3
Bradfd	225	84.9	0.0	69.3	15.6	4.4	10.7
Brightn	415	79.3	8.2	38.6	32.5	9.9	10.8
Bristol	519	85.6	5.6	15.8	64.2	8.9	5.6
Camb	384	89.8	2.3	37.0	50.5	0.0	0.0
Cardff	612	83.0	5.9	18.1	59.0	17.0	0.0
Carlis	81	81.5	0.0	59.3	22.2	6.2	12.4
Carsh	789	84.4	0.6	31.2	52.6	5.8	9.8
Chelms	155	76.1	0.7	75.5	0.0	17.4	6.5
Clwyd	83	91.6	1.2	90.4	0.0	6.0	2.4
Colchr	116	100.0	0.0	100.0	0.0	0.0	0.0
Covnt	429	80.9	1.2	79.7	0.0	19.1	0.0
D & Gall*	64	81.3	0.0	81.3	0.0	9.4	9.4
Derby	334	74.0	4.2	69.8	0.0	21.0	5.1
Derry**	69	95.6	1.5	94.1	0.0	0.0	4.4
Donc	154	78.6	0.0	60.4	18.2	3.9	17.5
Dorset	286	79.7	1.1	23.8	54.9	9.4	10.8
Dudley	212	73.6	0.9	51.4	21.2	26.4	0.0
Dundee*	210	86.7	0.0	86.7	0.0	2.4	11.0

Table 2.16. Continued

		Haemodialysis				Peritoneal dialysis	
Centre	N	Total	Home	Hospital	Satellite	CAPD	APD
Dunfn*	137	83.2	0.0	83.2	0.0	2.2	14.6
Edinb*	336	81.6	2.4	79.2	0.0	6.9	11.6
Exeter	404	82.7	0.5	34.2	48.0	10.2	7.2
Glasgw	683	91.4	4.1	70.3	17.0	6.4	2.2
Glouc	228	81.1	0.0	81.1	0.0	4.4	14.0
Hull	406	81.8	3.2	39.2	39.4	5.9	12.3
Inverns*	112	80.4	2.7	77.7	0.0	8.9	10.7
Ipswi	153	71.9	2.0	62.1	7.8	15.7	11.8
Kent	406	83.0	2.2	23.9	56.9	17.0	0.0
Klmarnk*	186	79.6	3.8	75.8	0.0	4.8	15.6
L Barts	900	79.1	0.8	29.4	48.9	8.1	12.8
L Guys	629	92.1	5.3	24.5	62.3	3.0	4.9
L Kings	480	82.3	0.0	29.2	53.1	5.8	11.9
L Rfree	719	90.3	2.0	37.1	51.2	2.5	7.2
L St.G	327	80.7	2.1	43.1	35.5	7.3	11.9
L West	1,313	97.3	0.8	29.9	66.5	1.1	1.6
Leeds	605	82.5	2.6	15.4	64.5	5.3	12.2
Leic	917	81.9	2.3	18.7	61.0	6.3	11.8
Liv Ain	146	95.2	2.1	8.2	84.9	1.4	3.4
Liv RI	492	81.9	2.6	43.3	36.0	7.3	10.6
M Hope	466	74.5	0.0	34.6	39.9	21.2	4.3
M RI	536	80.8	11.2	26.3	43.3	4.1	15.1
Middlbr	315	93.7	2.2	33.3	58.1	6.0	0.3
Newc	330	83.6	3.0	80.6	0.0	2.1	14.2
Newry**	115	89.6	3.5	86.1	0.0	0.0	10.4
Norwch	370	84.2	3.5	48.1	32.6	12.5	3.0
Nottm	519	78.6	2.9	48.6	27.2	6.6	14.8
Oxford	482	78.4	4.6	73.9	0.0	9.3	12.2
Plymth	169	75.2	1.8	73.4	0.0	16.0	8.9
Ports	571	83.4	0.0	23.5	59.9	16.6	0.0
Prestn	558	86.0	4.7	21.3	60.0	4.5	9.3
Redng	354	76.0	0.3	62.2	13.6	24.0	0.0
Sheff	672	89.3	6.9	35.9	46.6	10.7	0.0
Shrew	224	87.1	1.3	47.3	38.4	13.0	0.0
Stevng	408	92.9	0.0	35.5	57.4	7.1	0.0
Sthend	147	86.4	0.0	86.4	0.0	13.6	0.0
Stoke	373	80.7	1.6	50.4	28.7	5.4	13.9
Sund	206	86.4	0.5	66.5	19.4	5.8	7.8
Swanse	408	85.5	3.4	52.9	29.2	11.5	3.0
Truro	181	84.5	1.7	43.7	39.2	5.0	10.5
Tyrone**	101	89.0	1.0	88.0	0.0	0.0	11.0
Ulster**	97	97.9	2.1	95.8	0.0	0.0	2.1
Wirral	222	84.2	1.4	36.0	46.9	5.0	10.8
Wolve	351	85.5	0.9	25.1	59.5	14.3	0.3
Wrexm	100	73.0	3.0	70.0	0.0	26.0	1.0
York	206	92.2	1.0	64.1	27.2	7.3	0.5
England	**21,544**	**84.4**	**2.4**	**39.6**	**42.5**	**8.2**	**7.2**
N Ireland**	**804**	**90.2**	**2.8**	**87.5**	**0.0**	**1.0**	**8.7**
Scotland*	**2,135**	**86.6**	**2.5**	**78.6**	**5.4**	**5.6**	**7.8**
Wales	**1,313**	**82.6**	**4.5**	**42.7**	**35.4**	**14.9**	**2.5**
UK	**25,796**	**84.7**	**2.5**	**46.2**	**36.0**	**8.1**	**7.0**

* All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

** There are no satellite centres in Northern Ireland

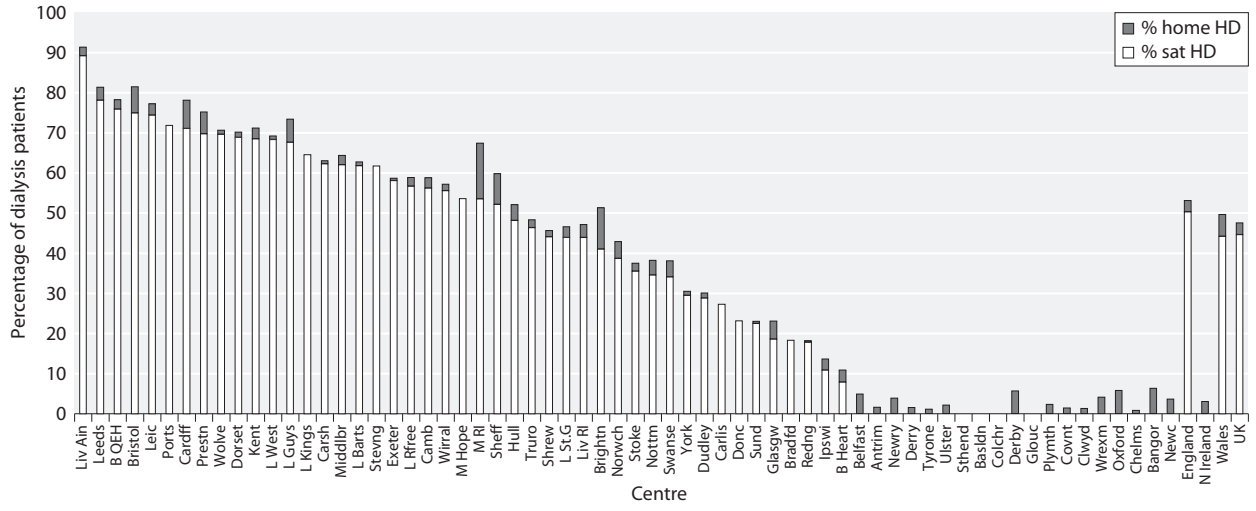

Fig. 2.8. Percentage of prevalent haemodialysis patients treated with satellite or home haemodialysis by centre on 31/12/2009
* Scottish centres (except Glasgow) excluded as information on satellite HD was not available

patients reducing to 2.5% of all dialysis patients in 2009 (figure 2.2 and table 2.16). There was a peak in the number of home haemodialysis patients in 1983, when 59% of HD patients were on home HD (about 2,200 patients, albeit fewer older patients were receiving RRT in this era). With the increase in the HD programme size, number of renal centres and provision of satellite HD there has been a continued fall in numbers of patients on home HD until 2003 when numbers levelled off and stabilised. In 2003 only 430 patients were on home HD and this number increased gradually over the years to 645 prevalent patients on home HD in 2009, accounting for 3.0% of the HD patient population.

In 2009, the percentage of dialysis patients receiving home HD varied from 0% in 15 centres, to greater than 5% in 6 centres, namely Brighton 8.2%, Bristol 5.6%, Cardiff 5.9%, London Guys 5.3%, Manchester RI 11.2% and Sheffield 6.9% (table 2.16).

There was some evidence of a slow increase in home HD activity since the 2002 NICE guidance was issued encouraging increased rates of home haemodialysis treatment [5]. The number of prevalent dialysis patients on home HD increased from 2.1% in 2008 to 2.5% in 2009. This increase was mainly due to an increase in prevalent dialysis patients on home HD in Wales and Northern Ireland (1.7% in 2008 vs. 2.8% in 2009) at renal centres in Belfast, Derry and Ulster. Improved coding of patients on home HD in Wales resulted in an increase in the number of prevalent patients returned to the UKRR, in particular the 2008 numbers were an underestimate of the true number of patients in Cardiff on this treatment modality. Of the 15 centres with no patients recorded to be on home haemodialysis in 2008, two centres (Derry 1.5% and Wolverhampton 0.9%) subsequently reported patients on this modality in 2009. Notable increases in the proportion of prevalent dialysis patients on home HD in 2008 compared with 2009 [3], were seen at Belfast (2.6% vs. 4.3%), Brighton (5.7% vs. 8.2%), Derry (0% vs. 1.5%), Kilmarnock (0.5% vs. 3.8%), Liverpool RI (1.2% vs. 2.6%) and Newry (1.8% vs. 3.5%). In 17 centres, the proportion of prevalent dialysis patients on home HD decreased slightly in 2009 compared with the previous year.

Change in modality

The relative proportion of RRT modalities in prevalent patients has changed dramatically over the past decade. The main features are depicted in figure 2.9, which describes a sustained decrease in the proportion of patients treated by PD after 2000. Possible explanations for this change include recently published evidence

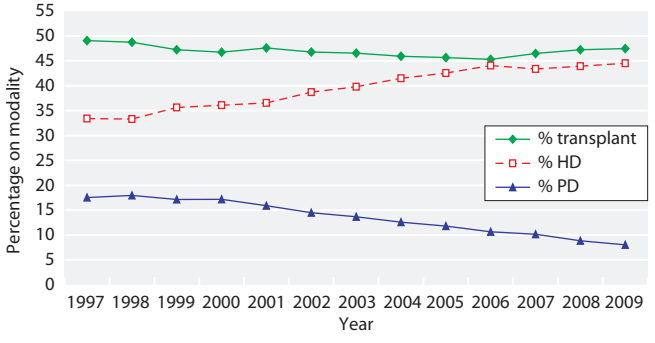

Fig. 2.9. Modality changes in prevalent RRT patients from 1997–2009

indicating that the equivalent survival demonstrated between HD and PD was only maintained for the first 2–3 years [6] and recent concerns regarding the risk of encapsulating peritoneal sclerosis which might result in patients being switched from PD to HD after a fixed time interval. Analysis of UKRR data has shown that this is not the explanation as the vintage of PD patients has not changed substantially over the last 8 years. The reduction in prevalent PD patients was due to a decrease in the number of new patients who were started on peritoneal dialysis in 2008 and 2009 and also to the declining proportion of patients starting RRT on peritoneal dialysis since 2001. The determinants of this pattern may be multi-factorial and include: an increase in HD capacity with the proliferation of satellite units, the effect of patient or physician choice regarding the treatment modality at start of RRT, the general health and fitness of patients starting RRT some of whom may be deemed less capable of undertaking PD independently and the rise in the number of patients receiving a live related transplant who may otherwise have gone onto PD. With the advent of assisted PD (more commonly used in France) [7] in conjunction with the increasing age of PD patients, there may be potential for some reversal or slowing in this decline.

The proportion of patients treated by HD was still increasing, although at a slower rate, and it may have begun to plateau from 2007 onwards. The proportion of patients with a functioning transplant had been on a slight downward trend but this has reversed since 2007, probably due to continued increases in living organ and non-heart beating donation [8]. It is worth noting that the proportion of patients with a functioning transplant in 2009 was only marginally higher compared with 2008.

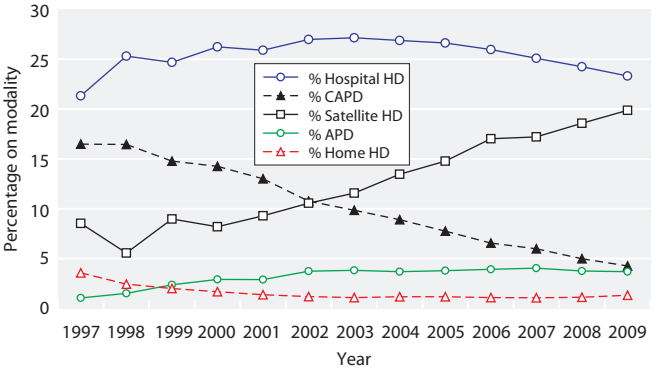

Fig. 2.10. Detailed dialysis modality changes in prevalent RRT patients from 1997–2009
* Scottish centres excluded as information on satellite HD is not available

Figure 2.10 depicts in more detail the modality changes in the prevalent dialysis population during this time and highlights a sustained reduction in the proportion of patients treated by CAPD. There was a sustained increase in the proportion of prevalent HD patients treated at satellite units with a steady decline in hospital centre haemodialysis since 2004.

International comparisons

Prevalence rates in the UK are similar to those in most other Northern European countries but lower than in Southern Europe and far lower than in the USA (figure 2.11).

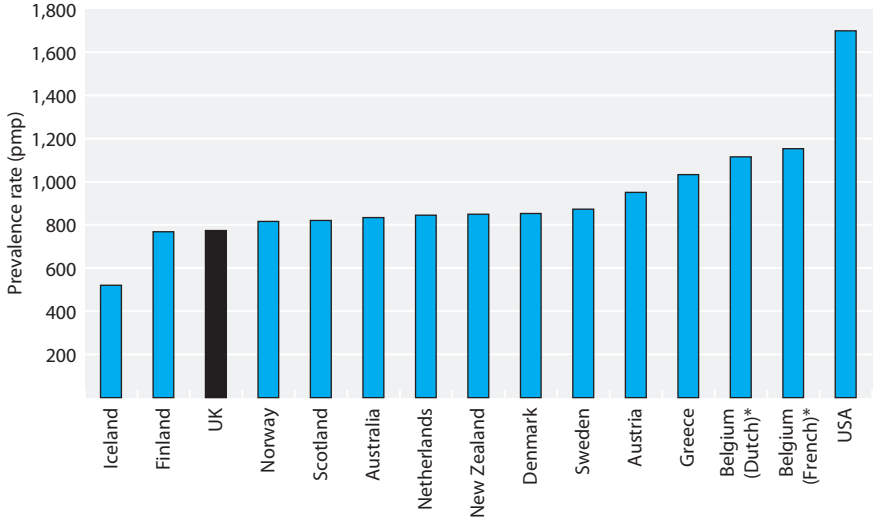

Fig. 2.11. RRT Prevalence rates (pmp) by country (latest available data)
* Data from USRDS, ERA-EDTA Registry and ANZDATA

Summary

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

Conflicts of interest: none

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Chapter 3
Demographic and Biochemistry Profile of Kidney Transplant Recipients in the UK in 2009: national and centre-specific analyses

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Key Words
Blood pressure · Bone metabolism · Chronic kidney disease · Deceased donor · eGFR · Epidemiology · Ethnicity · Graft function · Haemoglobin · Live donor · Primary renal diagnosis · Renal transplantation · Outcomes · Survival

Summary

- In 2009, renal transplant failure rates in prevalent patients remained stable at 2.9% per annum and transplant patient death rates remained stable at 2.5 per 100 patient years.
- The median age of incident and prevalent renal transplant patients in the UK was 48.4 and 50.8 years respectively.
- The median eGFR of prevalent renal transplant recipients was 49.9 ml/min/1.73 m^2.
- The median eGFR of patients one year post-live donor transplant was 54.1 ml/min/1.73 m^2.
- The median eGFR of patients one year post-deceased donor transplant was 50.1 ml/min/1.73 m^2.
- Of prevalent transplant patients, 14.3% had moderate to advanced renal impairment with an eGFR <30 ml/min/1.73 m^2.
- The median one year post-transplant haemoglobin for patients transplanted between 2002–2008 was 13.0 g/dl.
- In prevalent renal transplant patients the percentage with BP $<130/80$ (systolic BP <130 **and** diastolic BP <80 mmHg) was higher (29.6% vs. 24.2%) in those with better renal function (eGFR $\geqslant 45$ ml/min/1.73 m^2).
- In 2009, infection (28%), malignancy (23%) and cardiac disease (18%) were the commonest causes of death of prevalent transplant patients.

Introduction

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

This chapter is divided into 5 sections: (1) transplant activity, waiting-list and survival data; (2) transplant demographics; (3) clinical and laboratory outcomes; (4) analysis of prevalent patients by chronic kidney disease (CKD) stage; and (5) causes of death in transplant recipients. Methodology, results and conclusions of these analyses are discussed in detail for all five sections separately.

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

Unless otherwise specified, prevalent transplant patients were defined as patients with a functioning renal transplant on the 31st December 2009.

Transplant activity, waiting-list activity and survival data

Introduction

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

NHSBT attributes a patient to the centre that performed the transplant operation irrespective of where the patient was cared for before or after the procedure and hence only reports on transplant centre performance. Patients whose clinical management subsequently transfers back to a dialysis centre may be lost to NHSBT follow-up, but since all dialysis and transplant renal centres in the UK return data to the UKRR or Scottish Renal Registry, follow-up data are available for such patients.

Method

There are 23 UK adult renal transplant centres with 19 in England, 2 in Scotland and 1 each in Northern Ireland and Wales.

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

Results

During 2009, 2,600 kidney or kidney plus other organ transplants were performed. The absolute numbers of live donor and donor after cardiac death transplants continued to increase and comprised 37.8% and 19.1% of all kidney transplants performed respectively (table 3.1).

There are small differences in one and five year risk-adjusted patient and graft survival rates amongst UK renal transplant centres (table 3.2). These graft survival rates include grafts with primary non-function (which are excluded in some countries).

Using data from the UKRR on prevalent renal-only transplant patients on 1st January 2009, the death rate during 2009 was 2.5/100 patient years (CI 2.3–2.7) when censored for return to dialysis and 2.6/100 patient years (CI 2.4–2.9) without censoring for dialysis. These death rates are similar to those observed over the last few years.

During 2009, 2.9% of prevalent transplant patients experienced graft failure (excluding death as a cause of graft failure). This figure has remained almost constant since 2003.

Table 3.1. Kidney and kidney plus other organ transplant numbers in the UK, 1/1/2007–31/12/2009

Organ	2007	2008	2009	% change 2008–2009
Donor after brainstem death[a]	907	944	945	0
Donor after cardiac death[b]	300	439	496	13
Living donor kidney	804	924	983	6
Kidney and liver	9	17	15	−12
Kidney and heart	1	0	1	
Kidney and pancreas[c]	197	162	160	−1
Total kidney transplants	**2,218**	**2,486**	**2,600**	**5**

[a] Includes en bloc kidney transplants (6 in 2007, 3 in 2008, 3 in 2009) and double kidney transplants (5 in 2007, 1 in 2008, 6 in 2009)
[b] Includes en bloc kidney transplants (2 in 2008, 1 in 2009) and double kidney transplants (5 in 2007, 3 in 2008, 4 in 2009)
[c] Includes donor after cardiac death transplants (13 in 2007, 16 in 2008, 19 in 2009) and transplant including liver (1 in 2007, 1 in 2009)

Conclusions

The increased number of kidney transplants performed in 2009 was mostly due to the growing use of organs from donors after cardiac death and living kidney donors. There were small differences in graft survival between UK centres. Graft failure rates remained stable at 2.9% per annum and transplant patient death rates remained similar at 2.5 per 100 patient years.

Transplant demographics

Introduction

Since 2008, all 72 UK renal centres have established electronic linkage to the UKRR or Scottish Renal Registry, giving the UKRR complete coverage of individual

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

	Deceased donor 1 year survival		Deceased donor 5 year survival		Living kidney donor 1 year survival		Living kidney donor 5 year survival	
Centre	Graft	Patient	Graft	Patient	Graft	Patient	Graft	Patient
Belfast	94	96	83	92	95	100	96	96
B QEH	90	97	83	90	95	98	88	99
Bristol	94	96	87	85	98	99	95	99
Camb	93	97	86	88	98	100	91	97
Cardff	94	97	85	90	94	98	84	97
Covnt	97	97	88	91	95	100	93	97
Edin	91	95	85	85	96	98	93	94
Glasgw	94	97	81	84	96	97	94	97
L Guy's	93	95	82	89	97	97	92	94
Leeds	94	96	83	87	97	100	90	95
Leic	91	87	82	82	96	97	92	93
Liv RI	88	97	80	92	95	98	86	93
M Hope	95	95	82	89	97	98	87	97
Newc	93	94	82	85	98	100	93	94
Nottm	87	96	80	86	92	97	89	98
Oxford	97	96	87	86	99	97	92	94
Plymth	92	97	80	88	95	99	69	89
Ports	93	94	81	89	93	98	84	94
L Rfree	95	97	83	90	97	100	88	93
L Barts	95	94	84	89	98	99	80	89
Sheff	91	100	82	91	99	100	85	100
L St.G	93	98	87	91	99	100	90	98
L West	95	98	88	90	96	99	88	97
All centres	**93**	**96**	**84**	**88**	**97**	**99**	**90**	**96**

[a] Information courtesy of NHSBT: number of transplants, patients and 95%CI for each estimate; statistical methodology for computing risk-adjusted estimates can be obtained from the NHSBT website (see http://www.organdonation.nhs.uk/ukt/statistics/statistics.jsp)
Cohorts for survival rate estimation: 1 year survival: 1/1/2005–31/12/2009; 5 year survival: 1/1/2001–31/12/2005; first grafts only – re-grafts excluded for patient survival estimation. Since the cohorts to estimate 1 and 5 year survival are different, some centres may appear to have 5 year survival better than 1 year survival

patient level data across the UK. The UKRR is now able to obtain, analyse and report on a complete national cohort.

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

Methods

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

For the analysis of primary renal diagnosis (PRD) in transplant recipients, four centres (Cambridge, London Royal Free, Liverpool RI, Wirral) were excluded from some of the take-on years because of concerns relating to the reliability of PRD coding (with these centres submitting a high percentage of uncertain aetiology codes).

Information on patient demographics (age, gender, ethnicity and PRD) for patients in a given renal centre was obtained from UKRR patient registration data fields. Individual patients were assigned to the centre that returned data for them during 2009. The prevalence of transplant patients in areas covered by individual primary care trusts (PCT) or Health Boards/Social Care Areas (HB) was estimated based on the post code of the registered address for patients on RRT. Data on ethnic origin, supplied as Patient Administration System (PAS) codes, were retrieved from fields within renal centre IT systems. For the purpose of this analysis patients were grouped into Whites, South Asians, Blacks, Others and Unknown. The details of regrouping of the PAS codes into the above ethnic categories are provided in appendix H: Coding http://www.renalreg.com/Report-Area/Report 2010/Appendix-H.pdf. The UKRR requires a standard set of data items regarding comorbid conditions at the time of commencement of renal replacement therapy and first registration of the patient with the UKRR.

Results and discussion

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

The prevalence of renal transplant recipients in each PCT/HB in England, Northern Ireland (called Health and Social Care Trust Areas), Scotland (called Health Board) and Wales (called Local Health Board) and the proportion of prevalent patients according to modality in the renal centres across the UK is described in tables 3.4 and 3.5 respectively. After standardisation for age and gender, unexplained variability was evident in the prevalence of renal transplant recipients, with some areas having higher than the predicted number of prevalent transplant patients per million population and others lower. Access to renal transplantation in the UK is examined in greater detail in chapter 13.

The proportion of prevalent RRT patients with a transplant relative to the number on dialysis has been stable since at least 2000. Whilst the proportion of patients on HD has been increasing, the proportion on PD has been falling.

Until 2009, the number of patients awaiting kidney-only transplantation had been increasing annually. However, NHSBT statistics for 2010 suggest the number of patients awaiting kidney-only transplantation has stabilised, with very little increase from the previous year.

Age and gender

The gender ratio amongst incident and prevalent transplant patients has remained stable since 2004 (table 3.6 and figure 3.1). Note absolute patient numbers differ from those published in previous reports as a result

Table 3.3. The prevalence per million population (pmp) of renal transplants in adults in the UK on 31/12/2009

	England	Wales	Scotland	N Ireland	UK
All UK centres	19,418	1,198	2,038	630	23,284
Total population, mid-2009 (millions)[a]	51.8	3.0	5.2	1.8	61.8
Prevalence pmp transplant	375	399	392	352	377

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

Table 3.4. The prevalence per million population (pmp) of patients with a renal transplant and standardised rate ratio in the UK, as on 31st December 2005–2009

[a] PCT/HB = Primary Care Trust (England); Health and Social Care Trust Areas (Northern Ireland); Health Board (Scotland) and Local Health Board (Wales)
[b] Population numbers based on the 2009 mid-year estimates by age group and gender (data obtained from the Office of National Statistics)
[c] O/E = age and gender standardised acceptance rate ratio
PCTs with significantly high average rate ratios are bold in greyed areas
PCTs with significantly low average rate ratios are italicised in greyed areas
Blank cells = no data returned to the UKRR for that year
LCL = lower 95% confidence limit
UCL = upper 95% confidence limit

UK Area	PCT/HB[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2009		
			2005	2006	2007	2008	2009	O/E[c]	LCL	UCL
North East	County Durham	506,600	353	353	383	397	405	1.04	0.91	1.19
	Darlington	100,600	298	298	318	348	318	0.83	0.59	1.18
	Gateshead	190,500	420	394	388	394	409	1.07	0.85	1.33
	Hartlepool	90,800	374	396	407	374	363	0.96	0.68	1.35
	Middlesbrough	**140,300**	**399**	**392**	**399**	**428**	**463**	**1.30**	**1.02**	**1.66**
	Newcastle	284,300	310	327	359	362	376	1.10	0.91	1.33
	North Tyneside	**197,000**	**452**	**437**	**487**	**492**	**528**	**1.36**	**1.12**	**1.65**
	Northumberland	311,200	366	363	379	389	395	0.97	0.81	1.15
	Redcar and Cleveland	**137,600**	**443**	**465**	**480**	**516**	**538**	**1.39**	**1.10**	**1.74**
	South Tyneside	152,600	374	393	433	426	426	1.12	0.87	1.42
	Stockton-on-Tees Teaching	191,100	324	372	351	392	403	1.06	0.85	1.33
	Sunderland Teaching	281,700	366	369	387	401	383	1.00	0.83	1.21
North West	Ashton, Leigh and Wigan	306,400	157	196	359	369	346	0.89	0.73	1.08
	Blackburn with Darwen Teaching	139,900	172	186	322	329	315	0.91	0.68	1.22
	Blackpool	140,000	207	229	314	364	371	0.96	0.73	1.26
	Bolton	265,600	211	222	392	433	433	1.17	0.97	1.40
	Bury	182,800	98	109	356	345	394	1.04	0.83	1.32
	Central and Eastern Cheshire	*456,000*			*307*	*303*	*303*	*0.76*	*0.65*	*0.90*
	Central Lancashire	*457,800*	*205*	*223*	*286*	*306*	*310*	*0.81*	*0.69*	*0.95*
	Cumbria Teaching	494,900	267	291	315	335	372	0.92	0.80	1.06
	East Lancashire Teaching	380,900	278	286	394	407	383	1.01	0.86	1.19
	Halton and St Helens	295,900	250	257	291	321	335	0.87	0.72	1.06
	Heywood, Middleton and Rochdale	204,900			390	410	425	1.15	0.93	1.42
	Knowsley	149,300	308	308	322	328	355	0.97	0.74	1.27
	Liverpool	442,400	298	296	303	325	348	0.98	0.84	1.15
	Manchester Teaching	483,500			250	263	271	0.85	0.72	1.01
	North Lancashire Teaching	*327,000*	*239*	*266*	*327*	*318*	*312*	*0.81*	*0.67*	*0.98*
	Oldham	219,200	114	151	347	365	379	1.04	0.84	1.30
	Salford	225,300	142	151	266	293	311	0.87	0.68	1.09
	Sefton	273,400	278	296	318	300	315	0.81	0.66	1.00
	Stockport	283,600			335	356	381	0.98	0.81	1.19
	Tameside and Glossop	249,100			397	393	401	1.05	0.87	1.28
	Trafford	215,400			292	325	306	0.81	0.64	1.03
	Warrington	197,900	268	308	384	384	414	1.06	0.85	1.32
	Western Cheshire	232,900	322	301	331	322	348	0.89	0.72	1.11
	Wirral	308,600	295	311	301	327	343	0.91	0.75	1.10
Yorkshire and the Humber	Barnsley	226,500	327	353	358	384	393	1.01	0.82	1.25
	Bradford and Airedale Teaching	**506,900**	**327**	**335**	**369**	**377**	**400**	**1.16**	**1.01**	**1.33**
	Calderdale	201,500	377	387	407	437	437	1.14	0.93	1.41
	Doncaster	290,200	269	307	300	317	341	0.89	0.73	1.09
	East Riding of Yorkshire	337,100	249	252	297	326	344	0.85	0.71	1.02
	Hull Teaching	262,700	259	297	324	343	362	1.01	0.83	1.24
	Kirklees	406,800	386	408	411	411	425	1.16	1.00	1.35

Table 3.4. Continued

UK Area	PCT/HB[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2009		
			2005	2006	2007	2008	2009	O/E[c]	LCL	UCL
Yorkshire and the Humber	Leeds	787,600	256	286	297	315	325	0.93	0.83	1.06
	North East Lincolnshire	158,600	227	271	290	315	347	0.92	0.71	1.20
	North Lincolnshire	*157,100*	*280*	*299*	*306*	*312*	*280*	*0.71*	*0.53*	*0.95*
	North Yorkshire and York	*796,300*	*273*	*295*	*310*	*352*	*320*	*0.82*	*0.73*	*0.93*
	Rotherham	253,900	264	295	327	362	386	1.01	0.83	1.23
	Sheffield	547,100	236	254	265	300	316	0.89	0.76	1.03
	Wakefield District	323,800	287	296	303	327	334	0.86	0.71	1.04
East Midlands	*Bassetlaw*	*111,900*	*232*	*241*	*295*	*286*	*277*	*0.69*	*0.49*	*0.99*
	Derby City	244,300	192	217	229	250	299	0.84	0.66	1.05
	Derbyshire County	*726,400*	*223*	*237*	*278*	*297*	*297*	*0.75*	*0.65*	*0.85*
	Leicester City	**304,800**	**413**	**456**	**479**	**509**	**577**	**1.72**	**1.49**	**2.00**
	Leicestershire County and Rutland	683,200	329	341	366	395	403	1.04	0.92	1.17
	Lincolnshire Teaching	*700,200*	*278*	*277*	*280*	*294*	*300*	*0.76*	*0.66*	*0.87*
	Northamptonshire Teaching	684,000	278	281	300	346	358	0.94	0.83	1.06
	Nottingham City	300,800	233	239	249	256	263	0.81	0.65	1.01
	Nottinghamshire County Teaching	*665,000*	*293*	*307*	*316*	*326*	*337*	*0.86*	*0.76*	*0.98*
West Midlands	Birmingham East and North	407,400	287	319	326	349	361	1.07	0.91	1.26
	Coventry Teaching	312,600	310	320	342	358	381	1.10	0.92	1.32
	Dudley	*306,500*	*241*	*248*	*274*	*277*	*287*	*0.75*	*0.60*	*0.92*
	Heart of Birmingham Teaching	**280,500**	**328**	**360**	**378**	**396**	**403**	**1.35**	**1.12**	**1.62**
	Herefordshire	*179,000*	*285*	*291*	*285*	*274*	*291*	*0.72*	*0.55*	*0.94*
	North Staffordshire	211,500			298	312	345	0.87	0.69	1.10
	Sandwell	291,100	319	330	347	368	385	1.07	0.89	1.29
	Shropshire County	*291,900*	*212*	*223*	*274*	*295*	*322*	*0.81*	*0.66*	*0.99*
	Solihull	205,200	249	288	288	297	302	0.79	0.62	1.01
	South Birmingham	341,200	287	284	311	340	340	0.98	0.82	1.18
	South Staffordshire	*609,300*			*297*	*322*	*328*	*0.83*	*0.72*	*0.95*
	Stoke on Trent	246,900			324	369	389	1.05	0.86	1.28
	Telford and Wrekin	*162,300*	*129*	*173*	*216*	*240*	*265*	*0.70*	*0.52*	*0.95*
	Walsall Teaching	255,800	297	313	348	367	395	1.08	0.89	1.31
	Warwickshire	535,100	335	342	349	355	376	0.96	0.83	1.10
	Wolverhampton City	238,500	231	226	268	289	302	0.83	0.66	1.05
	Worcestershire	*556,600*	*246*	*259*	*277*	*289*	*311*	*0.78*	*0.67*	*0.91*
East of England	Bedfordshire	411,100	246	272	304	328	343	0.89	0.75	1.05
	Cambridgeshire	607,200	262	277	298	328	369	0.97	0.85	1.11
	East and North Hertfordshire	*545,600*	*236*	*246*	*279*	*312*	*323*	*0.86*	*0.74*	*1.00*
	Great Yarmouth and Waveney	*214,000*	*126*	*145*	*159*	*220*	*266*	*0.68*	*0.53*	*0.89*
	Luton	194,600	298	334	380	396	406	1.19	0.95	1.48
	Mid Essex	371,300	248	283	310	329	358	0.92	0.78	1.09
	Norfolk	*757,200*	*243*	*275*	*296*	*295*	*317*	*0.81*	*0.72*	*0.92*
	North East Essex	*324,800*	*231*	*243*	*252*	*262*	*283*	*0.75*	*0.61*	*0.92*
	Peterborough	171,000	193	240	269	269	316	0.87	0.67	1.14
	South East Essex	336,500	208	232	276	309	339	0.88	0.74	1.06
	South West Essex	405,000	230	235	286	294	333	0.90	0.76	1.06
	Suffolk	*596,200*	*236*	*267*	*287*	*304*	*334*	*0.86*	*0.75*	*0.99*
	West Essex	*282,400*	*251*	*266*	*266*	*269*	*308*	*0.81*	*0.65*	*0.99*
	West Hertfordshire	549,900	175	189	273	360	380	1.01	0.88	1.16
London	Barking and Dagenham	176,000	222	233	267	273	341	1.04	0.81	1.34
	Barnet	**343,200**	**288**	**312**	**414**	**440**	**498**	**1.38**	**1.19**	**1.60**
	Bexley	**225,800**	**381**	**390**	**438**	**465**	**469**	**1.27**	**1.05**	**1.53**
	Brent Teaching	**255,200**		**157**	**470**	**670**	**745**	**2.08**	**1.80**	**2.39**

Table 3.4. Continued

UK Area	PCT/HB[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2009		
			2005	2006	2007	2008	2009	O/E[c]	LCL	UCL
London	Bromley	310,200	322	355	400	422	416	1.10	0.93	1.31
	Camden	231,600	229	268	289	358	406	1.16	0.95	1.42
	City and Hackney Teaching	227,100		238	295	326	348	1.03	0.82	1.28
	Croydon	342,800	225	271	318	324	350	0.95	0.80	1.14
	Ealing	**316,300**	**291**	**300**	**370**	**560**	**579**	**1.59**	**1.38**	**1.84**
	Enfield	**291,400**	**357**	**388**	**426**	**480**	**494**	**1.37**	**1.17**	**1.62**
	Greenwich Teaching	226,200	243	274	314	318	340	0.98	0.79	1.23
	Hammersmith and Fulham	**169,800**	**224**	**259**	**247**	**389**	**459**	**1.29**	**1.03**	**1.61**
	Haringey Teaching	**225,400**	**302**	**333**	**359**	**421**	**484**	**1.35**	**1.12**	**1.63**
	Harrow	**228,600**			**455**	**591**	**669**	**1.81**	**1.55**	**2.13**
	Havering	*234,500*			*260*	*273*	*294*	*0.78*	*0.62*	*0.99*
	Hillingdon	**262,500**	**255**	**270**	**305**	**442**	**488**	**1.37**	**1.15**	**1.63**
	Hounslow	**234,200**	**260**	**278**	**286**	**508**	**576**	**1.60**	**1.35**	**1.89**
	Islington	**192,100**	**312**	**344**	**401**	**453**	**500**	**1.43**	**1.17**	**1.75**
	Kensington and Chelsea	169,900			224	294	318	0.84	0.64	1.09
	Kingston	166,900			359	371	389	1.07	0.84	1.37
	Lambeth	283,400	205	208	279	314	339	0.96	0.78	1.17
	Lewisham	**264,300**	**344**	**375**	**428**	**443**	**454**	**1.26**	**1.06**	**1.51**
	Newham	241,200	261	269	290	315	377	1.17	0.96	1.44
	Redbridge	267,700	280	310	336	396	426	1.20	1.00	1.44
	Richmond and Twickenham	*189,400*			*185*	*259*	*290*	*0.75*	*0.58*	*0.98*
	Southwark	**285,600**	**368**	**389**	**438**	**445**	**501**	**1.42**	**1.21**	**1.68**
	Sutton and Merton	398,900			371	381	411	1.11	0.96	1.30
	Tower Hamlets	234,800	183	213	226	230	264	0.83	0.65	1.06
	Waltham Forest	**224,500**		**330**	**379**	**405**	**437**	**1.25**	**1.03**	**1.53**
	Wandsworth	286,900			349	380	387	1.11	0.92	1.34
	Westminster	249,200			253	337	393	1.07	0.88	1.31
South East Coast	Brighton and Hove City	256,200	199	234	265	289	316	0.88	0.71	1.09
	East Sussex Downs and Weald	*333,700*	*222*	*216*	*267*	*297*	*300*	*0.77*	*0.63*	*0.93*
	Eastern and Coastal Kent	732,100			299	347	376	1.00	0.88	1.12
	Hastings and Rother	178,400	252	252	286	308	308	0.79	0.61	1.03
	Medway	254,900			322	373	408	1.09	0.90	1.33
	Surrey	1,100,500	236	275	328	354	365	0.95	0.86	1.05
	West Kent	678,600			360	386	398	1.04	0.92	1.17
	West Sussex	792,900	250	272	318	339	343	0.89	0.79	1.00
South Central	**Berkshire East**	**399,600**	**250**	**270**	**368**	**435**	**460**	**1.26**	**1.09**	**1.45**
	Berkshire West	**466,600**	**264**	**274**	**375**	**426**	**435**	**1.18**	**1.02**	**1.35**
	Buckinghamshire	508,700	336	387	409	411	411	1.07	0.93	1.23
	Hampshire	1,289,100	286	312	330	355	366	0.94	0.86	1.03
	Isle of Wight National Health Service	140,200	285	278	264	307	314	0.78	0.58	1.05
	Milton Keynes	242,300	268	289	322	334	351	0.93	0.76	1.16
	Oxfordshire	**615,900**	**362**	**390**	**401**	**421**	**425**	**1.15**	**1.02**	**1.30**
	Portsmouth City Teaching	203,400	300	310	324	364	359	1.05	0.83	1.32
	Southampton City	237,000	295	316	338	346	359	1.07	0.86	1.32
South West	Bath and North East Somerset	177,500	248	259	270	276	315	0.86	0.66	1.12
	Bournemouth and Poole Teaching	306,000	307	324	359	346	346	0.94	0.78	1.14
	Bristol	**433,000**	**365**	**386**	**402**	**436**	**453**	**1.31**	**1.14**	**1.51**
	Cornwall and Isles of Scilly	532,900	308	327	357	394	422	1.06	0.93	1.21
	Devon	747,500	276	298	337	361	391	0.99	0.88	1.11
	Dorset	404,200	312	336	383	401	411	1.03	0.88	1.20
	Gloucestershire	*588,700*	*321*	*323*	*328*	*338*	*328*	*0.85*	*0.73*	*0.97*

Table 3.4. Continued

UK Area	PCT/HB[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2009		
			2005	2006	2007	2008	2009	O/E[c]	LCL	UCL
South West	North Somerset	209,400	382	382	349	372	392	1.00	0.80	1.24
	Plymouth Teaching	**256,700**	**374**	**401**	**417**	**464**	**499**	**1.40**	**1.18**	**1.66**
	Somerset	523,600	325	338	353	359	376	0.96	0.83	1.10
	South Gloucestershire	262,300	377	389	423	427	431	1.13	0.94	1.36
	Swindon	203,700	299	304	314	344	363	0.96	0.77	1.21
	Torbay	133,900	299	306	351	411	463	1.18	0.92	1.52
	Wiltshire	*456,000*	*259*	*276*	*300*	*311*	*316*	*0.82*	*0.69*	*0.96*
Wales	Betsi Cadwaladr University	679,000	287	295	312	334	343	0.88	0.78	1.01
	Powys Teaching	131,700	258	304	342	357	372	0.92	0.69	1.21
	Hywel Dda	374,800	334	339	358	379	390	1.00	0.85	1.18
	Abertawe Bro Morgannwg University	**502,300**	**370**	**400**	**418**	**434**	**450**	**1.19**	**1.04**	**1.35**
	Cwm Taf	**290,500**	**451**	**489**	**516**	**540**	**578**	**1.55**	**1.33**	**1.80**
	Aneurin Bevan	**560,600**	**398**	**403**	**437**	**453**	**476**	**1.25**	**1.11**	**1.41**
	Cardiff and Vale University	**461,000**	**345**	**364**	**382**	**401**	**406**	**1.16**	**1.00**	**1.34**
Scotland	Ayrshire & Arran	367,000	341	365	379	409	401	1.01	0.86	1.19
	Borders	113,100	283	283	309	354	363	0.89	0.65	1.21
	Dumfries and Galloway	148,200	304	317	344	391	412	1.00	0.78	1.29
	Fife	363,400	281	292	297	322	336	0.87	0.73	1.04
	Forth Valley	*291,400*	*285*	*264*	*288*	*302*	*302*	*0.78*	*0.63*	*0.96*
	Grampian	545,400	328	339	352	359	389	0.99	0.87	1.13
	Greater Glasgow & Clyde	**1,199,000**	**383**	**392**	**413**	**426**	**435**	**1.15**	**1.06**	**1.26**
	Highland	311,000	309	350	370	421	463	1.13	0.96	1.33
	Lanarkshire	562,500	343	352	363	386	404	1.05	0.92	1.19
	Lothian	826,200	306	287	311	330	338	0.90	0.80	1.01
	Orkney	20,000	550	550	450	550	450	1.09	0.57	2.10
	Shetland	22,000	273	273	273	227	318	0.79	0.38	1.67
	Tayside	399,600	390	415	423	440	438	1.14	0.98	1.32
	Western Isles	26,100	268	268	345	307	307	0.74	0.37	1.49
Northern Ireland	Belfast	334,600	332	359	371	374	400	1.15	0.97	1.37
	Northern	458,300	299	329	334	353	362	0.99	0.85	1.15
	Southern	354,000	280	285	297	297	299	0.86	0.71	1.04
	South Eastern	344,200	302	320	340	357	366	0.99	0.83	1.18
	Western	297,900	262	295	302	309	322	0.91	0.74	1.11

of additional data cleaning and reallocation of patients. The average age of incident transplant patients has steadily increased since 2004. There has also been a gradual increase in the average age of prevalent transplant patients, which could reflect the increasing age at which patients are transplanted and/or improved survival after renal transplantation over the last few years. The prevalent transplant patient workload across the UK has increased from 14,881 patients in 2004 to 23,284 patients at the end of 2009. With the rapid expansion of this patient group there is a need for careful planning by renal centres for future service provision and resource allocation.

Primary renal diagnosis

The primary renal diagnosis of patients receiving kidney transplants in the UK has remained stable over the last 5 years (table 3.7).

Ethnicity

It was difficult to compare the proportion of patients within each ethnic group receiving a transplant to those commencing dialysis from the same group because data on ethnicity were missing in a considerable number of patients who were classified as ethnicity 'unknown' (table 3.8). The percentages of patients with unknown

Table 3.5. Distribution of prevalent patients on RRT by centre and modality on 31/12/2009

Centre	N	% HD	% PD	% transplant
Transplant centres				
B QEH	1,821	48	9	44
Belfast	680	36	5	59
Bristol	1,223	36	6	58
Camb	940	37	4	59
Cardff	1,440	35	7	58
Covnt	794	44	10	46
Edinb	700	39	9	52
Glasgw	1,468	43	4	53
L Barts	1,638	43	11	45
L Guys	1,511	38	3	58
L Rfree	1,546	42	5	53
L St. G	661	40	10	51
L West	2,725	47	1	52
Leeds	1,348	37	8	55
Leic	1,735	43	10	47
Liv RI	1,223	33	7	60
Man RI	1,436	30	7	63
Newc	897	31	6	63
Nottm	956	43	12	46
Oxford	1,320	29	8	63
Plymth	454	28	9	63
Ports	1,301	37	7	56
Sheff	1,216	49	6	45
Dialysis centres				
Abrdn	452	44	7	50
Airdrie	310	54	4	42
Antrim	215	58	7	35
B Heart	622	69	5	25
Bangor	110	72	28	0
Basldn	214	67	13	20
Bradfd	422	45	8	47
Brightn	737	45	12	44
Carlis	203	33	7	60
Carsh	1,302	51	9	39
Chelms	225	52	16	31
Clwyd	144	53	5	42
Colchester	116	100	0	0
D & Gall	118	44	10	46
Derby	419	59	21	20
Derry	115	57	3	40
Donc	196	62	17	21
Dorset	552	41	11	48
Dudley	292	53	19	27
Dundee	395	46	7	47
Dunfn	233	49	10	41
Exeter	731	46	10	45
Glouc	366	51	12	38
Hull	725	46	10	44
Inverns	224	40	10	50
Ipswi	308	36	14	50
Kent	744	45	9	45
Klmarnk	273	54	14	32
L Kings	786	50	11	39
Liv Ain	146	95	5	0
M Hope	784	44	15	41

Table 3.5. Continued

Centre	N	% HD	% PD	% transplant
Middlbr	707	42	3	55
Newry	167	62	7	31
Norwch	591	53	10	37
Prestn	939	51	8	41
Redng	618	44	14	43
Shrew	337	58	9	34
Stevng	580	65	5	30
Sthend	207	61	10	29
Stoke	640	47	11	42
Sund	368	48	8	44
Swanse	598	58	10	32
Truro	320	48	9	43
Tyrone	143	63	8	30
Ulster	114	83	2	15
Wirral	222	84	16	0
Wolve	477	63	11	26
Wrexm	219	33	12	54
York	321	59	5	36
England	**40,962**	**44**	**8**	**47**
Northern Ireland	**1,434**	**50**	**5**	**44**
Scotland	**4,173**	**44**	**7**	**49**
Wales	**2,511**	**43**	**9**	**48**
UK	**49,080**	**45**	**8**	**47**

ethnicity between 2004 and 2008 provided in this year's chapter are different from those in last year's chapter [2]; this reflects retrospective input of ethnicity data, improving data completeness.

Clinical and laboratory outcomes

Introduction

There continues to be marked variation in the completeness of data (tables 3.9a and b) reported by each renal centre, particularly for blood pressure. Better data records (or possibly better extraction of data held within renal IT systems) would facilitate more meaningful comparisons between centres and help to determine the causes of between-centre differences in outcomes. For this reason, along with differences in repatriation policies of prevalent transplant patients between centres as highlighted previously, caution needs to be exercised when comparing performance between centres.

The 72 renal centres in the UK comprise 52 centres in England, 5 in Wales, 6 in Northern Ireland and 9 in Scotland. Centres in Scotland only provide summary

Table 3.6. Median age and gender ratio of incident and prevalent transplant patients 2004–2009

	Incident transplants			Prevalent transplants[a]		
Year	N	Median age	M:F ratio	N	Median age	M:F ratio
2004	1,726	45.3	1.7	14,881	49.7	1.6
2005	1,771	45.4	1.5	16,686	49.7	1.6
2006	2,004	45.3	1.6	17,690	49.9	1.5
2007	2,151	45.6	1.5	20,678	50.1	1.5
2008	2,385	46.4	1.5	22,247	50.4	1.5
2009	2,497	48.4	1.6	23,284	50.8	1.5

[a] As on 31st December for given year

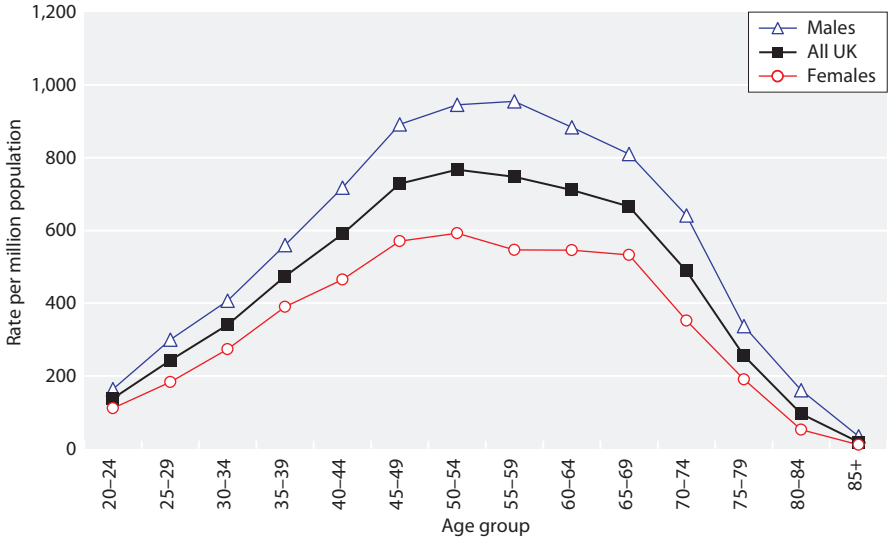

Fig. 3.1. Transplant prevalence rate per million population by age and gender on 31/12/2009

information and therefore laboratory outcome data for comparisons were not available for the Scottish renal centres. Four centres (Bangor, Colchester, Liverpool Aintree, Wirral) were reported as having no transplanted patients and were therefore excluded. After exclusion of these 13 centres, prevalent patient data from 59 renal centres across the UK were analysed.

For the one year post-transplant analyses, in which patients were assigned to the centres that performed their transplant, the two Scottish transplant centres

Table 3.7. Primary renal disease in renal transplant recipients 2005–2009

	New transplants by year						Established transplants on 1/1/2009	
Primary diagnosis	2005 %	2006 %	2007 %	2008 %	2009 %	2009 N	%	N
Aetiology uncertain/GN[a] not biopsy proven	18.9	17.5	16.9	16.4	16.1	388	20.3	4480
Diabetes	13.4	13.2	14.4	13.0	12.5	302	8.6	1901
Glomerulonephritis	19.6	19.6	20.7	19.4	20.6	498	19.8	4380
Polycystic kidney disease	11.9	12.6	13.4	13.1	13.0	314	12.2	2695
Pyelonephritis	12.4	12.3	11.6	12.4	11.0	265	15.0	3318
Renovascular disease	6.5	6.2	5.4	6.9	5.9	143	5.8	1287
Other	14.9	16.0	15.5	16.2	14.5	349	16.0	3531
Not available	2.4	2.4	2.0	2.8	6.3	153	2.4	524

[a] GN = glomerulonephritis

Table 3.8. Ethnicity of patients who received a transplant in the years 2004–2009

Year	% White	% South Asian	% Black	% Other	% Unknown
2004	74.0	6.9	5.2	1.9	12.1
2005	75.5	7.0	5.4	1.2	10.9
2006	73.5	7.9	6.5	2.2	9.9
2007	73.5	7.8	6.0	2.1	10.6
2008	70.0	8.1	6.4	2.2	13.3
2009	66.1	9.1	6.4	2.3	16.1

Northern Ireland centres included from 2005 onwards

Table 3.9a. Percentage completeness by centre for prevalent transplant patients on 31/12/2009[a]

Centre	N	Ethnicity	eGFR[b]	Blood pressure	Centre	N	Ethnicity	eGFR[b]	Blood pressure
Antrim	75	100	99	99	Leic	801	93	93	51
B Heart	155	100	91	2	Liv RI	710	94	92	84
B QEH	769	100	88	2	M Hope	311	99	96	0
Basldn	43	100	98	2	M RI	858	97	98	0
Belfast	391	99	97	76	Middlbr	384	99	94	57
Bradfd	194	100	88	91	Newc	557	100	97	0
Brightn	295	60	89	0	Newry	49	100	100	100
Bristol	680	99	99	90	Norwch	216	95	94	81
Camb	513	95	99	98	Nottm	424	100	98	97
Cardff	804	72	98	98	Oxford	795	90	99	21
Carlis	115	99	94	0	Plymth	268	76	98	0
Carsh	503	97	95	1	Ports	707	99	88	13
Chelms	68	93	96	96	Prestn	372	93	94	0
Clwyd	61	72	95	95	Redng	258	100	100	99
Covnt	352	97	88	84	Sheff	531	94	99	99
Derby	79	99	87	99	Shrew	112	99	100	31
Derry	46	100	94	94	Stevng	166	100	72	3
Donc	39	100	100	100	Sthend	58	93	98	86
Dorset	262	100	90	96	Stoke	258	49	97	0
Dudley	77	100	96	52	Sund	157	99	99	99
Exeter	321	94	96	91	Swanse	187	100	2	99
Glouc	132	98	97	99	Truro	135	83	99	98
Hull	313	66	96	0	Tyrone	41	100	100	98
Ipswi	151	99	99	99	Ulster	13	100	100	100
Kent	323	84	94	12	Wolve	121	100	96	97
L Barts	707	99	96	0	Wrexm	117	100	97	4
L Guys	846	84	97	0	York	112	79	99	90
L Kings	291	97	94	0	**England**	**18,744**	**92**	**95**	**36**
L RFree	804	98	94	0	**N Ireland**	**615**	**99**	**98**	**84**
L St.G	324	83	94	0	**Wales**	**1,169**	**79**	**82**	**89**
L West	1,355	84	98	0	**E, W & NI**	**20,528**	**92**	**94**	**41**
Leeds	722	89	96	88					

[a] Scottish centres are not shown as they do not provide biochemical data to the UKRR
[b] Patients with missing ethnicity were classed as White for eGFR calculation

were excluded as they do not submit biochemical data to the UKRR. After excluding these 2 transplant centres, one year outcomes are described for 21 transplant centres across the UK.

Compared with data published in the previous annual report [2], 7 centres (Brighton, Cardiff, Coventry, Newcastle, Preston, Sunderland, Swansea) are shown to have had a significant fall in data completeness for corrected calcium levels. This reflects these centres only submitting unadjusted calcium measurements, which in previous years the UKRR has used to calculate adjusted calcium levels. Due to concerns regarding accuracy, this has not been done for the 2010 annual report and hence the apparent fall in data completeness for these centres.

Methods

Data for key laboratory variables are reported for all prevalent patients with valid data returns for a given renal centre (both transplanting and non-transplanting centres) and for one year post-transplant results for patients transplanted 2002–2008, with patients attributed to the transplant centre that performed the procedure.

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

Table 3.9b. Percentage completeness by centre for prevalent transplant patients on 31/12/2009[a]

Centre	N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[b]	Serum phosphate	Serum PTH
Antrim	75	99	96	96	97	21
B Heart	155	90	66	86	87	19
B QEH	769	88	84	88	87	63
Basldn	43	98	95	95	74	58
Belfast	391	97	99	96	96	16
Bradfd	194	81	75	85	82	27
Brightn	295	89	27	0	85	30
Bristol	680	99	94	99	99	98
Camb	513	99	94	99	99	88
Cardff	804	97	89	0	97	12
Carlis	115	93	73	94	89	3
Carsh	503	95	69	94	94	3
Chelms	68	96	88	96	87	21
Clwyd	61	93	89	95	95	59
Covnt	352	86	0	0	44	25
Derby	79	87	62	85	84	57
Derry	46	93	96	91	91	43
Donc	39	100	95	100	100	33
Dorset	262	90	87	60	67	17
Dudley	77	96	87	57	96	74
Exeter	321	96	89	96	85	20
Glouc	132	97	72	95	94	41
Hull	313	94	37	94	94	22
Ipswi	151	98	83	99	99	57
Kent	323	100	88	96	95	0
L Barts	707	96	100	96	96	70
L Guys	846	98	84	93	93	26
L Kings	291	94	80	94	94	21
L RFree	804	58	89	93	93	68
L St.G	324	94	84	94	94	56
L West	1,355	99	94	69	69	0
Leeds	722	94	95	95	95	67
Leic	801	93	91	92	92	41
Liv RI	710	92	6	88	92	42
M Hope	311	84	97	96	96	77
M RI	858	98	71	98	98	59
Middlbr	384	93	63	92	91	19
Newc	557	96	93	0	96	50
Newry	49	100	100	98	98	55
Norwch	216	94	94	93	93	24
Nottm	424	98	86	96	94	88
Oxford	795	99	74	98	98	34
Plymth	268	89	69	97	96	15
Ports	707	89	50	84	87	6
Prestn	372	92	87	1	91	60
Redng	258	99	100	99	98	88
Sheff	531	99	77	99	99	34
Shrew	112	100	99	95	94	64
Stevng	166	95	90	93	90	68
Sthend	58	98	53	98	97	7
Stoke	258	100	100	100	99	35
Sund	157	99	99	0	99	96
Swanse	187	95	94	0	2	10
Truro	135	99	89	99	99	61
Tyrone	41	95	98	100	100	44

Table 3.9b. Percentage completeness by centre for prevalent transplant patients on 31/12/2009[a]

Centre	N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[b]	Serum phosphate	Serum PTH
Ulster	13	100	100	100	100	62
Wolve	121	96	89	95	86	64
Wrexm	117	95	94	97	97	94
York	112	95	91	86	97	24
England	**18,744**	**93**	**78**	**83**	**91**	**43**
N Ireland	**615**	**97**	**98**	**96**	**96**	**24**
Wales	**1,169**	**96**	**90**	**15**	**82**	**22**
E, W & NI	**20,528**	**94**	**80**	**79**	**90**	**41**

[a] Scottish centres are not shown as they do not provide biochemical data to the UKRR
[b] Serum calcium corrected for serum albumin

comparison of outcomes between centres are more robust. However, even the 12 months post-transplant comparisons could be biased by the fact that in some centres, repatriation of patients only occurs if the graft is failing whereas in others it only occurs if the graft function is stable.

Centres with <20 patients or <50% data completeness have been excluded from figures.

Prevalent patient data

Biochemical and clinical data for patients with a functioning transplant followed in either a transplanting or non-transplanting centre were included in the analyses. The cohort consisted of prevalent patients as on 31st December 2009. Patients were considered as having a functioning transplant if 'transplant' was listed as the last mode of RRT in the last quarter of 2009. Patients were assigned to the renal centre that sent the data to the UKRR but some patients will have received care in more than one centre. If data for the same transplant patient were received from both the transplant centre and non-transplant centre, care was allocated to the non-transplant centre. Patients with a functioning transplant of less than 3 months duration were excluded from analyses. For haemoglobin, estimated glomerular filtration rate (eGFR), corrected calcium and phosphate, the latest value in quarter 3 or quarter 4 of 2009 was used. For blood pressure (BP) and cholesterol, the latest value from 2009 was used. For parathyroid hormone (PTH), the latest value in the last 3 quarters of 2009 was used.

Estimated glomerular filtration rate (eGFR)

For the purpose of eGFR calculation, the original 4-variable MDRD formula was used (with a constant of 186) to calculate eGFR from the serum creatinine concentration as reported by the centre. A wide variety of creatinine assays are in use in clinical biochemistry laboratories in the UK, and it is not possible to ensure that all measurements of creatinine concentration collected by the UKRR are harmonised. Although many laboratories are now reporting assay results that have been aligned to the isotope dilution-mass spectrometry standard (which would necessitate use of the modified MDRD formula), this was not the case at the end of 2009. Patients with valid serum creatinine results but no ethnicity data were classed as White for the purpose of the eGFR calculation.

One year post-transplant data

Patients who received a renal transplant between 1st January 2002 and 31st December 2008 were assigned according to the renal centre in which they were transplanted. In a small number of instances, the first documented evidence of transplantation in a patient's record is from a timeline entry in data returned from a non-transplant centre, in these instances the patient was re-assigned to the nearest transplant centre (table 3.10).

Patients who had died or experienced graft failure within 12 months of transplantation were excluded from the analyses. For patients with more than one transplant during 2002–2008, they were included as separate episodes provided each of the transplants functioned for a year.

For each patient, the most recent laboratory or blood pressure for the relative 4th/5th quarter (10–15 months) after renal transplantation was taken to be representative of the one year post-transplant outcome. Again, for the purpose of the eGFR calculation patients with valid serum creatinine results but missing ethnicity data were classed as White.

Results and discussion

Post-transplant eGFR in prevalent transplant patients

When interpreting eGFR post-transplantation it is important to remember that estimated GFR formulae only have a modest predictive performance in the transplant population [3]. Median eGFR in each centre and percentage of patients with eGFR <30 ml/min/1.73 m^2 are shown in figures 3.2 and 3.3. The median eGFR was 49.9 ml/min/1.73 m^2, with 14.2% of prevalent transplant recipients having an eGFR <30 ml/min/1.73 m^2. Table 3.11 summarises the proportion of transplant patients with an eGFR <30 ml/min/1.73 m^2 by centre. Whilst local repatriation policies on timing of transfer of care of patients with failing transplants from transplant centres to referring centres might explain some of the differences, it is notable that both transplanting

Table 3.10. Number of patients reallocated to transplanting centre

Transplant centre	Total number of patients per transplant centre	Non-transplant centre	Number of patients reallocated to transplant centre
B QEH	566	Shrew	2
		Stoke	4
Belfast	147	Antrim	1
		Derry	5
		Newry	1
		Tyrone	1
Bristol	657	Glouc	6
Camb	746	Norwch	3
		Stevng	15
Cardff	590		n/a
Covnt	272		n/a
L Barts	393		n/a
L Guys	1,072	Kent	28
		L Kings	181
L Rfree	293	Sthend	3
L St.G	185	Brightn	9
		Carsh	7
L West	911		n/a
Leeds	896	Hull	21
Leic	389		n/a
Liv RI	637	Prestn	125
		Wrexm	1
M RI	303	M Hope	2
Newc	658	Carlis	9
		Middlbr	24
		Sund	12
Nottm	260		n/a
Oxford	757		n/a
Plymth	341		n/a
Ports	385		n/a
Sheff	336		n/a
Total	**10,794**		**460**

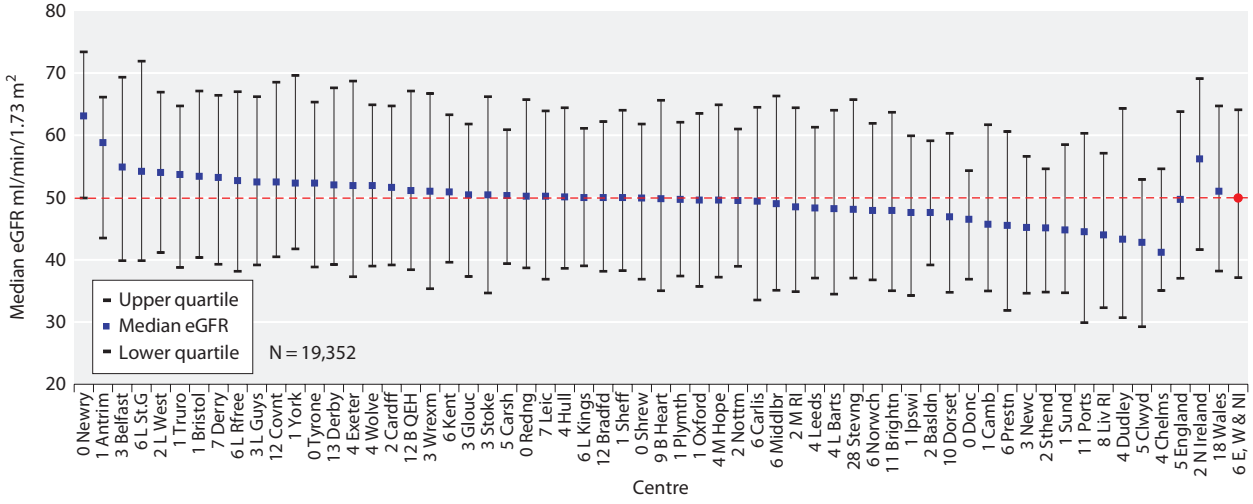

Fig. 3.2. Median eGFR in prevalent transplant patients by centre on 31/12/2009

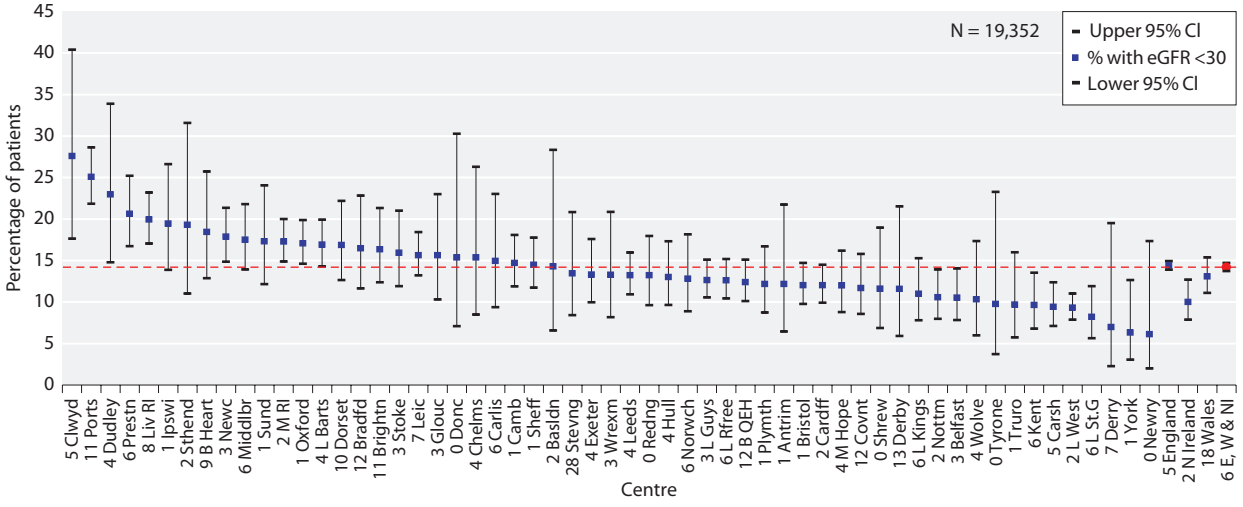

Fig. 3.3. Percentage of prevalent transplant patients by centre on 31/12/2009 with eGFR <30 ml/min/1.73 m^2

Table 3.11. Proportion of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 on 31/12/08

Centre	Number of patients with eGFR data	Patients with eGFR <30
Swansea	3	0
Ulster	12	8.3
Donc	39	15.4
Tyrone	41	9.8
Basldn	42	14.3
Derry	43	7.0
Newry	49	6.1
Sthend	57	19.3
Clwyd	58	27.6
Chelms	65	15.4
Derby	69	11.6
Antrim	74	12.2
Dudley	74	23.0
Carlis	107	15.0
York	111	6.3
Shrew	112	11.6
Wrexm	113	13.3
Wolve	116	10.3
Stevng	119	13.4
Glouc	128	15.6
Truro	134	9.7
B Heart	141	18.4
Ipswi	149	19.5
Sund	156	17.3
Bradfd	170	16.5
Norwch	203	12.8
Dorset	237	16.9
Stoke	251	15.9
Redng	257	13.2
Brightn	263	16.3
Plymth	263	12.2
L Kings	273	11.0
Hull	300	13.0
M Hope	300	12.0
Kent	301	9.6
L St.G	304	8.2
Exeter	308	13.3
Covnt	308	11.7
Prestn	349	20.6
Middlbr	360	17.5
Belfast	380	10.5
Nottm	416	10.6
Carsh	478	9.4
Camb	503	14.7
Sheff	525	14.5
Newc	537	17.9
Ports	626	25.1
Liv RI	652	19.9
Bristol	674	12.0
B QEH	678	12.4
L Barts	680	16.9
Leeds	695	13.2
Leic	748	15.6
L Rfree	753	12.6
Cardff	782	12.0
Oxford	785	17.1
L Guys	822	12.7
M RI	839	17.3
L West	1320	9.3

and non-transplant centres feature at both ends of the scale. The accuracy of the 4v MDRD equation in estimating GFR $\geqslant 60$ ml/min/1.73 m^2 is questionable [4], therefore a figure describing this is not included in this chapter. It is likely that centres with a high prevalence of patients with eGFR <30 ml/min/1.73 m^2 expend significant resources in the management of complications related to declining renal function as well as ensuring safe transition to dialysis and/or re-transplantation.

Figure 3.4 shows the percentage of prevalent patients by centre with eGFR <30 ml/min/1.73 m^2 as a funnel plot, enabling a more reliable comparison of outcomes between centres across the UK. The solid lines show the 2 standard deviation limits (95%) and the dotted lines the limits for 3 standard deviations (99.9%). With 57 centres included and a normal distribution, 2–3 centres would be expected to fall between the 95%–99% CI (1 in 20) and no centres should fall outside the 99.9% limits.

Although there was less variation between centres than in 2008, these data continue to show over-dispersion with 15 centres falling outside the 95% CI of which 5 centres were outside the 99.9% CI. Three centres (Carshalton, London St George's, London West) fall outside the lower 99.9% CI suggesting a lower than expected proportion of patients with eGFR <30 ml/min/1.73 m^2. Liverpool RI and Portsmouth fall outside the upper 99.9% CI suggesting a higher than expected proportion of patients with eGFR <30 ml/min/1.73 m^2.

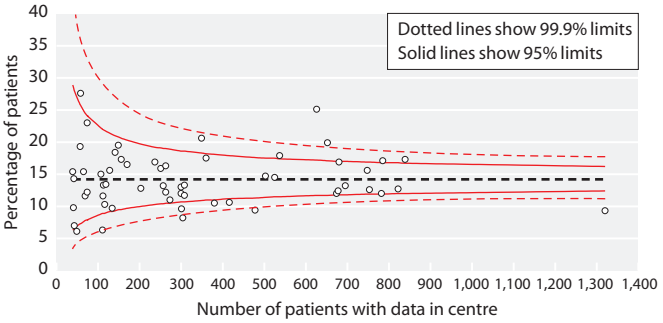

Fig. 3.4. Funnel plot of percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 by centre size on 31/12/2009

eGFR in patients one year after transplantation

Graft function at one year post-transplantation may predict subsequent long-term graft outcome [5]. Figure 3.5 shows that the median one year post-transplant eGFR for patients transplanted 2002–2008 was 51.5 ml/min/1.73 m^2. Figures 3.6a and 3.6b provide the same information divided according to source of organ as live donor and deceased donor respectively.

Regression analysis (least squares) indicated a small but significant upward trend (+0.99 ml/min change in eGFR/year) ($p < 0.001$) in the one year post-transplant median eGFR between 2002 and 2008 (figure 3.7). This suggests better graft function for patients transplanted more recently. Live donor transplantation as a proportion of the total number of transplants has been increasing year-on-year since 2000. Such recipients are known to have a higher one year post-transplant eGFR compared to deceased donor transplant recipients [6].

Figures 3.8a and 3.8b show one year post-transplant eGFR by donor type. An upward trend in eGFR ($p < 0.001$) over the time period is noticed with both live and deceased donor transplants and the rate of

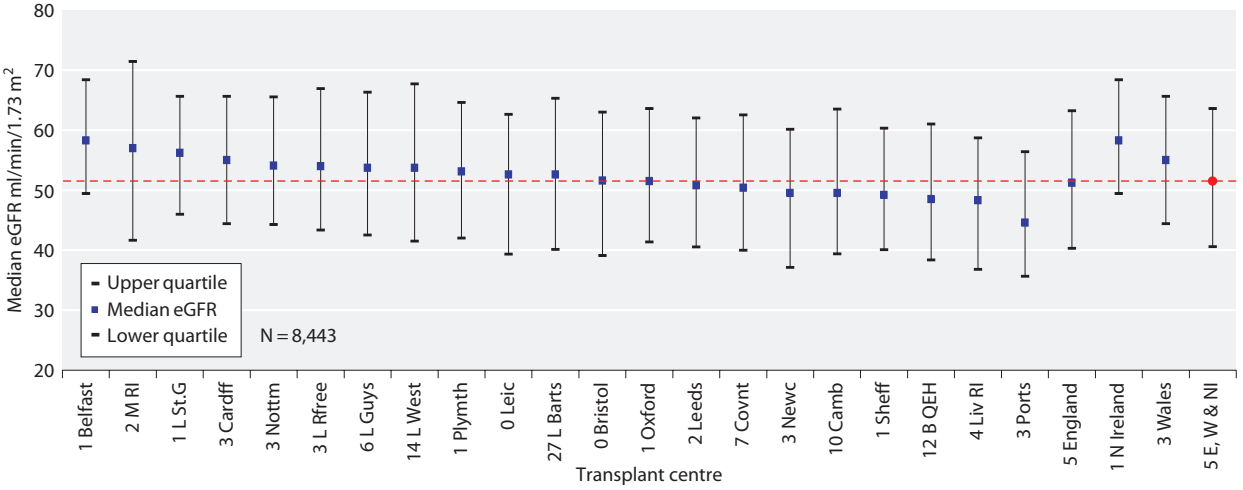

Fig. 3.5. Median eGFR one year post-transplant by transplant centre for patients transplanted between 2002–2008

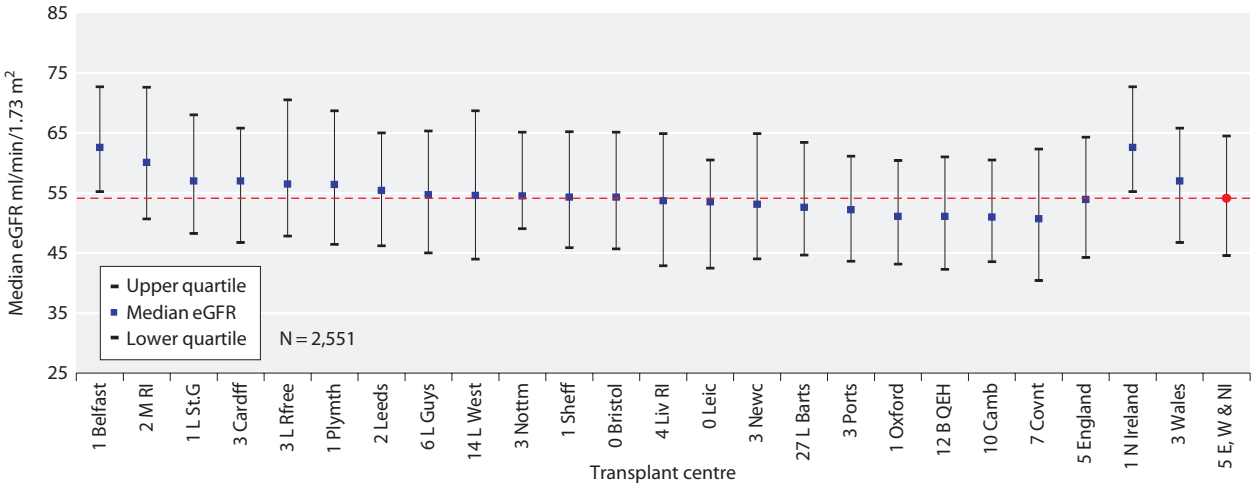

Fig. 3.6a. Median eGFR one year post-live donor transplant by transplant centre 2002–2008

change in slope of eGFR per year between the donor types (+0.85 ml/min/year for live donor transplants and +0.96 ml/min/year for deceased donor transplants) are also similar. Therefore changing donor demographics, with a higher proportion of live donor transplants more recently, does not explain the upward trend in one year post-transplant eGFR.

Haemoglobin in prevalent transplant patients

Transplant patients have previously fallen under the remit of the UK Renal Association Complications of Chronic Kidney Disease (CKD) guidelines. Updated guidelines regarding the management of anaemia in CKD were published by the association in 2010 [7]. However, the data presented in this chapter pre-dates this and therefore the previous standards are referred to. These state that ***'Patients with CKD should achieve a haemoglobin between 10.5–12.5 g/dl'*** [8]. However, many transplant patients with good transplant function will have haemoglobin concentrations >12.5 g/dl without the use of erythopoiesis stimulating agents, and so it is inappropriate to audit performance using the higher limit.

A number of factors including comorbidity, immunosuppressive medication, graft function, ACE inhibitor use, erythropoietin (EPO) use, intravenous or oral iron use, as well as centre practices and protocols for management of anaemia, affect haemoglobin concentrations in transplant patients. Figures 3.9, 3.10a and 3.10b report centre results stratified according to graft function as estimated by eGFR. The percentage of prevalent transplant patients achieving Hb >10.5 g/dl in each

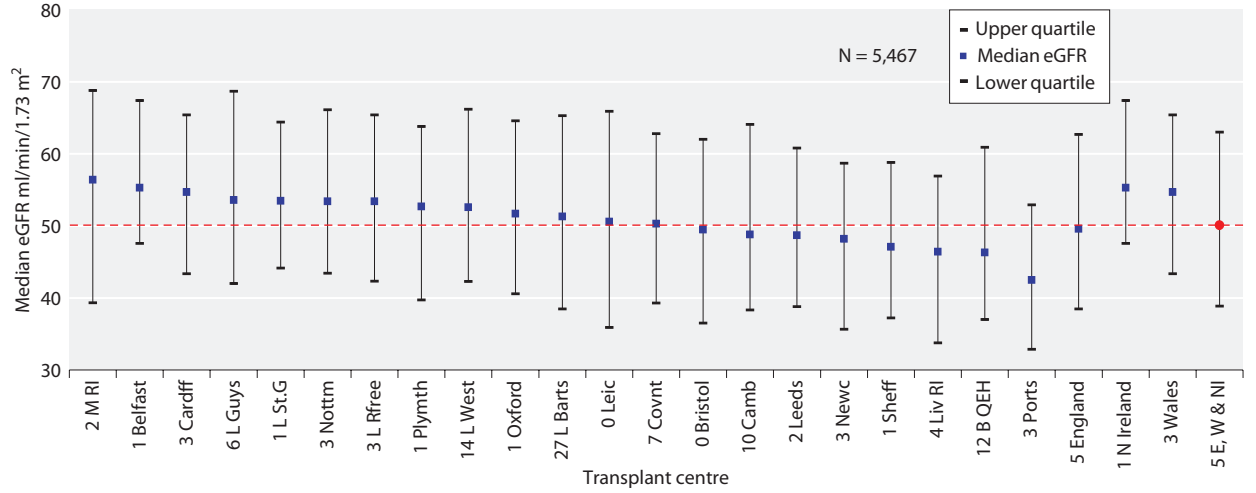

Fig. 3.6b. Median eGFR one year post-deceased donor transplant by transplant centre 2002–2008

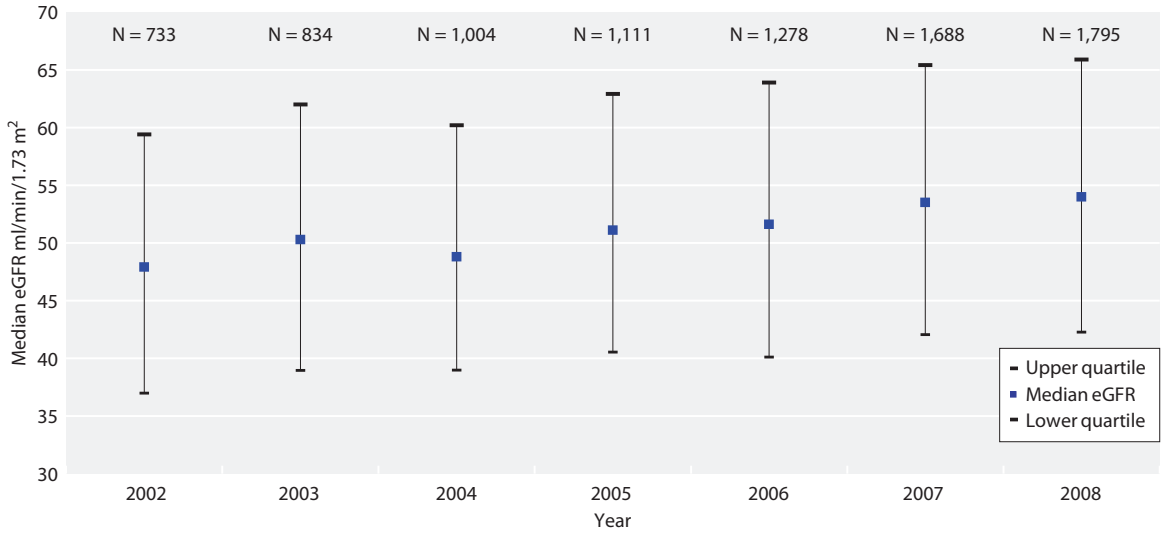

Fig. 3.7. Median eGFR one year post-transplant by year of transplantation 2002–2008

centre, stratified by eGFR, is displayed in figures 3.11a and 3.11b.

Figure 3.12 describes the percentage of prevalent patients by centre with haemoglobin <10.5 g/dl as a funnel plot enabling more reliable comparison of outcomes between centres across the UK. With 58 centres included and a normal distribution, 2–3 centres would be expected to fall between the 95%–99.9% CI (1 in 20) and no centres should fall outside the 99.9% CI purely as a chance event.

Two centres (Leeds, London Royal Free) fall outside the upper 99.9% CI and 4 further centres, (Leicester, London Guy's, Manchester Royal Infirmary, Portsmouth) fall outside the upper 95% CI indicating a higher than predicted proportion of transplant patients not achieving the haemoglobin target. Six centres (Antrim, Cardiff, Newcastle, Sheffield, Shrewsbury, Truro) perform better than expected with fewer than predicted patients having a haemoglobin <10.5 g/dl.

Haemoglobin in patients one year post-transplantation

The one year post-transplant haemoglobin for patients transplanted between 2002–2008 continued to be stable at 13.0 g/dl (figure 3.13).

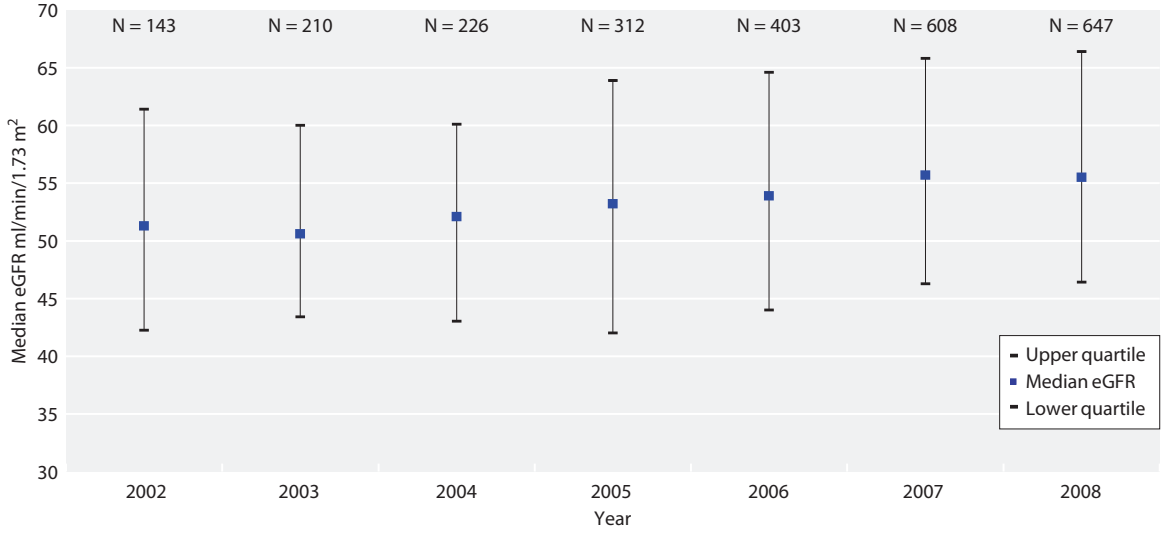

Fig. 3.8a. Median eGFR one year post-live donor transplant by year of transplantation 2002–2008

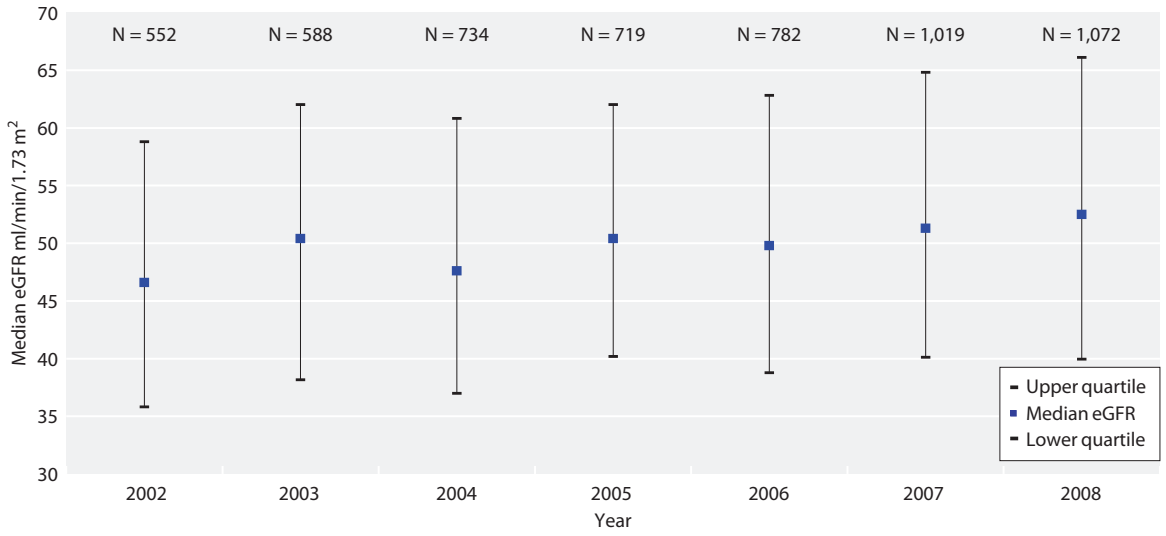

Fig. 3.8b. Median eGFR one year post-deceased donor transplant by year of transplantation 2002–2008

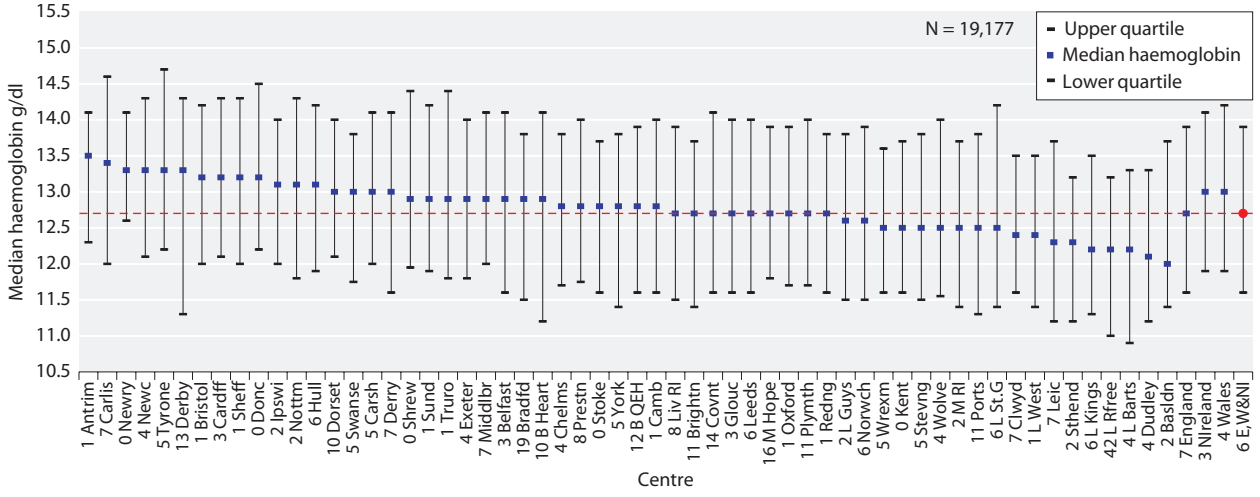

Fig. 3.9. Median haemoglobin for prevalent transplant patients by centre on 31/12/2009

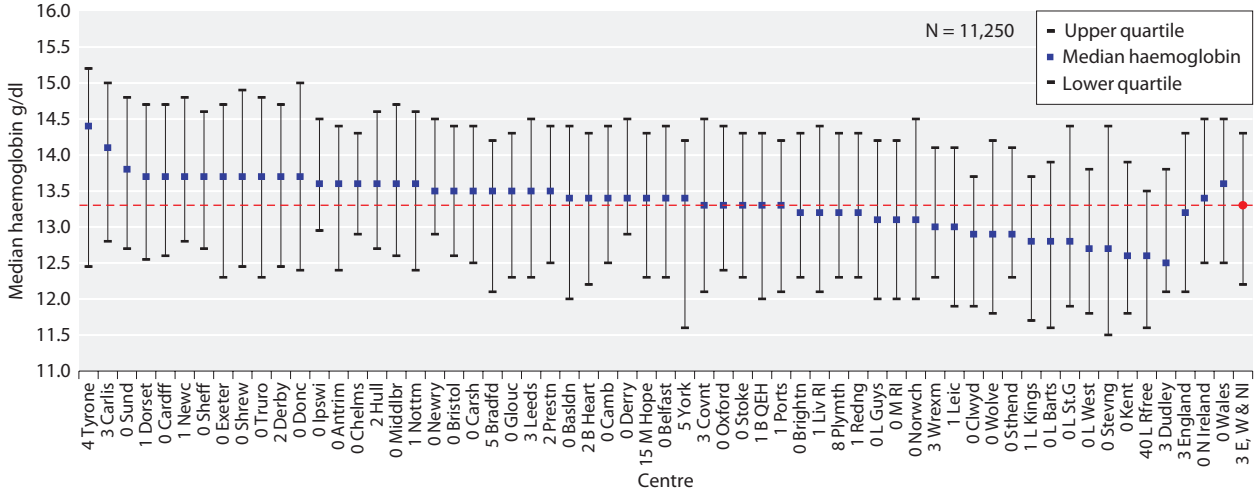

Fig. 3.10a. Median haemoglobin for prevalent transplant patients with eGFR $\geqslant 45$ ml/min/1.73 m^2 by centre on 31/12/2009

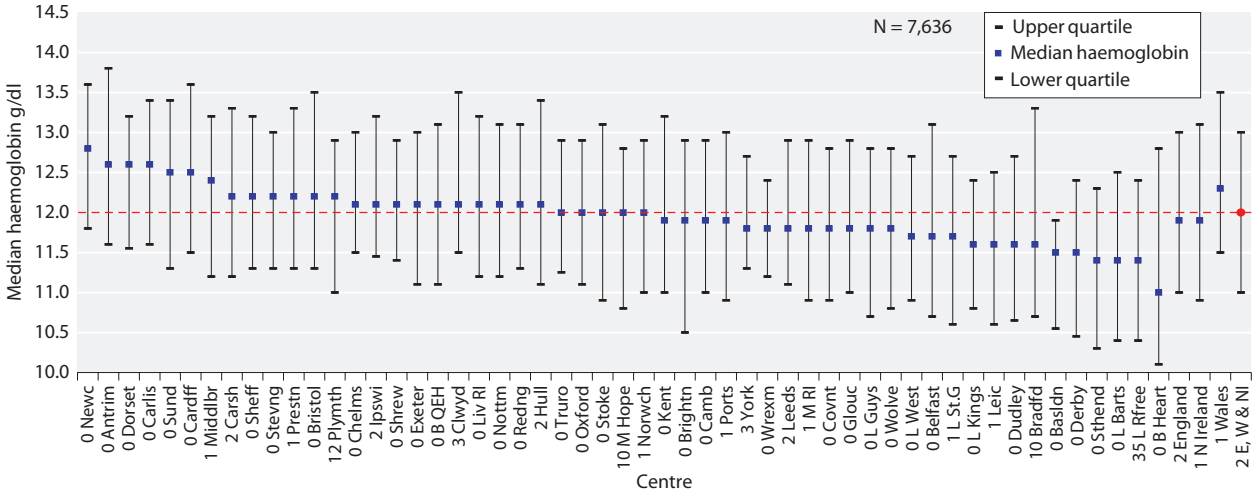

Fig. 3.10b. Median haemoglobin for prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 by centre on 31/12/2009

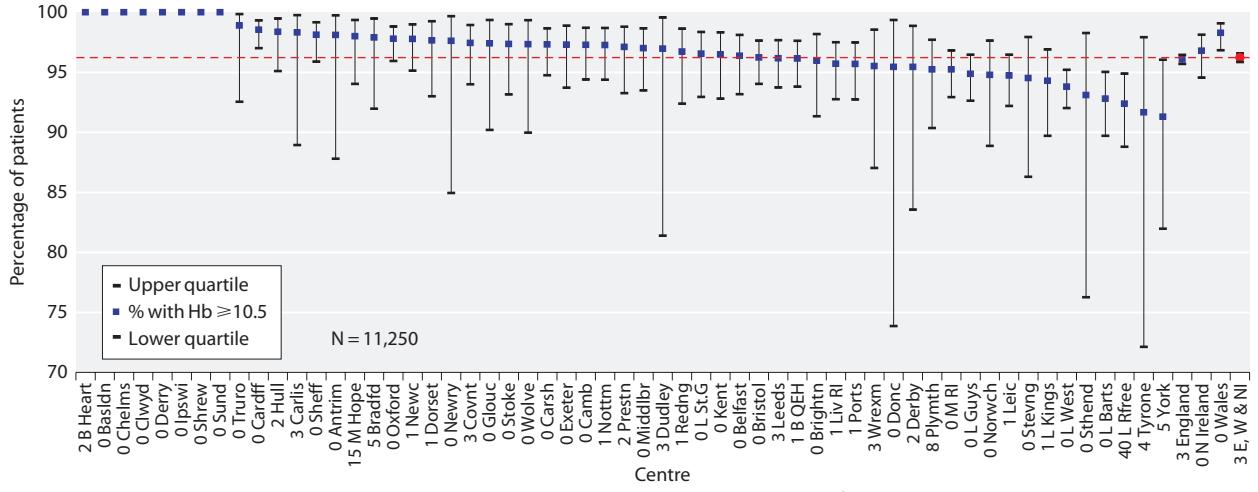

Fig. 3.11a. Percentage of prevalent transplant patients with eGFR ⩾45 ml/min/1.73 m^2 achieving haemoglobin ⩾10.5 g/dl by centre on 31/12/2009

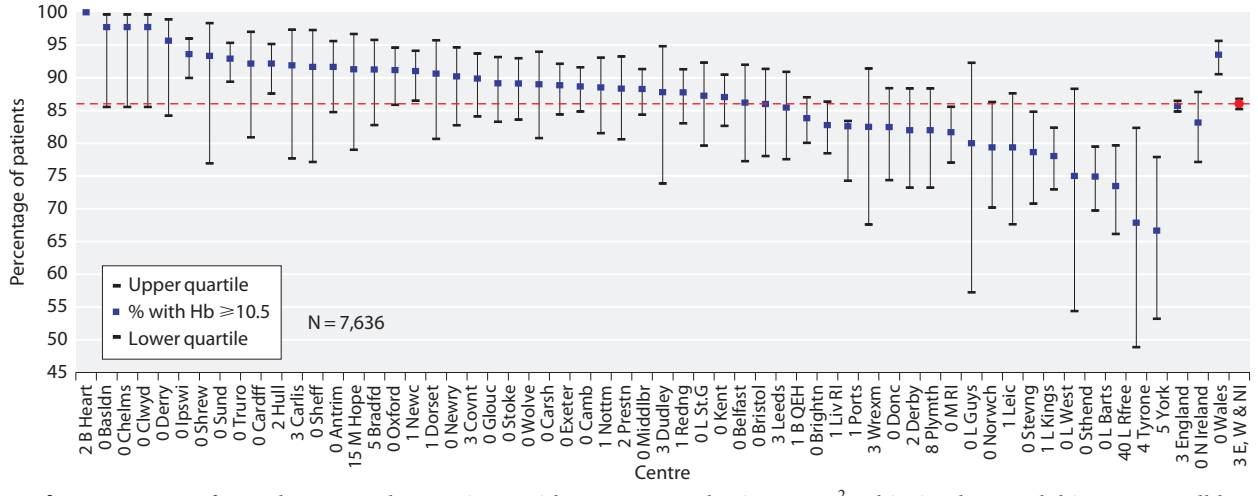

Fig. 3.11b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving haemoglobin ⩾10.5 g/dl by centre on 31/12/2009

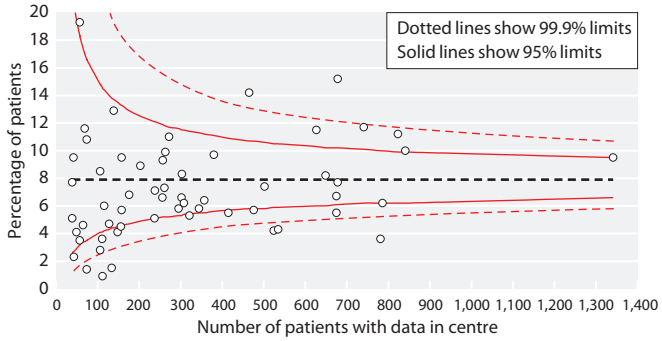

Fig. 3.12. Funnel plot of percentage of prevalent transplant patients with haemoglobin <10.5 g/dl by centre size on 31/12/2009

Blood pressure in prevalent transplant patients

In the absence of controlled trial data, the opinion-based recommendation of the UK Renal Association (RA) published in the 2010 guideline for the care of the kidney transplant recipient is that ***'Blood pressure should be <130/80 mmHg (or <125/75 mmHg if proteinuria)'*** [9]. This blood pressure target is the same as that used in previous annual reports [10].

As indicated in table 3.9a, completeness for blood pressure data returns was variable and only centres with >50% data returns were included for consideration. Despite this restriction, caution needs to be exercised in interpretation of these results because of the volume of missing data and potential bias, (e.g. a centre may be more likely to record and report blood pressure data electronically in patients with poor BP control).

Median systolic BP (figure 3.14), diastolic BP (figure 3.15) and percentage of patients achieving RA targets (figure 3.16) are shown. Higher blood pressure may have a cause or effect association with degree of graft function. Figures 3.17a and 3.17b demonstrate the association of transplant eGFR (stratified as ⩾ or <45 ml/min/1.73 m^2) with blood pressure. The percentage of patients with BP <130/80 (systolic BP <130 **and** diastolic BP <80 mmHg) was higher (29.6% vs. 24.2%) in those with better renal function (eGFR⩾45 ml/min/1.73 m^2).

Blood pressure in patients one year after transplantation

Figures 3.18 and 3.19 show median systolic and diastolic blood pressures in patients one year after transplantation, respectively.

At present, renal transplant recipients are considered as a sub-group of the native kidney disease population. There is no current evidence that suggests the knowledge gained from native kidney disease literature is not applicable to transplant recipients. Less than 27.5% of prevalent transplant patients across the UK achieved a BP of <130/80 mmHg, and it is necessary to evaluate new ways to achieve this goal or assess whether this is realistically achievable in the majority of patients.

Cholesterol in transplant patients

The Renal Association guidelines [10] state that ***'Three hydroxy-3 methylglutaryl-Co-enzyme A reductase inhibitors (statins) should be considered for primary prevention in all CKD including dialysis patients with a 10-year risk of cardiovascular disease, calculated as >20% according to the Joint British Societies' Guidelines***

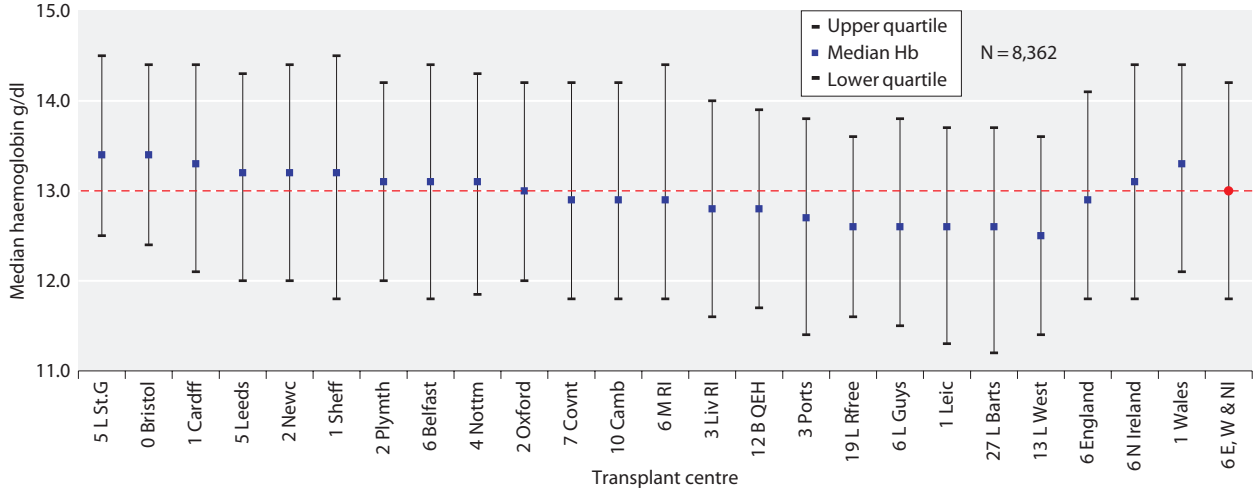

Fig. 3.13. Median haemoglobin one year post-transplant by transplant centre for patients transplanted between 2002–2008

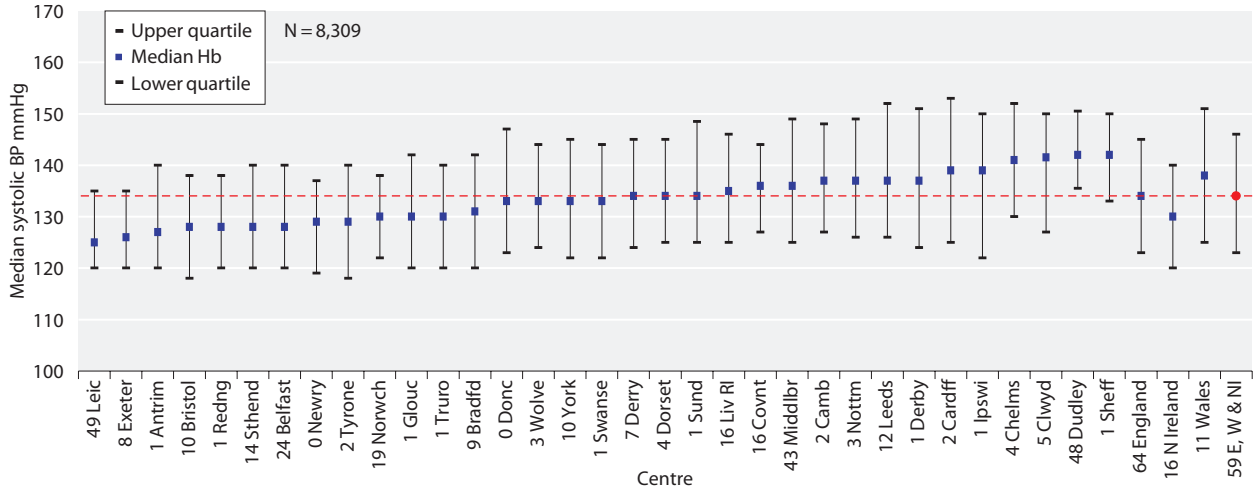

Fig. 3.14. Median systolic blood pressure for prevalent transplant patients by transplant centre on 31/12/2009

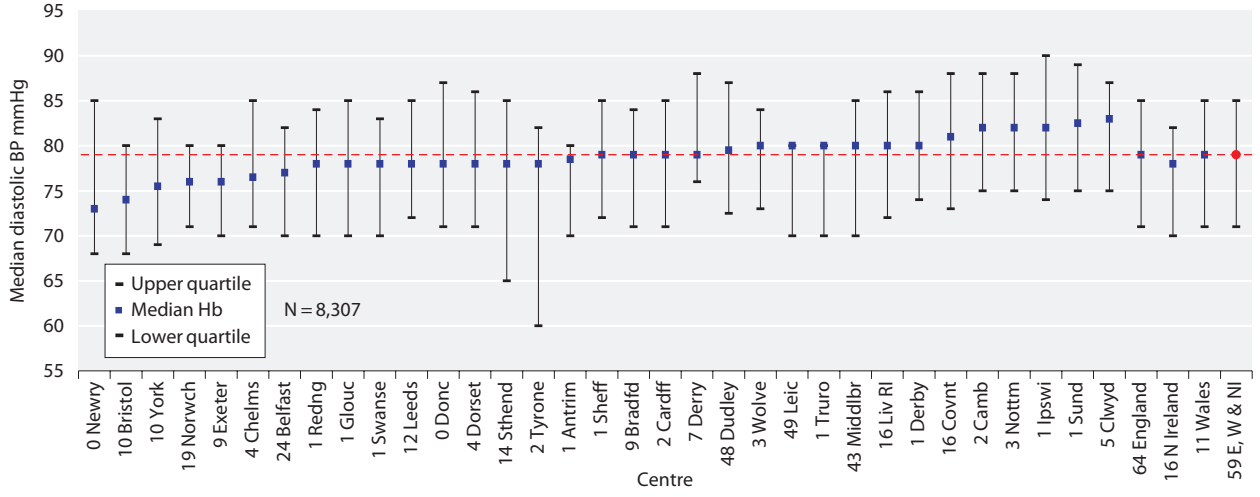

Fig. 3.15. Median diastolic blood pressure for prevalent transplant patients by transplant centre on 31/12/2009

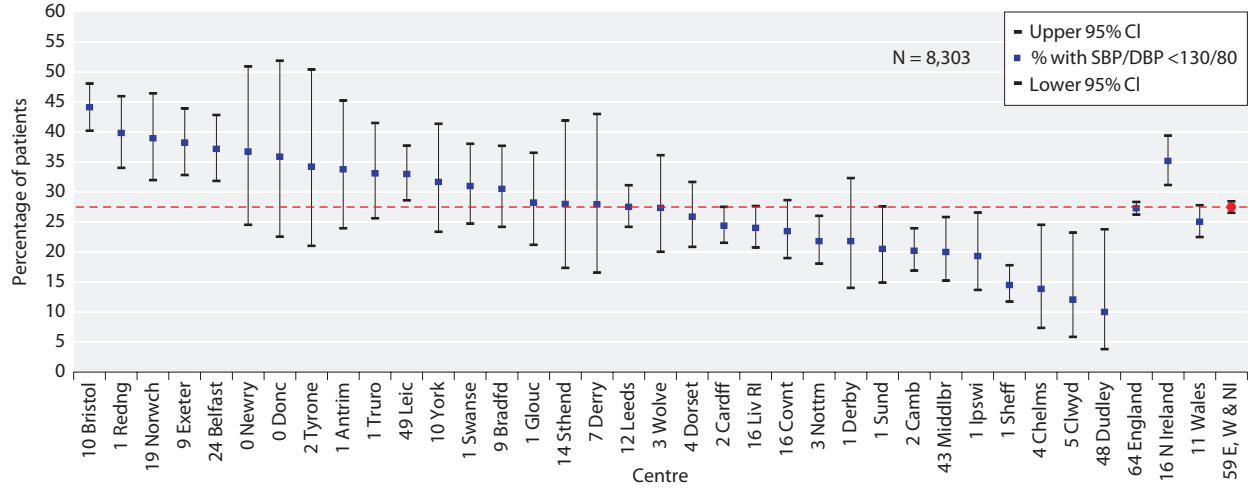

Fig. 3.16. Percentage of prevalent transplant patients achieving blood pressure target of <130/80 mmHg by centre on 31/12/2009

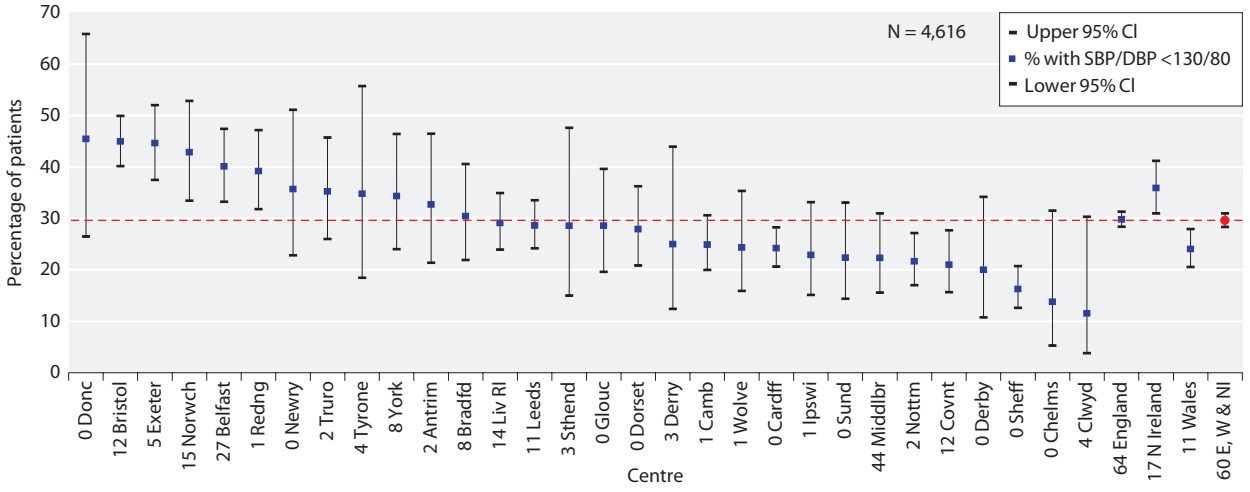

Fig. 3.17a. Percentage of prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 achieving blood pressure of <130/80 mmHg by centre on 31/12/2009

(JBS 2), despite the fact that these calculations have not been validated in patients with renal disease. A total cholesterol of <4 mmol/l or a 25% reduction from baseline, or a fasting low density lipoprotein (LDL)-cholesterol of <2 mmol/l or a 30% reduction from baseline, should be achieved, whichever is the greatest reduction in all patients'. The updated guidelines 2010 [11] are less specific regarding the management of dyslipidaemia, and therefore the older guideline is used for this report. Audit against this standard is not currently possible using data returned to the UKRR, because such an audit would require categorisation of 10-year risk in each patient, data for which are not available. There is at present no consensus amongst UK clinicians that all transplant patients should be treated as though they have a 10-year risk of cardiovascular disease of >20%, although further guidelines on the medical management of transplant patients and on the management of cardiovascular disease in CKD are in preparation. However previous UKRR reports have contained analyses of total cholesterol, and these are repeated here for comparison.

The percentage of prevalent transplant recipients achieving a cholesterol concentration <5 mmol/L by centre and stratified according to eGFR ($\geqslant$ or <45 ml/min/1.73 m^2) and median cholesterol concentration one year after transplantation are described in figures

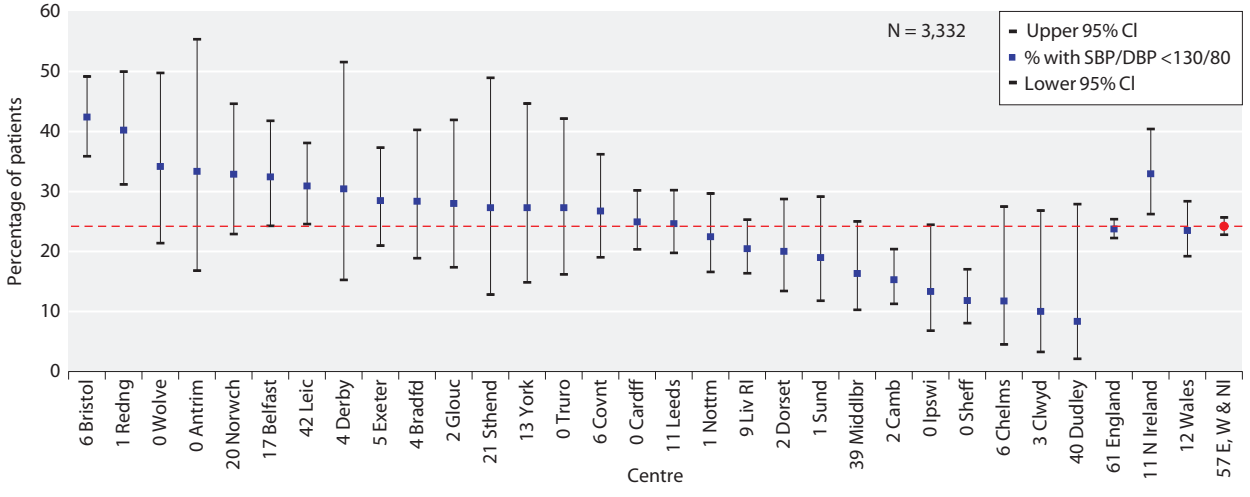

Fig. 3.17b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving blood pressure of <130/80 mmHg by centre on 31/12/2009

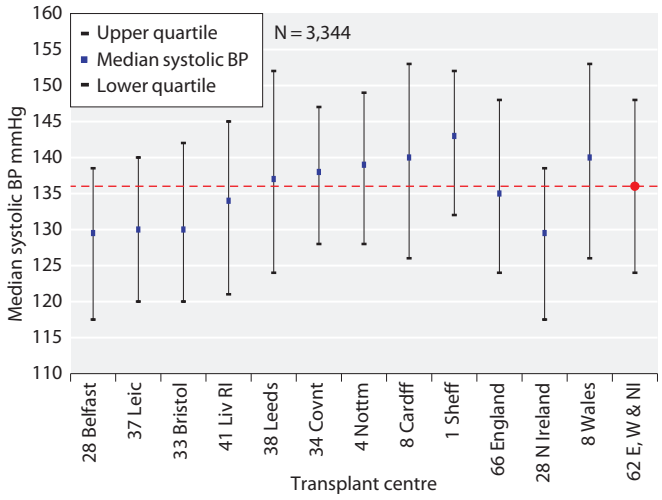

Fig. 3.18. Median systolic blood pressure one year post-transplant by transplant centre for patients transplanted between 2002–2008

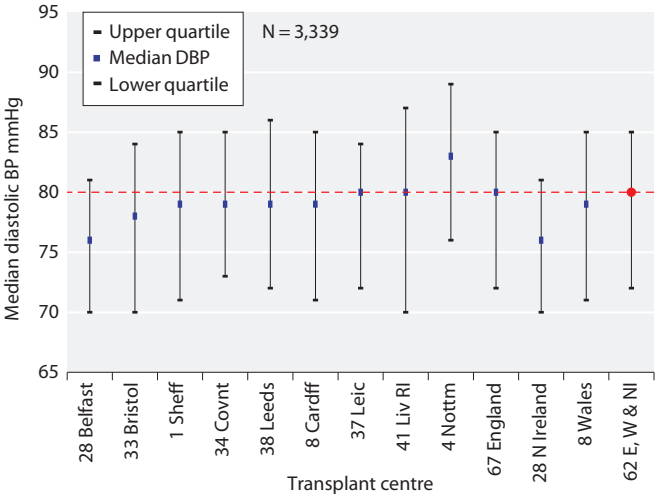

Fig. 3.19. Median diastolic blood pressure one year post-transplant by transplant centre for patients transplanted between 2002–2008

3.20a, 3.20b and 3.21 respectively. The median cholesterol concentration in the UK was 4.5 mmol/L. At the end of 2009, 69.9% of prevalent transplant patients had a total cholesterol concentration <5 mmol/L. The major between-centre differences in total cholesterol concentrations are likely to reflect the effects of significant differences in the clinical approach to the management of hypercholesterolaemia.

Bone mineral metabolism in transplant patients

In the absence of definitive literature concerning evaluation and management of bone mineral disorder in transplant recipients, guidelines derived from chronic native kidney disease are commonly adopted. It is beyond the scope of this commentary to discuss the appropriateness or otherwise of this strategy. Since there were no accepted guidelines on target biochemical values concerning bone disease in transplant patients in 2009 the CKD audit measures then extant have been applied.

Serum phosphate

The percentage of prevalent patients achieving a phosphate concentration <1.8 mmol/L are described in

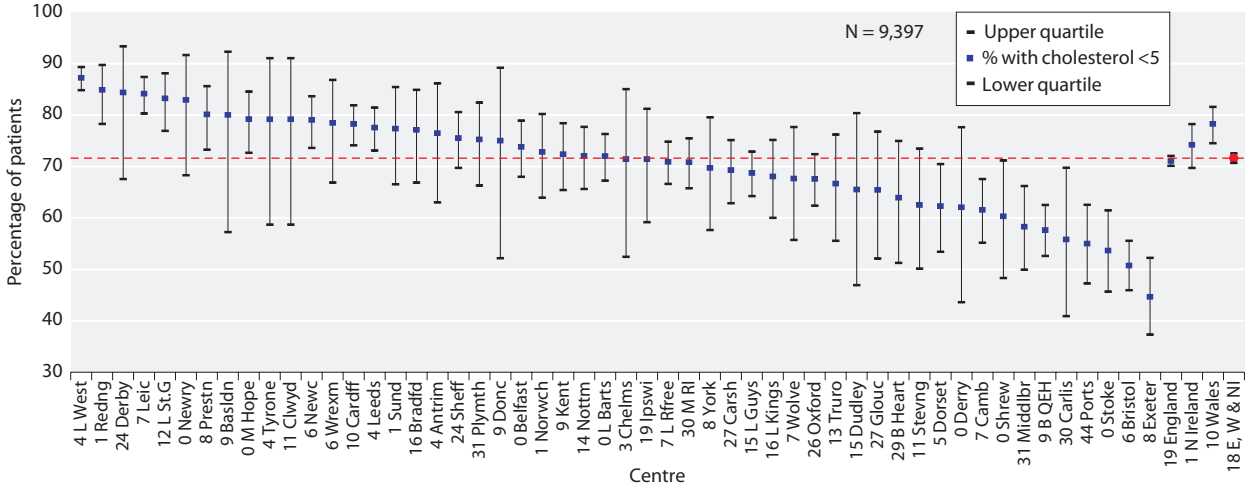

Fig. 3.20a. Percentage of prevalent transplant patients with eGFR ⩾45 ml/min/1.73 m^2 achieving total cholesterol <5 mmol/L by centre on 31/12/2009

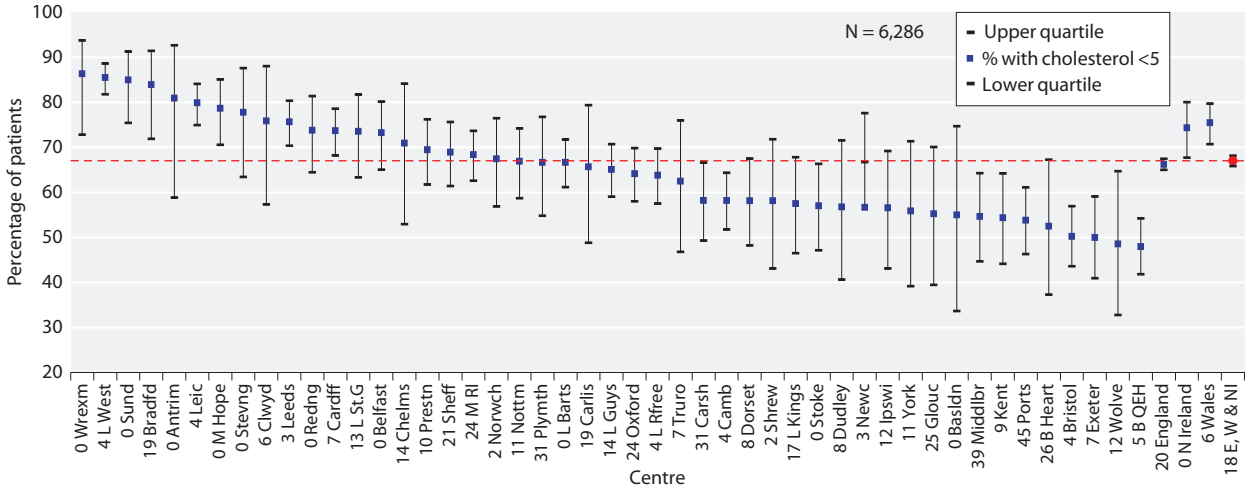

Fig. 3.20b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving total cholesterol <5 mmol/L by centre on 31/12/2009

figure 3.22 with further stratification based on eGFR ($\geqslant$ or <45 ml/min/1.73 m^2) in figures 3.23a and 3.23b. With 99% of prevalent patients achieving a phosphate concentration <1.8 mmol/L and achievement ranging from 95%–100%, this is probably not a useful clinical performance indicator.

Figure 3.24 describes median phosphate concentrations one year after transplantation. One year post-transplant, 34.4% of kidney recipients have phosphate concentrations in the range of 1.1–1.8 mmol/L. This low percentage mainly reflects patients having serum phosphate concentrations <1.1 mmol/L because of post-transplant phosphate losses.

Serum calcium

The percentage of prevalent transplant patients with a serum calcium concentration within the target range of 2.2–2.6 mmol/L are shown in figure 3.25 with further stratification based on eGFR ($\geqslant$ or <45 ml/min/1.73 m^2) in figures 3.26a and 3.26b.

In contrast to the phosphate results, there is wide inter-centre variation in achievement of in-range serum calcium concentrations (60.9% to 92.5%), with both transplanting and non-transplanting renal centres at either end of the performance spectrum. This spread is not explained by differences in graft function as estimated by eGFR. Further work to understand the

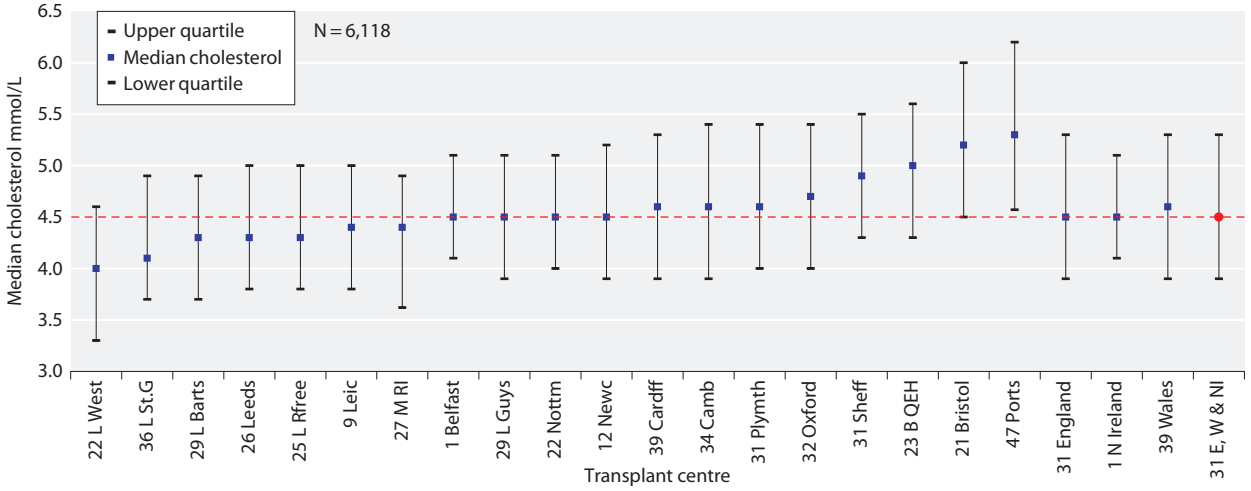

Fig. 3.21. Median total cholesterol one year post-transplant by transplant centre for patients transplanted between 2002–2008

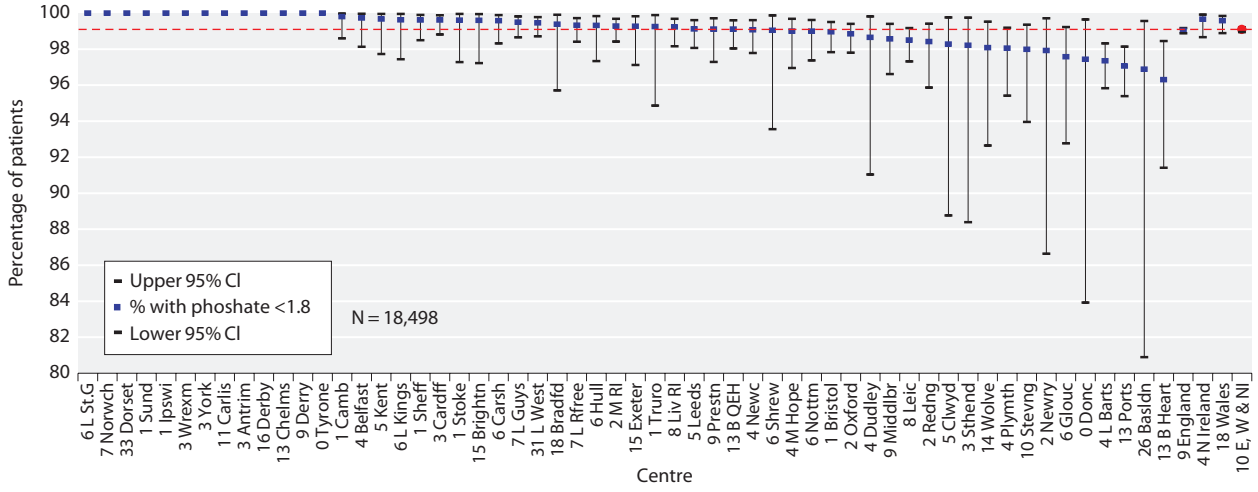

Fig. 3.22. Percentage of prevalent transplant patients with serum phosphate <1.8 mmol/L by centre on 31/12/2009

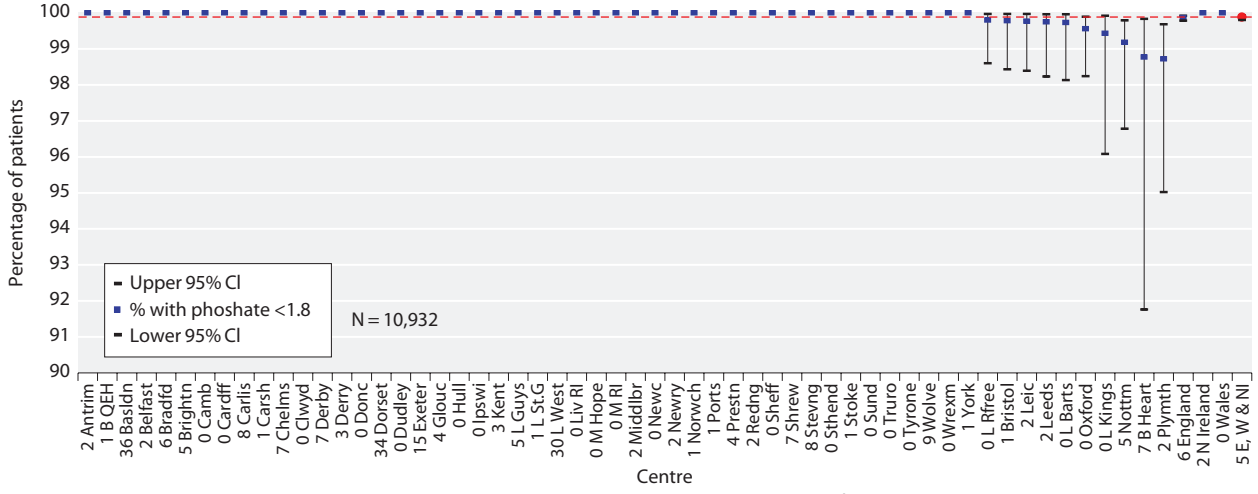

Fig. 3.23a. Percentage of prevalent transplant patients with eGFR ⩾45 ml/min/1.73 m^2 achieving serum phosphate <1.8 mmol/L by centre on the 31/12/2009

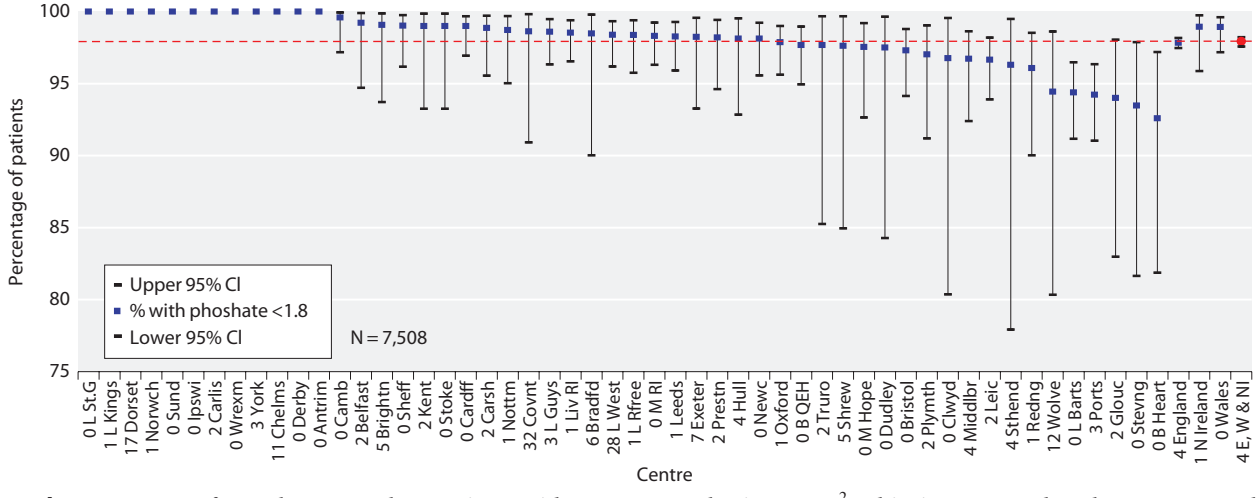

Fig. 3.23b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving serum phosphate <1.8 mmol/L by centre on the 31/12/2009

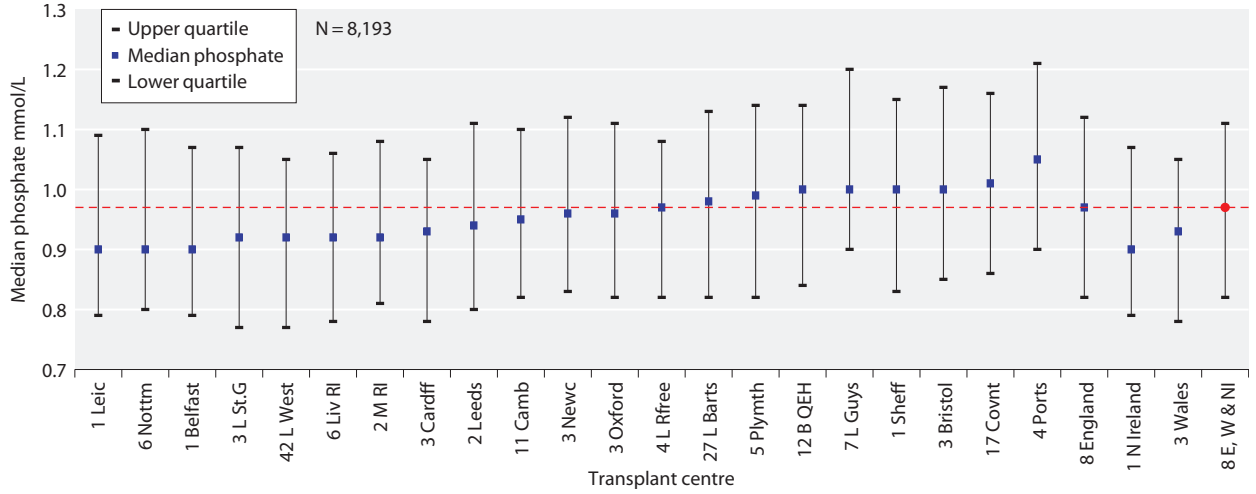

Fig. 3.24. Median serum phosphate one year post-transplant by centre for patients transplanted 2002–2008

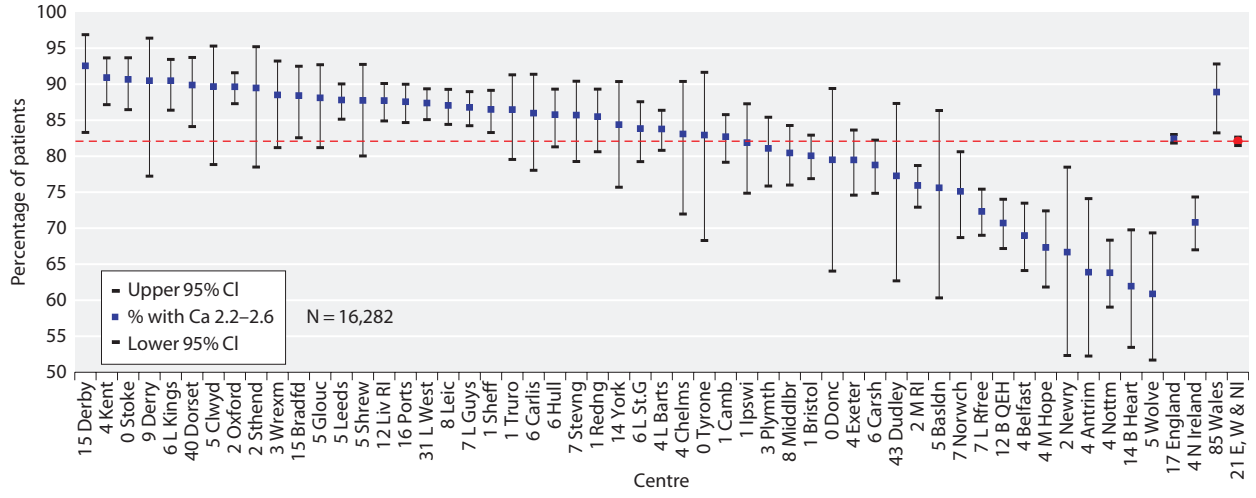

Fig. 3.25. Percentage of prevalent transplant patients with adjusted serum calcium between 2.2–2.6 mmol/L by centre on 31/12/2009

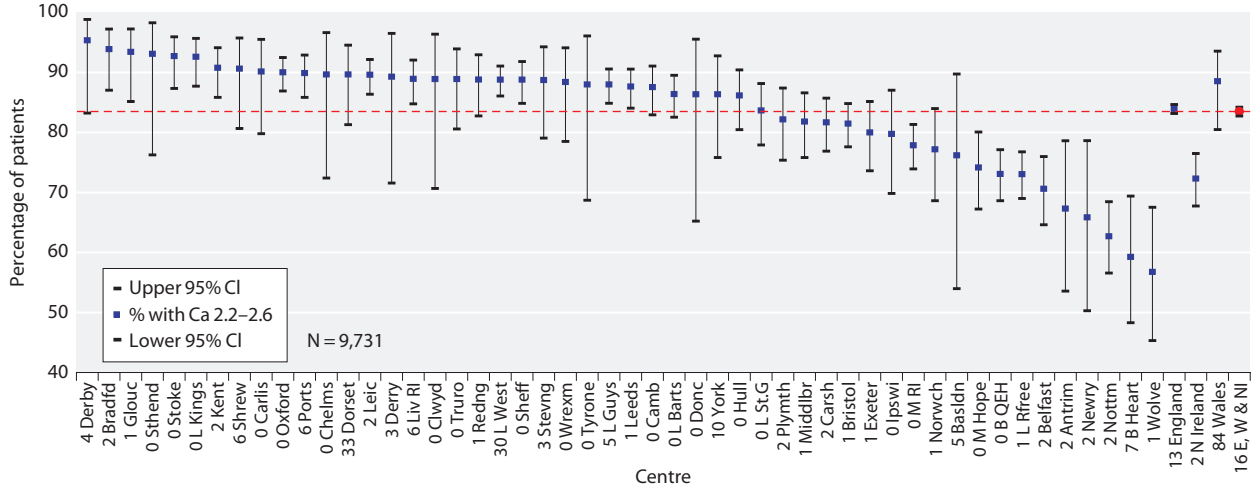

Fig. 3.26a. Percentage of prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 with adjusted serum calcium between 2.2–2.6 mmol/L by centre on 31/12/2009

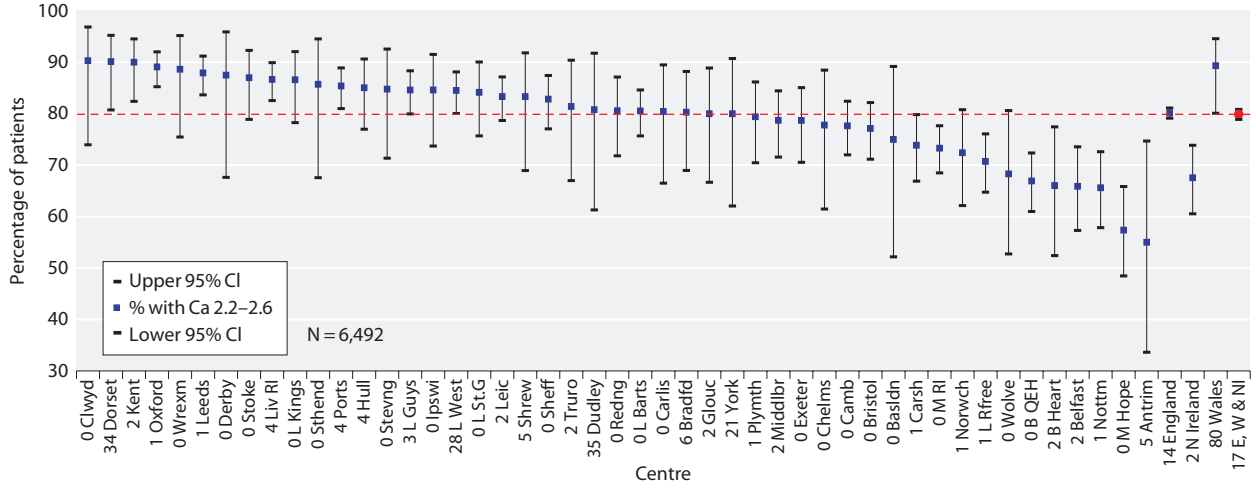

Fig. 3.26b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 with adjusted serum calcium between 2.2–2.6 mmol/L by centre on 31/12/2009

differences in laboratory measurement practices and albumin correction equations behind these variations is necessary.

Figure 3.27 demonstrates median serum calcium one year post-transplant.

Serum parathyroid hormone concentration

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

Analysis of prevalent patients by CKD stage

Introduction

About 3% of prevalent transplant patients returned to dialysis in 2009, a similar percentage to that seen over the last 8 years. Amongst patients with native chronic kidney disease, late presentation is associated with poor outcomes, largely attributable to lack of specialist management of anaemia, acidosis, hyperphosphataemia and to inadequate advance preparation for dialysis. Transplant recipients on the other hand, are almost always followed up regularly in specialist transplant or renal clinics and it would be reasonable to expect patients with failing grafts

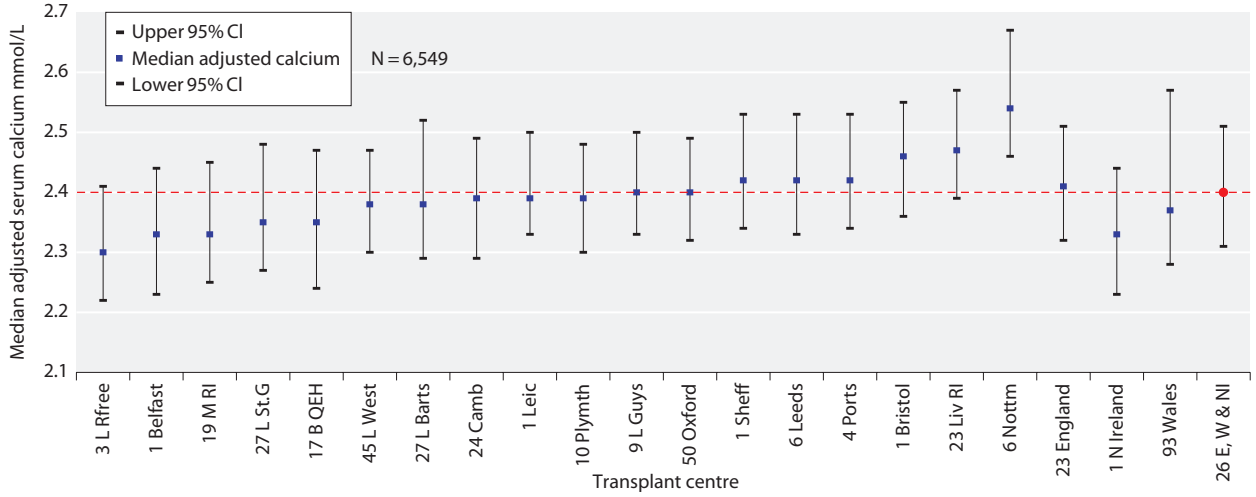

Fig. 3.27. Median adjusted serum calcium in patients one year post-transplant for patients transplanted 2002–2008

to receive appropriate care and therefore have many of their modifiable risk factors addressed before complete graft failure and return to dialysis.

Methods

The transplant cohort consisted of prevalent transplant recipients as on 31st December 2009 (n = 19,379) and were classified according to the KDIGO staging criteria with the suffix of 'T' to represent their transplant status. Patients with missing ethnicity information were classified as White for the purpose of calculating eGFR. Prevalent dialysis patients, except those who commenced dialysis in 2009, comprised the comparison dialysis cohort (n = 18,280) including 2,438 peritoneal dialysis patients. For both cohorts, the analysis used the most recent available value from the last two quarters of the 2009 laboratory data.

Results and discussion

Table 3.12 shows that 14.3% of the prevalent transplant population, or about 2,750 patients, had moderate to advanced renal impairment of eGFR <30 ml/min/1.73 m^2. The table also demonstrates that patients with failing grafts achieve UK Renal Association standards for key biochemical and clinical outcome variables less often than dialysis patients. This substantial group of patients represents a considerable challenge, as resources

Table 3.12. Analysis by CKD stage for prevalent transplant patients compared with prevalent dialysis patients on 21/12/2009

	Stage 1–2T (⩾60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
Number of patients	6,068	10,558	2,394	359	18,280
% of patients	31.3	54.5	12.4	1.9	
eGFR ml/min/1.73 m^2 [a]					
mean ± SD	75.6 ± 14.7	45.5 ± 8.3	23.9 ± 4.1	11.8 ± 2.4	
Median	71.6	45.7	24.3	12.3	
Systolic BP mmHg					
mean ± SD	133.5 ± 16.4	135.8 ± 17.7	138.9 ± 19.0	144.5 ± 20.0	131.2 ± 25.1
% ⩾130	59.3	62.9	68.4	83.0	49.8
Diastolic BP mmHg					
mean ± SD	77.8 ± 10.0	78.4 ± 11.0	78.7 ± 11.4	81.8 ± 12.5	70.0 ± 14.6
% ⩾80	48.0	49.2	53.1	58.5	24.4
Cholesterol mmol/L					
mean ± SD	4.5 ± 1.0	4.6 ± 1.1	4.7 ± 1.2	4.7 ± 1.2	4.0 ± 1.1
% ⩾5	27.6	31.1	34.6	37.5	16.6
Haemoglobin g/dl					
mean ± SD	13.5 ± 1.6	12.7 ± 1.6	11.6 ± 1.5	11.1 ± 1.5	11.5 ± 1.5
% <10.5	2.8	7.3	19.8	33.3	21.5
Phosphate mmol/L [b]					
mean ± SD	0.9 ± 0.2	1.0 ± 0.2	1.2 ± 0.3	1.5 ± 0.4	1.6 ± 0.4
% ⩾1.8	0.1	0.3	2.3	22.4	27.5
Corrected calcium mmol/L					
mean ± SD	2.4 ± 0.2	2.4 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.4 ± 0.2
% >2.6	7.8	8.2	5.9	7.7	7.4
% <2.2	8.9	9.3	16.9	25.8	18.4
PTH pmol/L					
median	8.3	10.0	15.2	26.6	26.3
% ⩾32	2.7	5.1	17.9	41.9	42.1

[a] Prevalent transplant patients with no ethnicity data were classed as White
[b] Only PD patients included in stage 5D, n = 2,438

need to be channelled to improve key outcome variables and achieve a safe and timely modality switch to another form of renal replacement therapy.

Causes of death in transplant recipients

Introduction

Differences in causes of death between dialysis and transplant patients may be expected due to selection for transplantation and use of immunosuppression. Chapter 6 includes a more detailed discussion on causes of death in dialysis patients.

Methods

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

Some centres have high data returns to the UKRR regarding cause of death, whilst others return no information. Provision of this information is not mandatory.

Adult patients aged 18 years and over, from England or Wales, were included in the analyses on cause of death. Previous analyses were limited to data from centres with a high rate of return for cause of death. When this was compared with an analysis of all the cause of death data on the database, the percentages in corresponding ERA-EDTA categories remained unchanged so the latter data were therefore included. Analysis of prevalent patients included all those aged over 18 years and receiving RRT on 1st December 2009.

Results and discussion

Causes of death in prevalent RRT patients in 2009 by modality and age

Tables 3.13, 3.14 and figure 3.28 show the differences in the causes of death between prevalent dialysis and transplant patients. These data were not adjusted for age or differences in comorbidity between the two groups. Death due to cardiovascular disease is less common in transplanted patients than in dialysis

Table 3.13. Cause of death by modality in prevalent RRT patients on 1/1/2009

	All modalities		Dialysis		Transplant	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	381	23	341	24	40	18
Cerebrovascular disease	76	5	68	5	8	4
Infection	339	21	279	19	60	28
Malignancy	150	9	101	7	49	23
Treatment withdrawal	208	13	207	14	1	0.5
Other	150	9	127	9	23	11
Uncertain	348	21	312	22	36	17
Total	**1,652**		**1,435**		**217**	
No cause of death data	2,352		1,965		387	

Table 3.14. Cause of death in prevalent transplant patients on 1/1/2009 by age

	All age groups		<55 years		⩾55 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	40	18	10	16.4	30	19
Cerebrovascular disease	8	4	3	5	5	3
Infection	60	28	19	31	41	26
Malignancy	49	23	10	16	39	25
Treatment withdrawal	1	0.5	0	0.0	1	1
Other	23	11	9	15	14	9
Uncertain	36	17	10	16	26	17
Total	**217**		**61**		**156**	
No cause of death data	387		106		281	

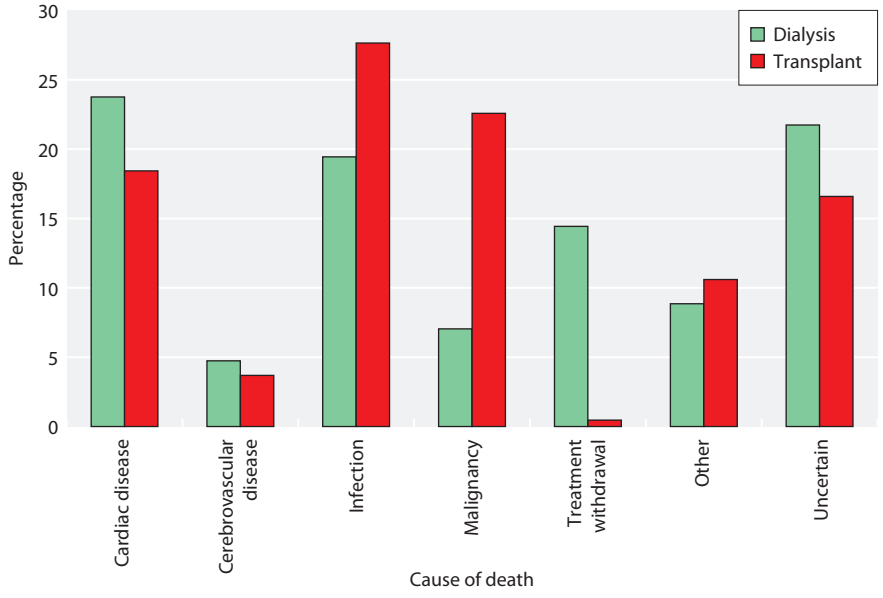

Fig. 3.28. Cause of death by modality for prevalent patients on 1/1/2009

patients, perhaps reflecting the cardiovascular screening undertaken as transplant work-up; transplant recipients are a pre-selected lower risk group of patients. Infection is the commonest reported cause of death in transplant recipients (28%) and presumably relates to the immunocompromised state of these individuals. In keeping with current literature regarding post-transplantation malignancy [12], cancer is also a frequent cause of death within the transplant population (23% of all deaths); this is also likely to reflect long-term immunosuppressive therapy.

In table 3.14 there are differences in the percentage of patients dying due to cardiac disease, infection and malignancy between patients aged <55 or $\geqslant 55$ years; this most likely reflects the small number of patients dying in the <55 age group.

Conflicts of interest: none

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Chapter 4
Comorbidities and Current Smoking Status amongst Patients starting Renal Replacement Therapy in England, Wales and Northern Ireland from 2008 to 2009

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Key Words
Comorbidity · Diabetes · Dialysis · eGFR · Ethnicity · Haemoglobin · Mortality · Renal replacement therapy · Smoking · Survival analysis

Summary

- Only 45.6% (n = 5,617) of the incident adult (⩾18 years) RRT patients reported to the UKRR between 2008 and 2009 had comorbidity data. In 2009, three centres provided data on 100% of new patients and 17 centres provided data for less than 5% of their new patients.
- In patients with comorbidity data, more than half had one or more comorbidities (56.5%) but in the subgroup of patients aged 65 years and over, 69.8% had one or more comorbidities.
- Diabetes mellitus and ischaemic heart disease were the most common conditions seen in 32.9% and 22.5% of patients respectively. Ischaemic heart disease, cerebrovascular disease, COPD, claudication and malignancy were more prevalent in patients 65 years and over.
- In 2008–2009, 12.4% of incident RRT patients were recorded as being smokers at the initiation of dialysis.
- Patients with peripheral vascular disease ($p = 0.0002$) and ischaemic heart disease ($p = 0.002$) were more likely to be referred to a nephrologist early and patients with malignancy ($p < 0.0001$) or liver disease ($p = 0.02$) were more likely to be referred late.
- In multivariable survival analysis, malignancy and the presence of ischaemic/neuropathic ulcers remained the strongest independent predictors of poor survival at 1 year after 90 days from the start of RRT in patients <65 years.

Introduction

The importance of adjusting for comorbidity in centre [1, 2] and international survival comparisons [3] is well recognised. As with all observational data, registry analyses exploring epidemiological issues, access to treatment or quality control, are subject to a number of selection biases. Such registry analyses can be significantly strengthened by adjustment for case-mix as differences in patient populations that exist across centres may affect process and outcome measures.

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

Methods

Study population

Incident adult ($\geqslant$18 years) RRT patients (n = 12,322) between 2008 and 2009 in the centres submitting data to the UKRR were considered. Of these, patients who had data recorded on comorbidity were included (n = 5,617; 45.6%). Data on completeness of comorbidity returns from each centre and overall may differ from those in previous UKRR reports due to some centres retrospectively entering previously missing comorbidity data.

Centre exclusions

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

Definition of comorbidity and method of data collection

Clinical staff in each centre are responsible for recording in yes/no format on their renal information technology (IT) system, the presence or absence of 13 comorbid conditions and information on current tobacco smoking (table 4.1) for each patient at the time of starting RRT. Definitions of each of these conditions are given in appendix B (http://www.renalreg.com/Report-area/Report2010/Appendix-B.pdf). Patients were classified as having complete comorbidity data if there was at least one entry (yes/no) for any one or more of the comorbid conditions. Comorbidities were grouped into broader categories for some analyses:

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

Table 4.1. Comorbid conditions listed in the UKRR dataset

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

Ethnicity data reporting

Some centres electronically upload ethnicity coding to their renal IT system from the hospital Patient Administration Systems (PAS) [4]. Ethnicity coding in PAS is based on self-reported ethnicity and uses a different system [5] to the remaining centres where ethnic coding is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks and Others. Appendix H details the regrouping of the PAS codes into the above ethnic categories.

Statistical methods

The statistical methods for the three individual sections of this chapter are described separately. The number of patients with data on comorbidity and other variables included in the analyses are summarised in figure 4.1.

1) Patient demographics

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

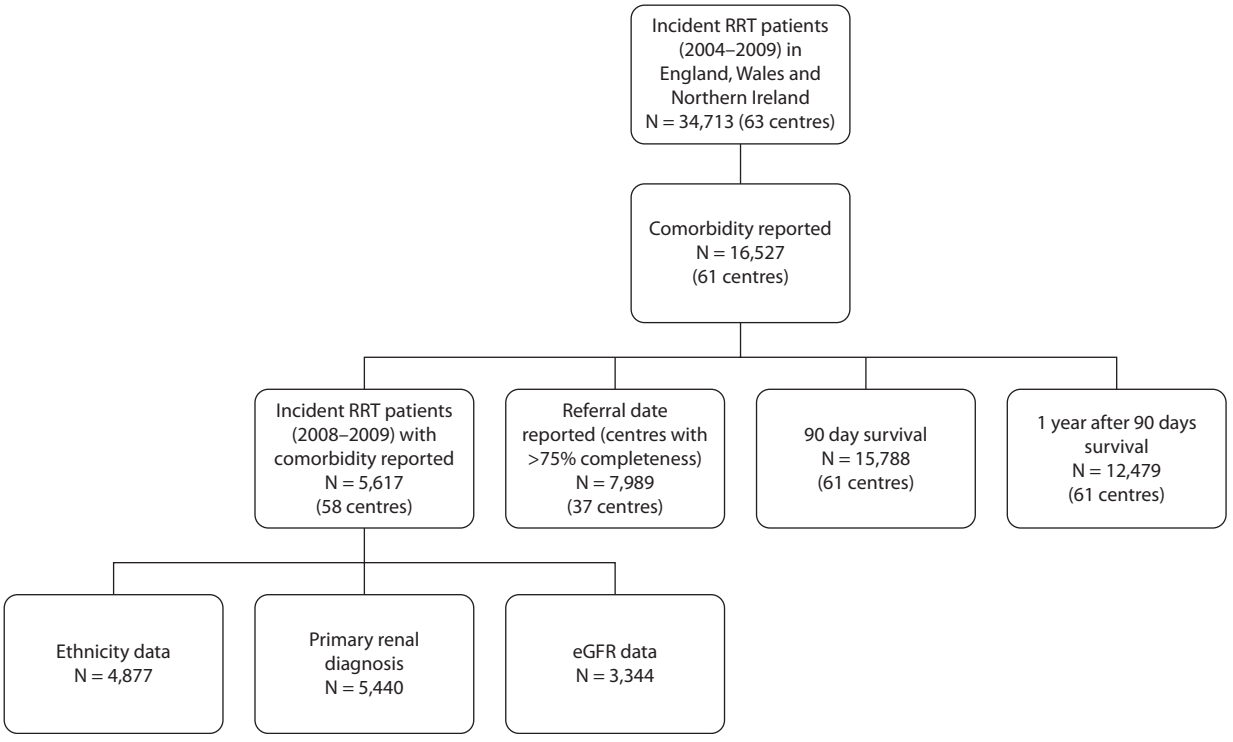

Fig. 4.1. Flow chart showing number of patients included in the various analyses

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

Referral time was defined as the number of days between the date first seen by a nephrologist and the date of starting RRT. Referral times of more than 90 days and less than 90 days define early and late presentation, respectively. Data on referral time were incomplete and therefore only patients with data on comorbidity and referral time from centres with >75% data completeness for referral time were included in this analysis (n = 7,989; 23.0% of all patients starting RRT between 2004 and 2009).

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

There is no defined eGFR at which patients should start RRT and a number of factors, including clinical presentation, symptoms, complications of uraemia and biochemistry, are used to determine dialysis initiation. However, there are defined eGFR thresholds for pre-emptive listing for a kidney transplant. The European Best Practice Guidelines (EBPG) recommend that patients with progressive irreversible deterioration in renal function and a creatinine clearance of <15 ml/min/1.73 m^2 should be considered for pre-emptive transplantation; patients with ERF secondary to diabetes should be considered for early and pre-emptive transplantation when their eGFR decreases to <20 ml/min/1.73 m^2 [7]. In the UK, the British Transplantation Society (www.bts.org.uk) endorse the EBPG and current UK Renal Association guidelines recommend that patients should be placed on the kidney transplant waiting list within six months of their anticipated dialysis start date [8]. There are no KDOQI guidelines for listing. It is therefore possible that patients could have started RRT with a transplant and an eGFR value as high as 20 ml/min/1.73 m^2.

For the eGFR analyses, incident RRT patients in 2008–2009 with comorbidity data were considered for inclusion (n = 5,617). Patients with no eGFR data (n = 1,443) were excluded, as were those with no eGFR data in the 14 days preceding RRT (n = 690). Patients with an eGFR >20 ml/min/1.73 m^2 (n = 140) were excluded from the eGFR analyses due to concerns about possible data extraction errors. This left 3,344 patients eligible for analysis. Many UKRR analyses, including those presented here, rely on the accuracy of the date of start of RRT. A discussion of the issues around definition of the start date is included in chapter 13 of the 2009 report [9].

3) Patient survival

The Registry collected data with a 'timeline' entry on all patients who had started RRT for ERF. Patients presenting acutely and initially classified as acute renal failure requiring dialysis who continued to require long-term dialysis, can be re-classified by clinicians as having had ERF from the date of their first RRT. The death rate was high in the first 90 days and variable between centres, due partly to individual clinical variation in the classification of patients

with acute kidney injury who may be deemed from the start to be unlikely to recover renal function. To remove this centre variation and allow comparison with results from other national registries, the association of comorbid conditions and survival 1 year after 90 days from start of RRT was also analysed.

For each of the follow up periods, the association of baseline comorbidity with survival was studied using univariate and multivariate Cox regression models. For analyses of survival within the first 90 days, the cohort included patients starting RRT between 1st January 2004 and 30th September 2009 to allow a minimum of three months follow-up from the start of RRT. For the 1 year after 90 days survival analyses, the cohort included patients who survived at least 90 days on RRT and who started RRT between 1st January 2004 and 30th September 2008.

For each variable, the models were used to estimate the hazard ratio of death, comparing patients with a particular comorbidity with those who did not have the comorbidity. For both the univariate and multivariate Cox models, patients were first stratified by age group (<65 years and >65 years) to account for the increasing incidence of certain comorbidities with age, which may otherwise obscure the analyses. The multivariate models used an automatic selection procedure to identify the variables most strongly related to survival. The potential variables to be included were: age (per 10 year increase), smoking status, diabetes (listed as PRD or not listed as PRD) and the other 12 comorbidities listed in figure 4.1. The automatic procedure starts by including only the variable most strongly related to survival. Then, with that variable included, it fits models adding each of the remaining variables in turn (singly) and chooses the variable that adds most to the model (in addition to the contribution made by the first variable included). The process continues in this way, adding variables that make a further significant contribution to the model, and removing any whose contribution becomes non-significant once other variables have been added. The final model only includes those variables selected by the process. These automatic methods have been used to give an indication of the variables most strongly related to survival but caution is needed in interpreting them because, amongst other things, when using correlated variables, a slight difference in the data (or in the algorithm chosen) could result in different variables being included in the final models. A better analysis would make a considered judgement of which variables should be included (rather than an automatic one) and would use interaction terms and/or adjustments other than age.

For each model, a R^2 value was calculated using the Royston and Sauerbrei method [10]. The R^2 value is the percentage of the variation in mortality which is explained by the variables included in the final model.

Results

Completeness of comorbidity returns from each participating centre

Of the 6,078 patients commencing RRT in centres in England, Wales and Northern Ireland in 2009, comorbidity data were provided for 2,697 (44.4%) (tables 4.2 and 4.3). Table 4.2 highlights the continued wide variation in the completeness of data returns with 3 centres providing data on 100% of patients, but 17 centres providing data for less than 5% of their new patients in 2009.

Limiting the analysis to only the centres that reported in 2004, data completeness for comorbidity has fallen from 52.1% in 2004 to 45.8% in 2009. When centres with 0% completeness for comorbidity were excluded, the median percentage of comorbidity returns in 2009 was 66.7%. This has shown an annual improvement since 2005, suggesting that once the renal information systems are set up to return comorbidity information, it is possible to improve data completeness.

Only patients in the UKRR database are included in table 4.2. Therefore for a small number of centres the numbers of new patients (N) shown for 2009 are different to those given in tables 1.1 and 1.3 in chapter 1 in which some manual corrections were made. As these additional patients are not in the database it was not appropriate to include them in the denominator for completeness calculations as, by definition, they could not have comorbidity data.

Prevalence of multiple comorbidity

Including all incident patients from the years 2008–2009 (n = 12,322), comorbidity data were available for 5,617 (45.6%). More than half of these patients had one or more comorbidities (56.5%) (table 4.4) but in the subgroup of patients aged 65 years and over, 69.8% had one or more comorbidities (table 4.5).

Frequency of each comorbid condition

Table 4.5 lists the prevalence of specific comorbidities and the percentage of the total number of incident patients for whom data was available for that item. Diabetes mellitus (either listed as cause of PRD or as a comorbidity) was present in 32.9% of all patients. Ischaemic heart disease, cerebrovascular disease, COPD, claudication and malignancy were more prevalent in patients 65 years and over. Liver disease, ischaemic/neuropathic ulcers and prior amputation were more frequently observed in younger patients; actual percentages, nevertheless, were quite small (table 4.5). Smoking was also more common amongst patients under 65 years. This broad stratification is quite misleading however, as prevalence of comorbidities increased markedly from 18–65 years and appeared to plateau beyond this (figures 4.2 and 4.3).

Table 4.2. Completeness of comorbidity data returns on incident patients from individual renal centres 2004–2009

	2004		2005		2006		2007		2008		2009	
Centre	N	% return	N	% return	N	% return	N	% return	N	% return	N	% return
Antrim			42	12	33	9	37	14	40	28	19	32
B Heart	106	0	121	2	115	0	101	2	106	1	99	16
B QEH	197	1	199	2	187	1	225	1	268	1	253	1
Bangor	36	64	40	55	42	60	36	69	41	68	30	77
Basldn	46	39	32	59	45	80	39	77	40	88	26	88
Belfast			130	25	119	25	89	34	69	32	53	38
Bradfd	61	92	67	96	50	100	88	99	63	90	54	96
Brightn	119	1	112	0	130	2	119	2	121	2	48	0
Bristol	164	82	175	81	176	98	157	83	176	74	157	80
Camb	107	1	111	0	155	2	127	1	113	0	138	1
Cardff	183	5	184	20	206	5	222	2	152	0	180	1
Carlis	29	79	31	84	27	85	26	88	30	77	24	83
Carsh	173	45	183	54	186	58	196	73	216	79	207	68
Chelms	50	48	40	50	49	84	52	54	34	38	38	45
Clwyd	13	23	26	19	18	22	22	36	15	40	17	53
Colchr									60	0	15	0
Covnt	80	0	85	0	105	2	112	0	115	0	119	0
Derby	67	75	72	74	69	67	63	84	92	90	78	91
Derry					3	67	8	50	6	50	16	56
Donc							18	94	26	27	40	43
Dorset	61	97	49	90	53	92	64	89	85	85	70	80
Dudley	54	0	38	0	45	2	39	0	47	0	66	0
Exeter	109	46	111	30	106	29	125	7	135	4	140	1
Glouc	54	85	61	97	72	89	58	95	47	85	79	65
Hull	108	87	127	98	105	91	99	97	113	91	102	72
Ipswi	46	46	59	29	42	62	41	46	38	34	38	3
Kent							175	62	140	66	128	60
L Barts	186	78	185	91	189	83	214	83	206	77	234	82
L Guys	122	7	146	12	153	12	165	7	166	3	179	3
L Kings	114	98	134	99	112	100	125	100	151	99	127	100
L Rfree			132	2	194	1	184	0	173	0	156	0
L St.G							96	68	100	67	108	55
L West	286	69	308	51	314	51	279	52	318	45	359	2
Leeds	185	82	171	74	180	77	129	81	161	79	156	87
Leic	163	93	226	66	243	68	245	77	242	76	222	67
Liv Ain	3	67	29	41	35	54	36	44	42	67	36	67
Liv RI	128	63	138	64	141	52	112	56	102	41	114	46
M Hope	112	43	112	34	131	12	121	12	141	1	118	0
M RI							161	27	134	36	150	44
Middlbr	101	91	84	90	109	72	99	63	93	90	95	85
Newc	107	1	112	4	106	1	106	1	98	1	100	0
Newry			28	14	13	23	15	27	21	86	20	100
Norwch	94	5	118	11	112	13	111	17	89	20	48	23
Nottm	107	95	145	99	137	97	129	93	116	89	124	94
Oxford	170	66	154	51	160	23	144	86	148	72	171	91
Plymth	63	43	60	47	93	67	76	79	69	70	60	77
Ports	119	67	149	64	175	63	157	66	170	54	151	40
Prestn	85	22	124	28	122	33	132	42	113	42	147	49
Redng	67	1	89	3	86	1	95	5	105	1	98	2
Sheff	167	59	158	42	168	57	166	56	180	51	142	52
Shrew	55	13	42	21	54	20	58	40	61	15	47	17
Stevng	84	37	92	42	122	48	89	70	103	76	97	74
Sthend	41	78	34	71	50	80	35	80	36	78	23	83
Stoke							87	0	82	0	109	0

Table 4.2. Continued

	2004		2005		2006		2007		2008		2009	
Centre	N	% return	N	% return	N	% return	N	% return	N	% return	N	% return
Sund	52	96	59	93	58	90	62	95	45	87	64	95
Swanse	95	93	100	96	116	97	126	98	124	97	113	97
Truro	68	79	32	88	52	79	45	91	40	35	51	45
Tyrone			24	33	29	52	22	55	25	48	19	68
Ulster			9	56	8	63	16	100	14	100	13	100
Wirral	67	15	60	7	52	0	53	0	42	2	62	0
Wolve	105	98	95	85	85	88	68	91	88	95	66	98
Wrexm	29	10	42	5	26	8	27	26	21	67	19	79
York	50	90	45	87	48	90	38	84	37	70	46	67
Totals	**4,888**		**5,531**		**5,811**		**6,161**		**6,244**		**6,078**	

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

Table 4.3. Summary of completeness of incident patient comorbidity returns (2004–2009)

	Years						Combined years
	2004	2005	2006	2007	2008	2009	
Number of renal centres included	50	56	57	62	63	63	
Total number of new patients	4,888	5,531	5,811	6,161	6,244	6,078	34,713
Number of patients with comorbid data entries	2,549	2,634	2,717	3,010	2,920	2,697	16,527
Percentage of patients with comorbid data entries	52.1	47.6	46.8	48.9	46.8	44.4	47.6
Percentage restricted to centres in since 2004	52.1	49.9	49.1	51.5	49.0	45.8	49.5
Median percentage amongst only centres returning >0% comorbidity	63.9	51.1	58.1	62.6	66.7	66.7	61.9

Prevalence of comorbidity by age band

Figures 4.2 and 4.3 illustrate the increasing prevalence of comorbidity with increasing age up to the 65–74 year age group in incident RRT patients. In those patients aged >75 years there was a slight reduction of most reported comorbidities.

Prevalence of comorbidity by ethnic origin

Figures 4.4 and 4.5 illustrate the presence of comorbidity by ethnic origin and age group. Figure 4.4 shows a higher prevalence of having at least one comorbidity amongst patients of White origin compared to the ethnic minority. Diabetes mellitus is much more frequently observed in South Asian patients (49.6%) than in White individuals (30.3%) (table 4.6).

Table 4.4. Number of reported comorbidities in patients starting RRT, as a percentage of those for whom comorbidity data were available 2008–2009

Number of comorbidities	0	1	2	3	4	5+
Percentage	43.5	29.2	13.4	7.8	3.7	2.5

Prevalence of comorbidity amongst patients with diabetes mellitus

Table 4.7 compares comorbidity amongst patients with and without diabetes (as either primary renal disease or comorbidity). As would be expected, patients with diabetes mellitus had higher rates of vascular disease (20.7% compared to 8.0% in non-diabetics). Similarly, ischaemic heart disease and cerebrovascular disease were more common in diabetics. Smoking at the time of initiation of RRT was the same for diabetics and non-diabetics (12.4%).

Late presentation and comorbidity

Table 4.8 shows the referral time for patients with and without various comorbidities. Patients with peripheral vascular disease and ischaemic heart disease were more likely to be referred to a nephrologist early and patients with malignancy or liver disease were more likely to be referred late.

Table 4.5. Frequency with which each condition was reported in incident RRT patients 2008–2009

Comorbidity	Age <65 years		Age ⩾65 years		p value*	% overall prevalence
	N	(%)	N	(%)		
Any comorbidity present	1,293	(44.2)	1,880	(69.8)	<0.0001	56.5
Angina	241	(8.3)	498	(18.6)	<0.0001	13.2
MI in past 3 months	54	(1.9)	88	(3.3)	0.0007	2.6
MI > 3 months ago	212	(7.3)	434	(16.3)	<0.0001	11.6
CABG/angioplasty	195	(6.7)	316	(11.8)	<0.0001	9.2
Cerebrovascular disease	187	(6.4)	395	(14.8)	<0.0001	10.4
Diabetes (not listed as PRD)	172	(6.0)	338	(12.7)	<0.0001	9.2
Diabetes listed as PRD	785	(26.9)	549	(20.4)	<0.0001	23.8
COPD	130	(4.5)	275	(10.3)	<0.0001	7.3
Liver disease	107	(3.7)	53	(2.0)	0.0001	2.9
Claudication	151	(5.2)	265	(9.9)	<0.0001	7.5
Ischaemic/neuropathic ulcers	126	(4.3)	76	(2.8)	0.0028	3.6
Angioplasty/vascular graft	67	(2.3)	146	(5.5)	<0.0001	3.8
Amputation	73	(2.5)	59	(2.2)	0.45	2.4
Smoking	406	(14.6)	256	(10.0)	<0.0001	12.4
Malignancy	200	(6.9)	528	(19.8)	<0.0001	13.1

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

Renal function at the time of starting RRT and comorbidity

Table 4.9 shows the geometric mean eGFR prior to starting RRT in patients with each of the individual comorbidities. The (geometric) mean eGFR prior to starting RRT in patients who were recorded as starting without any comorbidity present was 8.0 ml/min/1.73 m^2. In each case, average eGFR was slightly higher amongst patients with comorbidity compared to patients without any comorbidity.

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

All comorbidities were more prevalent in patients receiving haemodialysis as their initial modality of treatment rather than peritoneal dialysis (table 4.10). This difference was statistically significant for all comorbid conditions other than previous CABG/coronary angioplasty. The median age of patients with comorbidity data starting RRT on HD was 66.6 years compared

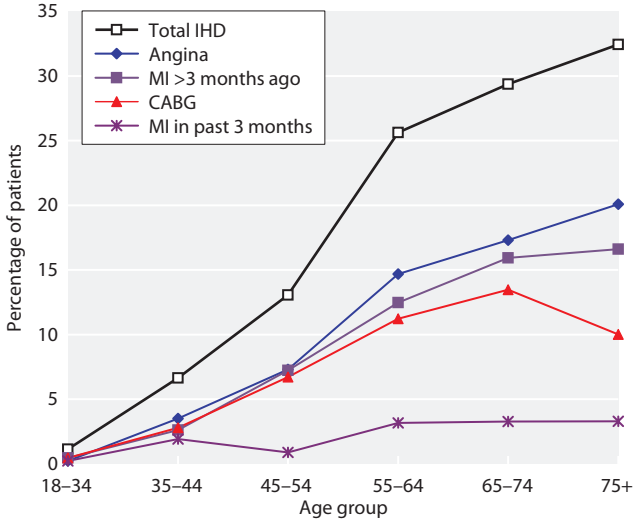

Fig. 4.2. Prevalence of ischaemic heart disease amongst incident patients 2008–2009 by age at start of RRT

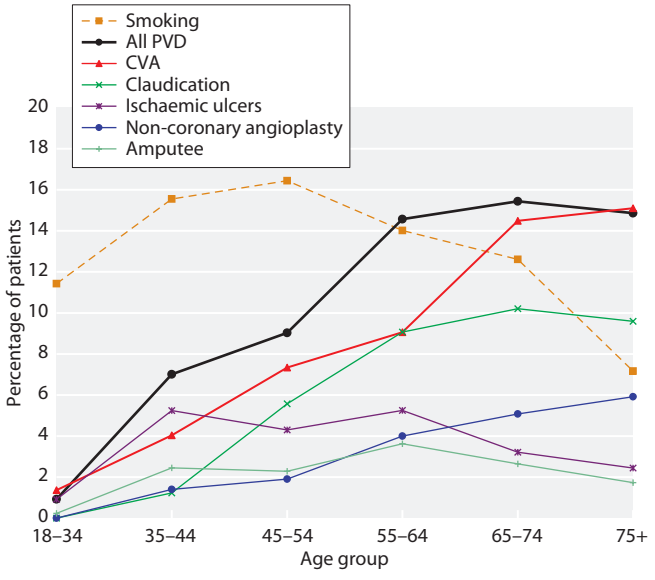

Fig. 4.3. Prevalence of non-coronary vascular disease amongst incident patients 2008–2009 by age at start of RRT

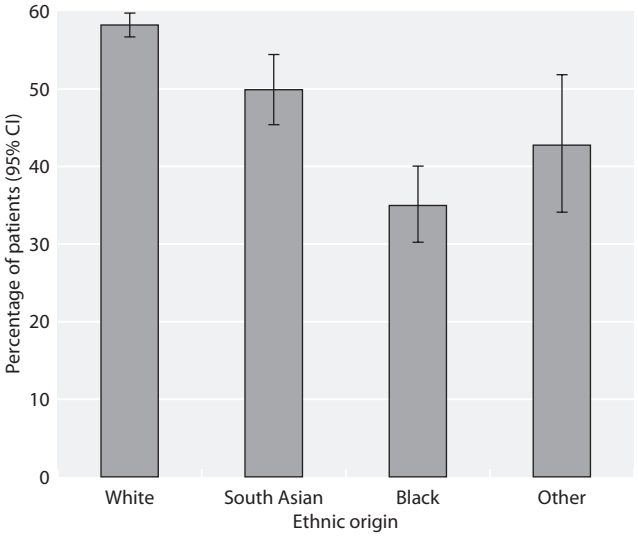

Fig. 4.4. Presence of comorbid conditions at the start of RRT by ethnic origin amongst patients starting RRT 2008–2009

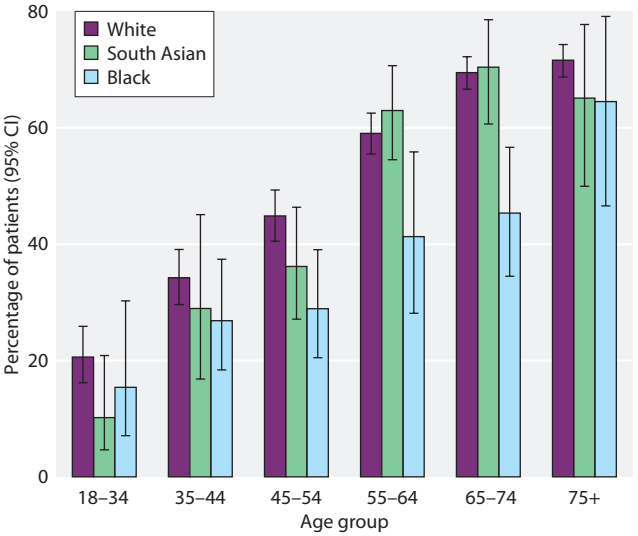

Fig. 4.5. Percentage of patients with comorbidity by ethnic origin in each age group at the start of RRT 2008–2009

Table 4.6. Prevalence of comorbidities amongst incident patients starting RRT 2008–2009 by ethnic group, as percentages of the total number of patients in that ethnic group for whom comorbidity data was available

	No. of patients (%) with comorbidity								
	White		South Asian		Black		Other		p value*
Ischaemic heart disease	883	(22.6)	135	(29.2)	31	(8.6)	13	(11.1)	<0.0001
Cerebrovascular disease	409	(10.5)	46	(10.0)	32	(8.9)	9	(7.7)	0.61
Diabetes (not listed as PRD)	334	(8.6)	45	(9.8)	25	(6.9)	5	(4.3)	0.18
Diabetes listed as PRD	856	(21.8)	186	(39.8)	103	(28.4)	30	(25.6)	<0.0001
COPD	308	(7.9)	16	(3.5)	9	(2.5)	3	(2.6)	<0.0001
Liver disease	103	(2.6)	17	(3.7)	16	(4.4)	7	(6.1)	0.031
Peripheral vascular disease	511	(13.1)	52	(11.3)	19	(5.3)	9	(7.8)	<0.0001
Smoking	512	(13.7)	28	(6.2)	20	(5.7)	13	(11.5)	<0.0001
Malignancy	556	(14.2)	20	(4.4)	21	(5.8)	9	(7.7)	<0.0001

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

Table 4.7. Number and percentage of patients with and without diabetes (either as primary diagnosis or comorbidity) who have other comorbid conditions

	Non-diabetic patients		Diabetic patients		
Comorbidity	N	(%)	N	(%)	p value*
Ischaemic heart disease	626	(17.4)	585	(32.5)	<0.0001
Cerebrovascular disease	303	(8.4)	254	(14.1)	<0.0001
COPD	264	(7.3)	122	(6.8)	0.46
Liver disease	99	(2.8)	49	(2.7)	0.96
Peripheral vascular disease	287	(8.0)	371	(20.7)	<0.0001
Smoking	428	(12.4)	213	(12.4)	0.95
Malignancy	534	(14.8)	169	(9.4)	<0.0001

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

Table 4.8. Percentage prevalence of specific comorbidities amongst patients presenting late (0–89 days) compared with those presenting early (>89 days)

	Late referral		Early referral		
Comorbidity	N	(%)	N	(%)	p value*
Ischaemic heart disease	371	(21.3)	1,540	(24.9)	0.002
Cerebrovascular disease	167	(9.5)	670	(10.8)	0.1
Diabetes (not listed as PRD)	145	(8.4)	541	(8.8)	0.5
COPD	122	(7.0)	437	(7.1)	0.9
Liver disease	62	(3.5)	156	(2.5)	0.02
Peripheral vascular disease	180	(10.3)	847	(13.7)	0.0002
Malignancy	347	(19.8)	684	(11.0)	<0.0001
Smoking	275	(16.0)	853	(14.0)	0.03

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

with 59.1 years for those starting on PD (Kruskal Wallis test, $p < 0.0001$). For each of the comorbid conditions, the median age of patients on HD was higher than for patients on PD (table 4.10).

Comorbidity and survival within 90 days of starting RRT

On univariate analysis stratified for age, most comorbidity was associated with an increased risk of death in the first 90 days when compared with a patient in the same age group without that comorbidity. This was true amongst patients aged <65 years and those aged ⩾65 years, the associations being more profound for those aged <65 years (data not shown). Multivariable stepwise Cox regression analyses stratified by age group (<65 and ⩾65) are shown in tables 4.11 and 4.12. As identified in the univariate models, comorbidities in younger patients were more indicative of early death than when present in older patients. Diabetes did not emerge as an independent predictor of death, probably due to its close association with ischaemic heart disease and peripheral vascular disease. Some comorbidities may appear not to be associated with an increased risk of death partly because of the low number of patients in these groups and partly because those who had severe disease and were thought likely not to survive 90

Table 4.9. eGFR within 2 weeks prior to the start of RRT by comorbidity 2008–2009

Comorbidity	eGFR geometric mean (ml/min/1.73 m^2)	eGFR 95% CI	p value*
No comorbidity present	8.0	7.9–8.2	Ref
Any comorbidity present	8.7	8.6–8.9	<0.0001
Angina	9.0	8.7–9.3	<0.0001
MI in past 3 months	9.0	8.3–9.8	0.013
MI > 3 months ago	9.2	8.9–9.5	<0.0001
CABG/angioplasty	9.4	9.0–9.8	<0.0001
Cerebrovascular disease	9.0	8.7–9.3	<0.0001
Diabetes (not listed as PRD)	8.7	8.4–9.0	0.001
Diabetes listed as PRD	9.1	8.9–9.4	<0.0001
COPD	9.1	8.8–9.5	<0.0001
Liver disease	8.4	7.8–9.1	0.304
Claudication	9.0	8.6–9.3	<0.0001
Ischaemic/neuropathic ulcers	9.1	8.5–9.6	0.001
Angioplasty/vascular graft	8.6	8.1–9.1	0.058
Amputation	9.3	8.7–10.0	0.001
Smoking	8.3	8.0–8.6	0.164
Malignancy	8.5	8.2–8.8	0.017

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

Table 4.10. Number (and percentage) of incident patients with comorbid conditions starting PD and HD 2008–2009

	HD			PD			
Comorbidity	N	(%)	Median age	N	(%)	Median age	p value*
Angina	626	(15.2)	71.2	111	(9.0)	67.8	<0.0001
MI in past 3 months	122	(3.0)	69.9	19	(1.6)	59.4	0.007
MI > 3 months ago	531	(12.9)	71.0	110	(9.0)	69.3	0.0002
CABG/angioplasty	403	(9.8)	69.3	103	(8.4)	67.6	0.15
Cerebrovascular disease	479	(11.6)	71.6	98	(8.0)	66.7	0.0004
Diabetes (not listed as PRD)	424	(10.3)	71.4	77	(6.3)	68.8	<0.0001
COPD	354	(8.6)	71.2	48	(3.9)	67.0	<0.0001
Liver disease	135	(3.3)	61.3	23	(1.9)	56.9	0.011
Claudication	351	(8.5)	70.6	61	(5.0)	65.4	<0.0001
Ischaemic/neuropathic ulcers	177	(4.3)	62.6	23	(1.9)	50.6	<0.0001
Angioplasty/vascular graft	177	(4.3)	72.0	35	(2.9)	65.4	0.024
Amputation	111	(2.7)	64.3	18	(1.5)	57.2	0.015
Smoking	506	(12.8)	61.9	141	(12.0)	56.4	0.46
Malignancy	621	(15.0)	72.6	102	(8.3)	68.7	<0.0001

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

Table 4.11. Multivariate Cox proportional hazards model* for predictors of death within the first 90 days of starting RRT during 01/01/2004–30/09/2009: patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	5.1	3.4–7.7	<0.0001
Amputation	4.7	2.6–8.4	<0.0001
Liver disease	3.7	2.1–6.5	<0.0001
Angina	1.9	1.2–3.0	0.005
Age (per 10 yrs)	1.6	1.3–2.0	<0.0001

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units), smoking and the 13 comorbidity variables except that 'diabetes (not listed as PRD)' was replaced by 'diabetes of either category' which included 'diabetes listed as PRD'.

Table 4.12. Multivariate Cox proportional hazards model* for predictors of death within the first 90 days of starting RRT during 01/01/2004–30/09/2009: patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
MI in past 3 months	2.3	1.6–3.2	<0.0001
Ischaemic/neuropathic ulcers	2.0	1.3–3.0	0.001
Malignancy	1.8	1.5–2.2	<0.0001
COPD	1.6	1.3–2.1	0.0002
Angina	1.5	1.2–1.9	0.0004
Age (per 10 yrs)	1.5	1.3–1.7	<0.0001
Smoking	1.4	1.0–1.8	0.024
MI > 3 months ago	1.3	1.1–1.7	0.015

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units), smoking and the 13 comorbidity variables except that 'diabetes (not listed as PRD)' was replaced by 'diabetes of either category' which included 'diabetes listed as PRD'.

days, may not be started on RRT (for instance, liver disease in those aged ⩾65 years).

The final five variables in the model examining death within the first 90 days of starting RRT in patients aged <65 (table 4.11) explain 40% of the variation in survival. For patients aged ⩾65, the final eight variables in the model explain 16% of the variation in survival (table 4.12).

Comorbidity and survival 1 year after 90 days of commencing RRT

Age, smoking and four comorbidities were independently associated with an increased hazard of death within the first year after 90 days for patients aged <65 years and four of these were among the eight variables independently associated with mortality beyond day 90 in patients ⩾65 years (tables 4.13 and 4.14). Diabetes mellitus was independently associated with increased

Table 4.13. Multivariate Cox proportional hazards model* for predictors of death in the year after the first 90 days of starting RRT during 01/01/2004–30/09/2008: patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	3.3	2.5–4.5	<0.0001
Ischaemic/neuropathic ulcers	2.6	1.8–3.7	<0.0001
Liver disease	2.1	1.4–3.2	0.0002
Diabetes of either category	1.9	1.5–2.4	<0.0001
Age (per 10 yrs)	1.4	1.2–1.5	<0.0001
Smoking	1.3	1.0–1.7	0.031

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units), smoking and the 13 comorbidity variables except that 'diabetes (not listed as PRD)' was replaced by 'diabetes of either category' which included 'diabetes listed as PRD'.

Table 4.14. Multivariate Cox proportional hazards model* for predictors of death in the year after the first 90 days of starting RRT during 01/01/2004–30/09/2008: patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
Amputation	2.7	1.8–4.1	<0.0001
Liver disease	2.0	1.3–3.0	0.001
Malignancy	1.8	1.5–2.1	<0.0001
Age (per 10 yrs)	1.7	1.5–1.9	<0.0001
Cerebrovascular disease	1.3	1.1–1.6	0.001
COPD	1.3	1.0–1.6	0.03
Angina	1.3	1.1–1.5	0.003
Smoking	1.3	1.0–1.5	0.02

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units), smoking and the 13 comorbidity variables except that 'diabetes (not listed as PRD)' was replaced by 'diabetes of either category' which included 'diabetes listed as PRD'.

mortality in patients <65 years but not in those aged ⩾65 years. Overall the final six variables in the model exploring death in the year after the first 90 days of starting RRT in patients <65 years explain 26% of the variation in survival. For patients ⩾65 years, only 12% of the variation in survival was explained by the eight variables included in the final model.

Discussion

Comorbidity data completeness has been a cause for concern since comorbidities were first reported by the UKRR in 1999 [11]. Overall rates of completeness are fairly static, though an improvement has been seen in those centres with an established mechanism for recording comorbidity information. The current rate of 44.4% in the UK compares with rates of 85% in Canada, 95–100% in Australia and New Zealand and 100% in the USA. Some work has recently been undertaken to learn from experience in these countries [12]. Comorbidity information should improve in the future through a combination of linkage with other secondary data sources (e.g. Hospital Episode Statistics dataset), statistical imputation techniques and local governance pressures now that comorbidity items form part of the National Renal Dataset.

Caution must be taken in interpreting the influence of comorbidity. In at least one study, patients with comorbidity recorded have significantly better health outcomes than those with missing comorbidity [13] so the generalisation of findings from the selected group of patients reported in this chapter cannot be assumed.

One further consideration is that even in analyses (both inside and outside the UK) with 100% comorbidity completeness, the proportion of variance in survival that can be explained by these major medical disorders generally remains below 50% when age, primary renal disease, ethnicity and comorbidities are included in the statistical model. Future studies of survival should consider other factors such as nutrition, mobility, cognition and socio-economic status at the start of dialysis to better assess the risk factors and outcomes for RRT patients. This is particularly important as we recognise that many older patients for instance, can be successfully transplanted with improved survival compared to matched wait-listed patients [14].

Conflicts of interest: none

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Chapter 5
Demography of the UK Paediatric Renal Replacement Therapy population in 2009

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Key Words
Aetiology · Children · Demography · End stage renal disease · Established renal failure · Incidence · Prevalence · Ethnicity · Treatment modality

Summary

- There were 751 children under 16 years reported as receiving RRT in 2009.
- In 2009, 70% of patients had received a transplant, 19% were on PD and 11% HD.
- The annual incidence of RRT has increased over the last 14 years from 8.1 pmarp (1995–1999) to 9.6 pmarp (2005–2009).
- Renal dyspasia ± reflux (34%), glomerulornephritis (16.9%) and obstructive uropathy (16.2%) were the commonest aetiologies.

Introduction

Established renal failure (ERF) requiring renal replacement therapy (RRT) is a rare but significant cause of long term morbidity and mortality during childhood. In the United Kingdom (UK), the annual incidence of treated ERF has remained stable at between 5 to 10 children per million age related population (pmarp) each year over the past 20–25 years although the prevalence rates have increased steadily to 56.1 pmarp in 2008 [1]. This increase in prevalence is likely to be a result of improved survival of children across the paediatric age range as a result of advances in the delivery of care with more effective dialysis, improved nutrition and the availability of better immunosuppressive medications following renal transplantation.

Accurate evaluation of the demographics of this cohort is important to inform further improvement in delivery of care and to form the basis of well designed research analysis. The objectives of this report are:

i) To describe the prevalence, incidence, causes of ERF and modality of treatment of children on RRT in the UK on 31st December 2009 and
ii) To describe trends of the same over the past 15 years.

Methods

Data collection took place across the 13 paediatric nephrology centres in the UK that provided care to all children on RRT in 2009. Some centres collected data electronically and submitted this to the UK Renal Registry (UKRR) with the remaining centres reporting data using 'paper-based' data returns. These data were then manually entered into the current paediatric UKRR database.

This year, five centres supplied data on paper returns with the remaining centres providing electronic files that were uploaded directly into the current paediatric UKRR database. Southampton provided an electronic file but due to technical difficulties was only able to send a limited dataset.

In this report patient groups are described as follows: patients who were receiving RRT on the 31st December 2009 are the 'prevalent group', patients who started RRT between 01/01/2009 and 31/12/2009 are the 'incident group' and patients that started RRT in the periods of 1995–1999, 2000–2005 and 2005–2009 are the '5 year groups'.

The populations used to calculate the incidence and prevalence rates were obtained from the Office for National Statistics (ONS) [2]. The mid-2009 population estimate produced by the ONS, based on the 2001 Census, was used for calculating the incident and prevalent group rates and the 2001 Census data was used for the 1995–2000 and 2000–2005 '5 year groups' and for the breakdown of the population into ethnic groups.

Statistical analyses were performed using SAS 9.2.

Results

Completeness of data returns

The procedures for data collection and processing are still evolving but there was good completion of the core data items as shown in table 5.1.

The UK paediatric prevalent ERF population in 2009

A total of 999 children and young people under 18 with ERF were receiving treatment at paediatric nephrology centres in 2009. At the census date, 67% had a

Table 5.1. Data completeness for paediatric prevalent ERF population in 2009

	Percentage completeness						
Centre	First seen date	RRT start date	Height at RRT start	Creatinine at RRT start	Treatment modality at 90 days	Ethnicity	Gender
Blfst_P	80.0	88.6	84.3	100.0	94.3	100.0	100.0
Bham_P	92.1	93.1	94.7	97.3	94.1	100.0	96.9
Brstl_P	91.1	100.0	92.5	97.4	100.0	100.0	98.2
Cardf_P	94.4	88.9	88.9	100.0	94.4	100.0	100.0
L GOSH_P	65.2	78.7	9.7	100.0	94.2	100.0	99.0
Glasg_P	85.5	87.0	92.8	100.0	89.9	100.0	100.0
L Eve_P	98.1	97.2	99.2	99.4	98.1	100.0	100.0
Leeds_P	97.5	96.2	93.1	100.0	100.0	100.0	98.7
Livpl_P	92.9	85.7	100.0	100.0	97.6	100.0	100.0
Manch_P	89.1	94.6	100.0	100.0	100.0	100.0	100.0
Newc_P	95.6	93.3	92.5	100.0	100.0	100.0	100.0
Nottm_P	88.0	99.0	30.8	100.0	98.0	100.0	100.0
Soton_P	97.2	36.1	0.0	7.1	40.3	100.0	100.0
UK	**86.8**	**87.0**	**75.3**	**50.0**	**92.6**	**100.0**	**99.3**

Table 5.2. The UK paediatric prevalent ERF population in 2009, by age group and gender

	All patients*		Males		Females		
Age groups	N	pmarp	N	pmarp	N	pmarp	Ratio M:F
0–1.99 years	34	21.6	24	29.8	8	10.4	2.9
2–3.99 years	57	38.3	33	43.3	23	31.7	1.4
4–7.99 years	139	50.1	86	60.5	52	38.4	1.6
8–11.99 years	195	70.5	122	86.4	72	53.3	1.6
12–15.99 years	326	110.5	192	127.0	132	91.8	1.4
Under 16 years	**751**	**65.0**	**457**	**77.3**	**287**	**50.9**	**1.5**

pmarp – per million age related population.
* 7 patients with missing gender are included in the 'all patients' column but not the gender columns.

Table 5.3. The UK paediatric prevalent ERF population by age and ethnic group in 2009

	White		South Asian		Black		Other	
Age groups	N	pmarp	N	pmarp	N	pmarp	N	pmarp
0–3.99 years	74	28.6	13	61.6	1	11.9	3	106.7
4–7.99 years	108	45.1	23	117.9	4	51.3	4	153.8
8–11.99 years	152	59.4	30	143.9	8	95.9	5	179.9
12–15.99 years	253	93.9	54	245.9	11	125.2	8	273.2
Under 16 years	**587**	**57.4**	**120**	**143.9**	**24**	**71.9**	**20**	**179.9**

functioning transplant, 15% were receiving peritoneal dialysis (PD) and 9% were receiving haemodialysis (HD). The modality was unknown in a further 9%.

As incomplete data was available for the 16–18 year old adolescent patients they have been excluded from these analyses. This report therefore presents data relating to patients less than 16 years of age only.

There were 751 children under 16 years of age receiving RRT in the UK in 2009. Table 5.2 shows the number of patients receiving RRT by age group and gender plus rate of RRT pmarp. The prevalence of RRT increased with age and was higher in males. The reported prevalence rate in under 16 year olds was 65 pmarp.

Table 5.3 shows the ethnic origin of current RRT patients. Increasing prevalence pmarp was observed with increasing age in all ethnic groups but children from ethnic minorities displayed higher prevalent rates of RRT when compared with White children.

Modality of treatment

Current treatment modality in the prevalent paediatric population less than 16 years old in 2009 is displayed in figure 5.1. Seventy percent of current paediatric patients had a functioning transplant and 30% were reported as being on dialysis.

The treatment modality in use at 90-days following commencement of RRT is displayed in figure 5.2. This shows that 51% of patients were treated with PD at 90 days whilst 20% of patients were treated with HD. Twenty-two percent of children under 16 were reported to have received a transplant either pre-emptively or by 90 days.

Table 5.4 demonstrates that in the under 2 year olds the majority of patients were being treated with PD

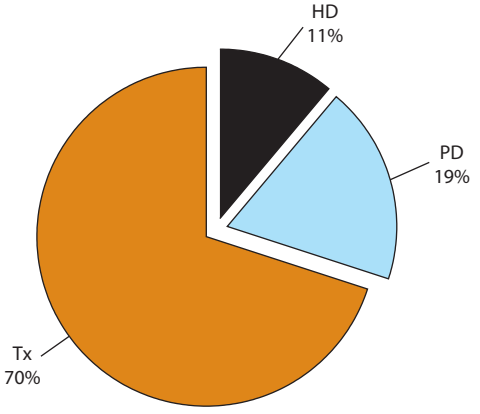

Fig. 5.1. The current RRT treatment used by prevalent paediatric patients less than 16 years old in 2009
* All patients from Southampton were excluded because of incomplete data.

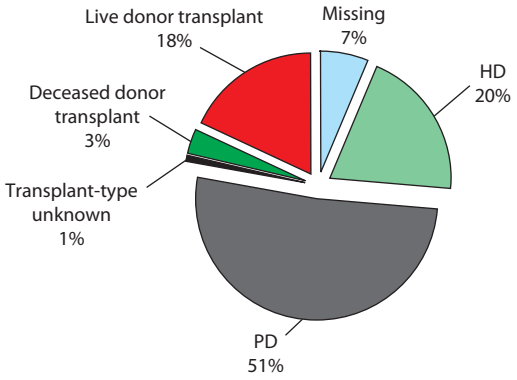

Fig. 5.2. Treatment modality at 90 days following commencement of RRT in prevalent paediatric patients under 16 years of age in 2009
* Patients from Southampton were excluded from this figure because of incomplete data.

(75%). This contrasts with older children in the 12 to 15.99 year age group where 81% had a functioning graft and almost as many people were on HD as PD.

Cause of ERF

Table 5.5 and figure 5.3 show the diagnostic categories for 635 of 751 current patients aged <16 years for whom a causative diagnosis was reported. Renal dysplasia ± reflux at 34% (216/635) was the commonest condition causing ERF with children commencing RRT across the paediatric age range.

Nearly 7% of the current RRT patients have been reported to have developmental delay and an additional 8% with congenital abnormality. Almost 1% other patients have cerebral palsy. Six percent of children receiving RRT were born prematurely (table 5.6).

Table 5.4. Current treatment modality by age in the prevalent paediatric ERF population in 2009

	Current treatment					
	HD		PD		Transplant	
Age groups	N	%	N	%	N	%
0–1.99 years	6	21.4	21	75.0	1	3.6
2–3.99 years	15	28.8	23	44.2	14	26.9
4–7.99 years	22	17.6	30	24.0	73	58.4
8–11.99 years	9	4.8	27	14.4	151	80.7
12–15.99 years	27	8.5	34	10.7	258	80.9
Under 16 years	**79**	**11.1**	**135**	**19.0**	**497**	**69.9**

Patients reported by Southampton have been excluded from this table.

Table 5.5. Number, percentage and gender by primary renal disease as cause of ERF in prevalent paediatric ERF population in 2009

Diagnostic group	Total	%	Males	Females	M:F ratio
Renal dysplasia±reflux	216	34.0	145	71	2.0
Glomerular diseases	107	16.9	50	57	0.9
Obstructive uropathy	103	16.2	97	6	16.2
Tubulo-interstitial	40	6.3	17	23	0.7
Uncertain aetiology	37	5.8	15	22	0.7
Metabolic	16	2.5	6	10	0.6
Congenital nephrotic syndrome	55	8.7	29	26	1.1
Reno-vascular disease	27	4.3	20	7	2.9
Polycystic kidney disease	21	3.3	7	14	0.5
Drug nephrotoxicity	3	0.5	1	2	0.5
Malignancy	10	1.6	3	7	0.4

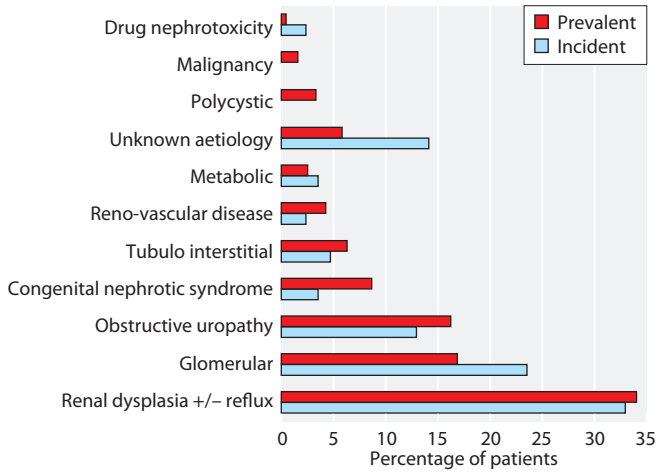

Fig. 5.3. Primary renal disease percentage in incident and prevalent paediatric ERF patients in 2009 for whom a causative diagnosis was reported

Table 5.6. Registered comorbidities at onset of RRT in prevalent paediatric patients with ERF in 2009

Comorbidity	Number of children	Percentage all RRT patients
Cerebral palsy	7	0.9
Chromosomal abnormality	18	2.3
Congenital abnormality	61	7.8
Congenital heart disease	21	2.7
Consanguinity	24	3.1
Developmental delay	49	6.3
Diabetes	3	0.4
Liver disease	13	1.7
Malignancy	9	1.1
Neural tube defect	5	0.6
Family member with ERF	17	2.2
Prematurity	48	6.1
Psychological disorder	3	0.4
Syndromic diagnosis	47	6.0

Table 5.8. Reported average incidence rate by age group, in 5-year time periods, of children under 16 years of age commencing RRT

	Per million age related population		
Age group (years)	1995–1999	2000–2004	2005–2009
0 to <4	8.4	8.7	10.8
4 to <8	4.6	6.0	6.4
8 to <12	8.2	8.4	7.8
12 to <16	11.0	12.4	13.4
Under 16 years	**8.1**	**8.9**	**9.6**

The UK incident paediatric ERF population in 2009

There were 133 patients under 18 years of age who commenced RRT at paediatric renal centres in 2009, as previously, the following analyses are restricted to the 107 patients who were under 16 years of age.

The incidence rate of RRT was 9.3 pmarp in 2009. These patients commencing RRT in 2009 are displayed by age and gender in table 5.7.

Table 5.8 and figure 5.4 show that the reported incidence of RRT has been rising since 1995. Observed incidence rates from one year to the next though are quite unstable because of small numbers. The highest incidence rates are seen in the 12–16 year old age group with the 0–4 year age group having the next highest rates. The average incidence rate per year in 5 year time periods is shown in table 5.8.

Trends in ERF demographics

Analysis of ERF demographics for children less than 16 years of age over the past 15 years confirmed there were 511 patients reported to the paediatric registry between 1995–1999, 580 between 2000–2004 and 627 between 2005–2009. Comparing the current 5 year

Table 5.7. The incident paediatric ERF population in the UK in 2009, by age group and gender

	All patients		Males		Females		
Age groups	N	pmarp	N	pmarp	N	pmarp	M:F ratio
0–1.99 years	18	11.5	12	14.9	4	5.2	2.9
2–3.99 years	8	5.4	4	5.2	4	5.5	1.0
4–7.99 years	20	7.2	16	11.3	4	3.0	3.8
8–11.99 years	20	7.2	12	8.5	7	5.2	1.6
12–15.99 years	41	13.9	17	11.2	23	16.0	0.7
Under 16 years	**107**	**9.3**	**61**	**10.3**	**42**	**7.5**	**1.4**

pmarp–per million age related population
* 4 children had missing gender

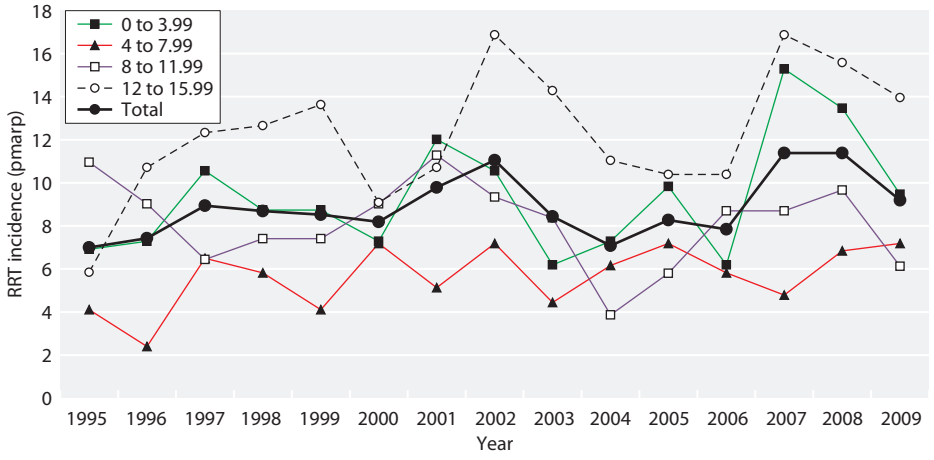

Fig. 5.4. The incidence rate per year of paediatric patients commencing ERF by age group and year at start of RRT

period with the previous 5 year periods there has been an overall increase in the number of children treated with RRT, particularly in children aged 12 to 16 years (table 5.9). The percentage of children on RRT who are from South Asian or Black ethnic backgrounds has increased during this period (table 5.10). The reported patient population at each paediatric renal centre has grown in size since 1995–1999 with the smallest increase seen in Cardiff and Belfast (table 5.11).

Table 5.12 shows the number and percentage of children receiving RRT with each of the major reported comorbidities to the UKRR over the last 15 years. In 2005–2009, 7.2% of children had a diagnosed syndrome, 5.4% had developmental delay and 7.3% had a congenital abnormality. The percentage of children receiving RRT with a reported comorbidity has remained stable over the past 5 years except for those with liver disease, malignancy and psychological disorders.

The percentage of children who were using PD at 90 days has fallen from 58% in 1995–1999 to 47% in 2005–2009 while the percentage commencing RRT on HD has increased from 19% in 1995–1999 to 23% in

Table 5.9. Number and percentage of children under 16 years who commenced RRT, by age group and 5 year period, at start of RRT

	1995–1999		2000–2004		2005–2009		
Age groups	N	%	N	%	N	%	% change
0–1.99 years	77	16.0	74	14.0	107	18.6	2.6
2–3.99 years	39	8.1	45	8.5	46	8.0	−0.1
4–7.99 years	68	14.1	88	16.7	93	16.1	2.0
8–11.99 years	128	26.6	130	24.6	122	21.2	−5.4
12–15.99 years	170	35.3	191	36.2	208	36.1	0.8
Under 16 years	**482**		**528**		**576**		

* There were 29 children in 1995–1999, 52 in 2000–2005 and 51 in 2005–2009 with no age at start of RRT and these are not included in this table

Table 5.10. Number and percentage of children under 16 years who commenced RRT by ethnicity and 5 year period of starting RRT

	1995–1999		2000–2004		2005–2009		1995–2009
Ethnic group	N	%	N	%	N	%	% change
White	420	82.2	464	80.0	486	77.5	−4.7
Asian	72	14.1	91	15.7	105	16.7	2.6
Black	10	2.0	15	2.6	21	3.3	1.3
Other	9	1.8	10	1.7	15	2.4	0.6

Table 5.11. Number and percentage of children under 16 years reported to the UKRR, by renal centre and 5 year period of start

	1995–1999		2000–2004		2005–2009	
Centre	N	%	N	%	N	%
Blfst_P	18	3.5	13	2.2	20	3.2
Bham_P	43	8.4	49	8.4	66	10.5
Brstl_P	39	7.6	50	8.6	35	5.6
Cardf_P	18	3.5	16	2.8	19	3.0
L GOSH_P	88	17.2	94	16.2	119	19.0
Glasg_P	35	6.8	32	5.5	50	8.0
L Eve_P	58	11.4	64	11.0	67	10.6
Leeds_P	47	9.2	56	9.7	58	9.3
Livpl_P	19	3.7	30	5.2	19	3.0
Manch_P	56	11.0	66	11.4	55	8.8
Newc_P	24	4.7	30	5.2	28	4.5
Nottm_P	53	10.4	57	9.8	74	11.8
Soton_P	13	2.5	23	4.0	17	2.7
Total	**511**		**580**		**627**	

2005–2009. The percentage receiving a transplant before 90 days has remained similar for the last 15 years.

Table 5.13 shows the diagnostic categories for 500 of the 511 (97.8%) patients in 1995–1999, for 553 of the 580 (95.3%) patients in 2000–2004 and 508 of the 627 (81%) patients in 2005–2009 aged <16 years for whom a causative diagnosis was reported.

There has been a decrease in the percentage of children receiving RRT with obstructive uropathy between 1995–1999 and 2005–2009 (17.4% vs. 13.2%) and an increase in unknown aetiology (4.0% vs. 9.1%) (table 5.13).

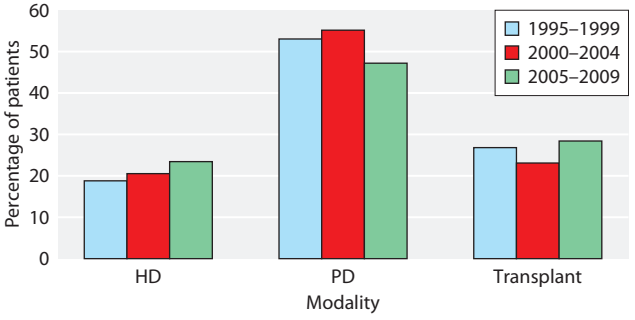

Fig. 5.5. Treatment modality at day 90 after starting RRT by 5 year time period

Table 5.12. Trends in comorbidity at the start of RRT in the paediatric population under 16 years, by 5 year period

	1995–1999		2000–2004		2005–2009	
Comorbidity	N	%	N	%	N	%
Cerebral palsy	2	0.4	9	1.6	6	1.0
Chromosomal abnormality	14	2.7	16	2.8	13	2.1
Congenital abnormality	35	6.8	46	7.9	46	7.3
Congenital heart disease	11	2.2	12	2.1	16	2.6
Consanguinity	21	4.1	22	3.8	14	2.2
Developmental delay	55	10.8	50	8.6	34	5.4
Liver disease	0	0.0	7	1.2	13	2.1
Malignancy	8	1.6	10	1.7	4	0.6
Neural tube defect	5	1.0	1	0.2	6	1.0
Family member with ERF	27	5.3	21	3.6	10	1.6
Prematurity	31	6.1	26	4.5	20	3.2
Psychological disorder	14	2.7	11	1.9	2	0.3
Syndromic diagnosis	32	6.3	34	5.9	45	7.2

Table 5.13. Number and percentage of children under 16 years for whom a primary renal diagnosis had been reported as a cause of ERF, by 5 year time period along with observed change in proportion of patients in each diagnostic group

	1995–1999		2000–2004		2005–2009		1995–2009
Primary renal diagnosis	N	%	N	%	N	%	% change
Renal dysplasia ± reflux	165	33.0	172	31.1	170	33.5	0.5
Glomerular diseases	107	21.4	130	23.5	103	20.3	−1.1
Obstructive uropathy	87	17.4	79	14.3	67	13.2	−4.2
Tubulo-interstitial	35	7.0	44	8.0	42	8.3	1.3
Unknown aetiology	20	4.0	24	4.3	46	9.1	5.1
Metabolic	19	3.8	24	4.3	20	3.9	0.1
Congenital nephrotic syndrome	31	6.2	24	4.3	25	4.9	−1.3
Reno-vascular disease	13	2.6	25	4.5	13	2.6	0.0
Polycystic kidney disease	14	2.8	12	2.2	12	2.4	−0.4
Drug nephrotoxicity	7	1.4	13	2.4	5	1.0	−0.4
Malignancy	2	0.4	6	1.1	5	1.0	0.6

Discussion

This report from the Paediatric Renal Registry has focussed on the description of the current demography and the demographic trends over the past 15 years of the UK paediatric ERF population. Over the past few years a sustained effort has been made by the members of the BAPN and the Paediatric RR sub-committee to improve data quality by (i) involving a data manager and a statistician as well as paediatric nephrologists in the team processing the data (ii) merging all available datasets into the larger adult UKRR database and (iii) aiming to have annual returns from all paediatric centres electronically. The benefits of this strategy of electronic data returns are obvious and have been discussed in previous UKRR reports [3, 4]. The recent mandating of reporting to the registry by the Department of Health has helped in implementing this policy locally at individual trusts.

On this background of ongoing 'process transition', 72.6% (569/751) of patients from 8 of 13 paediatric nephrology centres (Birmingham, Bristol, Cardiff, GOSH, Leeds, Manchester Nottingham and Southampton), had their data submitted electronically. Similarly, the merger of paediatric and adult UKRR databases remains as 'work in progress' with incomplete data for the majority of 16–18 year old patients, as they transition variably to adult colleagues across the UK. Further, subjects in this age group may present directly to adult services. Finally, although data for the paediatric ERF population from the UK has been reported pre-1990 [5] it was excluded from this report as it is likely to have been significantly under reported impacting on accuracy of analyses. This report therefore focuses on 751 children and adolescents <16 years of age, who were receiving RRT in 2009. The sub-section on the trends in demographics includes 511 from 1995–1999, 580 from 2000–2005 and 627 from 2005–2009 children and adolescents <16 years of age on RRT.

Completeness of data

As shown in table 5.1, completeness of data was >85% for key variables but two particular key data items 'height or length at start of RRT' and 'plasma creatinine at start of RRT' had lower completion rates at 75.3% and 50% respectively. Lack of these values has implications for the quality of any future reports that aim to analyse the impact of RRT on important variables such as growth. Further in this report is the somewhat surprising finding of little change in prevalent comorbidities listed in table 5.13 in children on RRT over the past 15 years. These data perhaps highlight the need for maintaining efforts to improve quality of data returns to and data processing within the UKRR. The authors are optimistic that the commitment of the clinical teams together with improved access to renal IT systems will help to improve data completeness.

Incidence, prevalence and trends

As shown in tables 5.7 and 5.8, the incident paediatric ERF population <16 years of age was stable at 9.3 pmarp. This was higher than that reported in the 2009 Registry Report [6]. Reviewing trends in incidence rates over the past 15 years suggests fluctuations from year to

year but a significant increase in average 5-year incident rates during this time period (table 5.8). Although yearly fluctuation has been described in recent reports from other renal registries [7] the increasing trend in average 5-year incidence rates of children on RRT does not appear to have been reported previously.

Analysis of the incidence rates in 4-year age bands as displayed in table 5.8 suggests this has been maximal in the 12–16 year age band followed by the 0–4 year age band with children less than 2 years old making up the larger proportion of these. A possible explanation for these observed demographic trends is that a greater proportion of children and adolescents <16 years now receive their RRT at paediatric nephrology centres only and that an increasing number of infants and young children are being considered for RRT as a result of improvements in techniques to provide nutritional support and dialysis therapy in this cohort. The increased take on rates in infants contributes significantly to workload as this is a particularly challenging group of patients to manage. A national audit of the care of these infants will provide greater detail.

The prevalence of children on RRT as shown in table 5.2 increased with age in keeping with improved survival with increasing age. This coupled with an increase in the number of children receiving RRT over the past 15 years (table 5.9) has led to a steady increase in the prevalent ERF population. This trend has been observed nationally and across all paediatric nephrology centres (table 5.11). Factors underlying the centre variation seen in the rise in reported patient numbers over time may include variations in the incidence of renal disease related to changes in ethnicity of the local population, changes in referral patterns and variations in the systems in place to support data collection.

Treatment modality of ERF and observed trends 1995–2009

In 2009, the treatment modality at 90 days for peritoneal dialysis was 51%, haemodialysis 20% and transplantation at 22% (figure 5.2). Analysis of these trends in 'modality at 90 days' over the past 15-years is displayed in figure 5.5 and shows an increase of 4% in patients on haemodialysis (from 19% in 1995–1999 to 23% in 2005–2009) and a reduction of 6% in peritoneal dialysis (53% in 1995–1999 to 47% in 2005–2009). There has been little change in the proportion of patients who have commenced their RRT careers with transplantation (27% in 1995–1999 to 28% in 2005–2009) with almost no observed change in the proportion of subjects commencing RRT following live-donor transplantation. At present it can only be speculated on the reasons for these observations. Some reasons include the increasing incidence of ERF in the youngest patients (<4 years of age) who are commencing RRT (table 5.9) and in whom dialysis often is the only possible modality, increasing incidence in ethnic minorities now commencing RRT (table 5.10) and in whom rates of live-donor transplantation remain low [6] and possible paediatric specific reasons including associated comorbidities, family and social issues for which there is little information but would benefit from more detailed review.

The majority of prevalent children (70%) on RRT have functioning transplants with a steady increase in prevalent children with a functioning transplant seen over the past 15 years (data not shown).

Comorbidities

Informally, paediatric nephrologists report they are managing children with increasingly complex medical problems. It is therefore perhaps surprising to see the relatively low rates of the listed comorbidities reported to the UKRR which have remained stable over time. The small increase in the number of ERF children with liver disease reflects the development of paediatric hepatology and liver transplantation over this time period. The reporting of psychological disorders has decreased but the authors feel this may be related to a lack of consistency in reporting comorbidities to the UKRR. It is difficult to make any comparisons of this data with other national registry reports as there remains no uniformity across registries for reporting and definition of comorbidities [8].

Causes of ERF and observed trends 1995–2009

Overall, renal dysplasia ± reflux at 34.0%, glomerulonephritis at 16.9% and obstructive uropathy at 16.2% were the commonest listed aetiologies for children with ERF accounting for 67.1% of all patients for whom a primary diagnosis had been reported. Renal dysplasia and obstructive uropathy were both more common in males with a male:female ratio of 2:1 and 16:1 respectively. Observation of trends over the 15-year period showed reduction in ERF secondary to obstructive uropathy (table 5.13), perhaps reflecting improvements in care as a result of early diagnosis and co-ordinated nephro-urological care for these children across the UK.

Conflicts of interest: none

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Chapter 6
Survival and Causes of Death of UK Adult Patients on Renal Replacement Therapy in 2009: national and centre-specific analyses

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Key Words
Cause of death · Comorbidity · Dialysis · End stage renal disease · Established renal failure · Haemodialysis (HD) · Outcome · Peritoneal dialysis (PD) · Renal replacement therapy (RRT) · Survival · Transplant · Vintage

Summary

- The 2008 unadjusted 1 year after 90 day survival for patients starting RRT was 87.3%.
- In incident patients aged 18–64, the unadjusted 1 year survival has risen from 85.9% in 1997 to 91.9% in 2008.
- In incident patients aged $\geqslant 65$, unadjusted 1 year survival has risen from 64.2% in 1997 to 75.8% in 2008.
- Diabetic prevalent patient one year survival rose from 76.6% in 2000 to 83.6% in 2009.
- RRT patients aged 30–34 had a mortality rate 19 times higher than the age matched general population, whereas RRT patients aged 85+ had a mortality rate 2.4 times higher.
- In the prevalent RRT dialysis population, cardiovascular disease accounted for 24% of deaths, infection 19% and treatment withdrawal 14%; 22% were recorded as uncertain.
- The median life years remaining for a 25–29 year old on RRT was 20 years and for a 75+ year old, 4 years.

Introduction

The analyses presented in this chapter examine (a) survival from the start of renal replacement therapy (RRT); (b) the survival amongst all prevalent RRT patients alive on 1st January 2009 and (c) projected life years remaining for RRT patients. They encompass the outcomes from the total incident UK dialysis population reported to the UK Renal Registry (UKRR), including the 18% who started on peritoneal dialysis and the 6% who received a pre-emptive renal transplant. These results are therefore a true reflection of the outcomes in the whole UK RRT population and are not distorted by focusing solely on the haemodialysis cohort. Additionally, analyses of the 1st year UK survival data include patients who were recorded as having started RRT for established renal failure (as opposed to acute kidney injury) but who had died within the first 90 days of starting RRT, a group excluded from most other countries' registry data.

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

The prevalent patient group was defined as all patients over 18 years old who had been on RRT for at least 90 days at one of the UK adult renal centres and who were alive on 31st December 2009. This included incident patients in 2009 and patients who had been on treatment for longer but excluded patients who had stopped treatment before this date.

Since 2006, the UK has openly reported and published centre-attributable RRT survival and remains the only country doing so. It is again stressed that these are raw data which continue to require very cautious interpretation. The Registry can adjust for the effects of the different age distributions of patients in different centres and the proportion of patients with diabetes, but lacks sufficient data from many participating centres to enable adjustment for other comorbidities and ethnic origin, which have been shown to have an impact on outcome (for instance, better survival is expected in centres with a higher proportion of Black and South Asian patients). This lack of information on case mix makes interpretation of any apparent difference in survival between centres difficult, although age and comorbidity, especially diabetes, are the major factors associated with survival [1, 2]. Despite the uncertainty about any apparent differences in outcome for centres which appear to be outliers, the UKRR will follow the clinical governance procedures as set out in chapter 2 of the 2009 UKRR report [3].

Methods

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

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

To allow comparisons between centres with differing age distributions, survival analyses were statistically adjusted for age and reported as survival adjusted to age 60. This gives an estimate of what the survival would have been if all patients in that centre had been aged 60 at the start of RRT. This age was chosen because it was approximately the average age of patients starting RRT 14 years ago at the start of the Registry's data collection. For the last 7 years the average age of patients commencing RRT in the UK has been stable around an age of 65 years, but the Registry has maintained age adjustment to 60 years for comparability with all previous years' analyses. All analyses were undertaken using SAS vs. 9.2.

Definition of the date renal replacement therapy started

The incident survival figures quoted in this chapter are from the first day of renal replacement therapy whether with dialysis or a pre-emptive transplant.

In the UKRR all patients starting RRT for ERF are included from the date of the first RRT treatment wherever it took place (a date currently defined by the clinician) if the clinician considered the renal failure irreversible; should a patient recover renal function within 90 days they were then excluded. These UK data therefore include some patients who developed acute irreversible renal failure in the context of an acute illness for instance and were recorded by the clinician as being in irreversible established renal failure. Capture of data on these patients requires accurate coding. Previously, the Registry asked clinicians to re-enter a

code for established renal failure in patients initially coded as having acute renal failure, once it had become clear that there was no recovery of kidney function. However, adherence to this requirement was very variable, with some clinicians entering a code for established renal failure only once a decision had been made to plan for long-term RRT [4]. All UK nephrologists have now been asked to record the date of the first haemodialysis session and to record whether the patient was considered to have acute kidney injury (acute renal failure) or to be in ERF at the time of the first session. For patients initially categorised as 'acute', but who were subsequently categorised as ERF, the UKRR will extract information from the first session of RRT onwards if available and will assign the date of this first session as the date of start of RRT.

Recent UKRR analyses of electronic data extracted for the immediate month prior to the start date of RRT provided by clinicians highlighted additional inconsistencies in the definition of this first date when patients started on peritoneal dialysis, with the date of start reported to the Registry being later than the actual date of start. These findings are described in detail in chapter 13 of the 2009 Report [4]. This concern is unlikely to be unique to the UK, but will be common to analyses from all renal centres and registries.

In addition to this varying clinical definition of day 0, there is international variability on when patient data are collected by national registries with some countries (often for financial reimbursement or administrative reasons) defining the 90th day after starting RRT as day 0 or others collecting data only on those who have survived 90 days and reporting as zero the number of patients dying within the first 90 days. Some other countries do not include initial urgent/emergency dialysis in intensive care units or acute wards.

Thus as many other national registries do not include reports on patients who do not survive the first 90 days, survival from 90 days onwards is also reported to allow international comparisons. This distinction is important, as there is a much higher death rate in the first 90 days, which would distort any such comparisons.

Methodology for incident patient survival

Patients are considered 'incident' at the time of their first RRT, thus patients re-starting dialysis after a failed transplant were not included.

The incident survival cohort was **NOT** censored at the time of transplantation and therefore included the 6% who received a pre-emptive transplant. Censoring would exclude this healthier patient cohort. An additional reason for not censoring was to facilitate comparison between centres. Centres with a high proportion of patients of South Asian and Black origin are likely to have a healthier dialysis population, because South Asian and Black patients are less likely to undergo early transplantation.

The incident ('take-on') population in any specific year excludes those who recovered within 90 days from the start of RRT, but includes patients who recovered from ERF after 90 days. Patients newly transferred into a centre who were already on RRT were excluded from the incident population for that centre and were counted at the centre at which they started RRT.

Some patients recover renal function after more than 90 days but subsequently returned to 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. If recovery was for 90 days or more the length of time on RRT was calculated from the day on which the patient restarted RRT.

The one year incident survival is for patients who started RRT in 2008 and was calculated for 1 full year through 2008 and 2009 (e.g. patients starting RRT on 1st December 2008 were followed through to 30th November 2009). The 2009 incident patients could not be analysed 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 2008 were not included in the cohort, as 1st quarter 2010 data on these patients were not yet available.

To help identify any centre differences in survival from the small centres (where confidence intervals are large), an analysis of 1 year after 90 day survival using a rolling 4 year combined incident cohort from 2005 to 2008 was also undertaken. For those centres which had joined the UKRR in the previous 1–3 years, the available data were included.

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

Adjustment of 1 year after 90 day survival for the effect of comorbidity was undertaken using a rolling 5 year combined incident cohort from 2004 to 2008. Eleven centres had returned >85% of comorbidity data for patients in the combined cohort. Adjustment was first performed to a mean age of 60 years, then to the average distribution of primary diagnosis for all the eleven centres. The individual centre data were then further adjusted for average distribution of comorbidity present at these centres.

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

Methodology for prevalent patient survival

For dialysis patients, all who had been established on RRT for at least 90 days on 1st January 2009 were included in these analyses.

For calculating the survival of transplant patients, those who had been established with a transplant for at least 6 months were included.

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 transplantation. 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. This censoring could cause apparent differences in survival between those renal centres with a high transplant rate and those with a low transplant rate, especially in younger patients where the transplant rate is highest. Censoring at transplantation systematically removes younger fitter patients from the survival data. The differences are likely to be small due to the relatively small proportion of patients being transplanted in a given year compared to the whole dialysis population (about 14% of the dialysis population aged under 65 and 1% of the population aged 65 years and over). Only the censored for transplantation results have been quoted throughout the prevalent analyses.

Methodology of causes of death

The ERA-EDTA registry codes for causes of death were used. These have been grouped into the following categories:

- Cardiac disease
- Cerebrovascular disease
- Infection
- Malignancy
- Treatment withdrawal
- Other
- Uncertain

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

Adult patients aged 18 years and over, from England, Wales, Scotland and Northern Ireland, were included in the analyses of cause of death. The incident patient analysis included all patients starting RRT in the years 2000–2008. Previously data analysis was limited to centres with a high rate of return for cause of death. When this was compared with an analysis of all the cause of death data on the database, the percentages in corresponding ERA-EDTA categories remained unchanged so the latter data were therefore included.

Analysis of prevalent patients included all those aged over 18 years and receiving RRT on 1 January 2009. The death rate was calculated for the UK general population (data from the Office of National Statistics) [5] by age band and compared with the same age band for prevalent patients on RRT on 1st January 2009.

Methodology of median life expectancy (life table calculations)

Kaplan Meier survival analyses were used to calculate the hazard of death by age group (18–34, 35–44, 45–54, 55–64, 65–74, 75+) for incident patients starting RRT from 1997 to 2008. The patient cohort inclusion criteria are the same to that of the incident cohort described above. Patients were then followed until death, censoring or end of the study period.

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

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

Data on the UK population in mid-2008 and the number of deaths in 2008 were obtained from the Office of National Statistics for each nation separately and added together [5]. The age-specific UK death rate was calculated as the number of UK deaths/UK population. The age-specific 'expected' rate of deaths in the RRT population was then calculated: years exposed for RRT patients × UK death rate/1,000. The age-specific observed number of RRT deaths was calculated as the actual number of deaths observed in 2009 and the RRT death rate as the actual number of deaths in 2009/years exposed for RRT patients × 1,000. The observed/expected ratio was then calculated.

Results of incident (new RRT) patient survival

The 2008 cohort included 6,767 patients who started RRT, without any periods of renal function recovery lasting more than 90 days.

It is hard to set survival standards at present because these should be age, gender and comorbidity adjusted and this is not yet possible from UKRR data. The current 5th Edition of the Clinical Practice Guidelines [6] does not set any standards for audit of patient survival.

The 3rd Renal Standards document defined standard primary renal disease using the ERA-EDTA diagnosis codes (including only codes 0–49); this excluded patients with renal disease due to diabetes and other systemic diseases. It is more widespread practice to simply exclude patients with diabetes, so these analyses are also included in this report to allow comparison with reports from other registries. The results are shown in table 6.1.

Table 6.1. One-year incident dialysis patient survival (from day 0–365), patients aged 18–54, 2008 and 2002 cohort (excludes patients whose first modality was transplantation)

	2008 cohort		2002 cohort	
First treatment	Standard primary renal disease	All primary renal diseases except diabetes	Standard primary renal disease	All primary renal diseases except diabetes
All dialysis %	97.6	96.2	95.4	93.9
95% CI	*96.4–98.4*	*95.1–97.1*	*93.7–97.1*	*92.2–95.5*
HD %	97.0	95.2	93.4	91.6
95% CI	*95.4–98.0*	*93.7–96.4*	*90.7–96.0*	*89.2–94.0*
PD %	99.0	98.8	98.6	97.9
95% CI	*96.9–99.7*	*97.1–99.5*	*71.1–100*	*96.3–99.6*

Table 6.2. Incident patient survival across the UK countries, combined 2 year cohort (2007–2008), adjusted to age 60

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

The trend of improving patient survival continued with improvement seen in both those patients with 'standard primary renal disease' and those with all other primary renal diseases (excluding diabetes). For a longer term comparison, the 2002 cohort is also shown.

Comparison of survival between UK countries

Two years' incident data have been combined to increase the size of the patient cohort, so that any differences between the 4 UK countries are more likely to be reliably identified (table 6.2). These data have not been adjusted for differences in primary renal diagnosis, ethnicity, socio-economic status or comorbidity, nor for differences in life expectancy in the general populations of the four countries. There was a significant difference in 90 day survival between the UK countries ($p = 0.03$) and the 1 year after 90 day survival was once again significantly different ($p < 0.0002$) between countries. It is postulated that greater prevalence of cardiovascular disease in Wales and Scotland compared with England may account for these differences.

Modality

It is impossible to obtain truly valid comparisons of survival of patients starting on different modalities, as modality selection is not random. In the UK patients starting peritoneal dialysis as a group were younger and fitter than those starting haemodialysis, and were transplanted more quickly. The age-adjusted one year survival estimates on HD and PD were 88.1% and 93.8% respectively which both show a trend in improvement in survival from 2002 (figure 6.1 and table 6.3).

Table 6.3. One-year after day 90 incident patient survival by first established treatment modality (adjusted to age 60) (excluding patients whose first modality was transplantation)

	Age adjusted 1 year after 90 days % survival *95% CI*	
Year	HD	PD
2008	88.1	93.8
	87.0–89.1	*92.5–95.2*
2007	87.0	94.0
	85.9–88.1	*92.8–95.3*
2006	86.8	94.2
	85.7–88.0	*92.9–95.5*
2005	85.8	93.2
	84.6–87.0	*91.8–94.6*
2004	85.7	90.4
	84.5–87.0	*88.8–92.1*
2003	85.7	92.2
	84.3–87.1	*90.7–93.8*
2002	84.0	90.4
	82.5–85.6	*88.6–92.3*

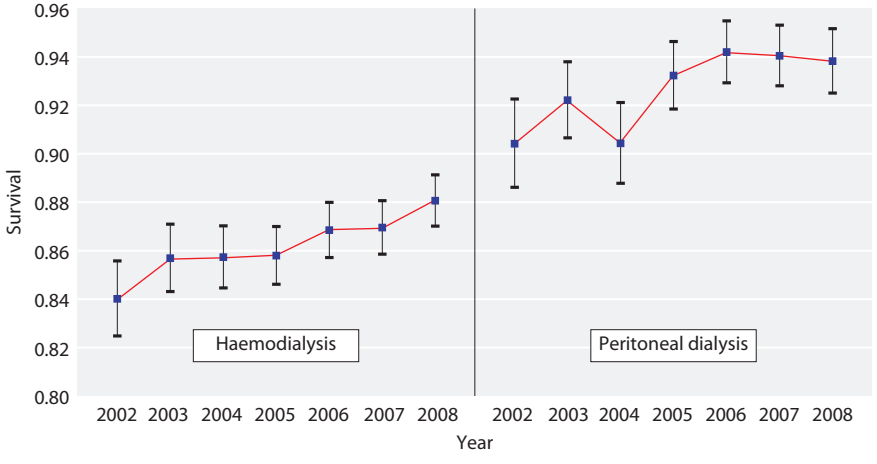

Fig. 6.1. Trend in 1 year after 90 day mortality by first established modality 2002–2008 (adjusted to age 60) (excluding patients whose first modality was transplantation)

Table 6.4. Unadjusted 90 day survival of incident patients, 2008 cohort, by age

Age	KM* survival (%)	KM 95% CI	N
18–64	97.3	*96.7–97.8*	3,519
⩾65	90.1	*89.0–91.1*	3,248
All ages	93.8	*93.2–94.4*	6,767

* KM = Kaplan–Meier

Table 6.5. Unadjusted 1 year after day 90 survival of incident patients, 2008 cohort, by age

Age	KM survival (%)	KM 95% CI	N
18–64	93.2	*92.3–94.0*	3,400
⩾65	80.4	*78.8–81.8*	2,921
All ages	87.3	*86.4–88.1*	6,321

* KM = Kaplan–Meier

Results from the USRDS and Australasian (ANZDATA) registries, after adjustment for comorbidity, are similar.

Age

Tables 6.4 to 6.9 show survival of all patients and those aged 65 and above and those aged below 65 years, for up to twelve years after initiation of renal replacement therapy. In the UK, short term survival remained similar

Table 6.6. Increase in proportional hazard of death for each 10 year increase in age, at 90 days and for 1 year thereafter, 2008 cohort

Interval	Hazard of death for 10 year age increase	*95% CI*
First 90 days	1.78	*1.64–1.93*
1 year after first 90 days	1.58	*1.49–1.67*

Table 6.7. Unadjusted KM survival of incident patients, 1997–2008 cohort for patients aged 18–64

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	11 year	12 year	*95% CI for latest year*	N
2008	**91.9**												***90.9–92.8***	**3,519**
2007	92.4	86.5											*85.3–87.6*	3,503
2006	91.4	85.7	80.9										*79.5–82.3*	3,211
2005	89.8	83.9	79.3	75.0									*73.4–76.5*	3,036
2004	89.9	84.1	78.0	72.5	67.9								*66.1–69.7*	2,700
2003	89.6	82.8	77.6	72.5	67.6	63.5							*61.5–65.4*	2,411
2002	88.6	81.8	76.4	71.3	66.6	62.9	59.1						*56.9–61.2*	2,114
2001	87.5	79.9	74.3	68.8	64.1	59.7	56.4	53.2					*50.8–55.4*	1,878
2000	89.6	82.0	75.4	70.6	65.4	60.5	56.5	53.4	51.1				*48.6–53.6*	1,613
1999	87.7	81.7	74.4	68.5	63.7	59.6	55.7	52.7	50.3	48.0			*45.3–50.6*	1,392
1998	86.8	79.5	72.8	67.7	61.7	57.0	53.0	50.5	47.6	46.3	44.1		*41.3–46.8*	1,288
1997	85.9	78.4	71.3	65.8	60.7	56.0	52.7	50.5	48.4	44.3	41.6	40.4	*37.0–43.8*	799

Table 6.8. Unadjusted KM survival of incident patients, 1997–2008 cohort for patients aged ⩾65

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	11 year	12 year	*95% CI for latest year*	N
2008	**75.8**												***74.2–77.2***	**3,248**
2007	74.9	61.1											*59.4–62.7*	3,211
2006	72.6	59.4	48.5										*46.7–50.2*	3,179
2005	72.9	58.7	46.7	37.7									*36.0–39.5*	3,093
2004	68.7	54.8	43.4	34.5	26.9								*25.2–28.6*	2,736
2003	69.2	53.8	42.4	32.5	24.8	19.5							*17.9–21.2*	2,386
2002	66.1	51.5	40.9	32.6	25.2	19.0	14.7						*13.2–16.2*	2,182
2001	67.2	52.1	39.4	30.4	23.0	17.2	13.1	10.0					*8.7–11.5*	1,866
2000	66.3	53.0	40.3	29.3	22.9	18.3	14.2	10.3	7.9				*6.6–9.4*	1,519
1999	66.2	50.8	38.6	29.0	21.7	15.6	11.3	8.9	7.1	5.8			*4.6–7.2*	1,269
1998	63.8	46.8	36.2	27.4	20.5	14.7	10.6	7.4	5.3	4.0	3.0		*2.1–4.2*	1,149
1997	64.2	46.5	33.5	24.1	16.3	11.5	7.8	6.2	4.5	3.8	2.8	2.1	*1.1–3.5*	590

Table 6.9. Unadjusted KM survival of incident patients, 1997–2008 cohort for patients of all ages

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	11 year	12 year	*95% CI for latest year*	N
2008	**84.1**												***83.2–85.0***	**6,767**
2007	84.0	74.3											*73.2–75.3*	6,714
2006	82.0	72.6	64.8										*63.6–65.9*	6,390
2005	81.2	71.2	62.8	56.1									*54.9–57.4*	6,129
2004	79.2	69.3	60.6	53.3	47.2								*45.9–48.6*	5,436
2003	79.4	68.4	60.1	52.6	46.4	41.6							*40.2–43.1*	4,797
2002	77.2	66.4	58.3	51.6	45.5	40.5	36.4						*35.0–37.9*	4,296
2001	77.4	66.1	56.9	49.7	43.6	38.5	34.8	31.7					*30.1–33.2*	3,744
2000	78.3	68.0	58.4	50.6	44.9	40.1	36.0	32.5	30.2				*28.6–31.9*	3,132
1999	77.4	66.9	57.3	49.6	43.6	38.6	34.4	31.8	29.6	27.8			*26.1–29.5*	2,661
1998	75.9	64.1	55.6	48.7	42.3	37.1	33.0	30.2	27.6	26.3	24.7		*23.0–26.5*	2,437
1997	76.7	64.9	55.3	48.2	42.0	37.2	33.7	31.8	29.8	27.2	25.2	24.2	*21.9–26.5*	1,389

to last year whilst there continued to be an improvement in longer term survival of patients on RRT. There was a steep decline in survival with advancing age (figures 6.2 and 6.3).

There was a curvilinear increase in death rate per 1,000 patient years with age, shown in figure 6.3 for the period one year after 90 days. There were no significant differences between the UK countries.

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

The KM long term survival curves published in all reports prior to the previous 3 years were censored at the time of transplantation. This was not made clear in the description of methodology and was misleading as

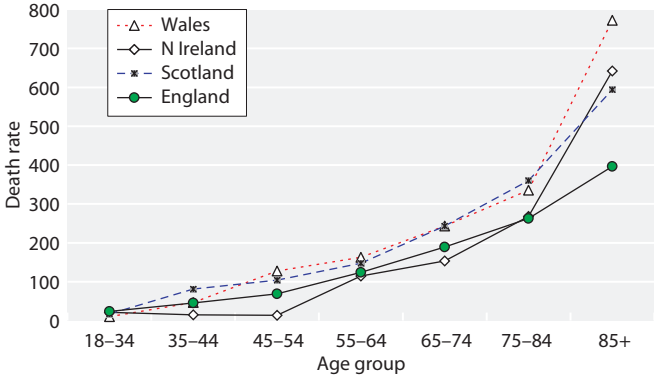

Fig. 6.3. One year after 90 days death rate per 1,000 patients years by UK country and age group for incident patients, 2005–2008 cohort

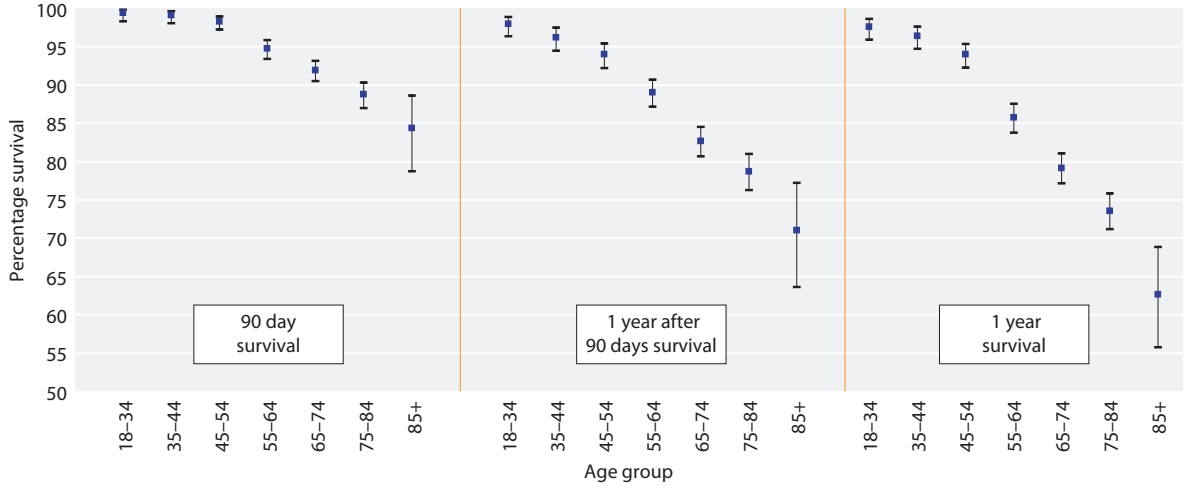

Fig. 6.2. Unadjusted survival of all incident patients by age band, 2008 cohort

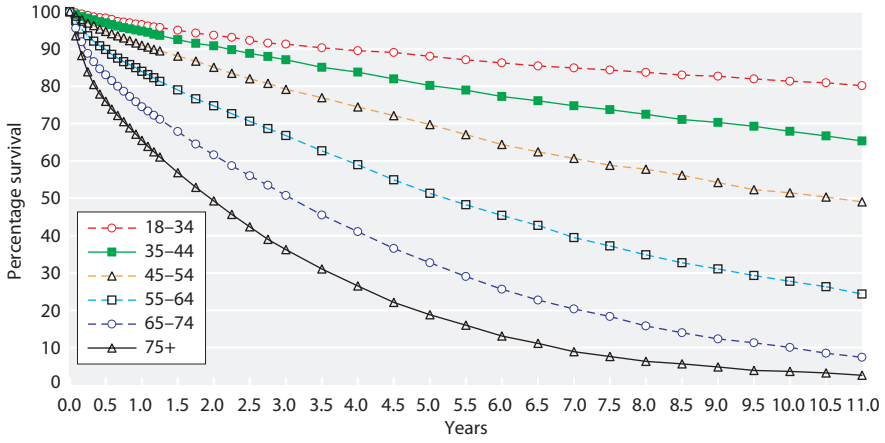

Fig. 6.4. Kaplan–Meier survival of incident patients 1998–2008 cohort (from day 0), without censoring at transplantation

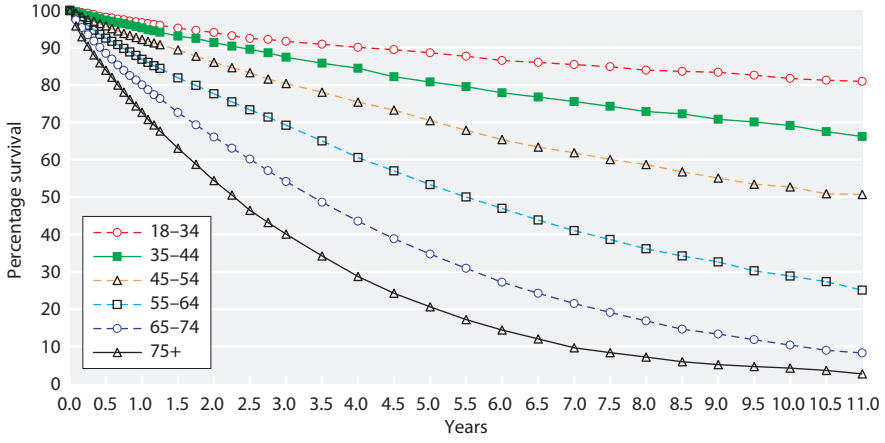

Fig. 6.5. Kaplan–Meier survival of incident patients 1998–2008 cohort (from day 90), without censoring at transplantation

it made the longer term outcomes of younger patients (who are more likely to have undergone transplantation) appear worse than was actually the case. This is because only those younger patients remaining on dialysis (who may have more comorbidity than those transplanted) will have been included in the censored survival analysis. Without censoring, the 10 year survival for patients aged 18–34 years is 81.3% (figure 6.4), which contrasts with a 56.4% survival if censoring at the time of transplantation (data not shown). For more detailed information on this effect, refer to the 2008 Report chapter 7 Survival [7].

From figure 6.4, it can be seen that 50% of patients starting RRT aged 50 survived for 10.5 years, 50% of patients starting aged 60 survived for 5 years and 50% of patients starting aged 70 survived for 3 years.

Figure 6.5 shows the survival of incident patients, excluding those who died within the first 90 days and shows that 50% of patients aged 60 survived for 5.5 years and 50% of patients aged 70 survived for 3.5 years.

Age and hazard of death by age in the first 12 months

Figure 6.6 shows the monthly hazard of death from the 1st day of starting RRT by age, which falls sharply during the first 3–4 months particularly for older

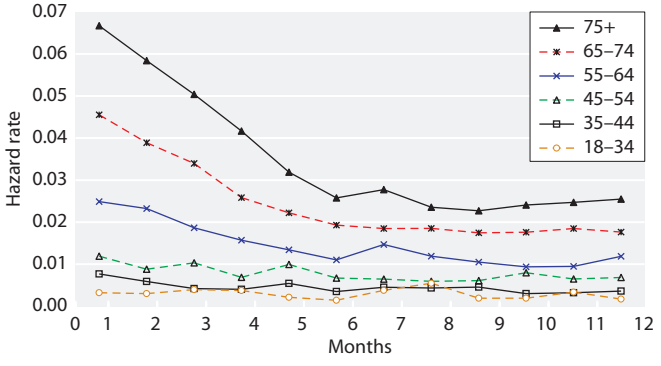

Fig. 6.6. First year monthly hazard of death, by age band 1997–2008 combined incident cohort

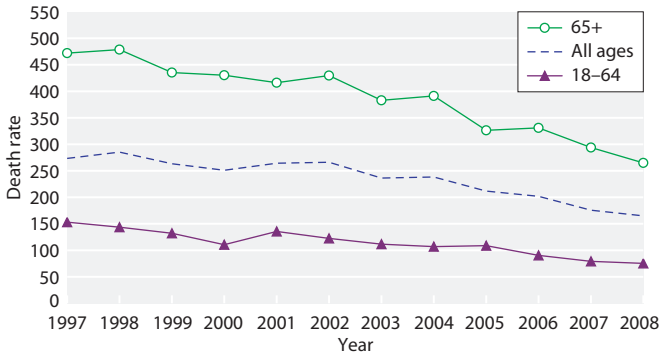

Fig. 6.7. One-year incident death rate per 1,000 patient years for all age groups

patients. In renal registries that receive details on all patients starting RRT from day zero, this difference in the change in hazard of death between the age groups will affect proportionality in any Cox model analysis that uses data starting from day zero and combines these different aged cohorts. This is why survival from day 90 is often used by other countries. Both are presented here to demonstrate this phenomenon of early deaths.

The hazard of death for each 10 year increase in patient age (unadjusted for primary renal disease) is shown in table 6.6. The difference in the hazard of death in the first 90 days and in the year after day 90 has been increasing over time (data not shown). This could reflect greater access to RRT for older and possibly more comorbid patients in recent years.

Changes in survival from 1997–2008

The 1st year death rate per 1,000 patient years is shown in figure 6.7. There was a continued fall in death rate in the 65 years and over age group to 265 per 1,000 patient years in 2008 from 294 per 1,000 patient years in 2007 and 331 per 1,000 patient years in 2006. In the under 65 year age group the fall in death rate also continued: from 90 per 1,000 patient years in 2006 to 75 per 1,000 patient years in 2008.

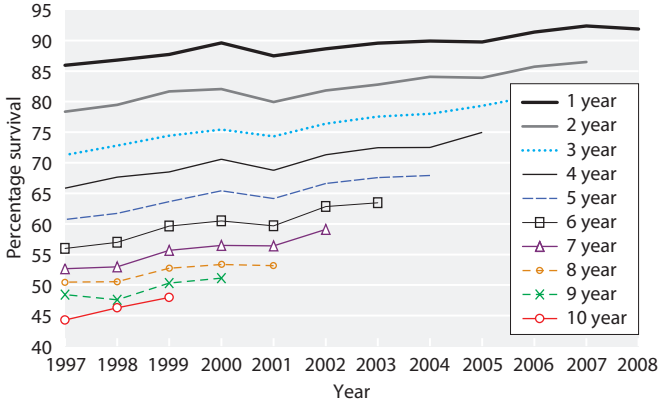

Fig. 6.8. Change in KM long term survival by year of starting RRT; for incident patients aged 18–64 years

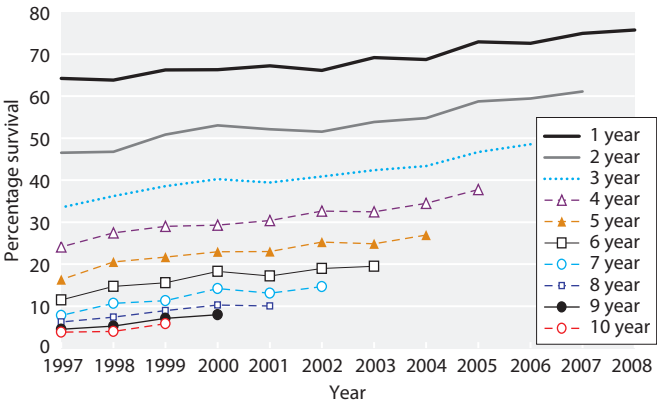

Fig. 6.9. Change in KM long term survival by year of starting RRT; for incident patients aged ⩾65 years

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

The unadjusted KM survival analyses (tables 6.7 and 6.8, figures 6.8 and 6.9) and annual death rates show a large improvement in 1 to 12 year survival across the time periods for both those under and those aged 65 years and over. One year survival amongst patients aged less than 65 years at start of RRT has improved from 85.9% in 1997 to 91.9% in 2008.

Change in survival on renal replacement therapy by vintage

RRT patients in the UK continued to show no evidence of a worsening prognosis with time on RRT (vintage). Figure 6.10 demonstrates this clearly for all patients. In the older age groups, there were decreasing numbers remaining alive beyond 7 years accounting for the increased variability seen. Figures 6.11 and 6.12 show these data for the non-diabetic and diabetic patients respectively.

Time trend changes in incident patient survival, 1999–2008

The time trend changes are shown in figure 6.13. The left hand plot, which includes only those centres that have been sending data continuously since 1999, shows a similar improvement in survival to the plot in which data from all renal centres is analysed.

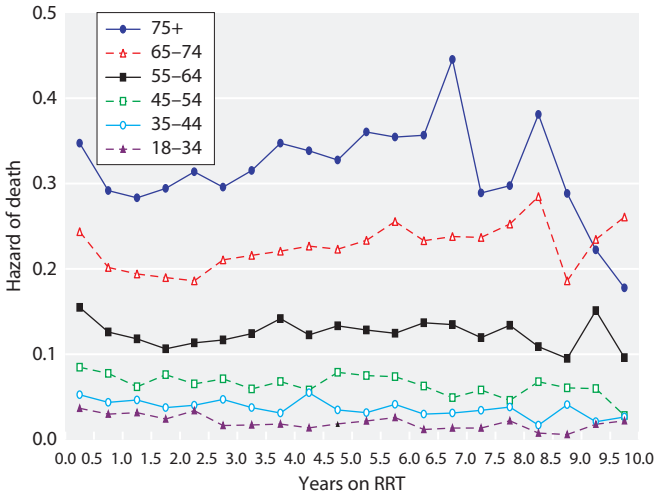

Fig. 6.10. Six monthly hazard of death, by vintage and age band, 1997–2008 incident cohort after day 90

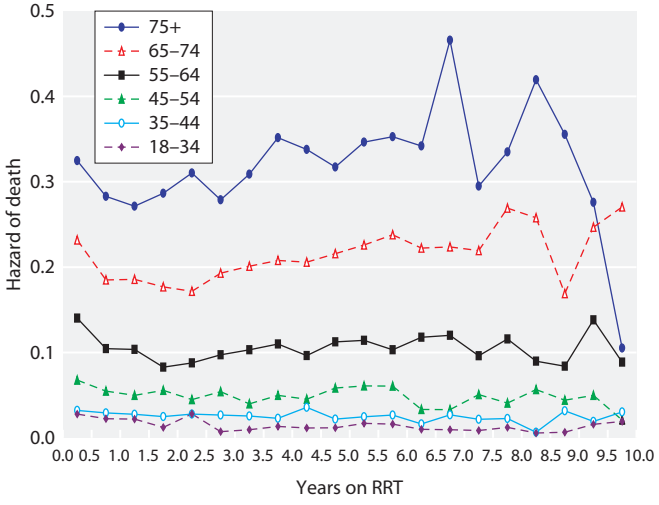

Fig. 6.11. Six monthly hazard of death, by vintage and age band, 1997–2008 non-diabetic incident cohort after day 90

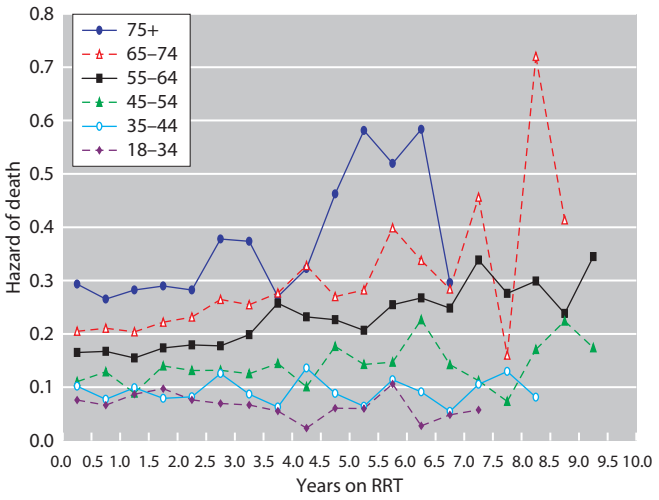

Fig. 6.12. Six monthly hazard of death, by vintage and age band, 1997–2008 diabetic incident cohort after day 90

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2008 incident cohort is shown in figure 6.14 for each renal centre. The tables for these data and for 90 day survival are given in appendix 1 at the end of this chapter (tables 6.24 and 6.25). The age-adjusted individual centre survival for each of the last 10 years can also be found in appendix 1, table 6.26.

In the analysis of 2008 survival data, some of the smaller centres had wide confidence intervals (figure 6.14). This was addressed by including a larger cohort across several years, which will also assess sustained performance. Similar to previous years, this is shown as a rolling 4 year cohort, with the data in this report for the 4 year period 2005 to 2008. These data are

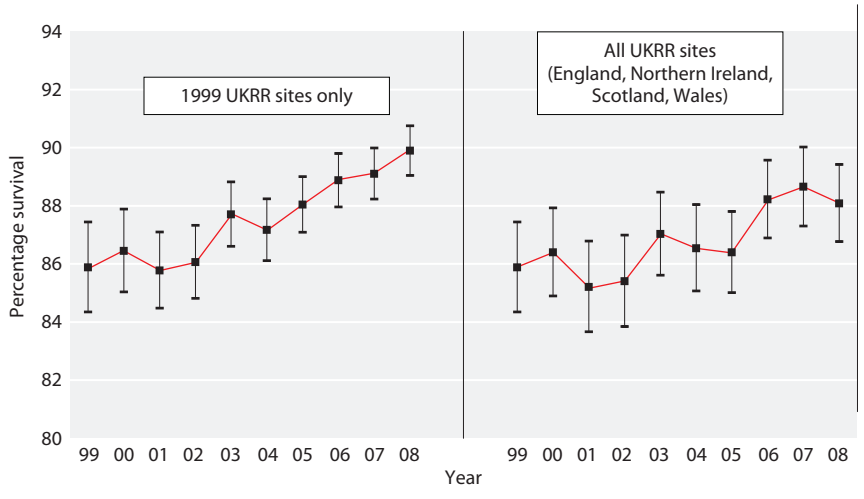

Fig. 6.13. Change in one-year after 90 day survival, 1999–2008 (adjusted to age 60)
Showing 95% confidence intervals

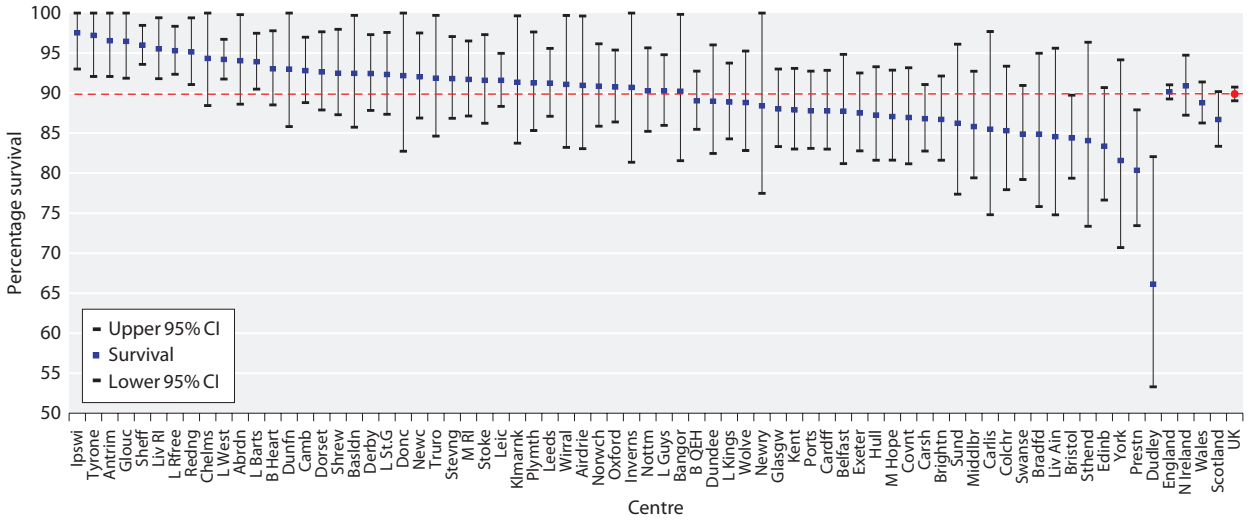

Fig. 6.14. Survival one-year after 90 days, adjusted to age 60, 2008 cohort

presented as a funnel plot in figure 6.15. For any size of incident cohort (x-axis) one can identify whether any given survival rate (y-axis) falls within plus or minus 2 standard deviations (SDs) from the national mean (solid lines, 95% limits) or 3 SDs (dotted lines, 99.9% limits). Table 6.10 allows centres to be identified on this graph by finding the number of patients treated by the centre and then looking up this number on the x-axis. These data have not been adjusted for any patient related factor except age (i.e. not comorbidity, primary renal disease or ethnicity) and have not been censored at transplantation, so the effect of differing centre rates of transplantation was not taken into account.

There are known regional differences in the life expectancy of the general population within the UK [8]. Table 6.11 shows differences in life expectancy between the UK countries. These differences in life expectancy are not accounted for in these analyses and are likely to be one of the reasons behind the variation in survival between renal centres [9].

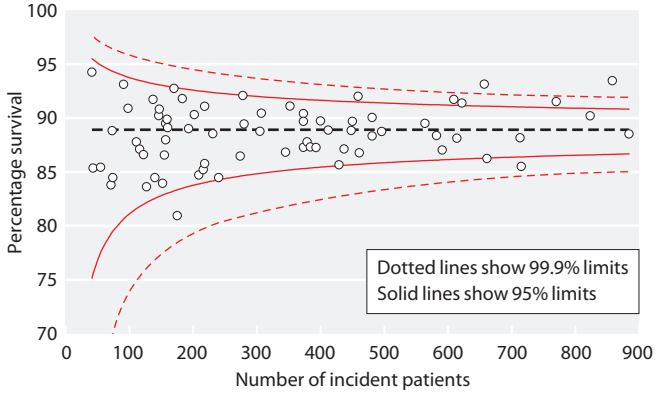

Fig. 6.15. Funnel plot for age adjusted 1 year after 90 days survival, 2005–2008 cohort

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

Comorbidity returns to the UKRR have remained poor. Using the combined incident cohort from 2004–2008, it was found that 11 centres had returned comorbidity data for more than 85% of patients and these centres were included in this analysis. Adjustment was first performed to age 60, then to the average distribution of primary diagnoses for all 11 centres. Further adjustment was then made to the average distribution of comorbidities present at those centres.

It can be seen that adjustment for age has the largest effect, with only minor differences within centres after adjustment for primary renal diagnosis; in two centres (Bradford, Swansea) adjustment for comorbidity had a noticeable effect on adjusted survival (table 6.12 and figure 6.16).

Results of prevalent patient survival analyses

Table 6.13 shows the one year survival on dialysis, after censoring at the time of transplantation. Patients who have been on dialysis for less than 90 days were excluded.

Table 6.10. Adjusted (to age 60) 1 year after 90 day survival, 2005–2008 incident cohort

Centre	N	1 year after 90 day survival %
Donc	41	94.2
Ulster	43	85.3
Colchr	55	85.4
D & Gall	71	83.8
Newry	73	88.8
Clwyd	74	84.5
Tyrone	91	93.1
Wrexm	98	90.9
Carlis	111	87.8
Inverns	116	87.1
Bangor	122	86.6
Liv Ain	127	83.6
Sthend	137	91.7
Dunfn	140	84.5
Antrim	146	90.2
Basldn	147	90.8
Dudley	152	83.9
York	155	86.6
Stoke	157	88.0
Chelms	157	89.5
Truro	159	89.9
Klmarnk	160	89.1
Ipswi	170	92.7
Airdrie	175	80.9
L St.G	183	91.8
Wirral	193	89.0
Shrew	202	90.3
Sund	209	84.7
Abrdn	216	85.2
Glouc	218	91.1
Dundee	218	85.8
Dorset	231	88.5
Bradfd	240	84.5
Plymth	274	86.5
Derby	278	92.1
M RI	280	89.4
Wolve	305	88.8
Kent	307	90.4
Middlbr	345	86.8
Redng	352	91.1
Belfast	373	90.4
Norwch	373	89.7
Edinb	373	87.3
Covnt	379	87.8
Stevng	384	87.3
Newc	393	87.2
B Heart	400	89.7
Hull	412	88.9
Swanse	429	85.7
Exeter	437	87.1
Brightn	448	88.8
Liv RI	450	89.7
Camb	459	92.0
Prestn	461	86.8
Nottm	481	90.0
M Hope	481	88.3
L Kings	496	88.7
Oxford	564	89.5
Leeds	582	88.4
Ports	591	87.0
L Guys	609	91.7
Bristol	614	88.1
Sheff	622	91.4
L Rfree	657	93.1
Glasgw	661	86.2
Carsh	713	88.2
Cardff	715	85.5
L Barts	770	91.5
B QEH	823	90.2
L West	858	93.4
Leic	884	88.5

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

Table 6.11. Life expectancy in years in UK countries, 2005–2008 (source ONS)

	At birth		At age 65	
Country	Male	Female	Male	Female
England	78.3	82.3	18.0	20.6
N Ireland	76.8	81.4	17.2	20.0
Scotland	75.4	80.1	16.5	19.1
Wales	77.2	81.6	17.4	20.1
UK	**77.9**	**82.0**	**17.8**	**20.4**

Table 6.14 gives the 2009 one-year death rate for prevalent dialysis patients in each UK country. The median age of prevalent patients in Northern Ireland and Wales was higher than those in England and this together with socio-economic reasons probably explains the higher death rate in these two countries.

Table 6.15 gives the 2009 one-year survival for transplanted patients.

Figure 6.17 shows the one year survival of dialysis patients who were alive and receiving dialysis on 1st January 2009.

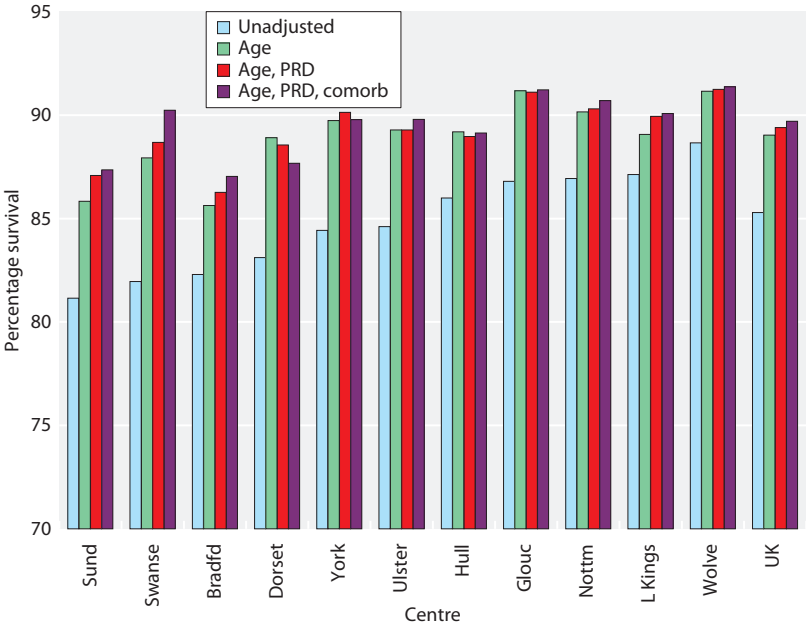

Fig. 6.16. The effect on survival after sequential adjustment for age, PRD and comorbidity, 2004–2008 cohort

One year survival of prevalent dialysis patients by centre

The age-adjusted one year survival of dialysis patients in each centre is shown in table 6.13 and is illustrated in figures 6.18 and 6.19; the data for those patients aged <65 years and those aged 65 years and over are separated. Figure 6.20 shows the age adjusted data (60 years) and in figure 6.21 as a funnel plot. The solid lines show the 2 standard deviation limits (95% limits) and the dotted lines the limits for 3 standard deviations (99.9% limits). With over 70 centres included, it would be expected by chance that 3 centres would fall outside the 95% (1 in 20) confidence limits. Table 6.13 allows centres to be identified by finding the number of patients treated by the centre and then looking up this number on the x-axis.

The 2009, one year death rate in prevalent dialysis patients by age band

The death rates on dialysis by age band are shown in figure 6.22. The younger patients included in this analysis are a selected higher risk group, as the similar aged transplanted patients have been excluded. The increase in death rate is non-linear with age: with a 10 year increase in age in the younger patients, the death rate increased by about 20 per 1,000 patient years compared with an increase of 100 per 1,000 patient

Table 6.12. The effect of adjustment for age, PRD and comorbidity on survival, 2004–2008 cohort

	% survival 1 year after 90 days			
Centre	Unadjusted	Age adjusted	Age, PRD adjusted	Age, PRD and comorbidity adjusted
Ulster	81.1	85.8	85.2	85.7
Bradfd	82.0	87.9	89.1	90.6
Dorset	82.3	85.6	86.1	86.8
York	83.1	88.9	89.1	88.2
Nottm	84.4	89.7	90.4	90.0
Hull	84.6	89.3	89.7	90.3
Glouc	86.0	89.2	89.1	89.3
L Kings	86.8	91.2	91.6	91.7
Wolve	86.9	90.2	90.9	91.2
Sund	87.1	89.1	90.0	90.1
Swanse	88.7	91.2	91.4	91.5
All centres	**85.3**	**89.0**	**89.5**	**89.8**

* Centres included if >85% comorbidity data available

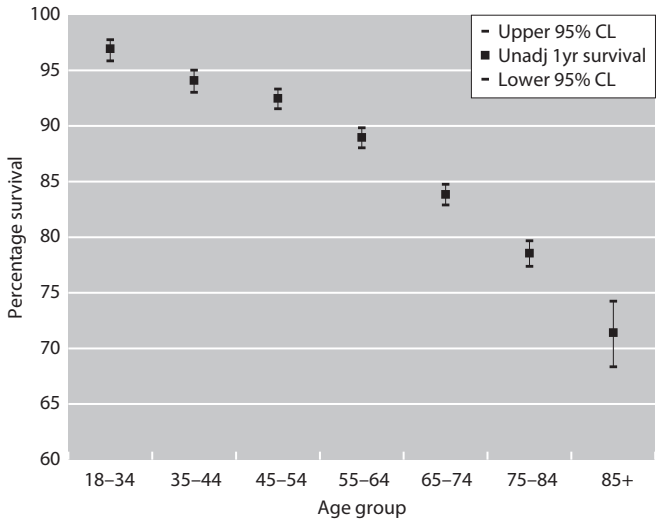

Fig. 6.17. One year survival of prevalent dialysis patients in different age groups, 2009

Table 6.13. One year survival of prevalent dialysis patients in each centre (adjusted to age 60), 2009

Centre	N	Adjusted 1 year survival	*Lower 95% CI*	*Upper 95% CI*
Abrdn	229	89.6	*85.9*	*93.4*
Airdrie	166	85.6	*80.6*	*91.0*
Antrim	147	89.6	*85.5*	*94.0*
B Heart	422	90.6	*88.1*	*93.2*
B QEH	948	90.2	*88.4*	*92.0*
Bangor	100	84.5	*78.4*	*91.0*
Basldn	163	92.4	*88.9*	*96.1*
Belfast	298	87.4	*84.0*	*91.0*
Bradfd	203	85.4	*80.8*	*90.2*
Brightn	412	87.6	*84.8*	*90.4*
Bristol	503	84.9	*82.1*	*87.8*
Camb	444	90.4	*88.0*	*92.9*
Cardff	563	86.8	*84.3*	*89.4*
Carlis	97	81.3	*74.3*	*88.9*
Carsh	767	89.3	*87.4*	*91.3*
Chelms	140	85.7	*80.7*	*91.0*
Clwyd	76	87.8	*81.3*	*94.9*
Colchr	101	90.9	*86.1*	*95.9*
Covnt	372	90.9	*88.3*	*93.6*
D & Gall	64	88.2	*81.6*	*95.4*
Derby	316	90.9	*88.0*	*93.8*
Derry	60	90.8	*84.5*	*97.6*
Donc	90	83.9	*77.3*	*91.0*
Dorset	238	89.8	*86.5*	*93.2*
Dudley	178	88.9	*84.7*	*93.4*
Dundee	190	93.8	*90.9*	*96.8*
Dunfn	142	87.6	*82.8*	*92.6*
Edinb	339	86.5	*83.1*	*90.1*
Exeter	372	85.1	*82.0*	*88.3*
Glasgw	670	88.6	*86.4*	*90.9*
Glouc	184	92.0	*88.8*	*95.4*
Hull	369	87.9	*84.9*	*91.0*
Inverns	120	92.2	*88.0*	*96.5*
Ipswi	148	85.1	*79.8*	*90.7*
Kent	383	88.0	*85.0*	*91.0*
Klmarnk	177	88.3	*84.2*	*92.7*
L Barts	835	90.7	*88.7*	*92.7*
L Guys	554	91.3	*89.1*	*93.5*
L Kings	476	87.9	*85.2*	*90.8*
L Rfree	710	89.7	*87.6*	*91.8*
L St.G	259	89.9	*86.7*	*93.2*
L West	1,307	92.2	*90.9*	*93.6*
Leeds	566	89.2	*86.9*	*91.6*
Leic	879	88.7	*86.8*	*90.7*
Liv Ain	118	92.2	*87.9*	*96.7*
Liv RI	474	89.2	*86.5*	*92.0*
M Hope	443	88.1	*85.2*	*91.0*
M RI	497	87.4	*84.6*	*90.4*
Middlbr	304	86.9	*83.5*	*90.4*
Newc	310	87.5	*84.1*	*91.0*
Newry	104	94.7	*91.0*	*98.6*
Norwch	355	89.0	*86.3*	*91.9*
Nottm	478	87.9	*85.2*	*90.6*
Oxford	504	89.0	*86.5*	*91.5*
Plymth	181	85.7	*81.4*	*90.3*
Ports	500	89.0	*86.6*	*91.5*
Prestn	481	89.7	*87.2*	*92.3*
Redng	296	92.1	*89.5*	*94.9*
Sheff	653	89.4	*87.2*	*91.6*
Shrew	210	88.3	*84.3*	*92.4*
Stevng	465	90.5	*88.1*	*92.9*
Sthend	135	91.1	*87.1*	*95.4*
Stoke	321	88.3	*85.1*	*91.6*
Sund	176	85.7	*80.9*	*90.8*
Swanse	397	87.6	*84.8*	*90.5*
Truro	161	88.6	*84.6*	*92.8*
Tyrone	99	87.1	*81.4*	*93.2*
Ulster	94	87.5	*82.0*	*93.2*
Wirral	205	90.4	*86.8*	*94.2*
Wolve	330	89.5	*86.6*	*92.6*
Wrexm	112	90.2	*85.4*	*95.2*
York	145	88.0	*83.4*	*92.9*
England	**20,178**	**89.2**	***88.7***	***89.6***
N Ireland	**802**	**89.0**	***87.0***	***91.0***
Scotland	**2,097**	**88.8**	***87.5***	***90.1***
Wales	**1,248**	**87.2**	***85.5***	***88.9***
UK	**24,325**	**89.0**	***88.6***	***89.5***

Table 6.14. One-year death rate per 1,000 prevalent dialysis patient years in 2009 and median age of prevalent patients by country

	England	N Ireland	Scotland	Wales
Death rate	146	155	149	184
95% CI	*140–152*	*128–187*	*132–167*	*160–211*
Median age	64.5	65.9	63.7	66.4

Table 6.15. One-year survival of prevalent RRT patients in the UK by modality (unadjusted unless stated otherwise)

Patient group	Patients	Deaths	KM survival	*KM 95% CI*
Transplant patients 2009				
Censored at dialysis	20,368	487	97.6	*97.3–97.8*
Not censored at dialysis	20,368	524	97.4	*97.2–97.6*
Dialysis patients 2009				
All	24,325	3,216	86.2	*85.8–86.7*
All adjusted age = 60	24,325	3,216	89.0	*88.6–89.5*
2 year survival – dialysis patients 2008				
All 1/1/2008 (2 year)	23,496	5,766	73.5	*72.9–74.1*
Dialysis patients 2009				
All age <65	12,438	945	91.8	*91.3–92.3*
All age 65+	11,887	2,271	80.7	*80.0–81.4*
Non-diabetic <55	6,045	254	95.4	*94.8–95.9*
Non-diabetic 55–64	3,600	332	90.3	*89.2–91.2*
Non-diabetic 65–74	4,448	645	85.2	*84.1–86.2*
Non-diabetic 75+	4,745	1,065	77.5	*76.3–78.7*
Non-diabetic <65	9,645	586	93.4	*92.9–93.9*
Diabetic <65	2,348	316	85.9	*84.4–87.3*
Non-diabetic 65+	9,193	1,710	81.2	*80.4–82.0*
Diabetic 65+	2,268	480	78.7	*77.0–80.3*

KM = Kaplan Meier survival
Cohorts of patients alive on 1/1/2009 unless indicated otherwise

years in the older age groups. In all age groups these death rates are lower than comparable death rates reported by the USRDS in 2009 [10].

One year survival of prevalent dialysis patients by UK country from 1997 to 2009

Scotland and Wales are showing a continued improvement in the age-adjusted survival on dialysis (figure 6.23) whilst England and Northern Ireland show no change in age-adjusted survival in the past 2 years. The change in prevalent survival by centre over the years 2000 to 2009 is shown in this chapter, appendix 1, table 6.27.

One year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2000 to 2009

The previously improving age-adjusted survival in patients with diabetic renal disease in the UK has plateaued over the last three years (table 6.16) with no further improvements in survival.

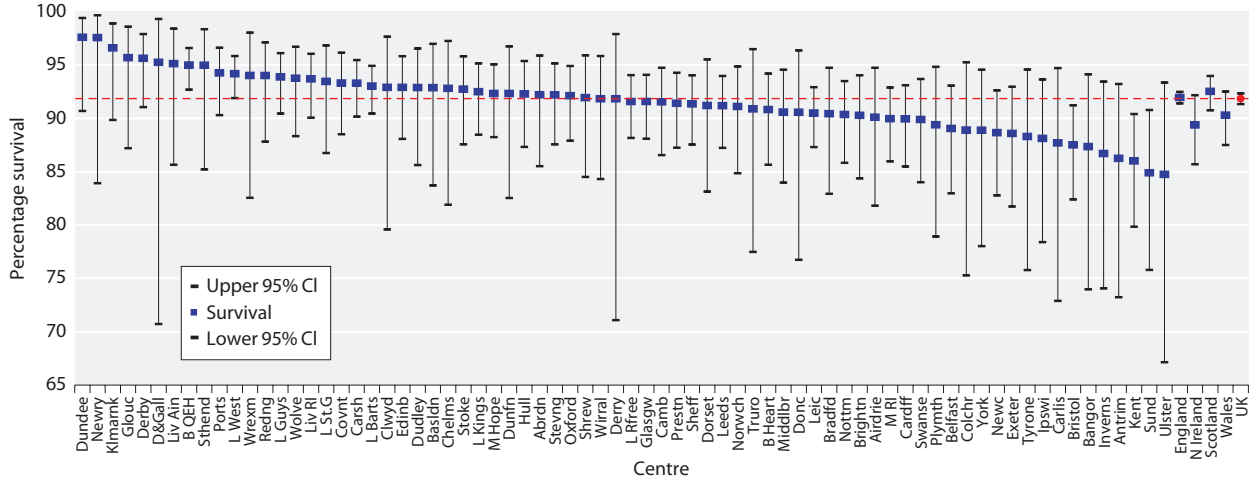

Fig. 6.18. One year survival of prevalent dialysis patients aged under 65 years in each centre, 2009

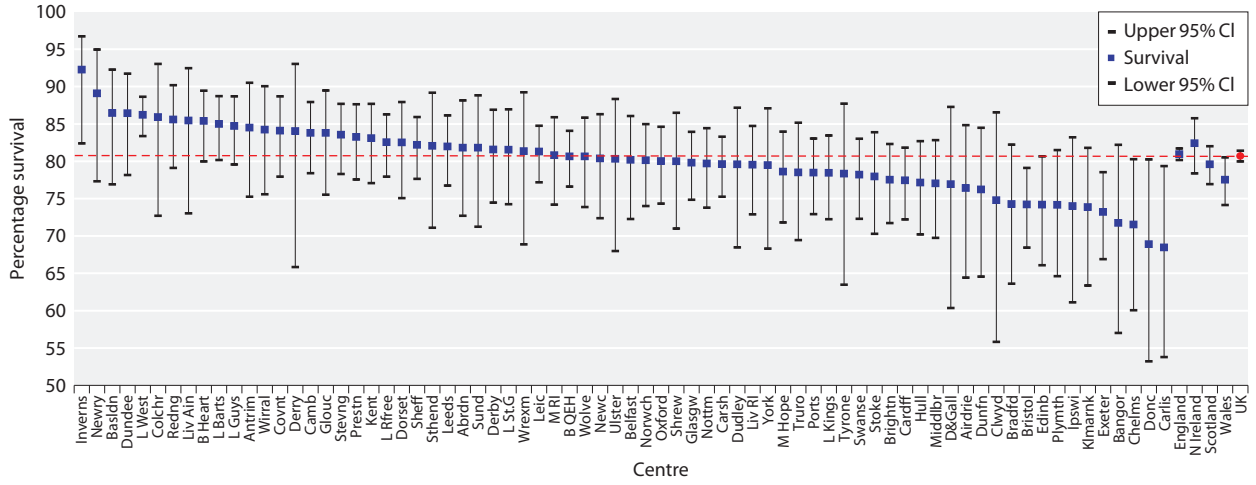

Fig. 6.19. One year survival of prevalent dialysis patients aged 65 years and over in each centre, 2009

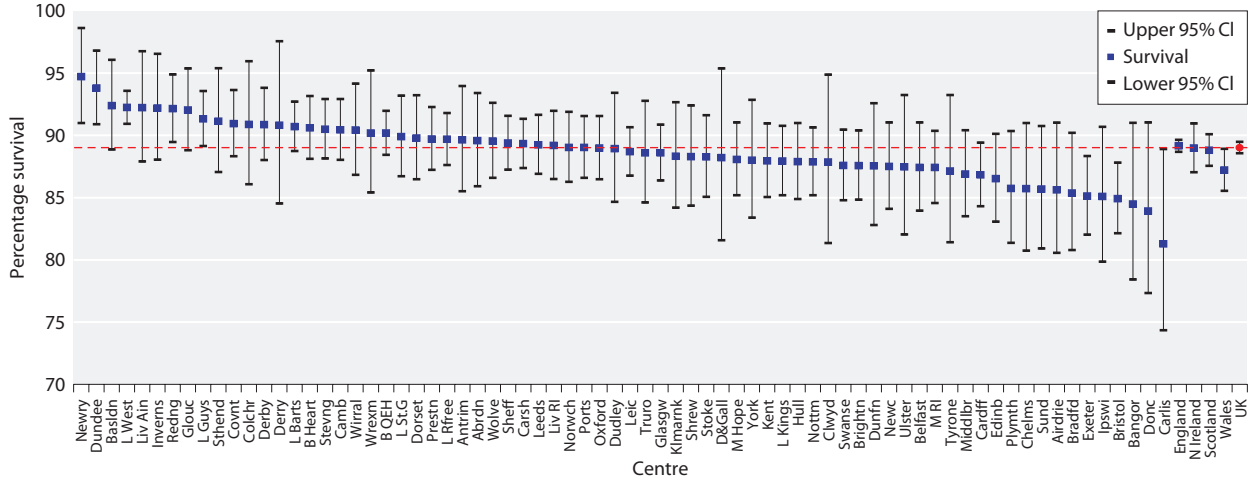

Fig. 6.20. One year survival of prevalent dialysis patients in each centre adjusted to age 60, 2009

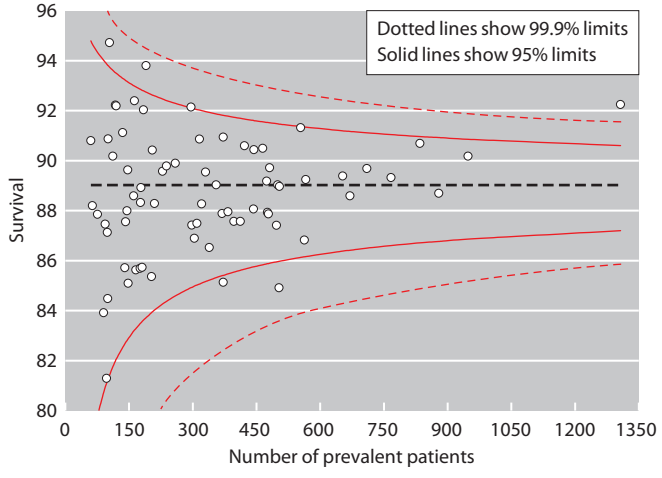

Fig. 6.21. One year funnel plot of prevalent dialysis patients in each centre adjusted to age 60, 2009

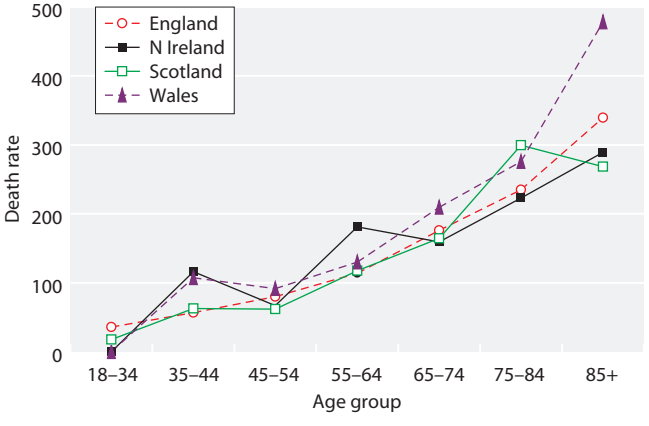

Fig. 6.22. One year death rate per 1,000 patient years by UK country and age group for prevalent dialysis patients, 2009

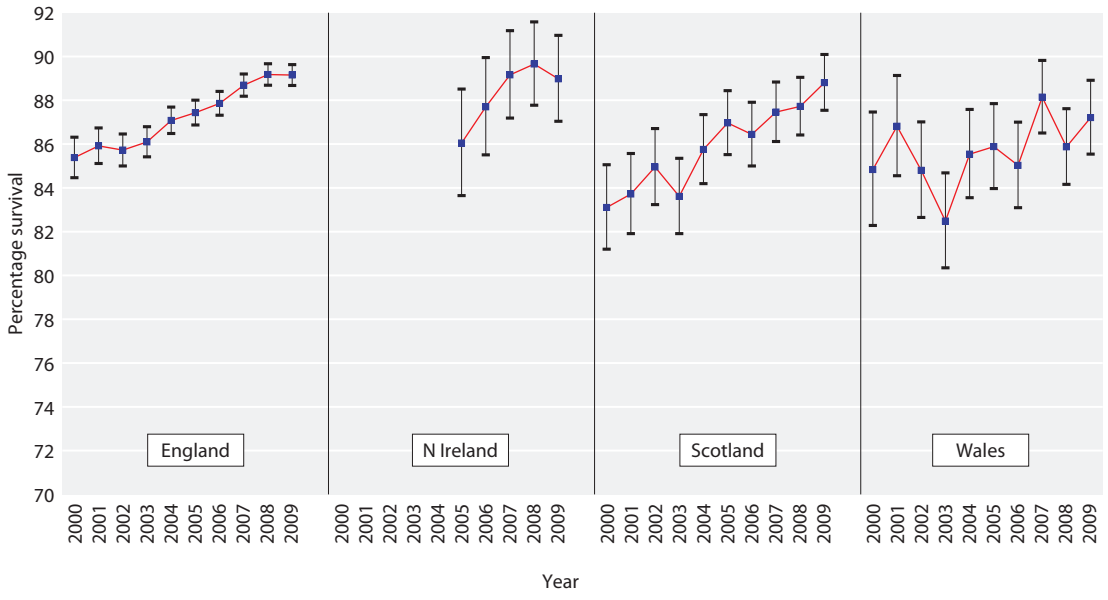

Fig. 6.23. Serial 1 year survival for prevalent dialysis patients by UK country from 2000–2009 adjusted to age 60

Death rate on RRT compared with the UK general population

The death rate compared to the general population is shown in table 6.17. Figure 6.24 shows that the relative risk of death on RRT decreased with age from 19 times that of the general population at age 30 to 34 to 2.4 times the general population at age 85+. With the reduction in rates of death on RRT over the last 10

Table 6.16. Serial 1 year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2000–2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1 year survival	76.6	77.3	78.6	77.9	80.7	82.5	81.8	84.7	83.6	83.6

Table 6.17. Death rate by age for all prevalent RRT patients on 1/1/2009, compared with the general population and with previous analyses in the 1998–2001 cohort

Age group	UK population mid 2008 (thousands)	UK deaths	Death rate per 1,000 population	Expected number of deaths in UK RR population	UKRR Registry deaths	UKRR deaths per 1,000 prevalent RRT patients	Observed: expected ratio 2009	Observed: expected ratio 1998–2001
20–24	4,230	2,032	0.5	0	12	12.9	27.0	41.1
25–29	4,076	2,364	0.6	1	17	11.5	19.8	41.8
30–34	3,828	3,024	0.8	2	29	15.2	19.2	31.2
35–39	4,439	4,775	1.1	3	65	21.4	19.9	26.0
40–44	4,712	7,186	1.5	6	112	27.4	18.0	22.6
45–49	4,353	10,125	2.3	11	167	35.8	15.4	19.0
50–54	3,807	13,978	3.7	17	207	44.2	12.0	12.8
55–59	3,634	20,542	5.7	26	304	65.3	11.6	10.1
60–64	3,642	31,932	8.8	44	420	82.8	9.4	10.4
65–69	2,757	39,338	14.3	63	535	122.2	8.6	7.9
70–74	2,399	55,598	23.2	95	685	166.4	7.2	7.2
75–79	1,985	78,774	39.7	125	675	214.3	5.4	5.3
80–84	1,455	101,056	69.5	128	504	274.6	4.0	4.0
85+	1,335	202,467	151.7	113	269	360.6	2.4	3.0
Total	46,652	573,191	12.3	635	4,001	89.4	6.3	7.7

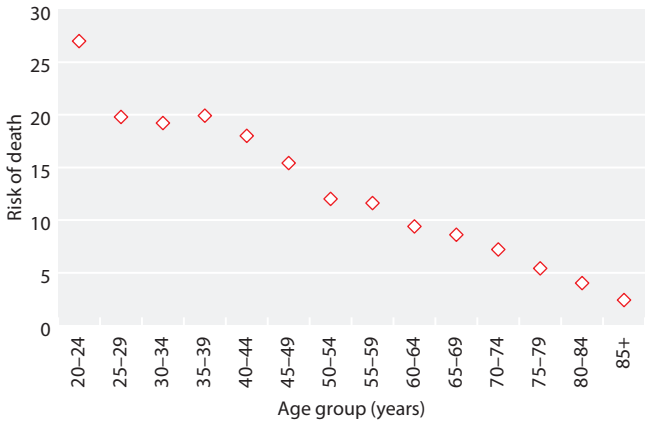

Fig. 6.24. Relative risk of death in all prevalent RRT patients in 2009 compared with the UK general population in 2008

years the age-standardised mortality ratios compared with the general population are falling (7.7 in 2001, 6.3 in 2009).

Results of analyses on causes of death

Data completeness

Data completeness is shown in table 6.18. Overall, it was less than 50% and has not improved over the last 5 years. Interpretation of patterns of cause of death must be cautious as it was not known whether non-return was associated with cause. Some centres consistently achieve a very high rate of data return for cause of death because a process is in place to make sure that

Table 6.18. Percentage completeness of EDTA causes of death for incident patients by centre and year of starting RRT

Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Abrdn	28.0	31.3	30.6	23.5	27.0	24.2	19.2	87.5	71.4	80.0
Airdrie	40.0	32.6	35.7	36.1	54.5	40.0	45.0	77.8	100.0	100.0
Antrim						10.0	18.2	14.3	0.0	100.0
B Heart	75.0	82.6	78.4	70.6	76.6	90.0	88.7	87.0	100.0	100.0
B QEH					36.7	2.2	3.0	5.8	1.7	0.0
Bangor			54.2	26.3	59.3	48.1	44.0	37.5	50.0	66.7
Basldn				48.0	59.3	33.3	57.1	46.2	80.0	80.0
Belfast						25.0	19.4	41.9	26.7	40.0
Bradfd		78.6	88.6	92.2	81.1	89.5	86.7	96.4	93.8	83.3
Brightn					3.8	3.3	3.5	0.0	0.0	0.0
Bristol	51.0	50.0	65.0	71.7	76.0	59.3	70.3	48.1	61.7	77.8
Camb		0.0	0.0	0.0	0.0	4.5	5.8	2.9	0.0	6.3
Cardff	0.0	0.0	0.8	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Carlis	36.0	27.3	65.0	60.9	75.0	71.4	58.3	71.4	77.8	100.0
Carsh	3.5	2.3	0.9	0.9	0.0	0.0	1.3	0.0	0.0	0.0
Chelms					55.9	88.9	80.8	94.4	40.0	50.0
Clwyd			12.5	0.0	11.1	6.3	63.6	50.0	100.0	0.0
Colchr									0.0	0.0
Covnt	20.0	9.2	14.3	2.1	0.0	0.0	0.0	0.0	0.0	0.0
D & Gall	94.0	72.2	92.3	83.3	72.7	88.2	90.9	100.0	100.0	100.0
Derby	39.0	43.9		55.6	73.0	90.9	85.2	92.9	82.4	78.6
Derry							100.0	0.0	100.0	*
Donc								100.0	80.0	75.0
Dorset				31.7	72.2	77.8	75.0	68.4	71.4	80.0
Dudley	29.0	4.5	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dundee	75.0	72.2	60.4	59.5	61.9	30.6	19.0	23.1	40.0	90.0
Dunfn	81.0	85.2	80.0	66.7	73.3	64.0	60.0	66.7	40.0	83.3
Edinb	76.0	59.5	56.9	42.0	53.7	51.1	64.4	86.2	100.0	100.0
Exeter	28.0	25.9	20.0	25.4	14.5	9.7	7.0	0.0	2.6	0.0
Glasgw	53.0	58.9	55.7	57.2	48.2	57.9	67.4	85.0	88.6	82.6
Glouc	53.0	71.9	53.1	51.4	60.6	56.7	20.8	54.5	57.1	81.8
Hull	73.0	67.9	67.6	57.4	64.7	62.5	47.1	63.3	32.1	18.2
Inverns	27.0	8.3	21.1	14.3	11.1	33.3	40.0	37.5	100.0	33.3
Ipswi			19.4	25.0	32.0	17.2	46.7	7.7	0.0	0.0
Kent								56.8	51.7	43.8
Klmarnk	7.7	14.3	28.6	33.3	30.0	30.4	37.5	85.7	85.7	66.7

Table 6.18. Continued

Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
L Barts					75.3	83.0	75.9	78.3	58.8	72.7
L Guys	0.0	4.2	1.3	2.6	0.0	4.5	2.9	3.8	0.0	0.0
L Kings			63.6	73.1	76.6	76.8	87.5	75.8	71.9	33.3
L Rfree						2.4	0.0	0.0	0.0	0.0
L St.G								22.2	10.0	0.0
L West			49.2	42.9	36.8	9.3	1.1	3.4	4.5	0.0
Leeds	49.0	59.6	58.0	42.4	48.4	51.3	40.0	15.0	23.3	16.7
Leic	70.0	75.6	81.6	81.6	78.6	74.8	72.9	60.3	62.8	80.0
Liv Ain					0.0	50.0	69.2	88.2	76.9	100.0
Liv RI		76.3	72.3	73.9	70.1	77.8	76.8	81.5	66.7	100.0
M Hope				0.0	0.0	0.0	2.1	0.0	0.0	0.0
M RI								2.4	0.0	0.0
Middlbr	77.0	74.6	67.1	55.2	52.5	68.3	35.2	23.7	18.2	33.3
Newc			42.6	28.3	36.7	50.0	46.5	47.2	43.8	11.1
Newry						45.5	0.0	25.0	66.7	100.0
Norwch					29.5	23.3	24.0	15.8	40.0	66.7
Nottm	93.0	97.5	96.8	95.9	96.8	92.6	87.0	95.0	100.0	100.0
Oxford	12.0	7.6	6.1	4.5	15.1	6.0	0.0	0.0	0.0	0.0
Plymth	47.0	39.2	50.0	56.3	44.7	40.6	47.6	56.7	46.2	25.0
Ports		25.0	21.3	20.0	19.0	11.9	20.0	13.3	27.5	36.4
Prestn	67.0	69.6	62.3	62.7	50.0	44.0	43.5	47.1	21.4	21.4
Redng	66.0	60.0	78.6	79.5	92.3	69.2	92.3	89.3	81.3	90.0
Sheff	57.0	42.3	52.8	29.5	3.7	2.7	9.2	1.7	11.5	0.0
Shrew					50.0	36.8	23.8	22.2	20.0	0.0
Stevng	26.0	42.2	67.2	39.7	42.4	51.2	45.8	36.0	12.5	60.0
Sthend	41.0	32.1	32.0	37.9	20.8	16.7	0.0	77.8	83.3	*
Stoke								28.6	6.7	55.6
Sund	51.0	57.7	60.5	51.6	46.9	73.5	64.3	64.0	70.0	40.0
Swanse	84.0	87.5	92.0	94.3	90.9	88.1	96.5	97.8	86.7	100.0
Truro		45.8	34.9	39.5	5.7	6.3	6.3	33.3	16.7	40.0
Tyrone						42.9	50.0	50.0	33.3	0.0
Ulster						83.3	60.0	100.0	80.0	0.0
Wirral			57.6	76.7	63.6	60.0	71.4	64.3	14.3	14.3
Wolve	91.0	88.1	84.1	81.8	71.4	57.8	55.3	55.0	64.7	100.0
Wrexm	9.8	3.7	19.0	9.5	16.7	25.0	54.5	55.6	60.0	100.0
York	33.0	44.0	58.3	62.9	62.5	58.3	40.9	63.6	46.7	66.7
England	**49.0**	**48.0**	**49.0**	**44.3**	**43.5**	**41.0**	**37.7**	**35.6**	**31.4**	**34.6**
N Ireland						**29.9**	**27.9**	**34.9**	**34.3**	**58.3**
Scotland	**54.0**	**51.5**	**51.1**	**47.6**	**48.0**	**47.5**	**53.1**	**72.7**	**82.1**	**85.9**
Wales	**26.0**	**33.2**	**37.8**	**37.0**	**31.3**	**34.1**	**40.6**	**36.2**	**48.9**	**55.6**
UK	**48.0**	**47.3**	**48.2**	**44.1**	**43.1**	**40.9**	**39.2**	**39.0**	**37.2**	**42.8**

Blank cells, data not available for that year
* no deaths recorded

these data were entered. The Scottish centres overall had the highest rate of data return. Several centres have shown significant improvement in data returns but others that were reporting these data in previous years appear to have discontinued collection.

Causes of death in incident RRT patients

Causes of death within the first 90 days

See table 6.19.

Causes of death within one year after 90 days

Treatment withdrawal as a cause of death (table 6.19 and table 6.20) was more common in the older age group.

Causes of death in prevalent RRT patients in 2009

Table 6.21 and figures 6.25 and 6.26 show the frequency of the causes of death for both prevalent dialysis and transplant patients. These data are neither age-adjusted nor

Table 6.19. Cause of death in the first 90 days for incident patients by age, 2000–2008

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	479	28	114	31	365	28
Cerebrovascular disease	86	5	20	5	66	5
Infection	292	17	47	13	245	19
Malignancy	137	8	37	10	100	8
Treatment withdrawal	260	15	43	12	217	16
Other	153	9	33	9	120	9
Uncertain	282	17	73	20	209	16
Total	**1,689**		**367**		**1,322**	
No cause of death data	2,120		470		1,650	

Table 6.20. Cause of death in 1 year after 90 days for incident patients by age, 2000–2008

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	684	24	212	27	472	24
Cerebrovascular disease	152	5	40	5	112	6
Infection	512	18	149	19	363	18
Malignancy	282	10	100	13	182	9
Treatment withdrawal	450	16	71	9	379	19
Other	196	7	68	9	128	6
Uncertain	529	19	159	20	370	18
Total	**2,805**		**799**		**2,006**	
No cause of death data	3,637		1,047		2,590	

adjusted for differences in the comorbidity between the two groups. Cardiac disease as a cause of death was less common in the transplanted patients as these were a pre-selected low risk group of patients. Malignancy and infection were both responsible for a greater percentage of deaths in the transplanted group. Treatment withdrawal still occurs in the transplanted group, in patients who choose not to restart dialysis when their renal transplant fails.

Table 6.22 shows there were no differences in the causes of death between transplanted patients aged <55 or ⩾55 years. Table 6.23 shows these data for dialysis patients. Dialysis patients aged 65 years and over were significantly more likely to withdraw from treatment than younger patients but otherwise causes of death were similar in both age groups.

Table 6.21 Cause of death in prevalent RRT patients by age and modality on 1/1/2009

	All age groups		Dialysis		Transplant	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	381	23	341	24	40	18
Cerebrovascular disease	76	5	68	5	8	4
Infection	339	21	279	19	60	28
Malignancy	150	9	101	7	49	23
Treatment withdrawal	208	13	207	14	1	0
Other	150	9	127	9	23	11
Uncertain	348	21	312	22	36	17
Total	**1,652**		**1,435**		**217**	
No cause of death data	2,352		1,965		387	

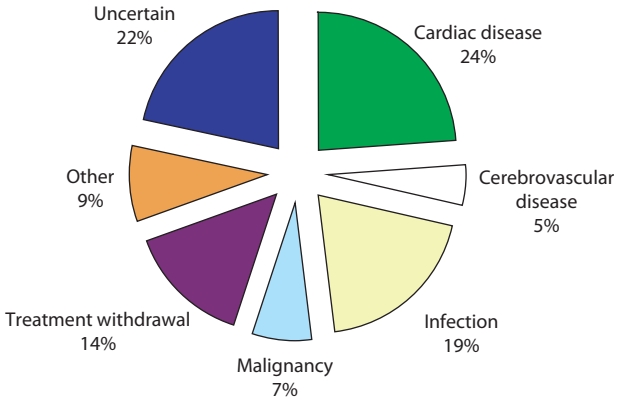

Fig. 6.25. Frequency of causes of death for prevalent dialysis patients in 2009

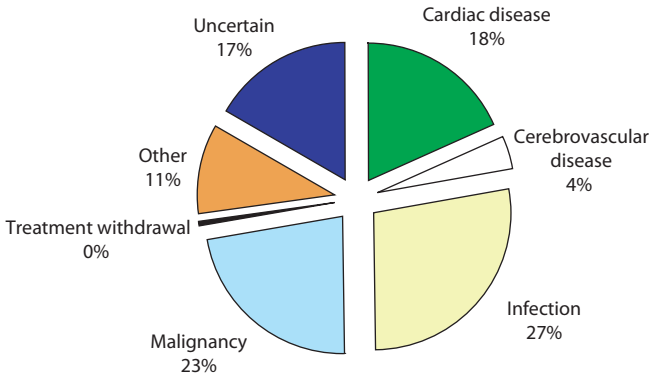

Fig. 6.26. Frequency of causes of death for prevalent transplant patients in 2009

Table 6.22. Cause of death in prevalent transplanted patients by age on 1/1/2009

	All age groups		<55 years		⩾55 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	40	18	10	16	30	19
Cerebrovascular disease	8	4	3	5	5	3
Infection	60	28	19	31	41	26
Malignancy	49	23	10	16	39	25
Treatment withdrawal	1	0	0	0	1	1
Other	23	11	9	15	14	9
Uncertain	36	17	10	16	26	17
Total	**217**		**61**		**156**	
No cause of death data	387		106		281	

Expected life years remaining on RRT

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

Figure 6.27 shows the median remaining life years expected by age band. All incident patients starting RRT from 1997 to 2008 have been included in this analysis and the projected median survival will be different for low risk (e.g. polycystic kidney disease with a transplant) vs. high risk (diabetic with previous myocardial infarction on dialysis) patients even within the same age band.

Conflicts of interest: none

Table 6.23. Cause of death in prevalent dialysis patients by age on 1/1/2009

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	341	24	108	24	233	23
Cerebrovascular disease	68	5	20	5	48	5
Infection	279	19	94	21	185	19
Malignancy	101	7	31	7	70	7
Treatment withdrawal	207	14	43	10	164	17
Other	127	9	57	13	70	7
Uncertain	312	22	90	20	222	22
Total	**1,435**		**443**		**992**	
No cause of death data	1,965		562		1,403	

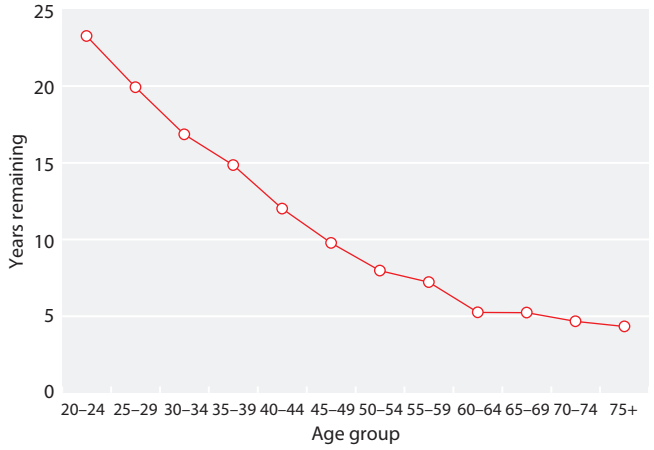

Fig. 6.27. Median remaining life years on RRT by age band, 2009

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Appendix 1: Survival tables

Table 6.24. One-year after 90-day incident survival by centre for 2008, unadjusted and adjusted to age 60

Centre	Unadjusted 1 yr after 90 d survival	Adjusted 1 yr after 90 d survival	Adjusted 1 yr after 90 d 95% CI	Centre	Unadjusted 1 yr after 90 d survival	Adjusted 1 yr after 90 d survival	Adjusted 1 yr after 90 d 95% CI
Abrdn	92.52	94.05	88.6–99.8	L Rfree	94.49	95.30	92.4–98.3
Airdrie	89.19	90.96	83.1–99.6	L St.G	90.84	92.33	87.4–97.6
Antrim	94.44	96.55	92.1–100.0	L West	93.08	94.21	91.8–96.7
B Heart	91.27	93.05	88.5–97.8	Leeds	89.59	91.24	87.1–95.6
B QEH	86.46	89.04	85.5–92.7	Leic	89.43	91.59	88.3–95.0
Bangor	84.94	90.23	81.6–99.8	Liv Ain	80.56	84.56	74.8–95.6
Basldn	89.74	92.46	85.7–99.7	Liv RI	94.77	95.53	91.8–99.4
Belfast	82.95	87.75	81.2–94.8	M Hope	85.79	87.07	81.6–92.9
Bradfd	85.42	84.86	75.8–95.0	M RI	91.22	91.71	87.1–96.5
Brightn	80.73	86.71	81.6–92.1	Middlbr	82.59	85.81	79.4–92.7
Bristol	81.19	84.39	79.4–89.7	Newc	90.66	92.04	86.9–97.5
Camb	89.62	92.81	88.8–97.0	Newry	85.71	88.40	77.5–100.0
Cardff	85.31	87.78	83.0–92.8	Norwch	86.83	90.86	85.9–96.2
Carlis	83.33	85.49	74.8–97.7	Nottm	88.41	90.29	85.2–95.7
Carsh	81.90	86.81	82.8–91.1	Oxford	88.42	90.77	86.4–95.4
Chelms	90.91	94.34	88.4–100.0	Plymth	88.79	91.27	85.3–97.6
Colchr	77.95	85.30	77.9–93.4	Ports	85.00	87.79	83.1–92.7
Covnt	84.07	86.96	81.2–93.2	Prestn	78.03	80.34	73.4–87.9
Derby	89.77	92.45	87.8–97.3	Redng	94.23	95.15	91.1–99.4
Donc	90.15	92.18	82.7–100.0	Sheff	94.22	96.00	93.6–98.5
Dorset	88.83	92.65	87.9–97.7	Shrew	88.33	92.48	87.3–98.0
Dudley	66.02	66.12	53.3–82.1	Stevng	90.51	91.82	86.8–97.1
Dundee	82.67	88.99	82.5–96.0	Sthend	79.31	84.07	73.4–96.3
Dunfn	90.00	92.99	85.8–100.0	Stoke	89.40	91.60	86.2–97.3
Edinb	79.71	83.36	76.6–90.7	Sund	84.09	86.23	77.4–96.1
Exeter	80.99	87.51	82.8–92.5	Swanse	80.74	84.87	79.2–90.9
Glasgw	85.25	88.03	83.3–93.0	Truro	88.19	91.86	84.6–99.7
Glouc	95.35	96.47	91.9–100.0	Tyrone	95.83	97.21	92.1–100.0
Hull	84.48	87.26	81.6–93.3	Wirral	89.19	91.09	83.2–99.7
Inverns	87.62	90.71	81.4–100.0	Wolve	86.62	88.82	82.8–95.2
Ipswi	97.37	97.54	93.0–100.0	York	72.87	81.58	70.7–94.1
Kent	84.24	87.90	83.0–93.1	**England**	**87.73**	**90.15**	**89.3–91.0**
Klmarnk	86.90	91.35	83.7–99.7	**N Ireland**	**87.09**	**90.91**	**87.2–94.7**
L Barts	94.19	93.92	90.5–97.5	**Scotland**	**85.22**	**88.79**	**86.3–91.4**
L Guys	88.87	90.27	86.0–94.8	**Wales**	**83.13**	**86.70**	**83.4–90.2**
L Kings	86.55	88.89	84.3–93.8	**UK**	**87.28**	**89.89**	**89.0–90.7**

Excluded: Data from centres with less than 20 patients are excluded (Clwyd, Derry, D & Gall, Ulster, Wrexham)

Table 6.25. Ninety day incident survival by centre for 2008, unadjusted and adjusted to age 60

Centre	Unadjusted 90 day survival	Adjusted 90 day survival	Adjusted 90 day 95% CI	Centre	Unadjusted 90 day survival	Adjusted 90 day survival	Adjusted 90 day 95% CI
Abrdn	96.4	97.5	94.2–100.0	L West	94.3	95.9	94.0–97.8
Airdrie	94.9	96.2	91.2–100.0	Leeds	91.9	94.0	90.8–97.2
Antrim	90.0	94.8	90.0–99.9	Leic	93.4	95.5	93.3–97.7
B Heart	91.4	94.5	91.0–98.1	Liv Ain	85.7	90.7	83.9–98.0
B QEH	91.4	94.1	91.8–96.5	Liv RI	95.1	96.3	93.2–99.5
Bangor	70.7	83.6	75.5–92.7	M Hope	95.7	96.5	93.9–99.3
Basldn	97.5	98.4	95.4–100.0	M RI	95.5	96.2	93.3–99.2
Belfast	97.1	98.2	95.9–100.0	Middlbr	93.5	95.7	92.4–99.1
Bradfd	92.1	93.0	87.3–99.1	Newc	95.9	96.9	94.0–99.9
Brightn	95.9	97.8	95.9–99.7	Norwch	95.5	97.5	95.1–99.9
Bristol	93.7	95.6	93.1–98.2	Nottm	91.4	93.7	89.9–97.6
Camb	93.8	96.4	93.8–99.1	Oxford	92.5	94.9	92.1–97.9
Cardff	96.7	97.6	95.6–99.7	Plymth	95.7	97.2	94.1–100.0
Carsh	93.0	95.8	93.6–97.9	Ports	91.8	94.2	91.3–97.3
Chelms	97.1	98.5	95.7–100.0	Prestn	96.4	97.1	94.4–99.9
Colchr	91.7	95.6	91.8–99.5	Redng	91.4	93.7	89.7–97.8
Covnt	93.9	95.5	92.3–98.8	Sheff	96.7	98.0	96.5–99.6
Derby	95.7	97.2	94.6–99.9	Shrew	98.4	99.1	97.5–100.0
Donc	88.5	92.7	85.3–100.0	Stevng	95.1	96.3	93.1–99.5
Dorset	87.1	93.1	89.2–97.2	Sthend	83.2	89.9	82.5–97.9
Dudley	89.4	92.3	86.1–98.9	Stoke	92.7	95.1	91.3–99.0
Dundee	84.4	91.6	86.7–96.8	Sund	97.8	98.3	95.1–100.0
Edinb	87.4	91.2	86.7–95.9	Swanse	95.1	96.7	94.2–99.3
Exeter	91.8	95.7	93.3–98.3	Truro	90.0	94.3	89.1–99.8
Glasgw	92.4	94.7	91.9–97.7	Wirral	92.9	95.2	90.2–100.0
Glouc	91.5	94.4	89.2–99.8	Wolve	95.5	96.8	93.8–99.9
Hull	92.9	95.1	91.8–98.5	Wrexm	85.7	89.7	80.1–100.0
Kent	95.7	97.3	95.1–99.5	York	83.8	91.8	85.8–98.3
Klmarnk	94.1	96.7	92.4–100.0	**England**	**94.0**	**96.0**	**95.4–96.6**
L Barts	97.6	97.6	95.6–99.7	**N Ireland**	**95.4**	**97.4**	**95.6–99.2**
L Guys	98.8	99.1	97.8–100.0	**Scotland**	**92.2**	**95.1**	**93.5–96.6**
L Kings	96.0	97.1	94.9–99.4	**Wales**	**92.3**	**95.0**	**93.1–96.9**
L St.G	97.9	98.5	96.4–100.0	**UK**	**93.8**	**95.9**	**95.4–96.5**

Excluded: centres with data from less than 20 incident patients (Clwyd, Derry, D & Gall, Ulster), centres with no deaths in 90 days (Carlisle, Dunfermline, Inverness, Ipswich, Newry, Tyrone)

Table 6.26. One year after 90-day incident survival by centre for incident cohort years 2000–2008, adjusted to age 60

	One year after 90 days survival								
Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008
Abrdn	79.8	92.3	88.0	82.9	89.9	79.5	82.8	85.2	94.0
Airdrie	83.1	84.7	78.5	78.8	85.6	72.3	75.6	84.7	91.0
Antrim						86.2	94.4	84.9	96.6
B Heart	83.7	85.8	88.7	86.5	87.6	85.9	89.9	90.9	93.0
B QEH					88.5	90.3	87.8	93.3	89.0
Bangor			83.1	88.9	84.2	81.4	81.5	92.7	90.2
Basldn				91.9	95.1	92.4	91.0	87.8	92.5
Belfast						90.4	92.3	90.1	87.7
Bradfd		93.4	86.4	84.5	84.5	85.7	76.9	86.8	84.9
Brightn					87.9	83.2	90.3	94.2	86.7
Bristol	86.7	85.7	88.0	87.2	87.8	83.5	93.2	90.9	84.4
Camb		90.7	82.2	88.9	87.6	91.0	92.3	91.7	92.8
Cardff	88.6	83.1	83.0	89.3	86.3	88.4	85.9	81.9	87.8
Carlis	78.4		87.8	78.3	87.0	82.8	91.1	92.8	85.5
Carsh	86.2	76.1	84.6	90.8	86.9	91.6	85.8	89.2	86.8
Chelms					81.4	86.6	87.2	90.3	94.3
Clwyd						80.1		82.8	
Colchr									85.3
Covnt	82.8	87.7	90.5	82.9	85.6	87.4	85.1	91.2	87.0
D & Gall		73.8	78.2						
Derby	88.3	85.0		83.7	86.8	89.3	92.7	94.0	92.4
Derry									
Donc									92.2
Dorset				86.3	91.2	82.7	90.0	86.1	92.7
Dudley	86.3	90.6	89.4	89.2	85.8	96.7	89.5	84.7	66.1
Dundee	77.6	86.8	84.0	89.6	84.2	85.6	89.7	79.4	89.0
Dunfn	72.2	70.2	87.0	85.7	87.9	77.1	83.2	85.3	93.0
Edinb	80.4	80.4	82.6	83.2	79.7	86.0	87.9	92.4	83.4
Exeter	85.4	85.4	87.1	85.2	86.8	86.2	87.8	86.8	87.5
Glasgw	84.7	79.8	83.8	85.5	81.2	84.4	84.8	88.2	88.0
Glouc	95.1	82.5	82.5	85.0	86.9	93.4	89.8	86.6	96.5
Hull	86.1	88.8	85.9	87.6	86.2	89.6	92.1	86.4	87.3
Inverns	84.1	91.7	83.7	88.0	83.5	85.4	91.0	80.1	90.7
Ipswi			98.3	93.7	91.2	85.6	96.1	94.3	97.5
Kent								92.5	87.9
Klmarnk	91.5	88.2	87.4	85.3	84.0	94.0	84.0	90.4	91.4
L Barts					87.6	93.0	91.6	87.9	93.9
L Guys	88.0	87.6	86.6	93.9	88.0	93.1	91.0	92.7	90.3
L Kings			88.1	85.9	88.8	88.9	88.8	88.3	88.9
L Rfree						91.6	92.3	93.4	95.3
L St.G								91.5	92.3
L West			93.2	95.6	91.9	94.1	94.0	92.0	94.2
Leeds	90.6	89.7	85.7	89.0	90.0	89.6	85.5	87.5	91.2
Leic	84.7	87.4	88.0	90.7	85.4	85.6	87.7	88.8	91.6
Liv Ain						85.5	86.3	80.4	84.6
Liv RI		87.2	85.0	83.4	84.8	91.1	83.8	89.6	95.5
M Hope				88.1	82.8	92.3	91.6	82.6	87.1
M RI								87.6	91.7
Middlbr	89.2	82.9	78.5	82.5	85.5	83.2	89.8	87.4	85.8
Newc			87.1	86.8	83.1	83.6	87.0	86.4	92.0
Newry						86.6			88.4
Norwch					86.1	90.2	89.0	89.0	90.9
Nottm	89.3	89.9	86.7	86.4	84.8	86.8	94.6	88.7	90.3
Oxford	90.0	86.6	89.0	87.9	90.6	87.0	90.8	89.2	90.8
Plymth	84.4	73.2	82.1	81.5	81.1	82.1	83.3	89.6	91.3

Table 6.26. Continued

	One year after 90 days survival								
Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008
Ports		86.7	86.2	87.9	89.4	83.5	86.4	89.9	87.8
Prestn	87.0	87.2	86.7	86.0	84.5	92.0	84.8	89.2	80.3
Redng	76.3	83.7	92.5	92.0	93.8	88.6	90.4	90.3	95.1
Sheff	94.9	94.3	84.4	90.1	89.9	92.1	89.5	87.2	96.0
Shrew					88.0	87.6	89.7	89.5	92.5
Stevng	91.1	81.2	87.7	94.8	87.7	79.7	88.4	88.8	91.8
Sthend	82.5	80.5	87.7	90.8	87.3	92.3	96.4	92.1	84.1
Stoke								85.5	91.6
Sund	83.6	85.2	71.3	81.4	88.1	82.5	82.6	87.6	86.2
Swanse	84.9	85.6	83.4	82.4	82.3	84.2	83.5	89.5	84.9
Truro		91.4	84.0	88.6	92.4	88.1	92.8	86.6	91.9
Tyrone							89.8	89.7	97.2
Ulster									
Wirral			78.2	94.9	82.5	88.3	91.0	86.9	91.1
Wolve	87.4	77.1	88.0	82.7	88.0	85.9	90.1	90.8	88.8
Wrexm	85.2	83.2	93.2	83.9	91.8	91.8	90.8	90.7	
York	83.6	87.0	82.4	78.7	90.0	85.3	83.2	94.6	81.6
England	**87.5**	**86.5**	**86.6**	**88.2**	**87.7**	**88.6**	**89.4**	**89.6**	**90.2**
N Ireland						**89.8**	**91.8**	**89.6**	**90.9**
Scotland	**82.1**	**82.7**	**83.8**	**85.4**	**83.7**	**84.0**	**85.0**	**86.6**	**88.8**
Wales	**87.0**	**84.1**	**84.5**	**85.9**	**85.7**	**86.3**	**85.6**	**85.7**	**86.7**
UK	**86.4**	**85.8**	**86.1**	**87.7**	**87.2**	**88.0**	**88.9**	**89.1**	**89.9**

Blank cells: centres with <20 patients for that year or centres with no data available for that year

Table 6.27. One year prevalent survival by centre for prevalent cohort years 2000–2009, adjusted to age 60

	One-year survival									
Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Abrdn	85.9	89.4	87.3	80.6	85.6	87.5	86.8	87.1	89.7	89.6
Airdrie	78.0	78.3	81.9	84.1	84.1	82.7	79.5	79.6	85.6	85.6
Antrim						83.6	92.0	85.7	89.1	89.6
B Heart	86.7	87.5	87.7	87.6	86.8	87.9	86.3	87.7	90.5	90.6
B QEH					89.2	89.1	88.8	88.6	88.7	90.2
Bangor			85.4	81.4	89.6	86.4	89.3	80.7	88.7	84.5
Basldn				81.6	88.0	90.7	90.2	91.0	93.1	92.4
Belfast						86.3	86.8	90.8	87.3	87.4
Bradfd		80.3	87.8	82.6	88.0	86.4	82.6	84.4	88.0	85.4
Brightn					87.2	84.1	87.7	87.6	89.5	87.6
Bristol	87.2	86.2	87.7	88.8	86.8	87.5	87.7	89.2	87.2	84.9
Camb		86.1	86.7	86.9	87.6	87.7	89.0	88.2	92.8	90.4
Cardff	85.3	85.8	86.0	80.9	84.5	84.4	84.4	88.8	82.8	86.8
Carlis	82.8	89.1	81.1	83.0	82.6	85.8	84.4	86.2	87.0	81.3
Carsh	83.1	83.8	82.9	85.2	88.0	86.5	89.2	88.9	90.0	89.3
Chelms					87.0	82.2	85.7	86.3	84.6	85.7
Clwyd			88.2	89.0	75.7	81.8	78.9	90.7	87.9	87.8
Colchr										90.9
Covnt	87.3	85.4	85.5	87.8	88.7	89.4	85.5	87.2	87.9	90.9
D & Gall	87.2	83.5	83.4	85.3	83.3	90.6	82.1	90.2	85.5	88.2
Derby	89.0	89.6		86.7	88.9	88.2	89.0	87.5	90.9	90.9
Derry								86.8	92.4	90.8
Donc									93.9	83.9
Dorset				90.2	88.1	90.4	86.3	87.4	89.8	89.8
Dudley	85.6	83.4	83.4	84.8	86.9	86.4	87.3	87.0	89.4	88.9
Dundee	77.2	86.3	85.2	84.0	85.5	87.8	87.6	84.0	84.2	93.8
Dunfn	76.6	79.4	82.7	83.9	89.1	91.1	88.9	89.1	90.2	87.6
Edinb	82.8	81.7	83.8	83.3	86.2	86.0	86.8	88.2	88.2	86.5
Exeter	86.3	85.2	87.5	86.7	86.1	84.3	90.9	87.4	85.5	85.1
Glasgw	86.1	83.5	85.9	83.9	85.6	87.4	86.5	88.4	87.8	88.6
Glouc	89.2	80.0	84.2	82.3	89.3	88.7	91.2	88.0	87.4	92.0
Hull	81.5	87.1	87.5	85.6	85.7	84.9	85.8	90.2	87.0	87.9
Inverns	81.4	89.0	88.6	87.6	86.9	87.1	86.4	94.5	89.1	92.2
Ipswi			82.5	85.1	90.5	86.2	85.0	85.5	91.6	85.1
Kent									86.6	88.0
Klmarnk	80.6	85.5	82.7	82.4	87.2	84.8	91.5	87.0	88.8	88.3
L Barts					83.9	85.6	88.3	89.2	88.7	90.7
L Guys	86.2	86.7	86.3	88.7	88.6	89.2	87.8	90.7	90.1	91.3
L Kings			81.1	77.5	81.6	86.5	88.9	84.9	88.4	87.9
L Rfree						90.1	90.5	90.5	91.3	89.7
L St.G								95.9	94.0	89.9
L West			89.7	91.4	91.1	91.6	91.7	91.9	90.5	92.2
Leeds	83.4	85.4	87.2	86.2	85.2	88.8	89.2	88.2	87.8	89.2
Leic	83.3	84.7	84.1	83.7	85.2	87.2	84.6	90.1	89.6	88.7
Liv Ain			90.8	90.9	87.2	97.0	86.8	91.0	89.0	92.2
Liv RI		81.2	82.1	84.5	85.9	84.0	88.1	85.4	87.5	89.2
M Hope				84.6	82.2	84.5	86.3	88.4	87.2	88.1
M RI								85.9	86.7	87.4
Middlbr	84.1	84.2	84.4	84.5	83.2	86.1	85.5	87.2	87.2	86.9
Newc			83.1	81.0	81.1	86.2	84.0	86.6	87.0	87.5
Newry						86.0	88.0	87.1	90.6	94.7
Norwch					87.0	87.7	89.9	87.0	90.9	89.0
Nottm	85.2	87.1	83.1	85.1	86.4	85.1	83.3	89.5	88.4	87.9
Oxford	87.8	88.3	85.6	86.6	88.1	87.5	88.0	87.4	88.3	89.0
Plymth	85.1	87.5	76.7	84.9	86.9	87.5	83.5	82.9	88.4	85.7

Table 6.27. Continued

	One-year survival by centre and year									
Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ports		83.8	80.8	81.6	89.1	85.4	84.8	89.8	88.7	89.0
Prestn	85.8	87.2	86.4	84.8	85.8	85.7	86.6	90.9	90.4	89.7
Redng	84.1	79.0	86.3	82.4	90.0	86.4	89.4	90.0	89.5	92.1
Sheff	84.2	88.0	90.5	91.0	87.8	87.1	89.2	88.7	88.8	89.4
Shrew					85.3	87.3	86.3	89.4	89.1	88.3
Stevng	89.6	91.2	86.6	88.4	89.5	88.6	89.8	89.7	92.9	90.5
Sthend	85.5	88.9	89.6	87.2	89.2	86.7	83.6	85.9	90.2	91.1
Stoke								84.6	87.4	88.3
Sund	77.1	79.3	78.4	76.0	82.8	86.5	79.5	83.3	87.7	85.7
Swanse	84.6	87.6	80.8	82.4	87.9	89.3	86.1	88.5	89.7	87.6
Truro		89.1	82.9	90.4	90.2	86.0	92.0	89.1	90.4	88.6
Tyrone						88.9	82.7	93.1	93.4	87.1
Ulster						86.1	91.6	89.4	92.3	87.5
Wirral			93.8	84.5	87.7	89.5	89.4	88.1	88.9	90.4
Wolve	84.6	90.1	86.7	83.9	86.6	87.6	89.6	88.0	93.2	89.5
Wrexm	84.3	88.1	87.3	86.0	86.2	84.6	85.1	88.9	86.0	90.2
York	86.7	80.0	85.4	81.3	83.1	88.7	83.5	89.1	88.3	88.0
England	**85.4**	**85.9**	**85.7**	**86.1**	**87.1**	**87.4**	**87.9**	**88.7**	**89.2**	**89.2**
N Ireland						**86.0**	**87.7**	**89.2**	**89.7**	**89.0**
Scotland	**83.1**	**83.7**	**85.0**	**83.6**	**85.8**	**87.0**	**86.4**	**87.5**	**87.7**	**88.8**
Wales	**84.8**	**86.8**	**84.8**	**82.5**	**85.5**	**85.9**	**85.0**	**88.1**	**85.9**	**87.2**
UK	**84.9**	**85.7**	**85.6**	**85.5**	**86.8**	**87.3**	**87.6**	**88.6**	**88.9**	**89.0**

Blank cells: data not available for that year or less than 20 patients in that year

Chapter 7
The Relationship between the type of Vascular Access used and Survival in UK RRT Patients in 2006

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Key Words
Arterio-venous fistula · Arterio-venous graft · End stage renal disease · End stage renal failure · Haemodialysis · Survival · Tunnelled haemodialysis catheter

Summary

- 1 year mean centre level survival was 86.4% (95% CI: 82.2–90.9) in 2006.
- Definitive access (AVF or AVG) was used by a mean of 69.8% of patients in included centres in 2005.
- The type of access in use was able to explain only 6% of the variation in centre level survival.

Introduction

The type of vascular access used for chronic haemodialysis has been postulated as one of the predictors of patient survival [1] mainly thought to be due to higher rates of infection and septicaemia in patients dialysing using cuffed, tunnelled dialysis catheters compared with arterio-venous fistulae (AVF) and arterio-venous grafts (AVG) [2, 3]. Early studies in incident patients in the USA found that those starting dialysis with a catheter had higher rates of late presentation to a nephrologist, greater burdens of comorbidity, lower serum albumin and creatinine [1] and were more likely to be underweight [2]. Whilst these studies attempted to adjust for these recognised differences between patient groups there is the possibility that bias by indication remains. One of the aims of the DOPPS 1 and 2 studies was to examine the effect of vascular access type on outcomes at a dialysis centre level to try and minimise this bias by indication [4]. The majority of patients enrolled in studies comparing survival using different types of dialysis access were not from the UK but from the USA [1–3], US/Europe/Japan/Australia and New Zealand combined [4, 5] and Australia/New Zealand [6]. The results may not apply to the UK where the rate of late presentation, diabetes and Black ethnicity, all of which affect survival, are much lower [7].

The above studies largely apply to incident dialysis patients in whom the confounding factors of the reason for use of venous catheter, such as late presentation, are particularly important. Conclusions from incident patients may not be applicable to well-established prevalent patients on haemodialysis who for a number of reasons may elect for, or be recommended to continue to use venous dialysis catheters. Some renal centres maintain that excellent long-term results can be obtained with appropriate choice of patient, catheter type and catheter care [8] and challenge the published recommendations on long-term use of catheters.

This is an observational UK centre level study reporting on the relationship between the percentage of established prevalent patients using definitive access and the subsequent 1 year survival.

Methods

The UK Renal Registry (UKRR) collects clinical and biochemical data for all patients receiving RRT in the UK from day 0; the data collection methods have been described in detail elsewhere [9]. In brief, renal information technology systems operating in English, Welsh and Northern Irish renal centres with appropriate software links to the UKRR database are able to export quarterly data files electronically to the UKRR on a predefined dataset including demographic data, primary renal diagnosis, postcode of residence at initiation of RRT and RRT modality. Data from renal centres in Scotland are submitted electronically via the Scottish Renal Registry. Data on vascular access are not routinely collected.

Data from a vascular access audit, performed by the Renal Association, in March 2005 were used. The percentage of haemodialysis patients using an AVF or AVG on dialysis on the 31st March 2005 in the main centres and satellite units was obtained and 1 year survival calculated until 31st March 2006. Patients receiving less than 3 months of dialysis at this date were excluded from the survival analyses.

Regression analysis was used to assess the amount of variation in 1 year survival that could be explained by the percentage of patients using an AVF or AVG in a centre. The results were weighted based on the number of patients in each centre. Survival was adjusted to age 60 and then by the percentage of patients with diabetes and who were non-White in each centre.

Results

There were vascular access audit data on 17,409 patients from 54 renal centres of which 16,984 (97.6%) patients also dialysed in centres which reported to the UKRR in 2005. This represented 74.8% of the patients known to the UKRR in 2005 which at that time represented 65 of the 72 renal centres in the UK.

15,418 patients survived for 1 year and 1,566 patients died or were lost to follow up in this time period. The mean centre level 1 year survival was 86.4% (95% CI: 82.2–90.9) and was 86.9% (95% CI: 82.8–91.2) after censoring for transplantation (table 7.1). The mean percentage of haemodialysis patients using definitive access (AVF or AVG) in a centre was 69.8% (SD 10.4) patients (table 7.2).

In the analyses adjusted for age alone a small positive association was found between the percentage of HD patients using an AVG or AVF in a centre and 1 year uncensored survival ($\beta = 0.06$, $p = 0.04$). The type of access in use was able to explain 6% of the variation in centre level survival (figure 7.1).

Adjusting this analysis for the percentage of non-White and diabetic patients in each centre did not change the association found ($\beta = 0.06$, $p = 0.04$).

Table 7.1. One year survival of patients on dialysis on the 31st March 2005, uncensored and censored for transplantation

		1 year survival uncensored			1 year survival censored		
Centre	N	%	LCL	UCL	%	LCL	UCL
Abrdn	211	87.7	83.5	92.1	87.3	83.1	91.8
Airdrie	182	83.3	78.2	88.8	82.7	77.5	88.4
Bangor	90	86.2	79.8	93.1	86.7	80.5	93.4
Barts	468	84.8	81.9	87.8	85.4	82.7	88.3
Basildon	167	90.9	86.3	95.7	90.3	85.5	95.2
Belfast	311	86.8	83.4	90.3	86.3	82.8	90.0
Bheart	350	87.0	83.7	90.5	87.6	84.5	90.9
BQEH	699	88.3	86.2	90.5	88.9	86.9	91.0
Bradfd	195	85.4	80.7	90.4	86.3	81.8	91.0
Brightn	317	83.8	80.4	87.4	84.4	81.0	87.8
Bristol	480	86.5	83.7	89.4	87.4	84.8	90.1
Camb	181	86.2	82.7	89.9	87.5	84.2	90.9
Carlis	96	85.7	79.0	92.9	85.8	79.3	93.0
Chelms	126	81.9	75.7	88.6	82.6	76.6	89.0
Clwyd	192	80.2	71.2	90.4	83.4	75.0	92.8
Covnt	274	88.9	85.7	92.3	89.5	86.4	92.7
D&Gall	81	91.5	85.7	97.7	91.0	84.9	97.5
Derby	293	87.4	83.5	91.4	88.1	84.5	91.9
Dundee	344	88.3	84.2	92.6	87.8	83.6	92.3
Dunfn	140	91.2	86.6	96.1	90.9	86.1	95.9
Edinb	271	86.6	82.8	90.5	86.1	82.2	90.1
GlasRI	385	88.0	84.9	91.3	87.4	84.1	90.8
GlasWI	362	88.3	85.0	91.6	87.8	84.4	91.3
Glouc	197	88.3	84.0	92.9	88.4	84.1	93.0
Guys	421	89.1	86.3	91.9	89.5	86.8	92.2
Hull	324	83.8	80.0	87.8	84.5	80.9	88.4
Inverns	112	87.6	82.3	93.3	87.2	81.7	93.1
Ipswi	253	84.1	78.6	90.0	84.8	79.8	90.2
Kings	374	86.3	82.7	90.1	86.7	83.2	90.4
Klmarnk	129	85.2	79.7	91.1	84.7	79.0	90.8
Leeds	257	88.3	85.8	91.0	88.9	86.4	91.4
Leic	627	86.3	83.8	88.9	87.3	85.0	89.7
Livrpl	545	84.4	81.3	87.6	85.1	82.1	88.3
ManWst	321	82.9	78.9	87.1	83.5	79.7	87.6
Middlbr	383	85.1	81.0	89.4	85.9	82.0	90.0
Newc	312	86.1	82.1	90.3	87.3	83.5	91.2
Norwch	287	86.1	82.1	90.4	87.1	83.3	91.1
Nottm	398	84.5	81.2	87.9	85.3	82.1	88.5
Oxford	423	87.4	84.7	90.1	87.8	85.2	90.4
Plymth	139	86.3	81.4	91.5	87.3	82.7	92.2
Prestn	353	84.9	81.5	88.4	85.7	82.4	89.0
Redng	236	85.3	80.8	90.1	86.3	82.1	90.8
Sheff	564	86.6	84.1	89.2	87.0	84.5	89.5
Stevng	360	88.5	85.8	91.3	88.8	86.2	91.6
Sthend	165	86.5	81.7	91.6	87.5	83.1	92.1
Swanse	339	89.2	86.1	92.4	89.7	86.7	92.7
Truro	213	85.6	81.4	90.1	85.7	81.5	90.1
Tyrone	109	89.1	83.9	94.6	88.7	83.3	94.4
Ulster	91	87.0	78.7	96.3	86.6	78.0	96.1
Wirral	214	88.3	83.8	93.1	89.0	84.6	93.5
Wolve	294	86.9	83.2	90.8	87.6	84.1	91.3
Wrexm	113	82.9	76.8	89.5	84.5	78.9	90.5
York	174	86.8	81.3	92.7	88.1	82.9	93.5

Table 7.2. Access type and dialysis modality for prevalent patients on the 31st March 2005

Centre	Number of patients							% PD	% HD	% HD patients with definitive access
	PD	HD	AVF	AVG	Tunnel	Temp	Other			
Abrdn	43	168	139	19	6	4	0	20.4	79.6	94.1
Airdrie	43	139	85	0	53	1	0	20.6	79.4	61.2
Bangor	23	67	56	2	7	2	0	25.6	74.4	86.6
Barts	13	455	218	58	144	35	0	32.0	68.0	60.7
Basildon	45	122	84	0	36	2	0	19.7	80.3	68.9
Belfast	49	262	122	6	119	15	0	24.7	75.3	48.9
Bheart	42	308	213	15	80	0	0	8.6	91.4	74.0
BQEH	25	674	475	17	178	4	0	17.2	82.8	73.0
Bradfd	38	157	109	0	48	0	0	23.8	76.2	69.4
Brightn	28	289	147	28	112	2	0	23.9	76.1	60.6
Bristol	98	382	272	53	51	6	0	15.5	84.5	85.1
Camb	34	147	123	0	24	0	0	33.8	66.2	83.7
Carlis	22	74	47	0	30	0	0	16.3	83.7	61.0
Chelms	29	97	58	7	30	2	0	28.1	71.9	67.0
Clwyd	132	60	40	0	20	0	0	17.8	82.2	66.7
Covnt	31	243	185	2	54	2	0	21.1	78.9	77.0
D & Gall	11	70	34	2	34	0	0	17.6	82.4	51.4
Derby	95	198	147	1	49	1	0	22.7	77.3	74.8
Dundee	214	130	84	1	43	2	0	25.7	74.3	65.4
Dunfn	54	86	51	1	34	0	0	19.6	80.4	60.5
Edinb	49	222	155	5	58	4	0	18.7	81.3	72.1
GlasRI	99	286	223	5	47	11	0	9.8	90.2	79.7
GlasWI	85	277	196	8	68	4	1	20.9	79.1	73.7
Glouc	70	127	101	7	19	0	0	21.1	78.9	85.0
Guys	22	399	281	24	93	1	0	19.9	80.1	76.4
Hull	50	274	166	10	80	18	0	13.6	86.4	64.2
Inverns	39	73	47	16	8	2	0	34.8	65.2	86.3
Ipswi	150	103	68	1	34	0	0	39.8	60.2	67.0
Kings	112	262	172	17	67	6	0	24.5	75.5	72.1
Klmarnk	21	108	56	3	48	1	0	31.6	68.4	54.6
Leeds	101	156	121	2	31	2	0	38.6	61.4	78.9
Leic	140	487	333	4	122	7	21	30.1	69.9	69.2
Livrpl	210	335	225	14	75	16	5	25.1	74.9	71.3
ManWst	73	248	163	4	81	0	0	37.7	62.3	67.3
Middlbr	146	237	174	4	57	2	0	9.5	90.5	75.1
Newc	86	226	122	4	96	4	0	16.9	83.1	55.8
Norwch	15	272	136	12	123	1	0	15.3	84.7	54.4
Nottm	91	307	160	25	121	1	0	30.1	69.9	60.3
Oxford	111	312	228	6	71	0	7	31.3	68.7	75.0
Plymth	30	109	58	14	37	0	0	27.8	72.2	66.1
Prestn	46	307	228	6	60	1	12	26.6	73.4	76.2
Redng	68	168	112	4	52	0	0	36.1	63.9	69.1
Sheff	17	547	412	33	100	2	0	22.4	77.6	81.4
Stevng	36	324	204	4	116	0	0	14.1	85.9	64.2
Sthend	41	124	96	0	26	2	0	15.1	84.9	77.4
Swanse	77	262	226	9	4	23	0	22.7	77.3	89.7
Truro	65	148	110	4	34	0	0	23.7	76.3	77.0
Tyrone		109	55	0	51	3	0	9.2	90.8	50.5
Ulster	46	45	28	0	17	0	0	4.3	95.7	62.2
Wirral	53	161	98	6	56	1	0	14.8	85.2	64.6
Wolve	15	279	156	15	106	2	0	16.2	83.8	61.3
Wrexm	29	84	49	11	22	2	0	32.8	67.2	71.4
York	58	116	81	7	27	1	0	20.0	80.0	75.9

PD = peritoneal dialysis, HD = haemodialysis, AVF = arteriovenous fistula, AVG = arteriovenous graft, Tunnel = tunnelled, cuffed dialysis catheter, Temp = temporary dialysis catheter, definitive access = AVF or AVG in use

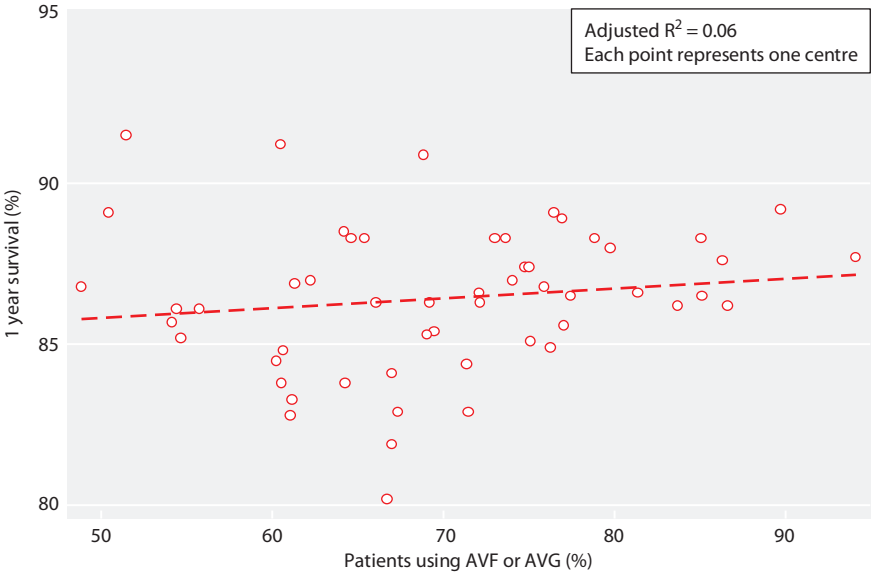

Fig. 7.1. Correlation between percentage of haemodialysis patients using definitive access in a centre and 1 year survival (adjusted to age 60)

Discussion

There was a small increase in mortality with higher rates of dialysis catheter use at centre level. This study was unable to adjust for individual patient characteristics as this level of data was unavailable. To some extent, this study has repeated work done by DOPPS and in the US but for the first time has studied only prevalent dialysis patients and looked at the UK dialysis population.

The rate of AVF/AVG use in this study was similar to rates in prevalent patients within the DOPPS 1 and 2 studies [4]. A 20% higher risk of death was noted in DOPPS 2 for those patients dialysing in centres with >10% catheters [10]. When DOPPS 1 and 2 patients were combined, a 12 % higher risk of death was seen in facilities with greater than 10% catheter rates [11]. However there was little evidence that the proportion of patients using a catheter was the determinant of worse survival as centres with between 20–100% catheter use had only a 13% higher risk of death [11] and one might expect a dose related increase in risk of death with higher catheter use if this was the causal mechanism [12]. The analysis of change in facility achievement over time within DOPPS 2 only compared the combination of several factors thought to be associated with improved survival rather than catheter use alone. However, when these data were reanalysed, case-mix adjusted mortality increased by 20% for every 20% higher rate of catheter use [5].

Vascular access for haemodialysis needs to be reliable, durable and efficient at providing adequate dialysis dose. There was a higher rate of access intervention required for each AVG (1.0 per patient/year) compared to AVF (0.2 per patient/year) [13]. There was no evidence of difference in flow rate or adequacy achieved between AVF and AVG [14] and some evidence of reduced flow rates leading to poorer achievement of dialysis adequacy comparing AVF with catheters [13]. This was not borne out in a recent study in Scotland where catheter mean blood flow rate of 300mls/min was achieved and only 13% of catheters had to be removed due to poor flow rates over a 2 year period [15]. Rates of infection are the most significant complication of catheters with rates being far lower in other types of access. In a large meta-analysis involving 373,563 tunnelled, cuffed dialysis catheters, there were 1.6 (95% CI: 1.5–1.7) infections per 1,000 catheter days [16]. The relative risk of AVG related infection compared to AVF was 1.47 (95% CI: 0.36–5.96) and 8.49 (95% CI: 3.03–28.20) compared to tunnelled, cuffed dialysis catheters [17]. However recent advances in exit site management and antibiotic line locks may alter these outcomes.

There are no randomised controlled trials (RCT) demonstrating improved patient survival with use of AVF/AVG and whilst efforts have been made to reduce the impact of unmeasured confounders in the relationship between catheter use and survival this can never be assured within observational analyses. Nevertheless the Renal Association clinical practice guidelines suggest 65% of incident and 85% of prevalent HD patients use an AVF with an AVG being second choice. The UK National Health Service is about to introduce a dialysis

tariff which will pay more for dialysis sessions performed with an AVF or AVG than with a venous catheter in an effort to encourage what is perceived as good practice [18]. Given the preponderance of professional opinion favouring AVF/AVG use, it is unlikely a RCT will ever take place and so the analysis that will be possible with data from the current large vascular access audit within the UK will be important to determine best practice in the UK.

In this observational study whilst increased venous catheter use was associated with an increase in one year mortality of prevalent established haemodialysis patients, this effect was very small and only accounted for some 6% of the variation in one year mortality between renal centres.

Conflicts of interest: none

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Chapter 8
Adequacy of Haemodialysis in UK Adult Patients in 2009: national and centre-specific analyses

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Key Words
Adequacy · Haemodialysis · Urea reduction ratio

Summary

- Data suitable for URR analyses were available in 14,849 (77%) of the 19,316 adult patients receiving HD in the UK at the end of 2009.
- In 2009, 85.5% of haemodialysis patients achieved a URR >65%, a small increase from 83% in 2008. The median URR in 2009 was 74% (compared with 73% in 2008).
- URR dose in the HD population was greater in those surviving on dialysis longer. Eighty-nine percent of patients who had survived on dialysis for more than two years achieved a URR >65% compared with only 68% of those on dialysis for only 6 months.
- There was large variation between centres in the percentage of patients achieving the UK Renal Association's URR guideline. Differences in sampling methodology of post-dialysis urea samples could explain part of the centre variability observed.

Introduction

Amongst patients with established renal failure (ERF), the delivered dose of HD is an important predictor of outcome [1] which has been shown to influence survival [2–4]. The delivered dose of HD depends on treatment (duration and frequency of dialysis, dialyser size, dialysate and blood flow rate) and patient (size, weight, haematocrit and vascular access) characteristics [5]. The two widely accepted measures of urea clearance are Kt/V, the ratio between the product of urea clearance (K, in ml/min) and dialysis session duration (t, in minutes) divided by the volume of distribution of urea in the body (V, in ml) and URR derived solely from the percentage fall in serum urea (URR) during a dialysis treatment. Whilst Kt/V is a more accurate descriptor of urea clearance, its calculation is complex and requires additional data items [6, 7] not commonly reported by most centres. The UKRR has chosen URR rather than Kt/V for comparative audit of haemodialysis adequacy as these results are more widely available.

Based on published evidence, clinical practice guidelines have been developed by various national and regional organisations [8–11]. There is considerable uniformity between them with regard to the recommendations for minimum dose of dialysis although there are differences in the methodology advised. The main objective of this study was to determine the extent to which patients undergoing HD treatment for established renal failure in the UK received the dose of HD recommended in the UK RA clinical practice guidelines [9].

Methods

Seventy-two renal centres in the UK submit data electronically to the UKRR on a quarterly basis [12]. The majority of these centres have satellite units but for the purposes of this study the data from the renal centres and their associated satellite units were amalgamated. Two groups of patients were included in the analyses. Firstly, analysis was undertaken using data from the prevalent HD patient population on 31st December 2009. For this analysis, data for URR were taken from the last quarter of 2009 unless that data point was missing in which case data from the 3rd quarter were taken. As the prevalent population only included those patients alive on 31st December 2009, data from those patients who had died before that date have not been included in the analysis. The second analysis involved incident patients who had started treatment with HD during 2009. For these patients, analysis was undertaken using the last recorded URR during the quarter in which the patient had started dialysis. Data from patients known to be receiving more or less than thrice weekly HD were omitted from analysis. However, because not all centres report frequency of HD, it is possible that data from a small number of patients receiving HD at a different frequency were included in the analyses.

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

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

The UK RA Clinical Practice Guidelines [9] in operation at the time these data were collected were as follows:

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

Every patient receiving thrice weekly HD should have consistently:

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

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

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

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

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

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

The RA clinical practice guidelines for HD dose apply specifically to patients undergoing thrice weekly HD. In these patients it is recommended that blood for biochemical measurement (including pre-dialysis urea for URR) should be taken before the mid-week dialysis session [9].

A potentially confounding factor is the methodology used for taking the post-dialysis blood sample. Advice given to renal centres following a postal survey in 2002 [13] aimed to achieve uniformity and this was reflected in the RA guidelines [14]. These recommended that the post-dialysis blood samples

should be collected either by the stop flow method, the simplified stop flow method or the stop-dialysate-flow method. No reliable data are available to clarify whether the important variations in post-dialysis sampling methodology that were identified at that time persist.

Results

Data completeness

Data regarding HD dose (URR) were available from 63 of the 72 renal centres which submitted data to the UKRR (table 8.1). Data were available for 77% (14,849) of the total prevalent population (19,316) treated with HD who met the inclusion criteria for these analyses.

Completeness in the 63 centres reporting URR data was generally good, with 51 centres reporting on more than 90% of patients and only one centre (Wirral) with less than 50% completeness. The centre reporting on less than 50% of prevalent patients was not included in the centre-level analyses although the patients were included in the national analyses. URR data were not received from nine centres (Brighton, London Barts, London Kings, London Royal Free, London St Georges, Manchester Royal Infirmary, Newcastle, Stoke, Swansea). The number preceding the centre name in each figure indicates the percentage of missing data from that centre.

Of the total incident patient population (4,531) starting HD during 2009 and meeting the inclusion criteria for URR analyses, 52% (2,362) had URR data available during the first quarter of treatment.

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

Table 8.1. Percentage completeness of URR data returns

Centre	% complete	Centre	% complete
Abrdn	99	L Rfree	0
Airdrie	100	L St.G	0
Antrim	99	L West	95
B Heart	95	Leeds	97
B QEH	95	Leic	99
Bangor	97	Liv Ain	68
Basldn	98	Liv RI	93
Belfast	97	M Hope	63
Bradfd	89	M RI	0
Brightn	0	Middlbr	95
Bristol	100	Newc	0
Camb	85	Newry	99
Cardff	94	Norwch	96
Carlis	100	Nottm	99
Carsh	92	Oxford	79
Chelms	100	Plymth	97
Clwyd	100	Ports	95
Colchr	99	Prestn	83
Covnt	97	Redng	96
D & Gall	98	Sheff	96
Derby	98	Shrew	94
Derry	93	Stevng	94
Donc	98	Sthend	95
Dorset	76	Stoke	0
Dudley	70	Sund	97
Dundee	97	Swanse	0
Dunfn	99	Truro	98
Edinb	99	Tyrone	98
Exeter	99	Ulster	100
Glasgw	97	Wirral	35
Glouc	100	Wolve	77
Hull	96	Wrexm	97
Inverns	90	York	68
Ipswi	100	**England**	**75**
Kent	93	**N Ireland**	**98**
Klmarnk	96	**Scotland**	**98**
L Barts	0	**Wales**	**64**
L Guys	91	**UK**	**77**
L Kings	0		

Achieved URR

For prevalent patients, the median URR (74% for UK; centre range 67%–80%) and percentage (85.5% for UK; centre range 56%–98%) attaining the RA guideline of a URR >65% from 62 renal centres are shown in figures 8.1 and 8.2. Figure 8.3 illustrates the close relationship between the two. All of the 47 centres which achieved a URR >65% in at least 80% of patients had a median URR of at least 70%. The 4 centres with a median URR of 68% or less achieved the RA guideline for HD dose in less than 65% of their patients. As previously reported, there continued to be considerable variation between renal centres, with 19 centres attaining the RA clinical practice guideline in >90% of patients and 5 centres attaining the guideline in <70% of patients.

Changes in URR over time

The change in the percentage attainment of the RA clinical practice guidelines (URR >65%) and the median URR for the UK from 1998 to 2009 are shown in figure 8.4. Northern Ireland has provided data since 2005 and was included in these analyses.

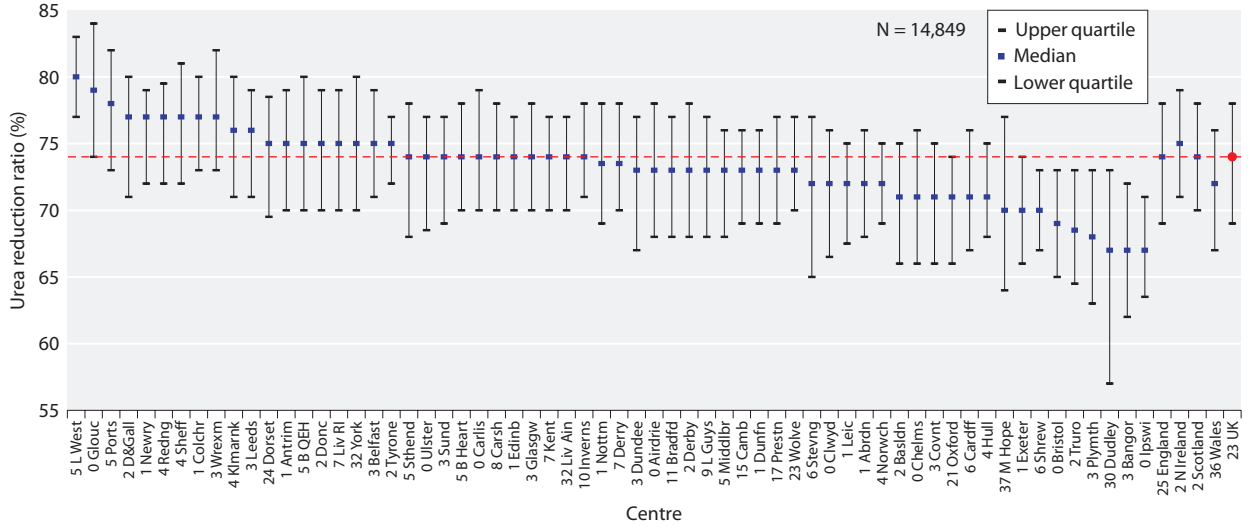

Fig. 8.1. Median URR achieved in prevalent patients in each centre, 2009

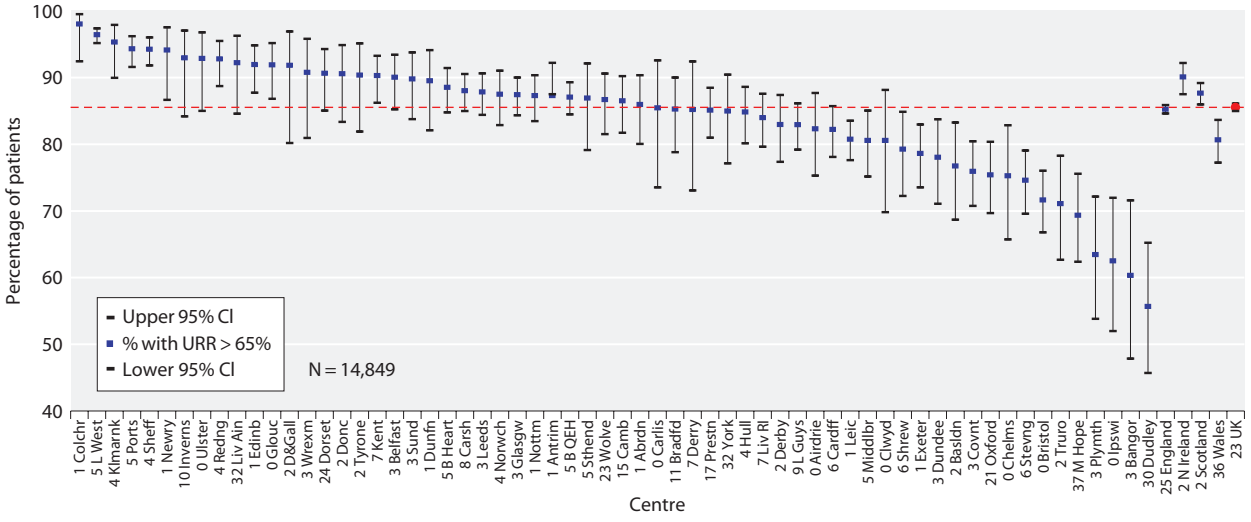

Fig. 8.2. Percentage of prevalent patients with URR >65% in each centre, 2009

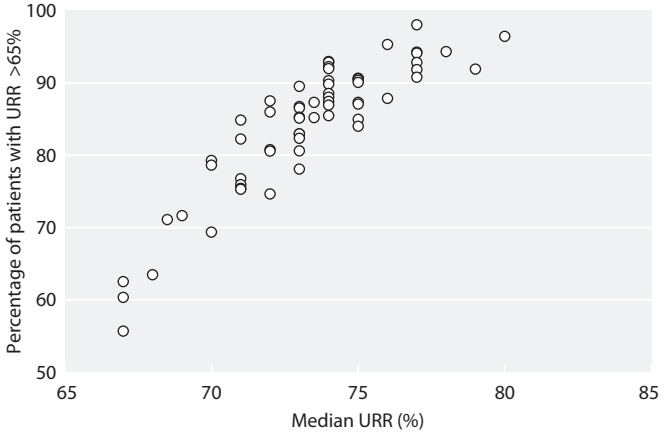

Fig. 8.3. Relationship between achievement of the Renal Association guideline for URR and the median URR in each centre, 2009

The proportion of patients attaining the RA guideline increased from 56% to 85.5% whilst the median URR has risen from 67% to 74% during the same time period.

Variation of achieved URR with time on dialysis

The proportion of patients who attained the RA guideline for HD was greater in those who had survived on dialysis longer (figure 8.5). Of those dialysed for less than 6 months, 68% had a URR >65%, whilst 89% of patients who had survived for more than two years attained the guideline in 2009.

The median URR during the first quarter after starting HD treatment of the incident HD population in the UK in 2009 was 66% (figure 8.6).

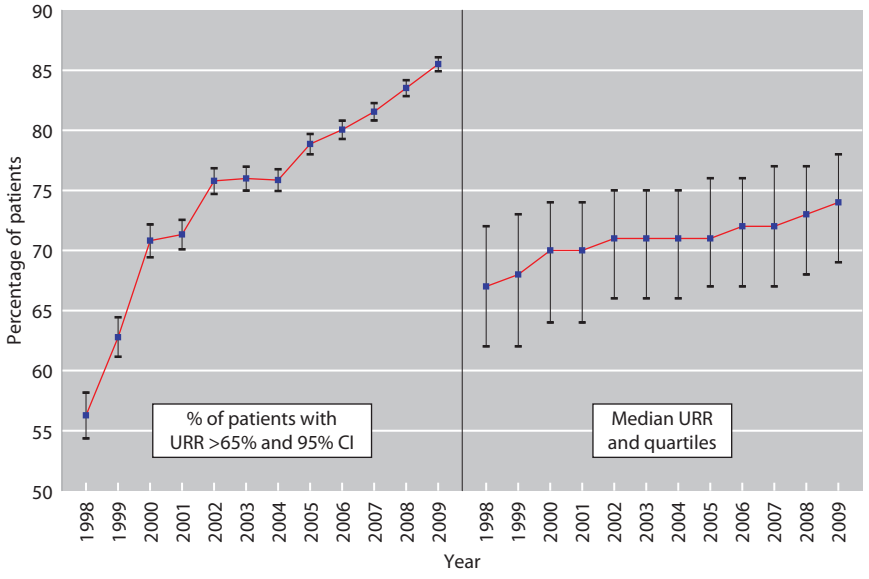

Fig. 8.4. Change in the percentage of patients with URR >65% and the median URR between 1998 and 2009 in the UK

Discussion

The dose of delivered HD is recognised as having an important influence on outcome in ERF patients treated with HD and has been shown to correlate with survival [2, 3]. It is therefore reassuring that the proportion of UK patients achieving the RA guideline for URR has been increasing in the last decade, with 85.5% of the HD population achieving the URR guideline in 2009.

In order to consistently achieve a URR >65% the UK RA clinical practice guidelines recommend that clinicians should aim for a minimum target URR of 70%. The median URR of patients undergoing HD in the UK in 2009 was 74% (centre range of 67%–80%) and only 6 centres had a median URR under 70%. Median URR showed a good correlation with the percentage achievement of URR target by centre. With the exception of two centres (Stevenage, Manchester Hope), those centres that reached a median URR ⩾70% all managed to achieve the target URR in at least 75% of their population.

In 2009, 89% of patients in the UK who had survived on HD for more than 2 years achieved the target of a

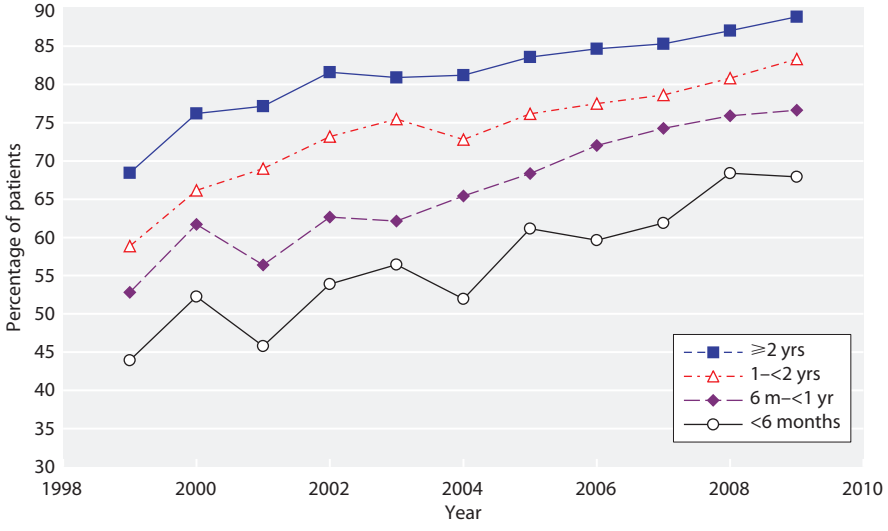

Fig. 8.5. Percentage of prevalent haemodialysis patients achieving URR >65% by survival on haemodialysis between 1999 and 2009

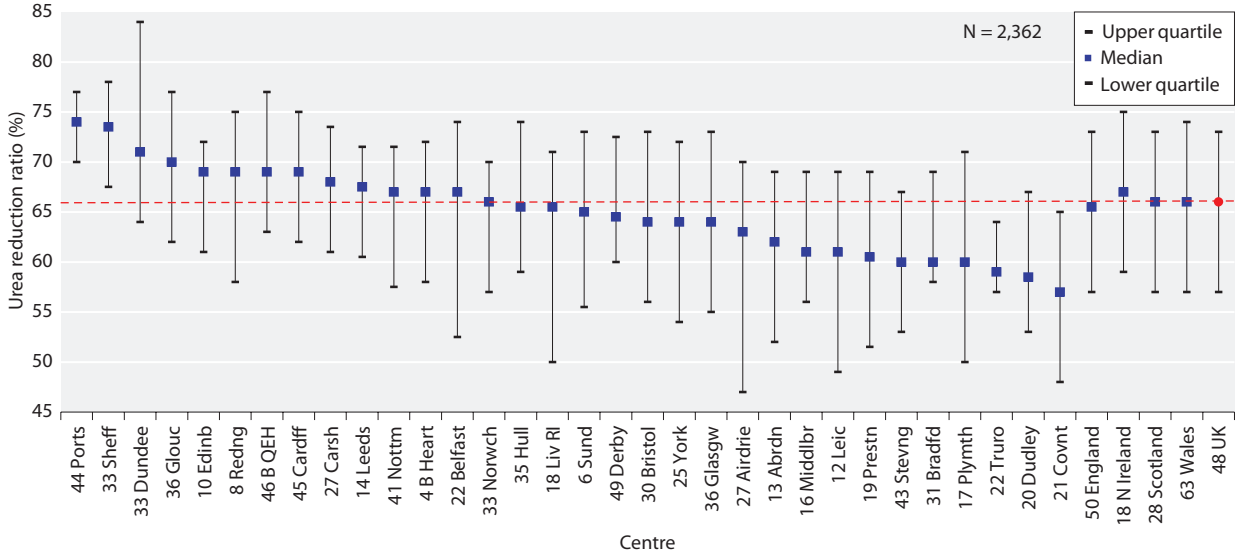

Fig. 8.6. Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2009

URR >65%. The figure for patients during the first 6 months after starting treatment was lower (68%).

There was a wide range (56%–98%) of achievement of the RA guideline between different centres which is likely to reflect genuine differences in HD dose although inconsistency in sampling methodology for the post-dialysis urea sample may play a part [13].

The use of urea clearance for measurement of HD dose is criticised by some [15] arguing that outcome is improved by longer treatment time independently of urea removal [5, 16–20] and that clearance of 'middle molecules' has an important impact [21, 22]. However, no consensus has yet emerged on alternative markers of HD dose and whilst this is the case the UKRR will continue to audit HD adequacy on the basis of urea clearance as assessed by URR.

Conflicts of interest: none

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Chapter 9
Haemoglobin, Ferritin and Erythropoietin amongst UK Adult Dialysis Patients in 2009: national and centre-specific analyses

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Key Words
Anaemia · Chronic kidney disease · Dialysis · End stage renal disease · Epidemiology · Erythropoietin · Erythropoietin Stimulating Agent · Ferritin · Haemodialysis · Haemoglobin · Quality improvement · Peritoneal dialysis

Summary

- In 2009, the median Hb of patients at the time of starting dialysis in the UK was 10.2 g/dl with 55% of patients having a Hb $\geqslant$10.0 g/dl.
- The median Hb of prevalent patients on HD in the UK was 11.6 g/dl with an IQR of 10.6–12.4 g/dl.
- The median Hb of prevalent patients on PD in the UK was 11.7 g/dl with an IQR of 10.7–12.6 g/dl.
- In 2009, 56% of HD patients had Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl compared to 54% in 2008.
- In 2009, 54% of PD patients had Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl compared to 55% in 2008.
- In England, Wales and Northern Ireland the median ferritin in HD patients was 441 µg/L (IQR 289–629) and 96% of HD patients had a ferritin $\geqslant$100 µg/L. These figures were almost identical to those in 2008 (median ferritin 436 µg/L (IQR 289–622), 95% of patients with median $\geqslant$100 µg/L).
- In England, Wales and Northern Ireland the median ferritin in PD patients was 249 µg/L (IQR 142–412) with 86% of PD patients having a ferritin $\geqslant$100 µg/L.
- In 2009, the mean Erythropoietin Stimulating Agent (ESA) dose was higher for HD than PD patients (9,507 vs. 6,212 IU/week) in England, Wales and Northern Ireland.

Introduction

This chapter describes UK Renal Registry (UKRR) data relating to the management of anaemia in dialysis patients during 2009. The chapter reports outcomes of submitted variables and analyses of these variables in the context of established guidelines and recommendations.

The renal National Service Framework (NSF) part one [1] and the RA minimum standards document 3rd edition [2] state that individuals with chronic kidney disease (CKD) should achieve a haemoglobin (Hb) of at least 10 g/dl within 6 months of being seen by a nephrologist, unless there is a specific reason why it was unachievable. At present the UKRR does not collect Hb measurements specifically from patients 6 months after meeting a nephrologist. However an indication of the attainment of this standard is given by the Hb of the incident patient population (i.e. the Hb at the start of dialysis). The achievement of these standards is mainly through the use of iron therapy (oral and intravenous) and Erythropoietin Stimulating Agents (ESAs).

The European Best Practice Guidelines (EBPG) [3] set a minimum target of 11 g/dl but suggest not to go higher than 12 g/dl in severe cardiovascular disease. The United States Kidney Disease Outcomes Quality Initiative (KDOQI) [4] guidelines set a target Hb range of 11–12 g/dl with a recommendation that the Hb target should not be greater than 13.0 g/dl. The NICE guidelines published in 2006 [5] and the 4th edition of the RA Clinical Practice Guidelines 2006 [6] recommended an outcome Hb of between 10.5 and 12.5 g/dl (with ESA dose changes considered at 11 and 12 g/dl) which allows for the difficulty in consistently narrowing the distribution to between 11 and 12 g/dl. Since 2007, the UKRR Annual Report has reported how the attempt to comply with both the 10.5–12.5 g/dl range and the minimum standard of Hb $\geqslant$ 10.0 g/dl has impacted on performance against a combination of measures. The risks associated with low ($<$10 g/dl) and high ($>$13 g/dl) Hb are not necessarily equivalent.

The national and international recommendations for target iron status in CKD used in this chapter remain unchanged from the 2006 UKRR Annual Report. The 2007 Renal Association (RA) Clinical Practice Guidelines Document, revised European Best Practice Guidelines (EBPGII), Dialysis Outcomes Quality Initiative (DOQI) guidelines and UK NICE anaemia guidelines all recommend a target serum ferritin greater than 100 µg/L and percentage transferrin saturation (TSAT) of more than 20% in patients with CKD. RA guidelines and EBPGII recommend hypochromic red cells (HRC) less than 10%. In addition, EBPGII recommends a target reticulocyte Hb content (CHr) greater than 29 pg/cell. KDOQI recommends a serum ferritin $>$200 µg/L for HD patients. The NICE guidelines suggest that a hypochromic red cell value $>$6% suggests ongoing iron deficiency.

To achieve adequate iron status across a patient population, RA guidelines and EBPGII advocate population target medians for ferritin of 200–500 µg/L, for TSAT of 30–40%, for hypochromic red cells of $<$2.5% and CHr of 35 pg/cell. EBPGII comments that a serum ferritin target for the treatment population of 200–500 µg/L ensures that 85–90% of patients attain a serum ferritin of 100 µg/L.

All guidelines advise that serum ferritin levels should not exceed 800 µg/L since the potential risk of toxicity increases without conferring additional benefit. The KDOQI and NICE guidelines advise against intravenous iron administration to patients with a ferritin $>$500 µg/L.

Serum ferritin has some disadvantages as an index of iron status. It measures storage iron rather than available iron, behaves as an acute phase reactant and is therefore increased in inflammatory states, malignancy and liver disease and may not accurately reflect iron stores if measured within a week of the administration of intravenous iron. Of the alternative measures of iron status available, HRC and CHr are generally considered superior to TSAT. Both however require specialised analysers to which few UK renal centres have easy access. Since TSAT is measured infrequently in many centres and most UK centres continue to use serum ferritin for routine iron management, ferritin remains the chosen index of iron status for this report.

The 5th edition of the UK Renal Association's Anaemia in CKD guideline [7] was published at the end of 2010 and attempted to unify targets with those published in the 2010 update NICE guideline on anaemia management in CKD [8]. In future reports the analyses will need to analyse performance against these new standards, but as this chapter examines 2009 data it remains appropriate to report against the old guidelines which were in use at the time. The KDIGO website [9] is a useful resource for comparison of international anaemia guidelines.

Methods

The incident and prevalent RRT cohorts for 2009 were analysed. The UKRR extracted quarterly data electronically from

renal centres in England, Wales and Northern Ireland; data from Scotland were provided by the Scottish Renal Registry. Patients receiving dialysis on 31st December 2009 were included in the prevalent analysis if they had been on the same modality of dialysis in the same centre for 3 months. The last available measurement of Hb from each patient from the last two quarters of 2009 was used for analysis. Patients were analysed as a complete cohort and also divided by modality into groups.

For the incident patient analyses, data from the first quarter after starting dialysis were used. Patients commencing RRT on PD or HD were included. Those receiving a pre-emptive transplant were excluded.

The last available ferritin measurement was taken from the last three quarters of the year and analysed for prevalent patients. Scotland is excluded from the analysis as data regarding ferritin is not included in its return.

The completeness of data items was analysed at both centre and country level. As in previous years all patients were included in analyses but centres with less than 50% completeness were excluded from the caterpillar and funnel plots showing centre performance. Centres providing relevant data from less than 20 patients were also excluded from the plots. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

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

The percentage achieving RA and other standards was calculated for Hb. The percentage of patients achieving serum ferritin $\geqslant 100\,\mu g/L$, $\geqslant 200\,\mu g/L$ and $\geqslant 800\,\mu g/L$ were also calculated. These are represented as caterpillar plots with 95% confidence intervals (CIs) shown.

Longitudinal analysis was performed to calculate overall changes in achievement of standards from 1998 to 2009.

The UK RA Clinical Practice [2, 6] and NICE [5] guidelines in operation at the time these data were collected were as follows:

Patients with CKD should achieve a Hb of at least 10 g/dl within 6 months of being seen by a nephrologist, unless there is a specific reason why it could not be achieved.

Patients with CKD treated with RRT should have a Hb of between 10.5 and 12.5 g/dl.

Patients with CKD should have a serum ferritin greater than 100 μg/L and percentage transferrin saturation (TSAT) of more than 20%.

Serum ferritin levels in patients with CKD should not exceed 800 μg/L.

Data regarding ESAs were collected from all renal centres. Erythropoietin data from the last quarter of 2009 were used. Scotland was excluded from the analysis as data regarding ESA was not included in its return. Centres were excluded if there was <90% completeness of ESA data. Centres reporting fewer than 70% of HD patients or fewer than 50% of PD patients treated with ESAs were considered to have incomplete data and were also excluded from further analysis. It is recognised that these exclusion criteria are relatively arbitrary but are in part based upon the frequency distribution graph of centres' ESA use. The percentage of patients on ESAs is calculated from these data and incomplete data returns risk seriously impacting on any conclusions drawn.

Data are presented as weekly erythropoietin dose. Doses of darbepoietin were harmonised with erythropoietin data by multiplying by 200 and correcting for frequency of administration less than weekly. No adjustments were made with respect to route of administration.

The ESA data were collected electronically from renal IT systems but in contrast to laboratory linked variables the ESA dose required manual data entry. The reliability depended upon who entered the data, whether the entry was linked to the prescription or whether the prescriptions were provided by the primary care physician. In the latter case, doses may not be as reliably updated as the link between data entry and prescription is indirect.

Results

Haemoglobin

Haemoglobin in incident dialysis patients

The Hb at the time of starting RRT gives the only indication of concordance with current anaemia management recommendations in the pre-dialysis (CKD 5 – not yet on dialysis) group.

Patients for conservative care of established renal failure were by definition excluded from the dataset. Patients were similarly excluded if they received a pre-emptive transplant. In the future the UKRR hopes to collect and report CKD 5 data from patients who subsequently commence RRT and for those managed conservatively.

The percentage of data returned and outcome Hb are listed in table 9.1. Nine of the ten renal centres excluded from this analysis are relatively small centres which had submitted data on fewer than 20 patients, only one was excluded because data completeness was less than 50% (Plymouth).

The median Hb of patients at the time of starting dialysis in the UK was 10.2 g/dl with 55% of patients having a Hb $\geqslant 10.0$ g/dl (vs. 10.2 g/dl and 57% for 2009 report). The variation between centres remained high (31–90%).

The median starting Hb by centre is shown in figure 9.1 and the percentage starting with a Hb $\geqslant 10.0$ g/dl by centre is given in figure 9.2. The distribution of Hb in incident dialysis patients during 2009 is shown in figure 9.3.

Incident dialysis patients from 2008 were followed for one year and the median haemoglobin (and percentage with a Hb $\geqslant 10.0$ g/dl) of survivors at the end of each

Table 9.1. Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis during 2009

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Abrdn	100	49	9.8	8.1–12.6	8.8–10.5	39
Airdrie	91	41	9.7	7.7–12.9	8.5–10.7	49
Antrim	91	20	9.9	7.3–11.7	9.0–10.8	40
B Heart	99	91	9.7	7.2–12.7	9.0–11.2	44
B QEH	76	173	9.9	7.2–13.1	8.8–11.0	49
Bangor	97	28	11.5	8.8–13.0	10.6–12.3	82
Basldn	100	23	9.6	8.0–11.8	9.0–10.4	39
Belfast	91	41	9.3	7.2–12.2	8.6–10.2	41
Bradfd	96	49	10.0	7.8–12.7	9.1–11.2	51
Brightn	100	42	10.9	8.1–13.4	9.1–11.8	69
Bristol	100	132	9.9	8.1–12.5	9.2–10.6	49
Camb	93	101	9.9	8.1–12.6	9.1–11.2	45
Cardff	100	153	10.3	8.2–13.2	9.4–11.5	59
Carlis	100	21	11.0	8.8–14.2	10.1–12.1	81
Carsh	96	184	10.4	8.6–12.5	9.7–11.2	66
Chelms	94	32	11.3	7.6–15.3	10.3–12.6	81
Clwyd	100	15				
Colchr	71	10				
Covnt	90	94	10.3	8.1–12.3	9.4–11.0	61
D & Gall	94	16				
Derby	93	67	10.0	7.7–11.7	9.3–10.9	51
Derry	100	13				
Donc	97	38	10.2	7.3–12.6	9.0–11.1	55
Dorset	98	63	10.2	8.9–13.1	9.7–11.5	73
Dudley	98	57	9.5	7.0–12.1	8.7–10.4	33
Dundee	89	56	9.7	7.6–12.3	8.8–11.1	46
Dunfn	100	29	11.7	9.1–15.3	11.3–12.4	90
Edinb	100	78	10.9	8.0–13.7	9.9–12.2	74
Exeter	100	125	9.9	8.1–12.2	9.0–10.7	49
Glasgw	93	149	10.0	7.5–13.7	8.9–11.2	52
Glouc	100	73	9.8	7.7–12.3	9.0–11.0	47
Hull	96	92	10.3	7.8–12.9	9.2–11.3	60
Inverns	79	15				
Ipswi	94	34	9.9	7.2–12.3	8.5–10.4	44
Kent	96	104	10.2	7.9–12.8	9.2–11.1	56
Klmarnk	69	24	10.2	8.7–11.7	9.5–11.1	67
L Barts	100	219	9.8	7.4–12.7	8.8–11.2	47
L Guys	61	87	9.8	7.9–12.1	8.6–10.6	44
L Kings	100	116	9.9	8.5–12.5	9.1–10.8	48
L Rfree	67	72	10.2	7.8–13.5	9.3–11.5	57
L St.G	93	79	10.4	7.7–13.0	9.2–11.5	63
L West	84	249	10.7	8.6–13.6	9.8–12.0	71
Leeds	100	134	10.0	7.8–12.6	9.0–10.9	54
Leic	99	188	10.1	7.9–12.7	9.3–11.1	56
Liv Ain	79	27	9.8	7.9–13.3	8.5–10.8	37
Liv RI	95	96	10.5	8.0–13.5	9.1–11.5	63
M Hope	83	84	9.8	7.2–13.1	8.6–10.8	43
M RI	98	114	10.1	7.6–12.9	9.0–11.3	54
Middlbr	99	87	9.4	6.3–11.9	8.1–10.3	31
Newc	92	79	10.2	6.3–13.8	8.7–11.4	53
Newry	100	19				
Norwch	87	41	10.3	7.6–12.9	9.4–11.3	61
Nottm	100	114	9.8	7.8–12.5	8.6–11.1	46
Oxford	99	140	10.3	8.1–13.2	9.3–11.7	60
Plymth	46	22				
Ports	100	86	10.2	7.4–13.9	9.2–11.2	56
Prestn	95	115	10.2	8.1–12.8	9.2–11.1	55
Redng	100	91	10.1	7.8–12.9	9.0–11.3	56
Sheff	100	132	10.2	8.1–13.1	9.3–11.2	59
Shrew	98	41	10.7	8.7–14.3	9.2–11.9	66
Stevng	100	87	10.2	7.8–12.6	9.1–11.0	55

Table 9.1. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Sthend	100	22	10.2	6.8–13.7	9.1–11.0	59
Stoke	100	99	10.5	8.1–13.0	9.3–11.5	62
Sund	100	61	10.4	7.8–13.6	9.2–11.6	64
Swanse	98	101	10.3	8.0–13.1	9.3–11.4	61
Truro	98	48	10.5	8.3–13.3	9.5–11.9	63
Tyrone	95	19				
Ulster	100	13				
Wirral	81	46	10.3	8.1–13.2	9.3–11.4	61
Wolve	100	63	10.0	8.1–12.8	9.0–11.3	52
Wrexm	94	16				
York	98	41	9.8	8.3–12.5	9.1–10.6	41
England	**93**	**4,485**	**10.1**	**7.8–12.9**	**9.1–11.2**	**55**
N Ireland	**95**	**125**	**9.9**	**7.5–12.5**	**8.8–10.8**	**50**
Scotland	**92**	**457**	**10.2**	**7.7–13.2**	**9.0–11.4**	**57**
Wales	**99**	**313**	**10.5**	**8.0–13.1**	**9.4–11.5**	**62**
UK	**93**	**5,380**	**10.2**	**7.8–13.0**	**9.1–11.2**	**55**

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

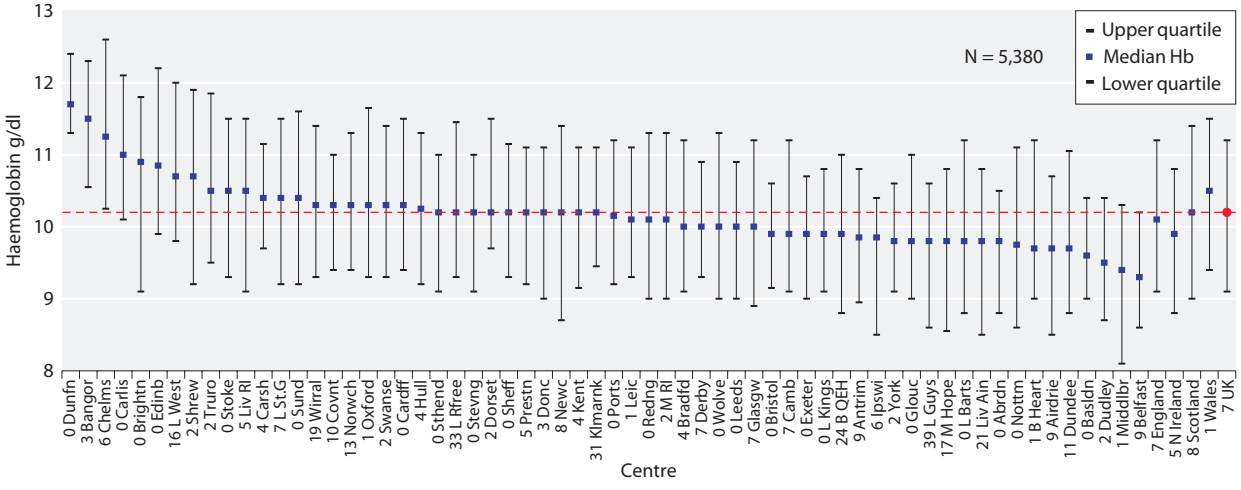

Fig. 9.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2009

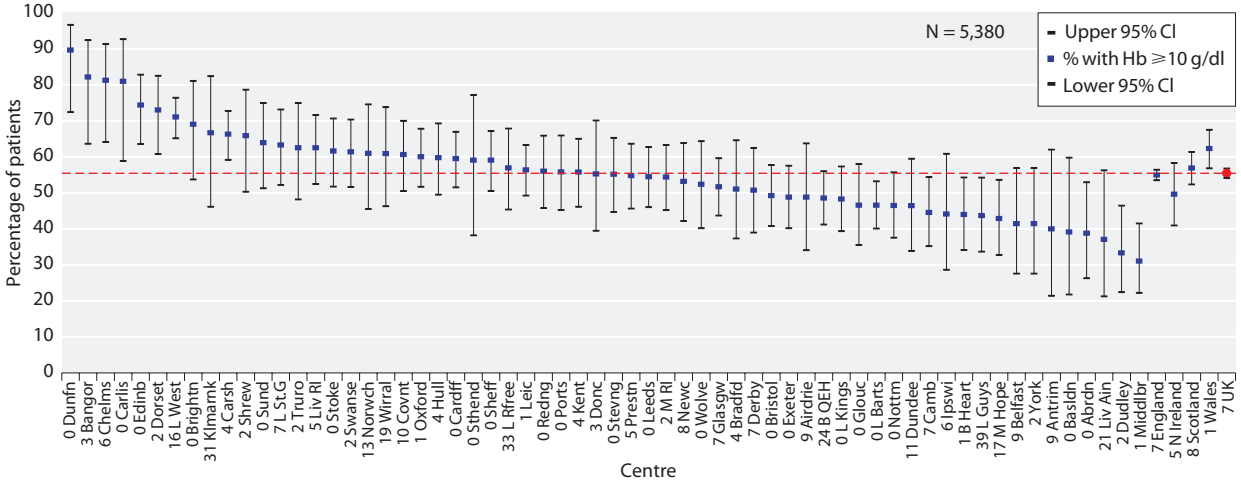

Fig. 9.2. Percentage of incident dialysis patients with Hb ⩾10 g/dl at start of dialysis treatment in 2009

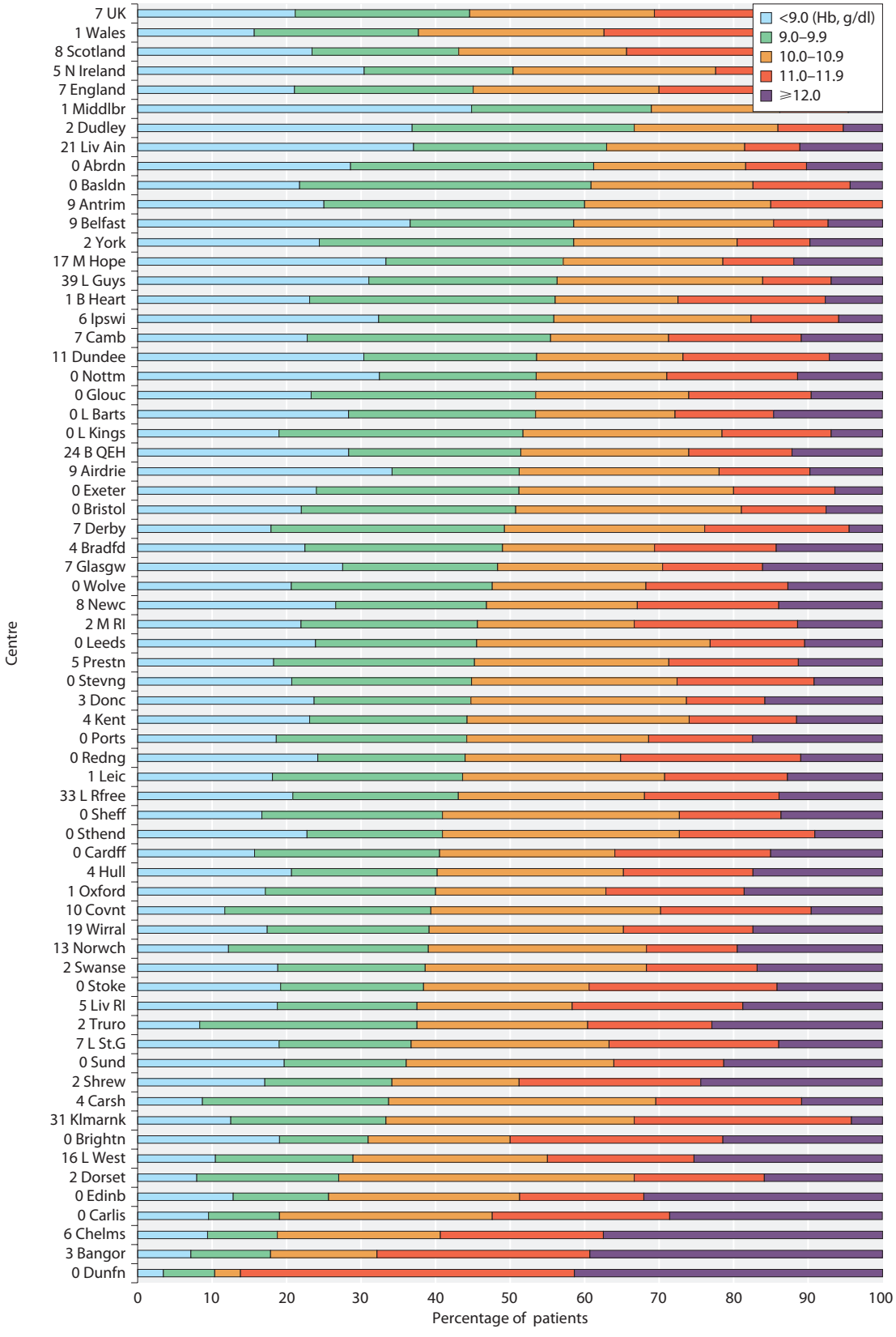

Fig. 9.3. Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment in 2009

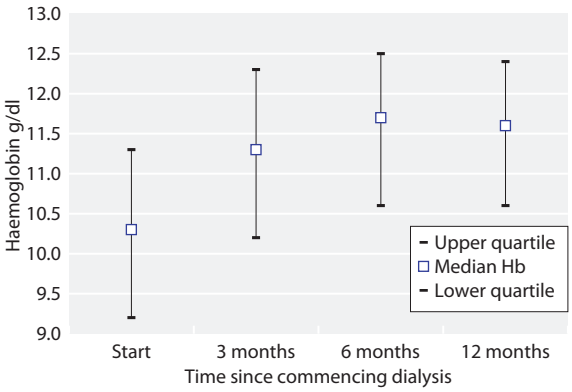

Fig. 9.4. Median haemoglobin, by time on dialysis, for incident dialysis patients in 2008

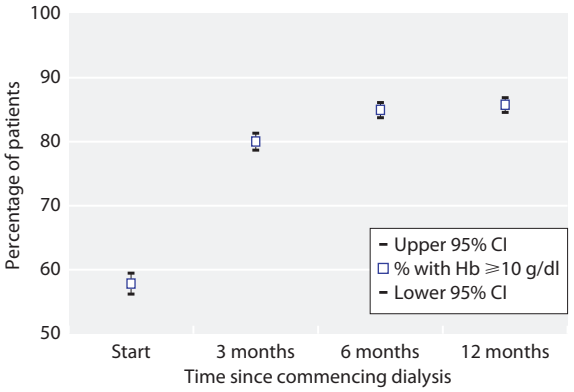

Fig. 9.5. Percentage of incident dialysis patients in 2008 with Hb ⩾10 g/dl, by time on dialysis

quarter was calculated (figures 9.4 and 9.5). Hb is markedly higher in those surviving 3 months reflecting both the treatment administered and poor survival of sicker, more anaemic patients.

The annual distribution (figure 9.6) of Hb in incident dialysis patients has remained relatively stable since 2002. The reduction in the proportion of patients with Hb ⩾12.0 g/dl seen in 2008 was sustained in 2009.

Haemoglobin in prevalent haemodialysis patients

Compliance with data returns and Hb outcome for prevalent HD patients in the 72 UK renal centres are shown in table 9.2.

The median Hb of patients on HD in the UK was 11.6 g/dl with an IQR of 10.6–12.4 g/dl. In the UK, 85% of HD patients had a Hb ⩾10.0 g/dl. These UK averages are very similar to the values for 2008 published in the 2009 Report. The median Hb by centre, compliance with the previous UK minimum standard of Hb ⩾10.0 g/dl and EBPG standard of Hb ⩾11.0 g/dl are shown in figures 9.7, 9.8 and 9.9 respectively. The distribution of Hb in HD patients by centre is shown in figure 9.10. The compliance with the NICE and RA Clinical Practice Guidelines recommended range of 10.5–12.5 g/dl is shown in figure 9.11. The majority of centres complied well with respect to both outcomes but it was possible to fall within 2–3 SDs of the mean in the funnel plot (figure 9.12) for a percentage of patients with Hb ⩾10.5 and ⩽12.5 g/dl and yet have a poor compliance with percentage of Hb ⩾10.0 g/dl (figure 9.13). This demonstrates that compliance with one standard (Hb ⩾10.5 and ⩽12.5 g/dl) can be achieved without compliance with another standard (Hb ⩾10.0 g/dl). Table 9.2 can be used in conjunction with figures 9.12 and 9.13 to identify centres.

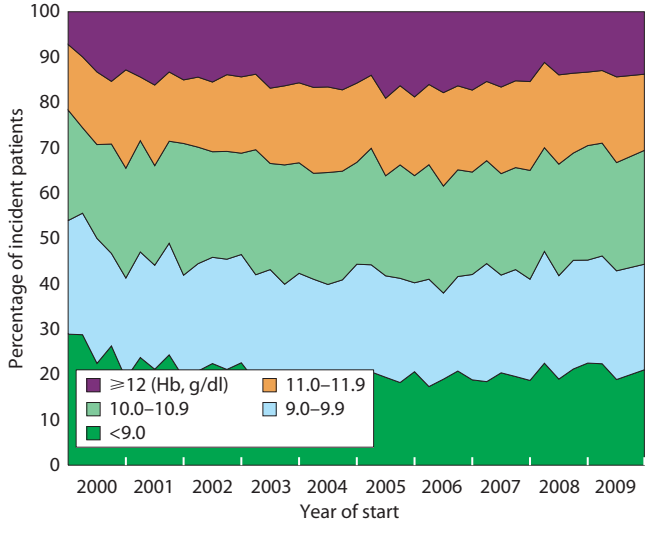

Fig. 9.6. Distribution of haemoglobin in incident dialysis patients, 2000–2009

Haemoglobin in prevalent peritoneal dialysis patients

In the UK 88% of patients on PD had a Hb ⩾10.0 g/dl (table 9.3). The median Hb of patients on PD in the UK was 11.7 g/dl with an IQR of 10.7–12.6 g/dl. These UK averages are very similar to the values for 2008 published in the 2009 Report. The median Hb by centre, compliance with the UK minimum standard Hb ⩾10.0 g/dl and EBPG Hb ⩾11.0 g/dl are shown in figures 9.14, 9.15 and 9.16 respectively. The compliance with recommended range Hb ⩾10.5 and ⩽12.5 g/dl (NICE & RA) is shown in figure 9.17. The distribution of Hb in PD patients by centre is shown in figure 9.18. The funnel plot for percentage Hb ⩾10.0 g/dl is shown in figure 9.19. Table 9.3 can be used to identify centres in the funnel plot.

Table 9.2. Haemoglobin data for prevalent HD patients

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Abrdn	99	185	11.6	8.9–13.2	10.6–12.3	11.3	1.4	84	66	61
Airdrie	100	147	11.4	9.2–13.5	10.7–12.0	11.4	1.2	93	69	67
Antrim	99	120	11.4	9.2–13.1	10.9–12.2	11.5	1.2	88	71	70
B Heart	96	388	11.5	8.6–13.5	10.4–12.4	11.3	1.5	81	63	54
B QEH	98	792	11.4	8.5–13.7	10.3–12.3	11.3	1.6	82	62	54
Bangor	100	74	11.8	9.4–13.4	10.8–12.5	11.6	1.3	89	70	55
Basldn	99	131	11.1	8.8–13.2	10.1–11.9	11.0	1.5	77	55	51
Belfast	96	220	11.1	8.8–13.6	10.3–12.1	11.2	1.4	81	57	56
Bradfd	94	166	11.4	9.2–13.7	10.5–12.4	11.4	1.4	87	63	57
Brightn	100	291	11.6	9.4–13.5	10.7–12.3	11.5	1.2	89	70	67
Bristol	100	403	11.2	8.7–13.7	10.3–12.1	11.2	1.5	81	55	53
Camb	93	304	11.7	8.7–13.5	10.7–12.5	11.5	1.4	86	70	57
Cardff	99	445	11.6	9.1–13.7	10.6–12.4	11.5	1.4	87	65	55
Carlis	100	57	11.4	9.8–13.6	11.0–12.2	11.6	1.1	93	81	70
Carsh	98	602	11.4	9.4–13.3	10.6–12.1	11.4	1.2	88	63	66
Chelms	100	109	12.0	9.6–14.0	11.2–12.9	12.0	1.5	88	79	45
Clwyd	91	67	12.1	8.8–14.7	10.7–13.3	11.9	1.9	84	70	46
Colchr	99	101	11.8	9.6–13.5	10.9–12.8	11.7	1.3	90	73	54
Covnt	98	307	11.1	9.0–13.2	10.3–11.9	11.1	1.4	82	55	57
D & Gall	98	49	11.3	9.1–13.2	10.8–12.1	11.3	1.3	84	65	65
Derby	100	236	11.8	9.1–13.5	10.8–12.5	11.6	1.4	86	71	57
Derry	100	60	11.6	9.0–13.5	11.0–12.5	11.6	1.3	92	75	63
Donc	100	109	11.9	9.2–14.1	10.6–12.7	11.7	1.5	88	70	53
Dorset	100	215	12.0	8.8–14.1	11.0–12.8	11.8	1.6	89	75	53
Dudley	85	122	10.5	8.4–13.1	9.6–11.9	10.7	1.7	67	39	42
Dundee	99	167	11.8	9.1–14.1	11.0–12.8	11.9	1.5	91	77	54
Dunfn	99	105	12.0	9.2–15.4	11.0–13.3	12.2	1.9	90	76	52
Edinb	100	246	12.0	9.7–14.7	11.2–13.0	12.1	1.6	92	80	54
Exeter	100	302	11.3	9.0–13.0	10.2–12.1	11.1	1.3	82	58	60
Glasgw	98	562	11.4	8.7–14.6	10.4–12.7	11.6	1.8	83	64	46
Glouc	100	173	11.5	9.3–13.5	10.3–12.4	11.4	1.4	87	64	55
Hull	100	300	11.6	8.9–13.9	10.8–12.4	11.6	1.4	89	71	60
Inverns	93	76	11.6	8.6–14.1	10.4–12.8	11.5	1.6	82	68	45
Ipswi	100	97	11.5	8.9–12.8	10.5–12.1	11.2	1.2	88	59	69
Kent	100	313	11.6	9.2–13.6	10.8–12.4	11.6	1.3	87	69	63
Klmarnk	97	136	11.5	9.2–13.4	10.5–12.3	11.4	1.3	88	65	60
L Barts	100	646	11.1	8.5–13.3	10.0–12.1	11.0	1.5	75	53	52
L Guys	97	519	11.0	8.6–13.1	10.0–11.9	10.9	1.4	75	51	51
L Kings	99	369	11.2	9.0–13.1	10.5–12.0	11.2	1.2	86	61	65
L Rfree	76	470	11.6	8.8–13.6	10.6–12.5	11.4	1.5	86	67	52
L St.G	100	247	11.3	8.6–13.4	10.1–12.1	11.2	1.6	77	59	51
L West	100	1,191	12.3	10.0–14.1	11.5–13.0	12.2	1.3	95	84	52
Leeds	99	463	11.5	9.0–13.6	10.6–12.3	11.4	1.4	86	65	58
Leic	100	705	11.6	8.8–13.8	10.6–12.4	11.5	1.5	87	69	57
Liv Ain	71	96	11.5	9.2–13.0	10.6–12.2	11.4	1.2	86	68	64
Liv RI	98	363	12.2	8.7–14.4	10.9–13.2	12.0	1.7	87	75	41
M Hope	79	259	11.5	8.2–13.9	10.3–12.4	11.3	1.8	78	62	48
M RI	61	247	11.7	9.0–13.8	10.4–12.7	11.6	1.5	83	66	48
Middlbr	99	264	11.4	8.1–13.7	10.4–12.2	11.2	1.6	81	66	54
Newc	100	252	11.7	8.4–14.2	10.6–12.7	11.6	1.8	81	69	49
Newry	99	93	11.8	8.6–13.5	10.7–12.6	11.5	1.6	85	69	52
Norwch	100	295	11.7	9.4–13.4	10.9–12.4	11.6	1.3	91	71	61
Nottm	100	379	11.6	9.0–13.6	10.9–12.5	11.6	1.4	89	75	61
Oxford	100	334	11.5	8.9–13.7	10.4–12.3	11.4	1.6	83	64	53
Plymth	53	60	11.4	9.3–13.1	10.5–12.2	11.2	1.3	82	58	63
Ports	100	441	11.6	9.1–14.0	10.6–12.7	11.6	1.5	86	66	47
Prestn	96	432	11.4	9.1–13.7	10.6–12.2	11.4	1.4	86	66	59
Redng	100	248	11.6	9.0–13.6	10.8–12.4	11.5	1.3	87	72	62
Sheff	100	570	11.6	9.0–13.7	10.6–12.5	11.5	1.4	84	69	54
Shrew	100	182	11.6	9.6–13.7	10.8–12.6	11.7	1.3	94	70	55

Table 9.2. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Stevng	100	351	11.4	9.2–13.2	10.5–12.1	11.3	1.2	86	65	64
Sthend	98	119	11.3	8.9–12.9	10.3–11.9	11.1	1.2	82	59	61
Stoke	100	277	11.6	9.2–13.5	10.5–12.4	11.4	1.4	81	66	56
Sund	99	164	11.7	8.8–13.9	10.6–12.6	11.5	1.6	84	67	49
Swanse	100	318	11.2	8.9–13.0	10.3–11.9	11.1	1.2	85	59	61
Truro	99	138	11.5	9.2–13.3	10.5–12.1	11.4	1.2	88	67	62
Tyrone	94	81	12.0	10.0–13.5	11.2–12.6	11.9	1.3	95	83	62
Ulster	100	86	11.4	9.1–13.1	10.6–12.1	11.3	1.2	87	62	67
Wirral	69	118	11.8	9.4–14.4	10.5–12.7	11.8	1.5	86	69	50
Wolve	100	287	11.6	8.7–14.2	10.8–12.6	11.6	1.5	89	70	58
Wrexm	100	71	11.7	10.1–13.7	11.0–12.8	11.9	1.2	97	76	54
York	98	166	12.0	9.0–14.5	11.0–12.6	11.9	1.5	90	76	55
England	**96**	**16,170**	**11.6**	**8.9–13.7**	**10.6–12.4**	**11.5**	**1.5**	**85**	**66**	**56**
N Ireland	**98**	**660**	**11.5**	**9.1–13.5**	**10.7–12.3**	**11.4**	**1.4**	**86**	**67**	**61**
Scotland	**98**	**1,673**	**11.6**	**9.0–14.3**	**10.7–12.6**	**11.6**	**1.6**	**87**	**69**	**53**
Wales	**99**	**975**	**11.5**	**9.0–13.7**	**10.5–12.3**	**11.4**	**1.4**	**87**	**65**	**56**
UK	**96**	**19,478**	**11.6**	**8.9–13.7**	**10.6–12.4**	**11.5**	**1.5**	**85**	**67**	**56**

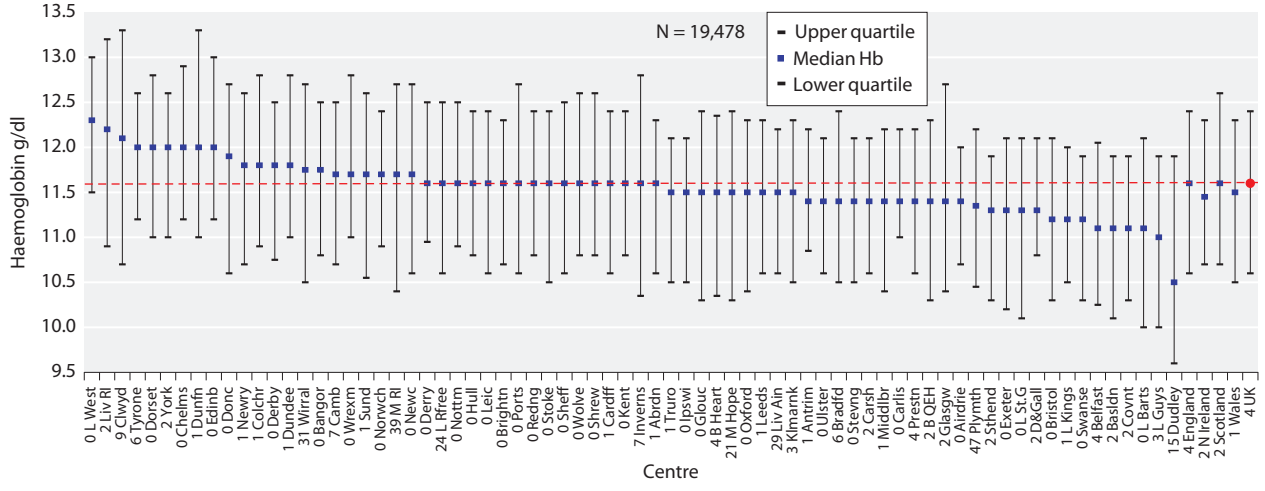

Fig. 9.7. Median haemoglobin in patients treated with HD

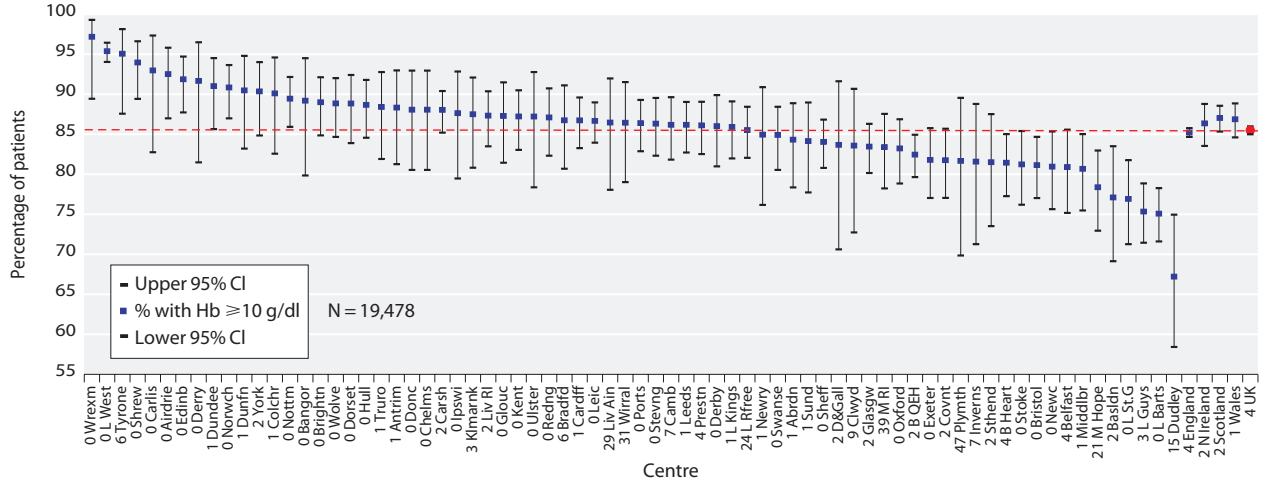

Fig. 9.8. Percentage of HD patients with Hb ⩾10 g/dl

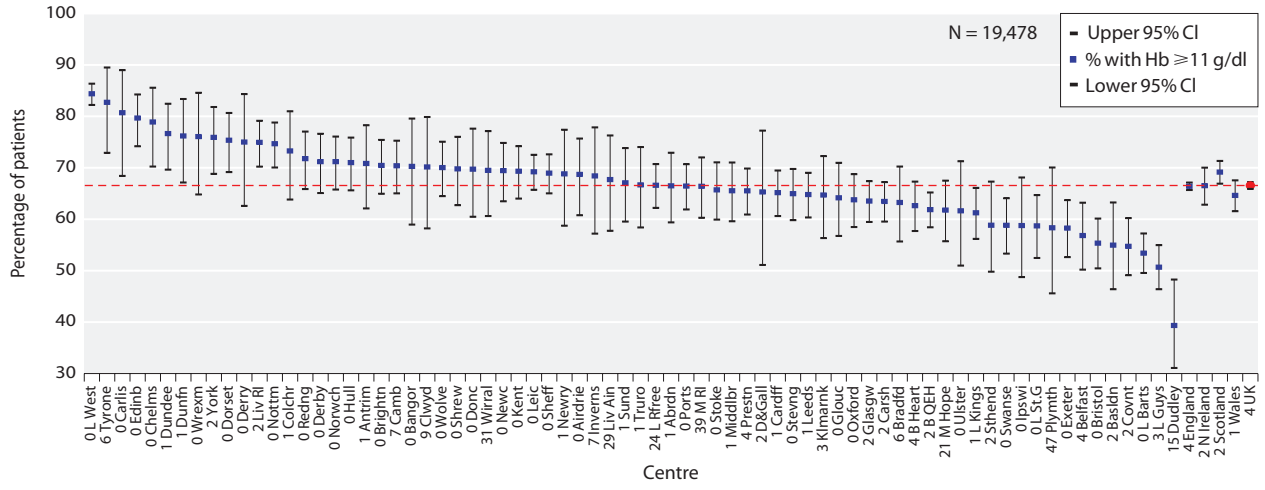

Fig. 9.9. Percentage of HD patients with Hb ⩾11 g/dl

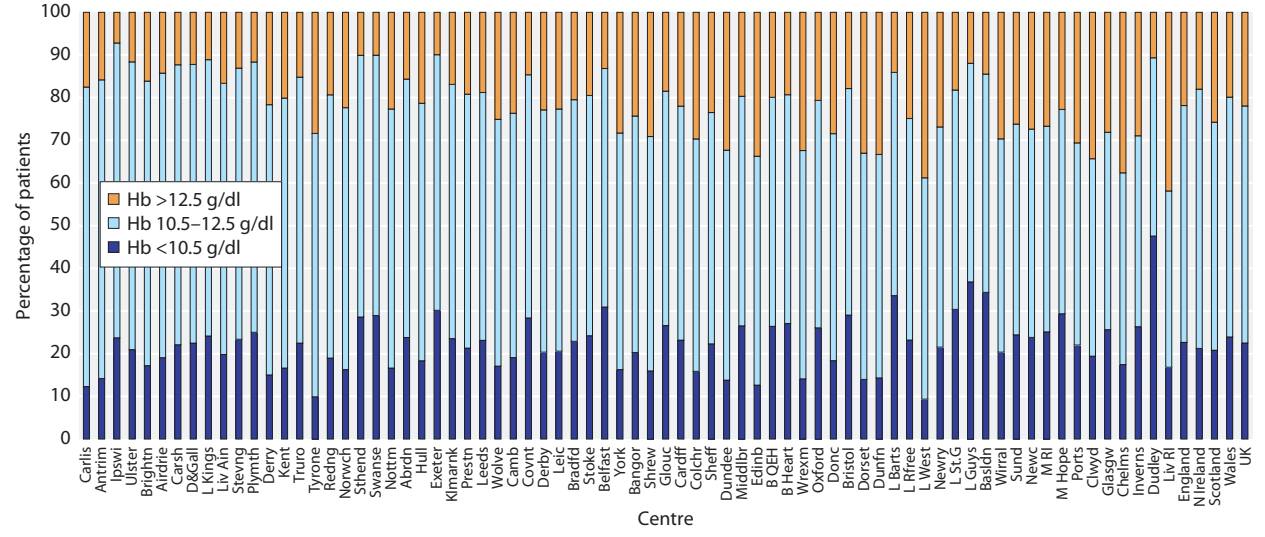

Fig. 9.10. Distribution of haemoglobin in patients treated with HD

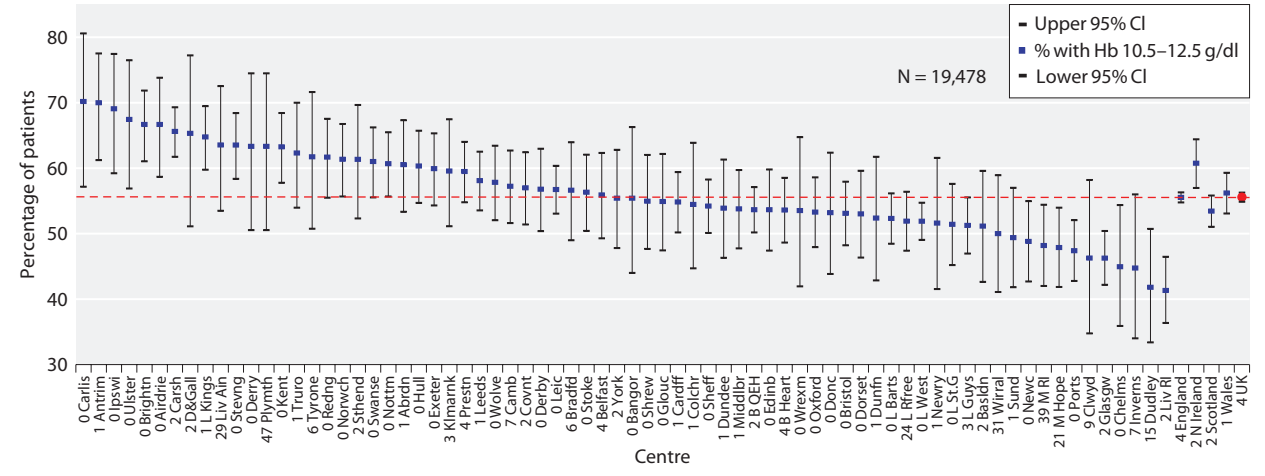

Fig. 9.11. Percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

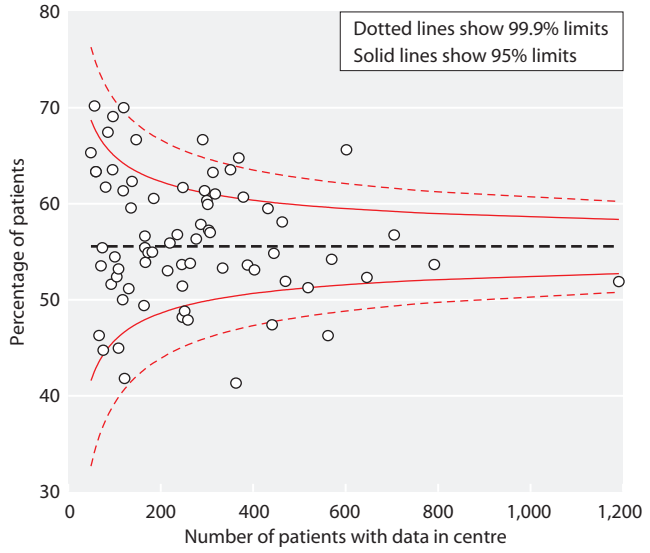

Fig. 9.12. Funnel plot of percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

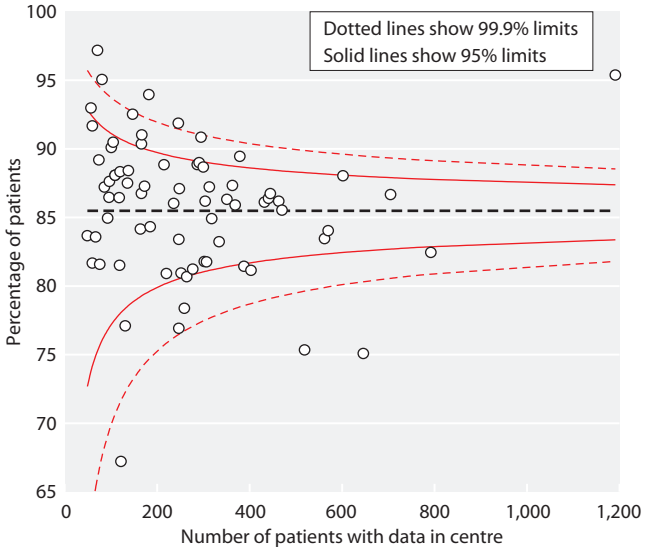

Fig. 9.13. Funnel plot of percentage of HD patients with Hb ⩾10 g/dl

Table 9.3. Haemoglobin data for prevalent PD patients

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Abrdn	100	28	12.3	10.7–13.8	11.6–13.3	12.3	1.1	100	89	61
Airdrie	100	9								
Antrim	100	14								
B Heart	100	27	12.0	9.3–14.3	10.1–12.5	11.6	1.6	78	67	44
B QEH	84	120	11.8	8.8–14.4	10.5–12.7	11.6	1.7	85	67	48
Bangor	100	29	12.5	10.3–13.9	11.8–13.1	12.4	1.1	100	86	48
Basldn	100	25	11.6	9.4–15.0	11.0–12.4	11.7	1.7	84	76	56
Belfast	100	34	11.0	9.6–13.7	10.1–12.1	11.2	1.2	79	50	53
Bradfd	100	31	11.3	9.0–13.1	10.6–12.2	11.4	1.2	90	68	65
Brightn	100	76	11.5	8.1–14.3	10.5–12.6	11.4	1.7	82	66	50
Bristol	100	68	12.0	8.9–14.7	11.0–13.3	12.0	1.9	87	75	43
Camb	100	31	11.9	8.3–14.2	10.5–12.9	11.6	1.8	87	74	52
Cardff	100	97	11.8	9.9–14.8	11.0–13.0	12.0	1.5	95	75	58
Carlis	100	13								
Carsh	99	110	11.7	8.7–13.8	10.7–12.8	11.6	1.6	84	65	52
Chelms	100	31	12.2	9.9–14.3	11.3–13.0	12.2	1.4	94	81	52
Clwyd	86	6								
Colchr	n/a	n/a								
Covnt	97	71	11.4	9.6–13.4	10.8–12.2	11.5	1.2	92	68	66
D & Gall	100	11								
Derby	100	82	12.0	9.3–14.4	10.8–12.8	11.9	1.5	93	74	49
Derry	100	3								
Donc	97	29	11.9	9.3–13.9	11.3–12.6	11.9	1.4	90	79	59
Dorset	98	53	11.9	10.1–13.8	11.2–12.6	11.8	1.3	96	79	62
Dudley	98	49	11.7	9.2–13.9	10.3–12.3	11.5	1.4	86	63	51
Dundee	100	20	12.0	9.3–15.3	11.3–12.9	12.1	1.6	90	80	55
Dunfn	95	19								
Edinb	95	53	11.2	7.9–13.8	10.3–12.5	11.2	1.6	81	55	49
Exeter	100	64	11.8	9.2–14.0	11.0–12.7	11.8	1.4	91	77	52
Glasgw	100	54	11.8	8.4–14.5	10.3–12.9	11.7	1.7	89	72	43
Glouc	100	39	11.5	8.1–14.0	10.5–12.2	11.3	1.4	79	69	59
Hull	98	62	11.8	8.5–14.7	10.8–13.0	11.8	1.9	82	71	44

Table 9.3. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Inverns	14	3								
Ipswi	100	42	11.5	8.9–13.4	10.5–12.6	11.5	1.4	88	64	52
Kent	100	64	11.7	9.4–13.1	10.9–12.6	11.7	1.2	91	72	56
Klmarnk	94	32	11.9	9.3–13.3	10.0–12.5	11.4	1.4	75	69	53
L Barts	99	164	11.7	9.7–14.2	10.8–12.6	11.7	1.4	92	71	59
L Guys	100	44	11.4	8.6–13.2	10.2–12.2	11.2	1.6	80	61	52
L Kings	100	68	11.6	9.0–14.4	10.7–12.7	11.5	1.9	90	72	53
L Rfree	80	51	10.8	8.0–14.0	10.3–11.6	11.1	1.7	82	45	51
L St.G	97	56	11.8	9.0–13.8	10.8–12.8	11.8	1.5	93	71	52
L West	100	31	11.5	9.9–13.1	10.4–12.1	11.4	1.3	94	58	65
Leeds	99	85	11.6	8.7–13.8	10.6–12.2	11.5	1.5	87	66	58
Leic	98	145	11.6	9.1–14.2	10.8–12.5	11.6	1.6	88	68	57
Liv Ain	43	3								
Liv RI	100	80	11.9	9.8–14.3	11.1–12.9	11.9	1.5	94	76	59
M Hope	88	98	11.5	8.6–14.1	10.3–12.5	11.3	1.7	79	58	48
M RI	99	88	11.5	8.7–13.7	10.5–12.6	11.4	1.6	80	60	49
Middlbr	94	15								
Newc	100	48	11.8	9.0–13.9	11.0–12.4	11.7	1.4	88	77	65
Newry	100	12								
Norwch	91	50	12.1	9.9–14.3	11.3–13.1	12.1	1.6	94	82	54
Nottm	100	101	11.5	9.1–14.0	10.7–12.6	11.6	1.5	87	70	53
Oxford	100	93	11.8	9.0–13.7	10.8–12.8	11.8	1.5	88	74	49
Plymth	97	37	12.1	9.8–14.4	11.2–13.1	12.1	1.3	92	78	54
Ports	99	80	12.1	9.0–14.5	10.9–13.1	12.0	1.7	86	71	46
Prestn	100	65	11.9	9.2–13.5	10.9–12.8	11.8	1.5	89	74	51
Redng	99	72	11.6	9.2–13.9	10.8–12.4	11.6	1.5	89	68	60
Sheff	100	68	11.9	10.0–13.9	11.3–12.6	11.8	1.1	96	81	60
Shrew	100	27	11.9	9.6–14.0	10.2–12.6	11.6	1.5	81	70	44
Stevng	96	27	11.6	9.6–13.6	10.4–12.3	11.4	1.4	85	63	52
Sthend	94	16								
Stoke	99	68	11.6	9.7–14.0	10.6–12.6	11.6	1.4	91	66	53
Sund	100	24	11.9	9.7–14.3	11.0–12.6	11.7	1.4	88	75	54
Swanse	100	50	11.9	10.1–13.7	11.1–12.6	11.8	1.5	96	76	62
Truro	100	21	12.0	9.8–13.5	11.3–12.4	11.8	1.2	90	76	62
Tyrone	91	10								
Ulster	100	2								
Wirral	69	18								
Wolve	100	40	12.0	8.8–13.6	10.9–12.8	11.8	1.4	88	73	53
Wrexm	95	21	12.0	10.0–15.1	11.1–12.6	12.0	1.6	95	76	52
York	100	15								
England	**97**	**2,885**	**11.7**	**9.1–14.1**	**10.7–12.6**	**11.7**	**1.5**	**88**	**70**	**54**
N Ireland	**99**	**75**	**11.7**	**9.6–13.8**	**10.4–12.6**	**11.6**	**1.3**	**84**	**65**	**49**
Scotland	**91**	**229**	**11.7**	**9.1–14.0**	**10.7–12.7**	**11.6**	**1.6**	**87**	**71**	**51**
Wales	**99**	**203**	**11.9**	**10.1–14.4**	**11.1–12.9**	**12.0**	**1.4**	**96**	**77**	**57**
UK	**97**	**3,392**	**11.7**	**9.2–14.1**	**10.7–12.6**	**11.7**	**1.5**	**88**	**70**	**54**

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

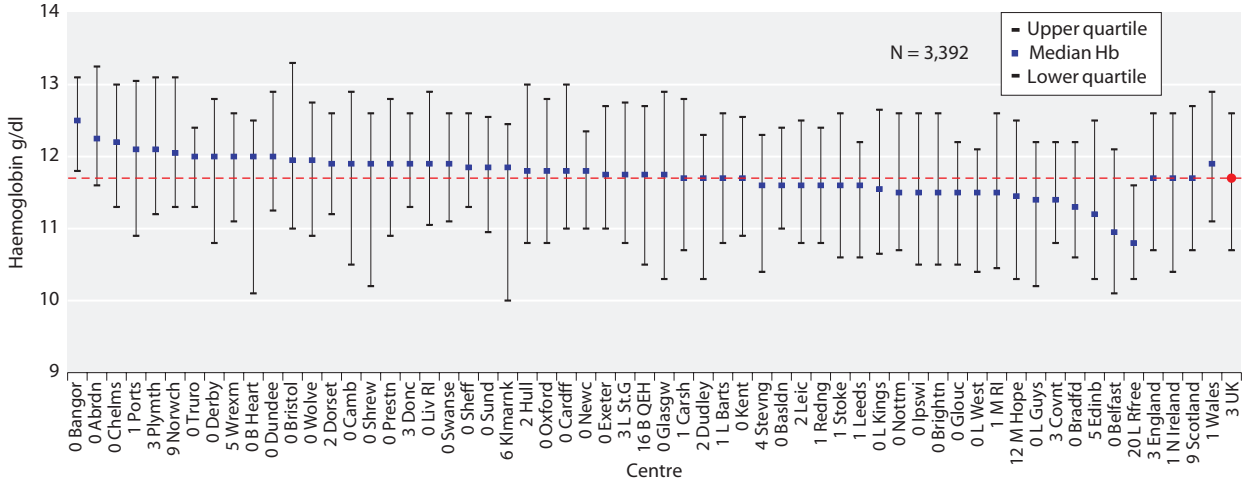

Fig. 9.14. Median haemoglobin in patients treated with PD

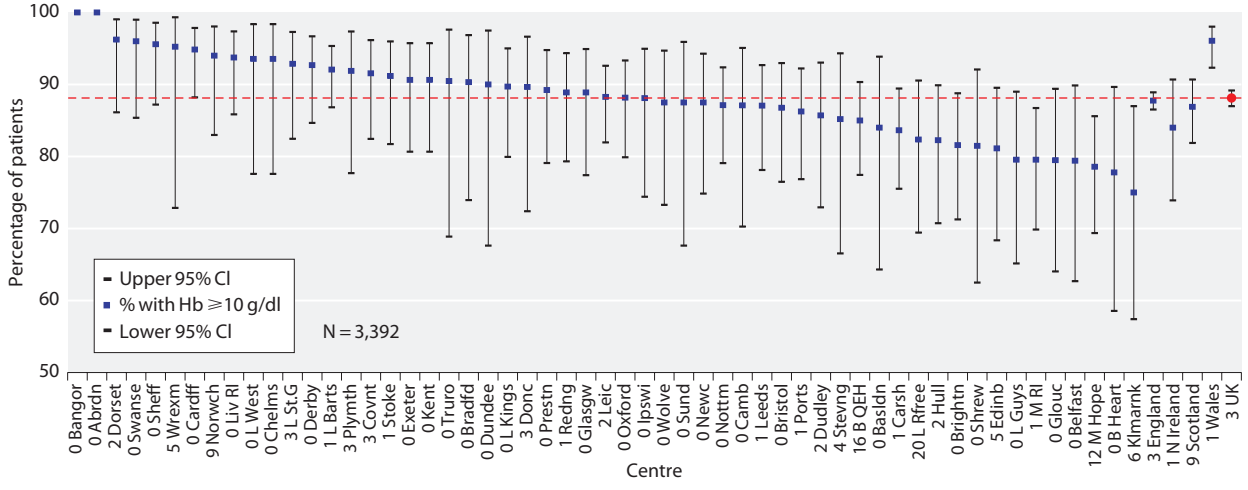

Fig. 9.15. Percentage of PD patients with Hb ⩾10 g/dl

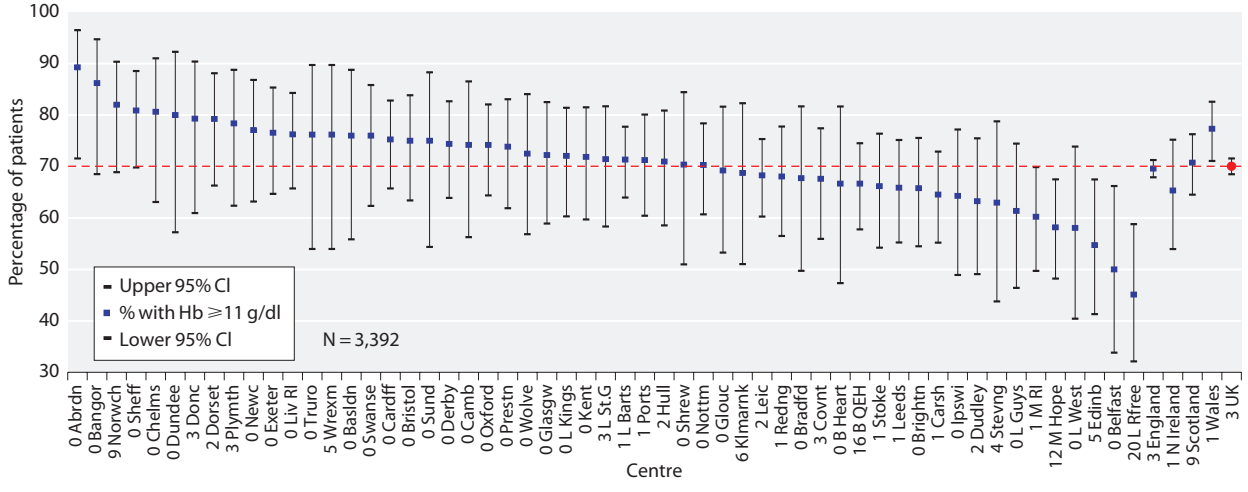

Fig. 9.16. Percentage of PD patients with Hb ⩾11 g/dl

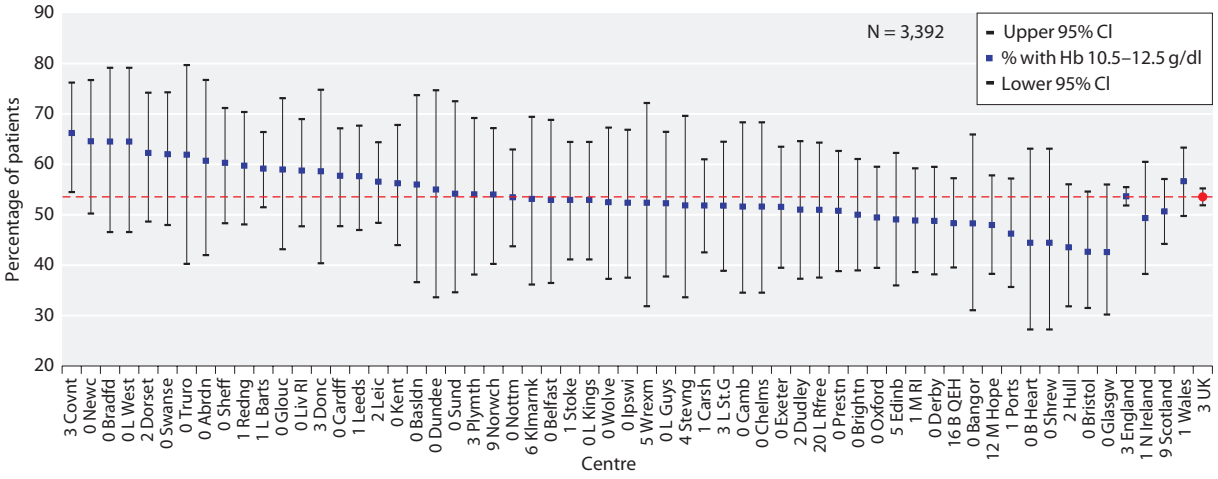

Fig. 9.17. Percentage of PD patients with Hb ⩾10.5 and ⩽12.5 g/dl

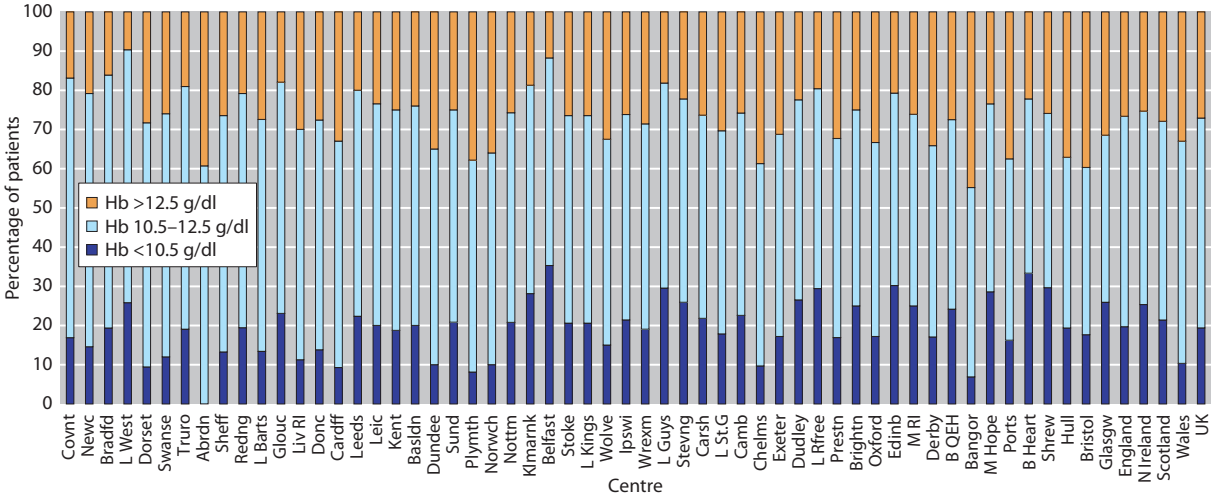

Fig. 9.18. Distribution of haemoglobin in patients treated with PD

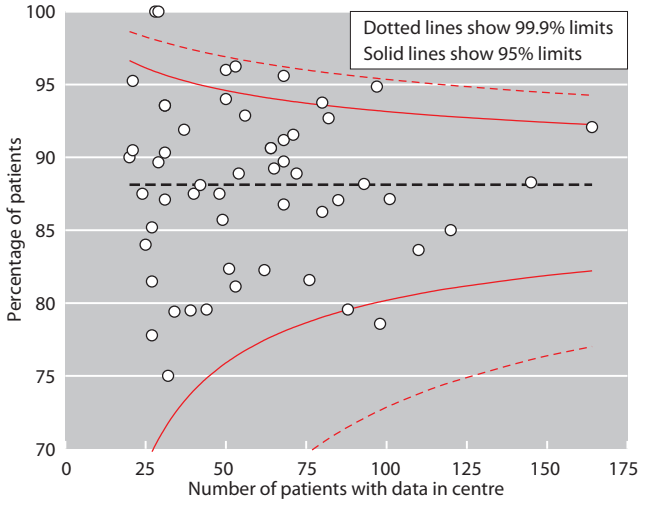

Fig. 9.19. Funnel plot of percentage of PD patients with Hb ⩾10 g/dl

Relationship between Hb in incident and prevalent dialysis patients in 2009

The relationship between the percentage of new and prevalent dialysis (HD and PD) patients with a Hb ⩾10.0 g/dl is shown in figure 9.20. As expected, all centres have a higher percentage of prevalent patients achieving a Hb ⩾10.0 g/dl than incident patients. Overall in the UK, 86% of prevalent patients, compared to 55% of incident patients, had a Hb ⩾10.0 g/dl in 2009.

Correlation between median haemoglobin and compliance with clinical guidelines

Rose-Day plots (figures 9.21 to 9.24) are used to show the relationship between a centre's median Hb and their compliance with minimum standards for Hb ⩾10.0 g/dl and ⩾11.0 g/dl in HD and PD populations. Compliance

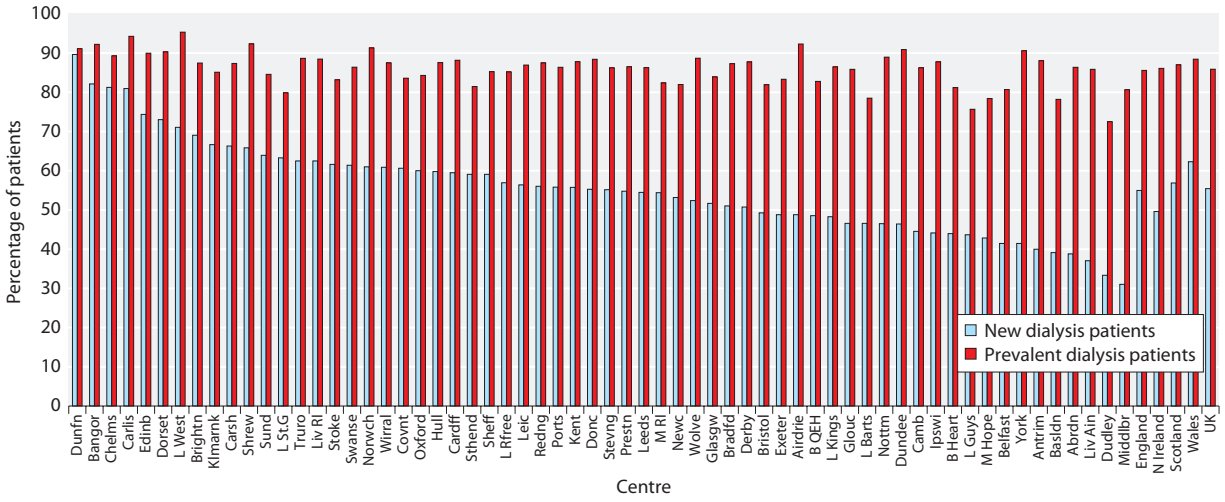

Fig. 9.20. Percentage of new and prevalent dialysis patients with Hb ⩾10 g/dl

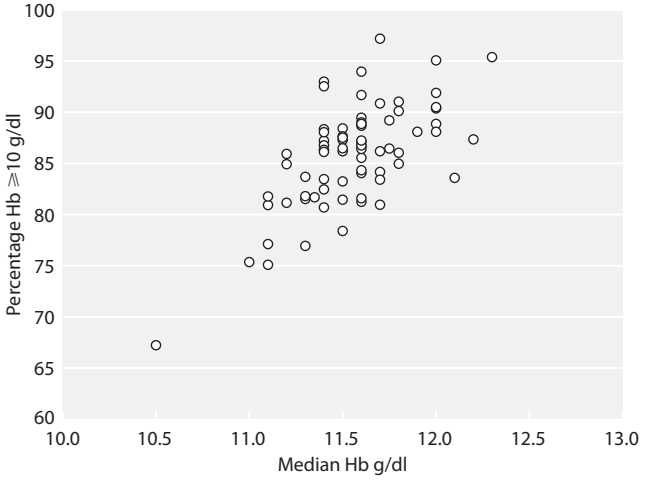

Fig. 9.21. Percentage of HD patients with Hb ⩾10 g/dl plotted against median haemoglobin

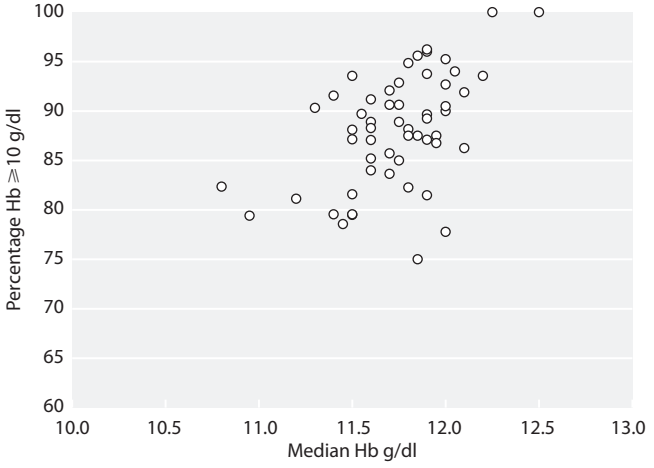

Fig. 9.23. Percentage of PD patients with Hb ⩾10 g/dl plotted against median haemoglobin

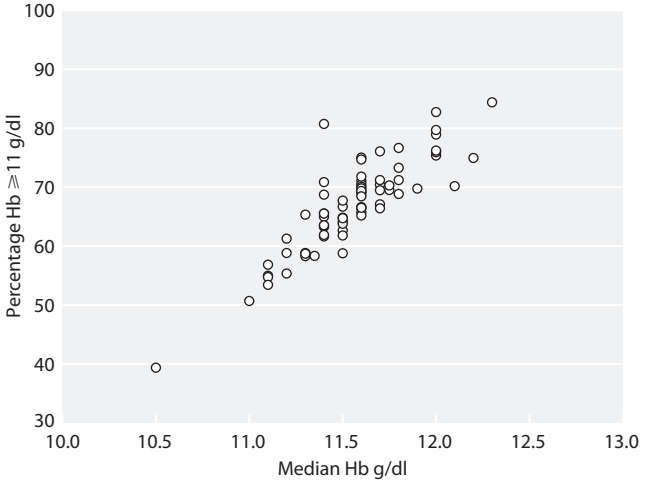

Fig. 9.22. Percentage of HD patients with Hb ⩾11 g/dl plotted against median haemoglobin

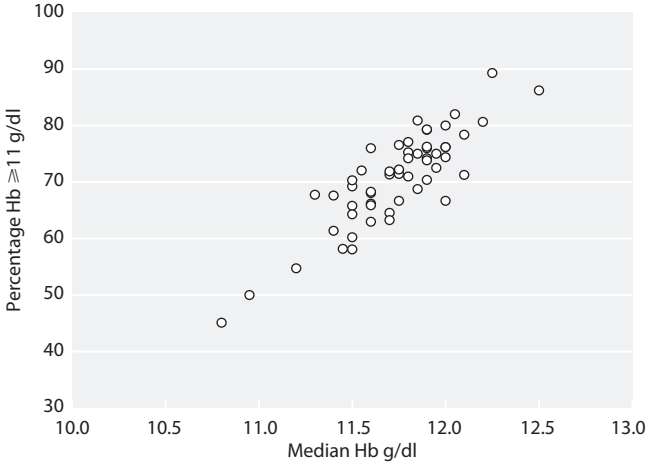

Fig. 9.24. Percentage of PD patients with Hb ⩾11 g/dl plotted against median haemoglobin

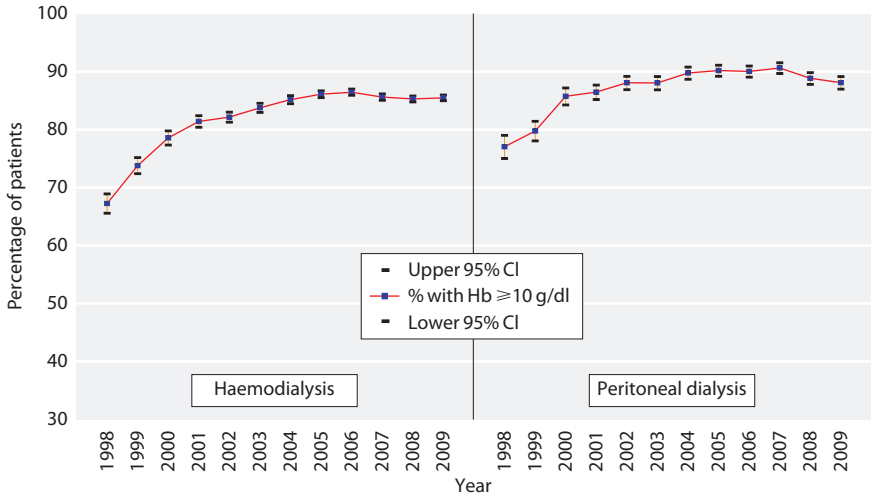

Fig. 9.25. Percentage of prevalent HD and PD patients (1998–2009) with Hb ⩾10 g/dl

with minimum standards by year (1998 to 2009) is shown in figure 9.25 for prevalent patients (by treatment modality) and in figure 9.26 for incident and prevalent patients (all dialysis patients).

Median haemoglobin and length of survival on RRT

Median Hb of cohorts of patients who had survived different lengths of time on RRT were analysed in both HD and PD patients (figures 9.27 and 9.28). The results suggest that incident patients selected for PD have higher Hb than incident HD patients. There has been little change over the last 5 years.

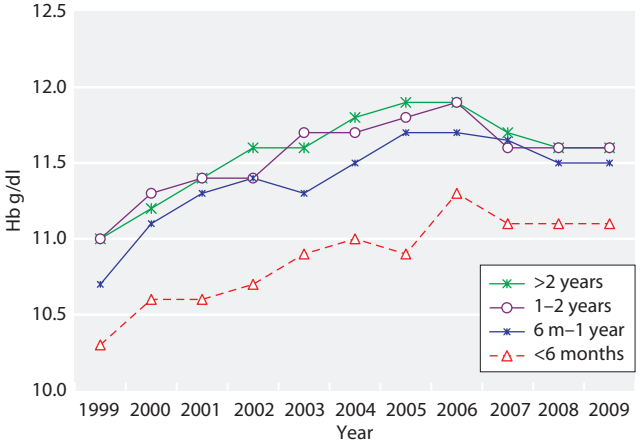

Fig. 9.27. Median haemoglobin and length of survival on RRT (HD patients)

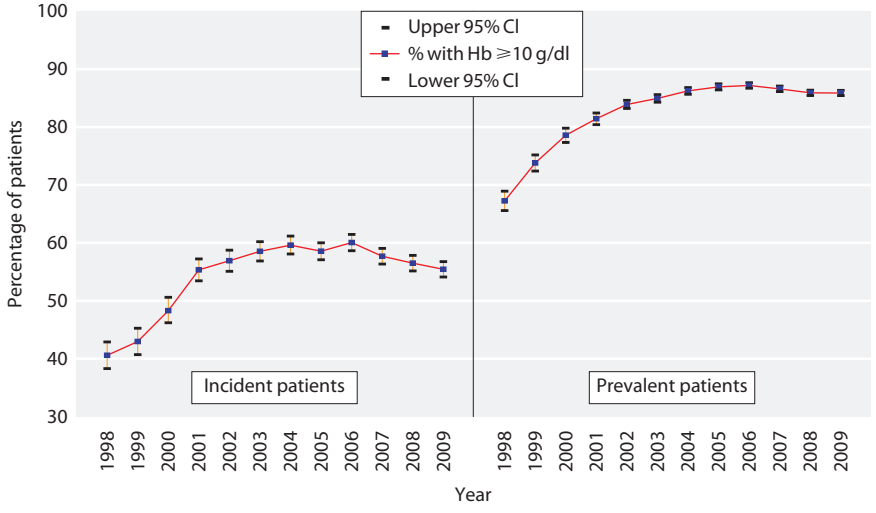

Fig. 9.26. Percentage of incident and prevalent dialysis patients (1998–2009) with Hb ⩾10 g/dl

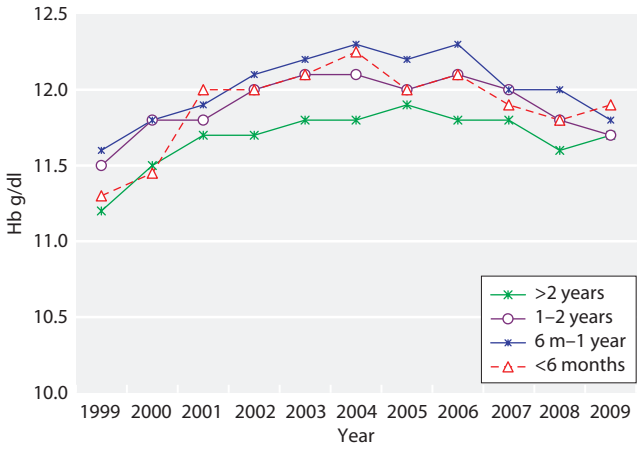

Fig. 9.28. Median haemoglobin and length of survival on RRT (PD patients)

Factors affecting haemoglobin

Ferritin

Ferritin in prevalent dialysis patients

Percentage returns and summary statistics for serum ferritin are shown for the 63 renal centres in England, Northern Ireland and Wales in tables 9.4 and 9.5 for HD and PD patients respectively.

The median and IQR for serum ferritin for HD and PD patients is given, by centre, in figures 9.29 and 9.30 respectively. The percentage of patients with serum ferritin ⩾100 µg/L, ⩾200 µg/L and ⩾800 µg/L are shown in figures 9.31, 9.32 and 9.33 for HD and figures 9.34, 9.35 and 9.36 for PD respectively.

All centres achieved greater than 80% compliance with a serum ferritin ⩾100 µg/L for HD patients and all but 4 centres achieved >90% compliance. The PD population had a lower median ferritin value (249 µg/L, IQR 142–412 vs. 441 µg/L, IQR 289–629 for HD). In 2009, 29 centres (compared to 35 in 2008) reported less than 90% of PD patients compliant with serum ferritin ⩾100 µg/L.

Changes in ferritin 2001–2009

The compliance with guidelines for ferritin in the HD populations was stable at approximately 95% for 4 years and increased slightly in 2009. In the PD population the compliance decreased every year for 5 years but increased from 2008 to 2009 negating much of this 5 year drop. The serial values are shown in figure 9.37. The difference between the compliance in HD and PD was probably because more PD patients achieve adequate Hb without any iron or ESA therapy. The median serum ferritin outcome over time is shown in figure 9.38.

Ferritin and length of time on renal replacement therapy

In HD (but not PD patients), the median serum ferritin was greatest in those who had survived longest (figures 9.39 and 9.40).

Erythropoiesis stimulating agents in prevalent dialysis patients

Patients treated and dose variation–ESA prescription and modality

Treatment of renal anaemia with ESAs has offered a major way to improve quality of life for dialysis patients. These agents represent some of the most expensive prescribed drugs in hospital based practice and thus approaches to achieving normal haemoglobin levels

Table 9.4. Ferritin in HD patients

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Antrim	99	120	453	194–1007	326–651	100.0	15.8
B Heart	92	375	285	56–662	186–410	89.3	2.4
B QEH	97	784	399	142–790	305–488	97.2	5.0
Bangor	100	74	437	131–950	327–594	97.3	10.8
Basldn	99	131	329	134–598	242–405	97.0	1.5
Belfast	98	224	579	107–1221	358–793	95.1	24.1
Bradfd	93	163	518	168–953	336–706	98.2	14.7
Brightn	80	234	449	170–964	322–592	97.4	11.5
Bristol	99	400	414	78–1026	266–592	93.8	11.8
Camb	80	263	257	39–716	149–393	87.8	4.2
Cardff	97	438	281	93–605	187–388	93.8	2.3
Carlis	100	57	617	272–1983	489–912	100.0	29.8
Carsh	96	587	385	76–880	278–515	93.2	8.4

Table 9.4. Continued

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Chelms	100	109	383	192–992	324–497	97.3	8.3
Clwyd	99	73	466	194–837	274–607	100.0	9.6
Colchr	99	101	751	377–1463	573–939	100.0	44.6
Covnt	99	310	320	91–786	204–505	93.9	4.5
Derby	100	236	406	94–964	292–607	94.5	8.1
Derry	98	59	447	85–1165	255–685	91.5	15.3
Donc	100	109	489	212–945	362–677	98.2	10.1
Dorset	99	213	449	168–777	349–578	97.7	3.8
Dudley	80	115	306	26–972	147–468	80.9	6.1
Exeter	99	298	273	95–615	196–370	94.0	2.7
Glouc	95	165	450	148–886	300–599	97.6	7.3
Hull	99	298	423	177–788	317–547	98.0	4.7
Ipswi	91	88	524	139–928	362–608	97.7	12.5
Kent	99	310	395	77–1035	211–570	91.9	11.3
L Barts	99	644	449	160–1003	311–600	98.5	9.9
L Guys	96	513	465	100–1073	326–630	95.1	12.5
L Kings	99	368	547	193–1109	414–727	98.9	16.9
L Rfree	79	491	419	86–1380	247–679	93.5	18.7
L St.G	99	245	403	174–933	291–498	97.1	7.4
L West	92	1093	556	262–1397	425–760	98.9	23.2
Leeds	99	461	429	92–792	279–568	94.6	4.8
Leic	100	703	375	102–820	252–518	95.2	5.8
Liv Ain	63	86	701	166–1503	478–946	98.8	41.9
Liv RI	98	364	594	127–1631	344–933	97.3	34.6
M Hope	18	59					
M RI	52	210	359	54–763	241–503	91.4	3.3
Middlbr	97	260	563	69–1619	275–1032	92.3	36.9
Newc	100	252	634	224–1361	440–858	99.2	31.4
Newry	99	93	754	121–1267	479–996	95.7	46.2
Norwch	97	287	591	111–1426	355–887	96.2	32.8
Nottm	100	379	611	272–1080	500–744	98.4	19.3
Oxford	98	329	280	70–731	169–422	90.6	3.7
Plymth	98	111	487	174–1381	338–660	98.2	13.5
Ports	99	438	257	55–692	173–363	88.1	2.7
Prestn	99	443	577	137–1536	364–905	96.2	33.2
Redng	99	247	516	202–1113	377–671	98.8	13.8
Sheff	100	570	488	114–1020	352–638	95.1	12.6
Shrew	100	182	390	73–983	230–564	91.2	10.4
Stevng	97	340	438	155–866	295–588	98.5	6.2
Sthend	98	119	308	161–549	257–388	97.5	1.7
Stoke	100	277	837	281–1916	574–1191	99.6	53.1
Sund	98	161	631	284–1736	442–874	100.0	32.3
Swanse	100	317	359	66–806	218–558	92.4	5.1
Truro	99	138	486	228–1020	354–650	100.0	10.9
Tyrone	88	76	580	236–1375	385–917	98.7	35.5
Ulster	100	86	519	168–1408	368–666	98.8	11.6
Wirral	65	111	794	247–1971	512–1062	98.2	48.7
Wolve	100	286	521	220–987	417–622	99.0	8.0
Wrexm	73	52	372	194–945	270–550	100.0	7.7
York	81	137	501	51–953	343–638	92.0	11.0
England	**93**	**15,650**	**444**	**112–1153**	**294–630**	**95.6**	**14.0**
N Ireland	**97**	**658**	**536**	**138–1243**	**357–790**	**96.7**	**24.6**
Wales	**97**	**954**	**325**	**93–794**	**215–481**	**94.4**	**4.7**
E, W & NI	**93**	**17,262**	**441**	**111–1146**	**289–629**	**95.6**	**13.9**

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

Table 9.5. Ferritin in PD patients

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 μg/L	% ferritin ⩾800 μg/L
Antrim	100	14					
B Heart	96	26	149	54–586	104–337	76.9	3.9
B QEH	84	120	184	37–620	103–298	77.5	1.7
Bangor	97	28	188	18–544	125–305	85.7	3.6
Basldn	100	25	138	48–631	89–412	68.0	0.0
Belfast	100	34	200	19–974	124–342	79.4	5.9
Bradfd	100	31	167	38–469	109–310	83.9	0.0
Brightn	96	73	307	112–1007	208–456	97.3	12.3
Bristol	97	66	206	28–688	116–396	81.8	1.5
Camb	97	30	324	55–646	229–408	90.0	0.0
Cardff	99	96	128	19–443	67–216	67.7	1.0
Carlis	100	13					
Carsh	98	109	217	59–949	153–344	90.8	5.5
Chelms	100	31	202	49–745	73–335	67.7	3.2
Clwyd	86	6					
Colchr	n/a	n/a					
Covnt	88	64	183	44–614	99–278	75.0	3.1
Derby	99	81	336	96–803	250–532	93.8	6.2
Derry	100	3					
Donc	97	29	191	25–599	108–307	75.9	3.5
Dorset	98	53	243	67–523	170–341	88.7	0.0
Dudley	92	46	164	22–457	59–246	60.9	2.2
Exeter	100	64	203	44–559	140–334	89.1	0.0
Glouc	85	33	199	35–881	154–277	87.9	6.1
Hull	97	61	348	110–849	207–487	95.1	6.6
Ipswi	90	38	206	29–768	120–392	81.6	2.6
Kent	97	62	303	76–857	212–558	91.9	8.1
L Barts	98	163	277	73–921	161–432	87.7	8.0
L Guys	100	44	143	36–433	86–209	68.2	0.0
L Kings	100	68	199	54–575	139–306	83.8	1.5
L Rfree	98	63	347	86–1494	234–563	92.1	15.9
L St.G	97	56	276	60–996	163–358	94.6	5.4
L West	100	31	233	76–499	182–345	93.6	0.0
Leeds	100	86	253	85–667	176–360	91.9	4.7
Leic	98	145	281	51–820	194–414	89.7	6.2
Liv Ain	0	0					
Liv RI	100	80	330	58–932	148–550	85.0	5.0
M Hope	1	1					
M RI	98	87	145	47–376	97–200	74.7	1.2
Middlbr	88	14					
Newc	100	48	442	48–1258	220–751	93.8	20.8
Newry	100	12					
Norwch	87	48	203	41–851	102–469	75.0	6.3
Nottm	100	101	269	61–847	166–399	89.1	5.9
Oxford	94	87	207	51–657	122–328	80.5	4.6
Plymth	97	37	267	76–837	174–505	91.9	5.4
Ports	86	70	229	43–761	122–377	82.9	2.9
Prestn	100	65	331	59–857	181–527	90.8	7.7
Redng	100	73	453	112–855	343–575	97.3	6.9
Sheff	100	68	257	77–759	151–394	94.1	4.4
Shrew	100	27	220	106–517	142–377	96.3	0.0
Stevng	82	23	227	89–820	161–338	78.3	8.7
Sthend	94	16					
Stoke	100	69	586	77–1507	294–810	94.2	27.5
Sund	96	23	457	174–1480	242–567	100.0	8.7
Swanse	100	50	226	57–829	130–346	84.0	6.0

Table 9.5. Continued

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Truro	90	19					
Tyrone	100	11					
Ulster	100	2					
Wirral	62	16					
Wolve	100	40	213	30–641	101–377	77.5	2.5
Wrexm	23	5					
York	100	15					
England	**92**	**2,738**	**257**	**52–842**	**148–422**	**86.7**	**5.8**
N Ireland	**100**	**76**	**202**	**42–1346**	**124–403**	**80.3**	**6.6**
Wales	**90**	**185**	**171**	**31–535**	**103–284**	**76.8**	**2.7**
E, W & NI	**92**	**2,999**	**249**	**50–829**	**142–412**	**86.0**	**5.7**

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

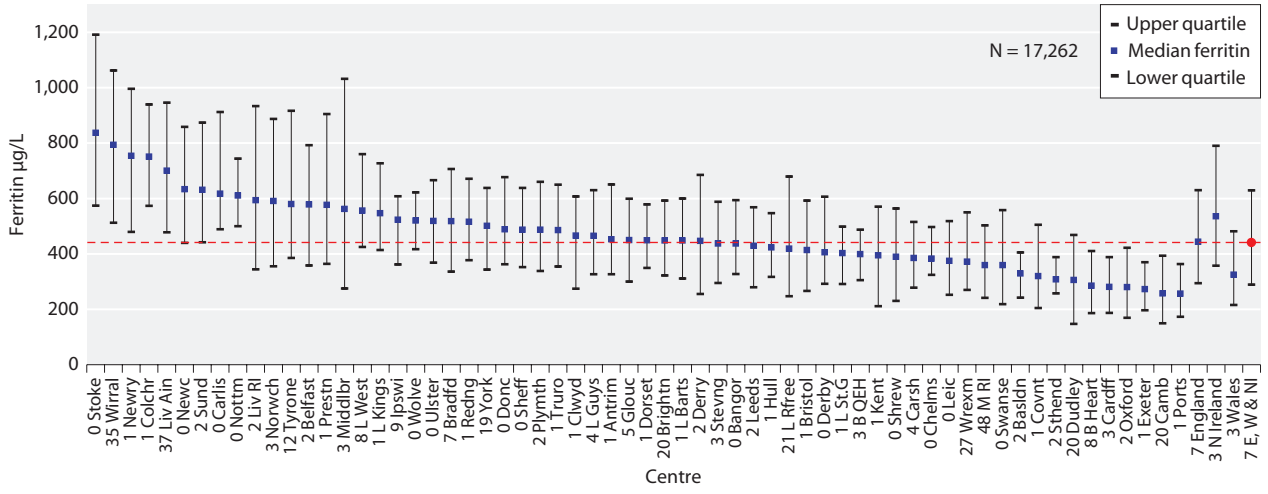

Fig. 9.29. Median ferritin in patients treated with HD

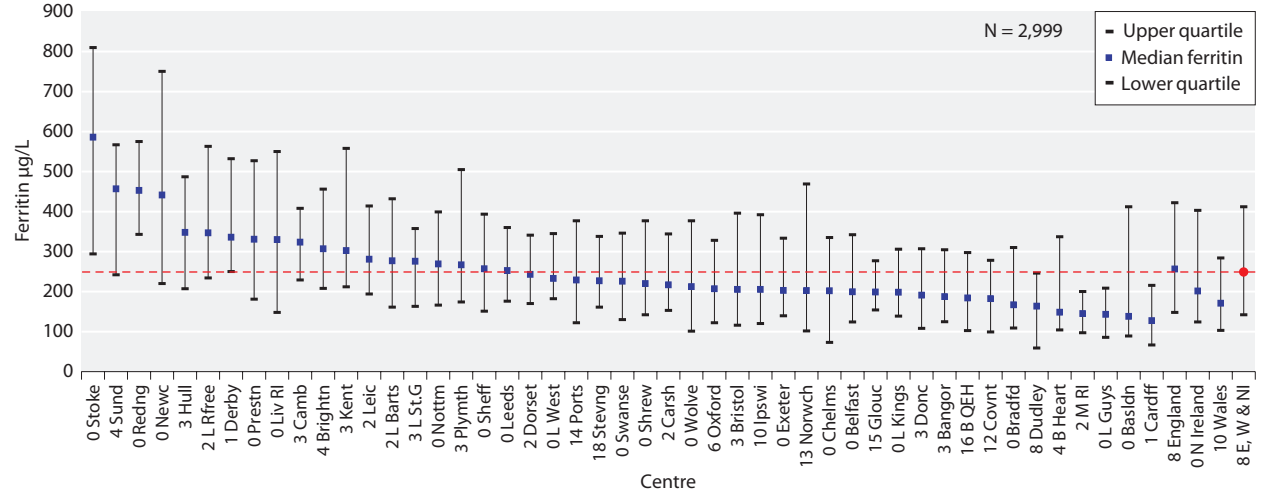

Fig. 9.30. Median ferritin in patients treated with PD

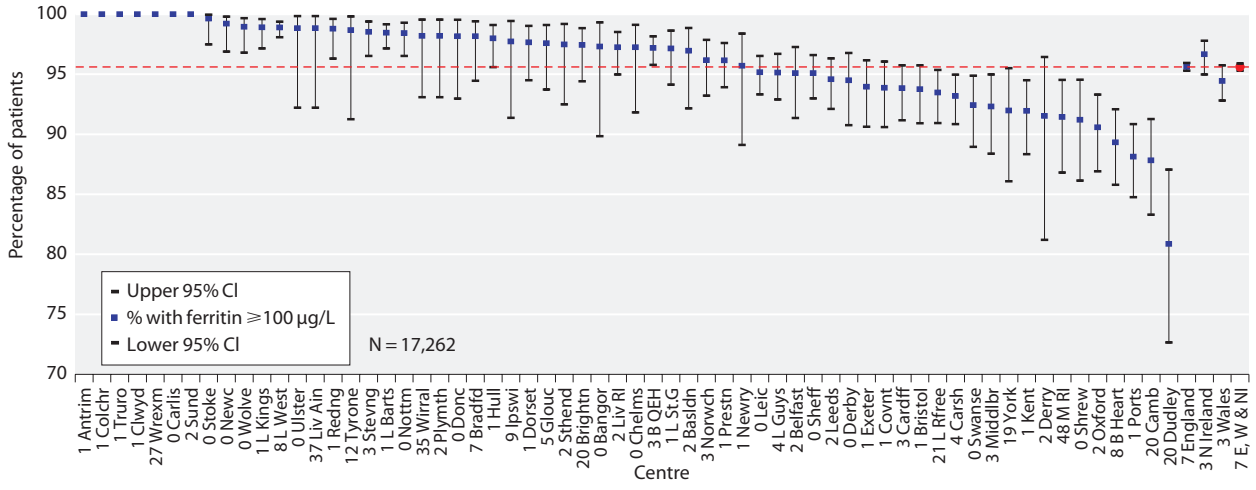

Fig. 9.31. Percentage of HD patients with ferritin ⩾100 µg/L

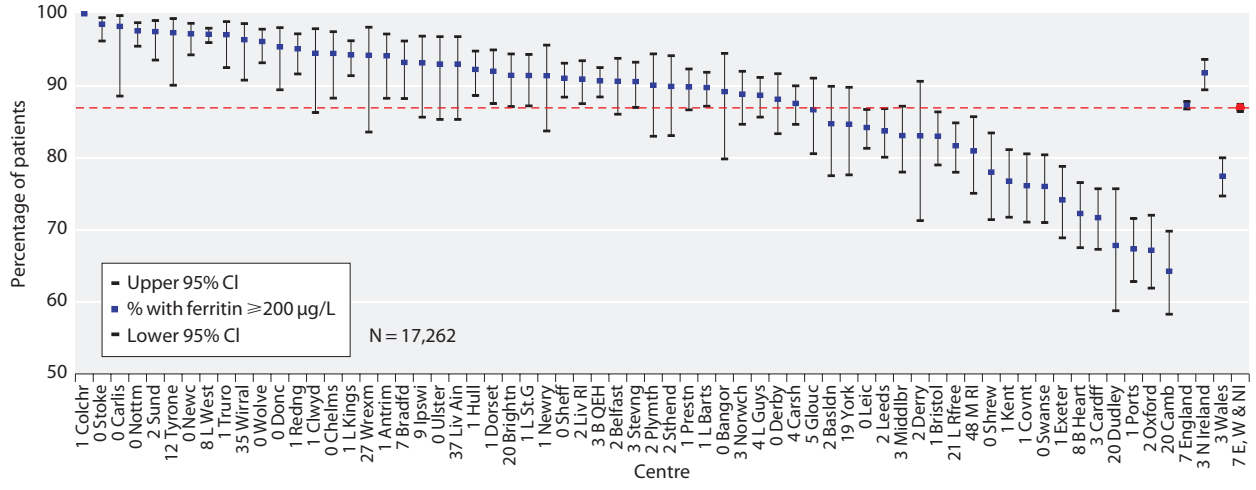

Fig. 9.32. Percentage of HD patients with ferritin ⩾200 µg/L

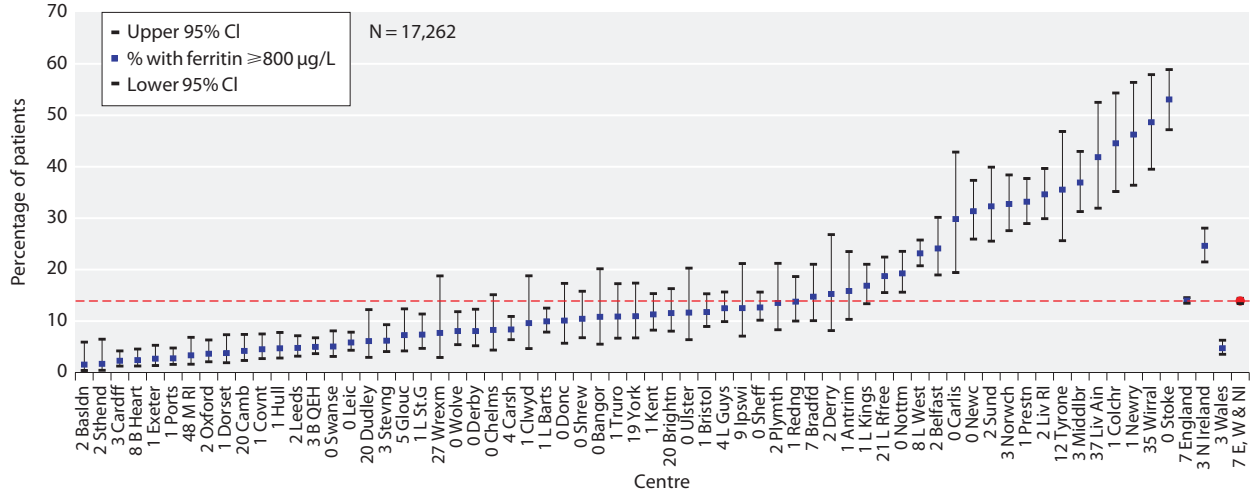

Fig. 9.33. Percentage of HD patients with ferritin ⩾800 µg/L

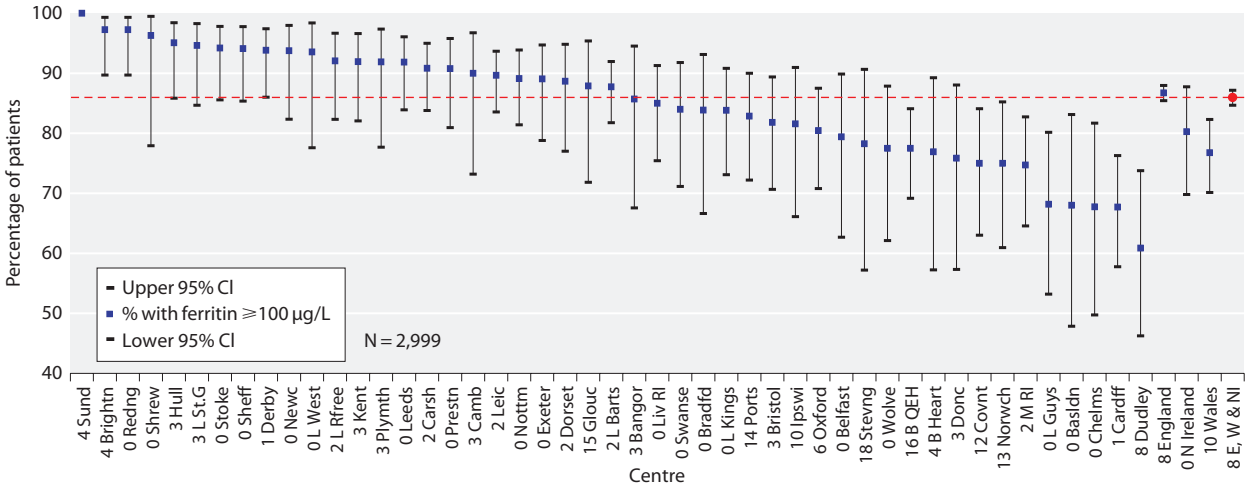

Fig. 9.34. Percentage of PD patients with ferritin ⩾100 µg/L

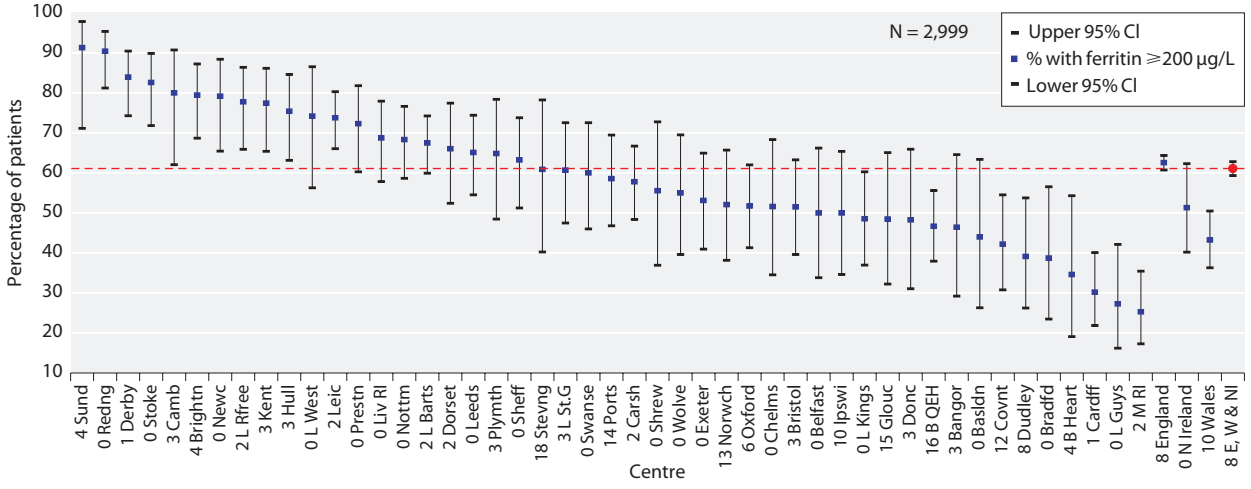

Fig. 9.35. Percentage of PD patients with ferritin ⩾200 µg/L

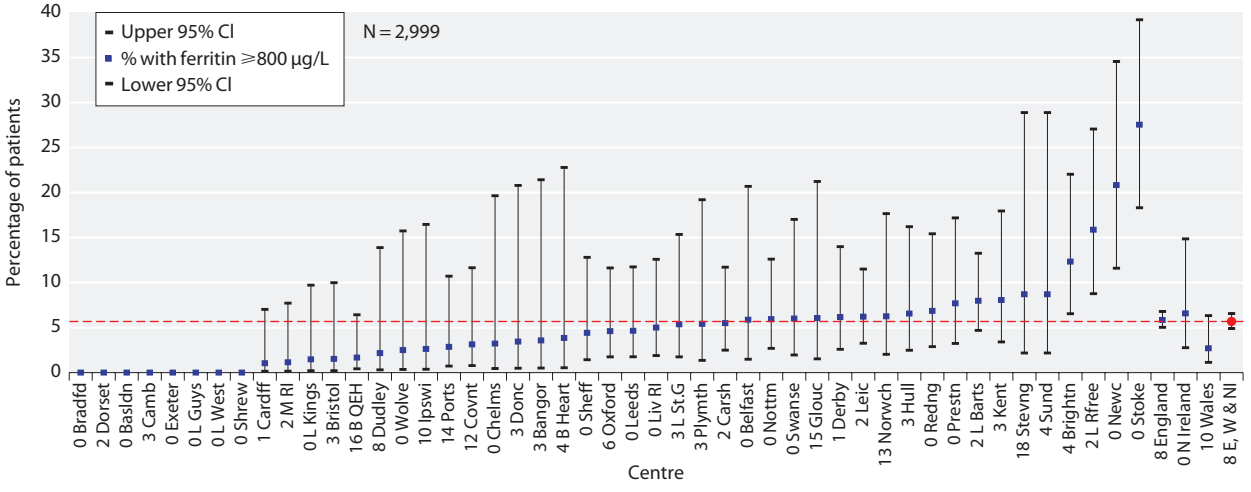

Fig. 9.36. Percentage of PD patients with ferritin ⩾800 µg/L

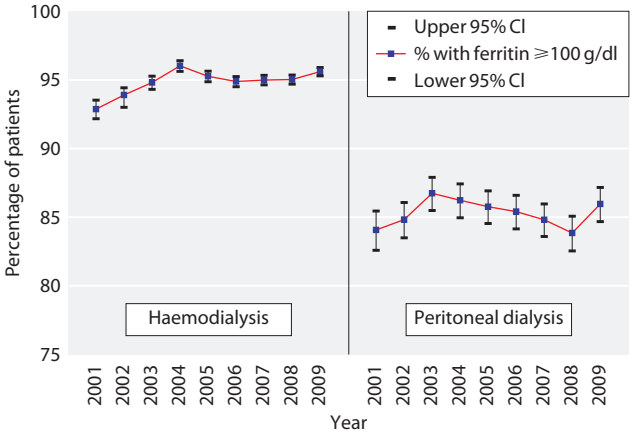

Fig. 9.37. Percentage of patients with ferritin ⩾100 µg/L (2001–2009)

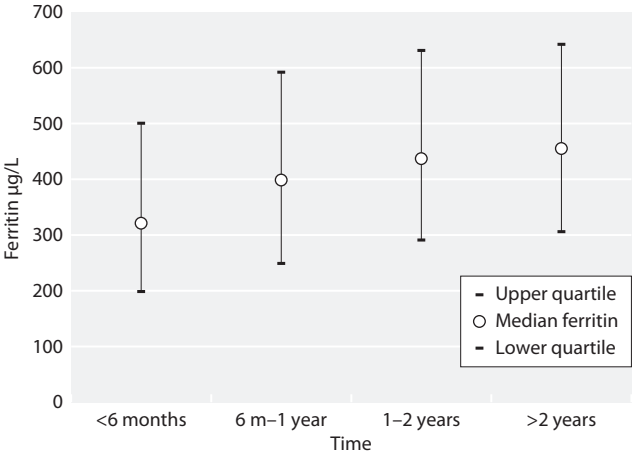

Fig. 9.39. Median ferritin and length of survival on RRT (HD)

with the lowest possible doses are desirable. Furthermore, recent studies such as the CREATE and CHOIR studies suggest that driving the haemoglobin levels above 13 g/dl and/or high doses of ESAs per se may be associated with an excess of cardiovascular risk compared to the comparator groups in these and other studies [10, 11]. Table 9.6 shows the percentage of patients treated and the dose of ESA given in HD patients. Equivalent data for PD patients are shown in table 9.7. As shown in previous reports there is substantial variation in the average doses of ESA prescription used in UK dialysis units. The median dose for prevalent HD patients varied from 4,000 to 13,500 IU/week. In PD patients, in whom target haemoglobin can be achieved with substantially less agent, the median dose varied from 3,000–8,000 IU/week. The mean doses for 2009 prevalent patients in England, Wales and Northern Ireland were 9,507 IU/week for HD and 6,212 IU/week for PD patients.

ESA prescription: age and modality associations

The proportion of patients on an ESA was higher for HD (91%) than PD (75%) and this difference was present and similar across all age bands (figure 9.41). The percentage of the whole cohort which maintained a Hb ⩾10 g/dl without requiring ESA (by age band and modality) is shown in figure 9.42. Overall 7% of HD patients and 24% of PD patients maintained their Hb ⩾10 g/dl without an ESA (figure 9.41). Interestingly for HD patients, older patients were less

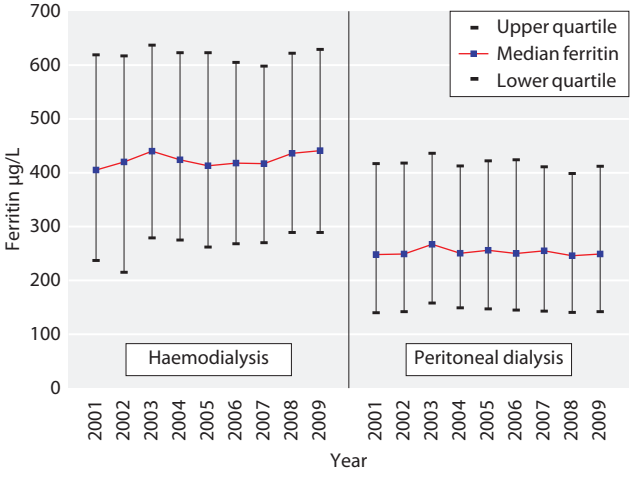

Fig. 9.38. Median ferritin of prevalent patients (2001–2009)

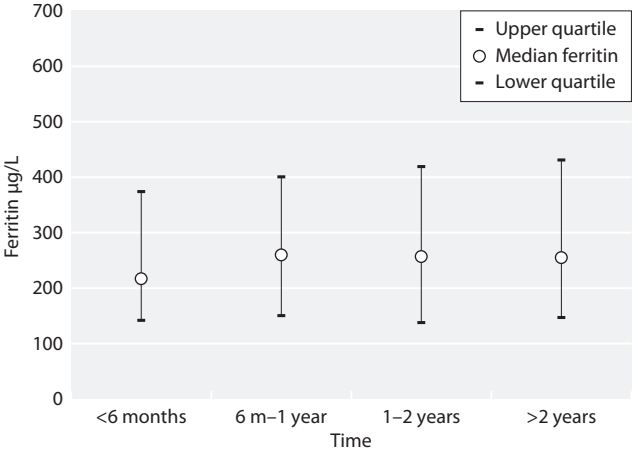

Fig. 9.40. Median ferritin and length of survival on RRT (PD)

Table 9.6. ESA prescribing in HD patients

Centre	N in ESA data file	% on ESA	N on ESA	% with dose data	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb ⩾10 g/dl and not on ESA
Antrim	121	93	113	100	9,637	8,000	7
B Heart	406	85	344	100	10,430	8,000	13
Bangor	74	77	57	98	12,124	9,000	22
Basldn	133	94	125	100	10,056	8,000	5
Belfast	229	93	214	100	7,668	6,000	5
Bradfd	176	87	153	97	6,909	6,000	8
Bristol	403	94	380	100	10,431	8,000	5
Chelms	109	97	106	100	14,755	13,500	2
Covnt	314	92	290	99	12,380	12,000	7
Derry	60	93	56	100	10,536	9,000	7
Donc	109	97	106	100	9,641	8,000	3
Dorset	215	89	192	100	11,596	8,000	10
Exeter	302	97	293	99	9,693	8,000	3
Ipswi	97	97	94	100	8,670	8,000	3
Kent	314	93	292	100	11,354	9,000	6
Leeds	468	92	430	97	5,875	4,000	7
Leic	706	98	690	98	8,447	6,000	2
Liv RI	370	95	351	100	9,646	8,000	4
Middlbr	268	80	214	100	6,334	6,000	16
Newry	94	95	89	100	7,528	4,000	5
Norwch	295	92	270	100	8,826	8,000	8
Nottm	379	96	365	100	10,123	9,000	3
Oxford	335	92	308	100	12,266	10,000	7
Prestn	448	87	389	7			10
Redng	249	94	233	0			5
Sheff	571	91	518	100	10,438	8,000	9
Shrew	182	90	163	95	8,587	8,000	9
Sthend	121	95	115	100	12,017	12,000	4
Swanse	318	81	259	0			17
Truro	139	98	136	95	7,239	5,000	1
Tyrone	86	97	83	100	9,530	9,000	2
Ulster	86	99	85	100	6,536	5,000	1
Wolve	287	92	264	100	9,017	6,000	7
Wrexm	71	90	64	92	7,678	6,000	8
York	169	71	120	99	7,520	6,000	27
England	**7,565**	**92**	**6,941**	**91**	**9,620**	**8,000**	**7**
N Ireland	**676**	**95**	**640**	**100**	**8,338**	**6,000**	**5**
Wales	**463**	**82**	**380**	**31**	**9,810**	**8,000**	**16**
E, W & NI	**8,704**	**91**	**7,961**	**89**	**9,507**	**8,000**	**7**

Blank cells denote centres excluded from analyses due to missing or very incomplete dosage data

likely to have a haemoglobin above 10 g/dl without an ESA if they were on HD but this association was not apparent for older patients on PD.

Figure 9.43 shows the percentage of anaemic patients (Hb <10.0 g/dl) receiving an ESA. A minority of patients had a Hb <10 g/dl and appeared to not be receiving ESA therapy. There are several potential explanations for this including some patients being declared unresponsive to ESA therapy and therefore no longer on treatment, some individuals may have just become anaemic and not yet started therapy and others may have been on ESA treatment but not had it recorded.

ESA prescription and gender

Provision of ESA by age and gender for HD and PD patients is shown in figures 9.44 and 9.45. For both modalities across all age ranges, a higher percentage of females were on ESA treatment. In HD patients, 94% of females were receiving ESA therapy compared to 90% of males. In PD patients, 78% of

Table 9.7. ESA prescribing in PD patients

Centre	N in ESA data file	% on ESA	N on ESA	% with dose data	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb ⩾10 g/dl and not on ESA
Antrim	14						
B Heart	27	70	19	100	6,368	4,000	30
Bangor	29	69	20	100	4,740	4,000	31
Basldn	25	52	13	100	6,385	4,000	48
Belfast	34	74	25	100	4,820	3,000	26
Bradfd	31	81	25	76	7,053	6,000	19
Bristol	68	75	51	98	6,578	4,000	25
Camb	31	81	25	100	6,528	4,000	16
Cardff	97	60	58	0			39
Carlis	13						
Chelms	31	77	24	100	7,042	5,500	23
Clwyd	7						
Covnt	73	73	53	100	8,321	6,000	25
Derry	3						
Donc	30	83	25	100	6,220	4,000	14
Dorset	54	83	45	100	5,300	4,000	13
Dudley	50	62	31	94	4,745	4,000	35
Exeter	64	81	52	100	5,430	4,000	19
Ipswi	42	81	34	100	5,842	4,000	19
Leeds	86	87	75	99	5,486	4,000	12
Leic	148	84	125	97	4,936	4,000	15
Liv RI	80	86	69	100	9,169	8,000	14
Newry	12						
Norwch	55	58	32	100	4,198	4,000	38
Nottm	101	77	78	100	5,067	3,750	22
Oxford	93	78	73	100	8,329	4,000	22
Plymth	38	61	23	100	6,348	4,000	38
Prestn	65	65	42	2			34
Redng	73	81	59	0			18
Sheff	68	65	44	100	7,500	6,000	35
Shrew	27	67	18	94	6,000	4,000	33
Sthend	17						
Swanse	50	82	41	0			18
Truro	21	95	20	95	5,227	4,000	5
Tyrone	11						
Ulster	2						
Wolve	40	75	30	100	6,183	4,000	23
York	15						
England	**1,466**	**76**	**1,115**	**89**	**6,306**	**4,000**	**23**
N Ireland	**76**	**71**	**54**	**100**	**5,065**	**3,000**	**29**
Wales	**183**	**67**	**123**	**20**	**4,867**	**4,000**	**32**
E, W & NI	**1,725**	**75**	**1,292**	**83**	**6,212**	**4,000**	**24**

Blank cells denote centres excluded from analyses due to low patient numbers or very incomplete dosage data

females compared to 73% of males were on ESA treatment.

ESAs and time on renal replacement therapy

The percentage of patients on ESA by time on RRT and dialysis modality is shown in figure 9.46. This is a cross-sectional analysis at the final quarter of 2009. Patients who had previously changed RRT modality were still included in this analysis. Interestingly, the proportion of PD patients requiring ESA rises with duration of RRT from 73% after 1 year of PD, to 86% after 10 or more years. This almost certainly reflects the loss of residual renal function. For at least the first 10 years on RRT, a greater percentage of HD patients are receiving ESA treatment than patients on PD at any given time point.

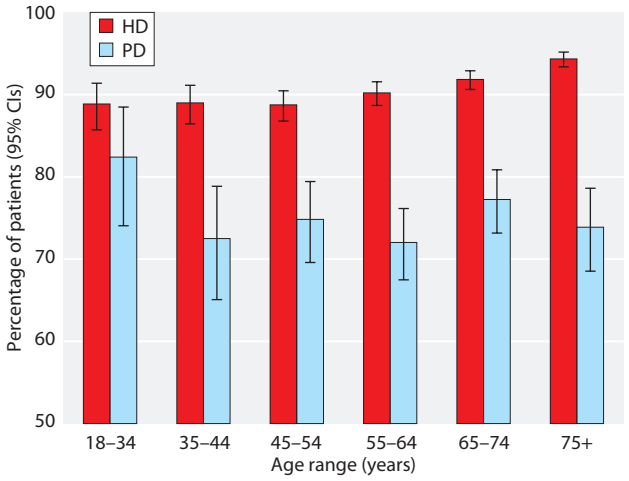

Fig. 9.41. Percentage of dialysis patients on ESA, by age group and treatment modality

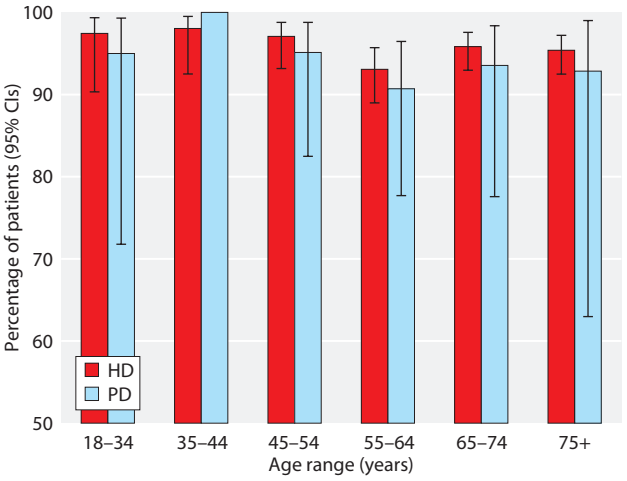

Fig. 9.43. Percentage of patients with Hb <10 g/dl who are on ESA, by age group and treatment modality

ESA dose and success with guideline compliance

There is no significant relationship between centres' mean ESA dose and median Hb for HD patients (figure 9.47) or compliance with the EPBG minimum standard for Hb for HD patients (figure 9.48). This is not surprising as the most anaemic patients and those least responsive to ESAs are often those given the biggest doses. Figure 9.49 shows the frequency distribution of weekly ESA dose by treatment modality.

It is known that not all patients treated with dialysis who have a Hb above the new RA guideline ceiling of 12.5 g/dl are receiving ESA. As a result, it has been suggested that it may be inappropriate to include these patients within the group not meeting this RA target for two reasons: firstly, the high Hb remains outside the control of the clinician, and secondly, the recent trials suggesting that it may be detrimental to achieve a high Hb in renal patients were based only upon patients treated with ESAs [10, 11].

Figures 9.50 and 9.51 show the percentages of HD and PD patients in each centre whose Hb lies above, within or below the RA guidelines of 10.5–12.5 g/dl. These charts also show the proportion of patients with a Hb above 12.5 g/dl who were receiving, or were not receiving ESAs. These analyses are restricted to the centres with acceptable ESA returns as stipulated above. These figures

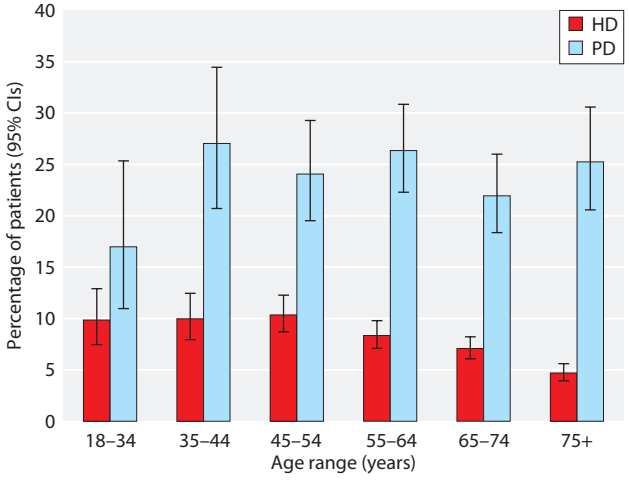

Fig. 9.42. Percentage of whole cohort who are not on ESA and have Hb ⩾10 g/dl, by age group and treatment modality

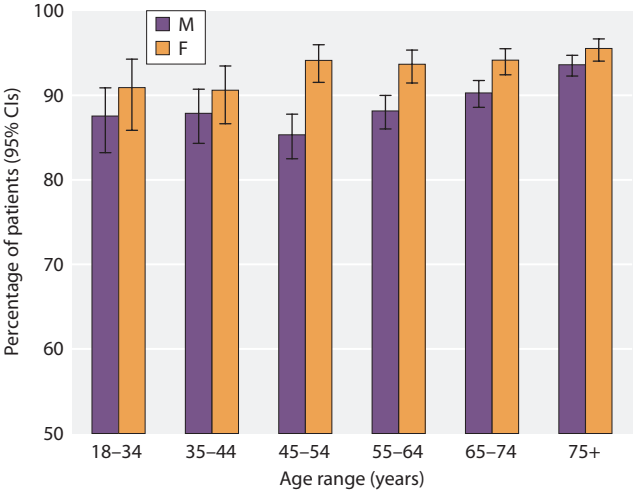

Fig. 9.44. Prescription of ESA by age and gender in patients treated with HD

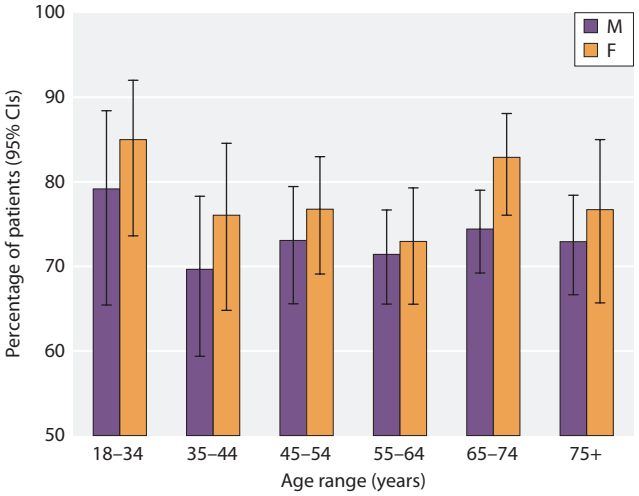

Fig. 9.45. Prescription of ESA by age and gender in patients treated with PD

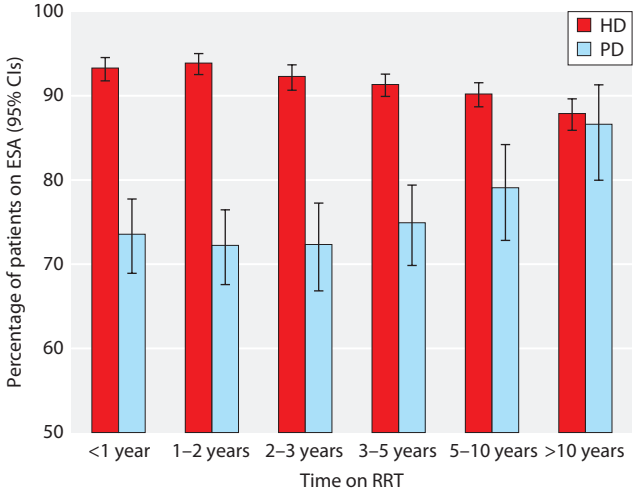

Fig. 9.46. Percentage of patients on ESA by time on RRT

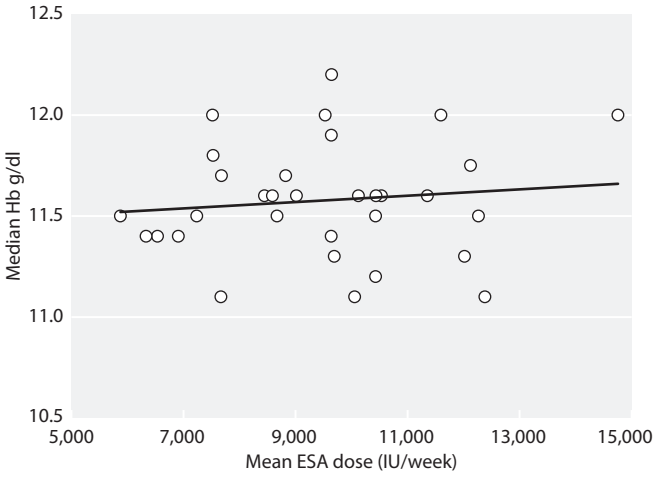

Fig. 9.47. Median Hb versus mean ESA dose in patients treated with HD, by centre

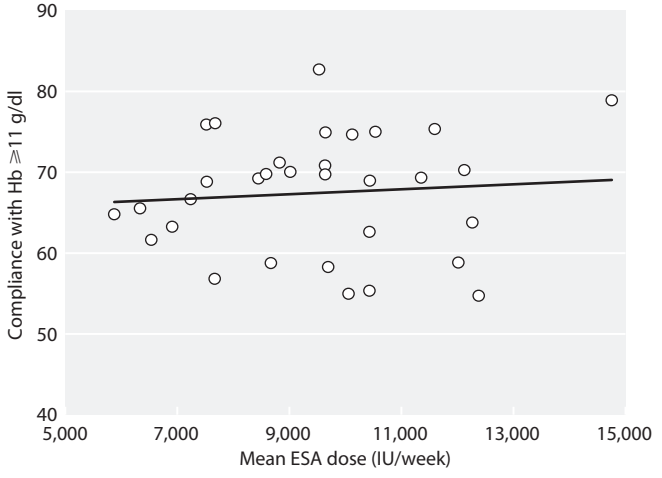

Fig. 9.48. Compliance with European Best Practice Guidelines versus mean ESA dose in patients treated with HD, by centre

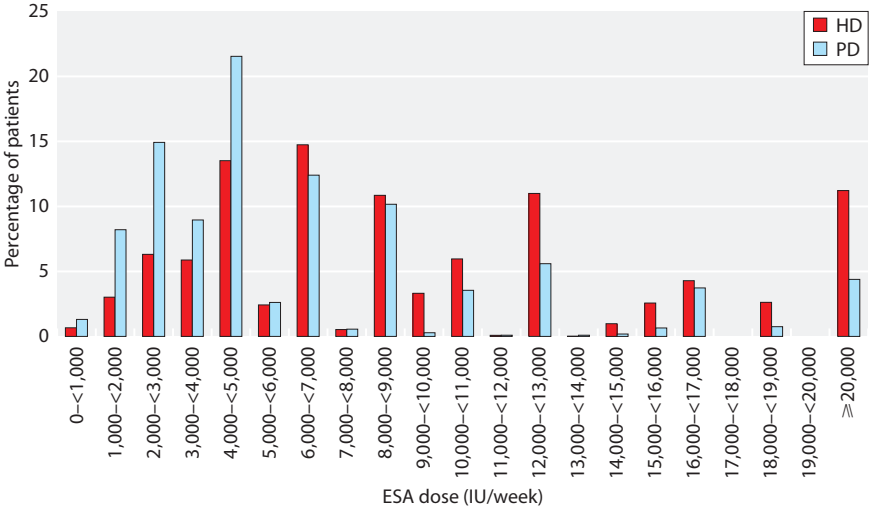

Fig. 9.49. Frequency distribution of weekly ESA dose

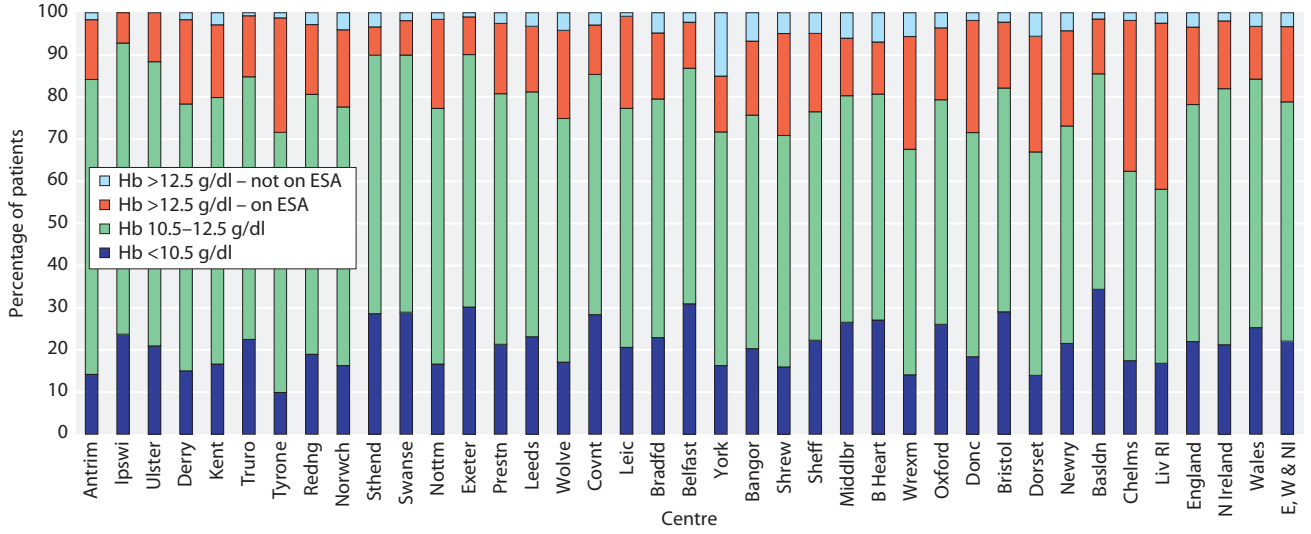

Fig. 9.50. Distribution of haemoglobin in patients treated with HD and the proportion of patients with Hb >12.5 g/dl receiving ESA

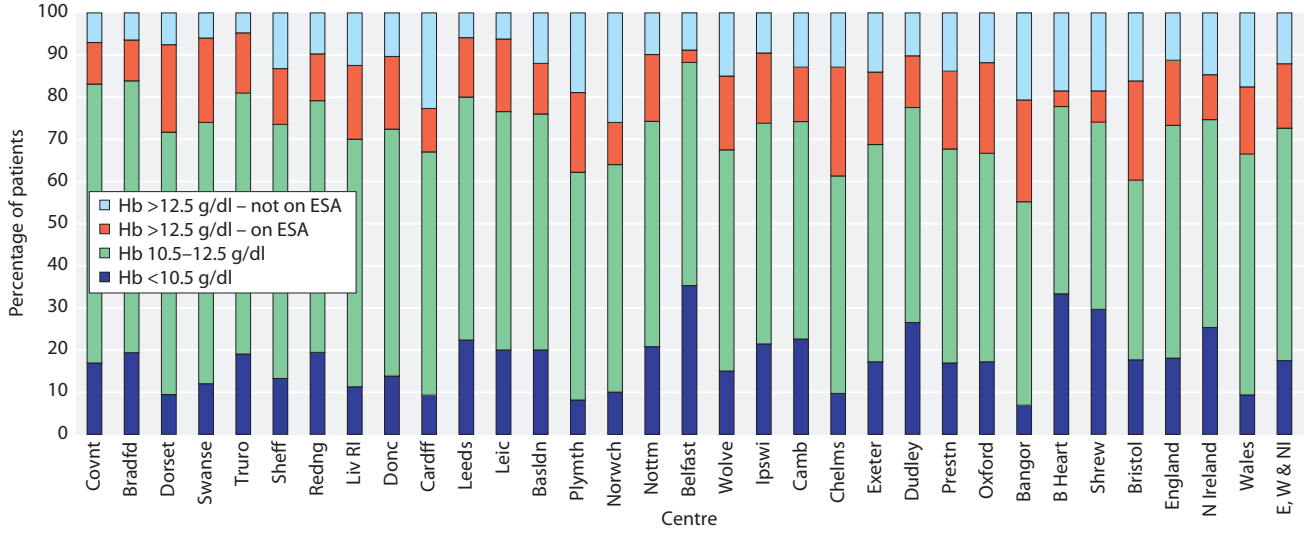

Fig. 9.51. Distribution of haemoglobin in patients treated with PD and the proportion of patients with Hb >12.5 g/dl receiving ESA

show that 21.2% of HD patients had a Hb above the RA ceiling of 12.5 g/dl, but 3.3% were not receiving ESA. Patients on PD were more likely to have a high Hb without the use of ESA (27.4% with Hb >12.5, with 12.1% not on ESAs).

Discussion

Haemoglobin outcomes for patients on HD and PD in the UK were largely compliant with the RA minimum standard of Hb ⩾10.0 g/dl (85% and 88% respectively). Achieving compliance whilst also attempting compliance with the NICE guidelines published in 2006 and the 4th edition of the RA Clinical Practice Guidelines 2006 [6] recommended outcome Hb of between 10.5 and 12.5 g/dl requires careful positioning of the median outcome Hb for each centre. It also requires a reduction in the standard deviation of Hb to reach compliance levels higher than ~60% even if the median Hb falls on 11.5 g/dl.

Of the 44 centres achieving >85% compliance with Hb ⩾10.0 g/dl in HD patients, 19 centres achieved ⩾60% compliance with Hb between 10.5–12.5 g/dl. This is an improvement from the 9 centres out of 47

which were reported last year. The presentation of funnel plots for compliance with Hb $\geqslant$10.0 g/dl and Hb between 10.5–12.5 g/dl (figures 9.12 and 9.13) may enable centres to continue adjusting their desired Hb outcome in light of the NICE guidelines.

Narrowing the population Hb distribution would appear to be important if centres wish to achieve compliance with Hb >10 g/dl whilst avoiding higher Hb outcomes i.e. >12.5 g/dl [10–12]. Nine of the 10 centres achieving the greatest compliance with Hb between 10.5 and 12.5 g/dl had the lowest standard deviations for Hb (1.1 to 1.2 g/dl) in HD patients. If some centres consistently achieve these narrow distributions and the critical behaviour(s) by which they achieve these outcomes were identified, other centres could attempt to copy their behaviour.

Previous reports have highlighted the need to avoid improving compliance with the NICE guidelines at the expense of the Hb $\geqslant$10.0 g/dl minimum standard. This year's analyses confirm that the UK dialysis population are maintaining compliance with more than 85% of patients having a Hb $\geqslant$10.0 g/dl. The use of a target Hb between 10.5–12.5 g/dl alone would infer equivalent risk of Hb >12.5/dl as for <10.5 g/dl. The NICE guidance [5] on limiting upper Hb was primarily a health economic decision and at the time was not given on the grounds of safety. However recent studies highlight the lack of benefit and possible harm related to higher Hb outcomes. The evidence for improving Hb $\geqslant$10 g/dl remains unchanged.

Compliance with advice regarding iron stores as reflected by ferritin has remained stable in the UK and the percentage of patients with serum ferritin greater than 100 μg/L showed that the provision of iron to UK dialysis patients has been maintained.

Overall the data demonstrated that UK renal centres continued to give a high priority to the management of factors influencing Hb. The improvements to compliance with the NICE guidelines shown in the last report have been maintained with 61 centres achieving $\geqslant$50% compliance with Hb between 10.5–12.5 g/dl for HD patients compared with 60, 51 and 35 centres respectively in the previous 3 UKRR reports. The overall UK compliance with this range has also improved from 48% to 56% over the same period.

Conflicts of interest: none

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Chapter 10
Calcium, Phosphate, Parathyroid Hormone, Bicarbonate and Total Cholesterol Concentrations amongst patients receiving haemodialysis or peritoneal dialysis in England, Wales and Northern Ireland in 2009: national and centre-specific analyses

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Key Words
Bicarbonate · Biochemical variables · Calcium · Cholesterol · Dialysis · Haemodialysis · Parathyroid hormone · Peritoneal dialysis · Phosphate · Quality improvement

Summary

- 61% of HD patients and 70% of PD patients had a serum phosphate between 1.1–1.8 mmol/L.
- 24% of HD and 23% of PD patients had a serum phosphate >1.8 mmol/L.
- 74% of HD and 75% of PD patients had adjusted calcium between 2.2–2.5 mmol/L.
- 28% of HD and 32% of PD patients has a serum PTH between 16–32 pmol/L.
- 72% of HD and 83% of PD patients achieved the audit measure for bicarbonate.

Introduction

The UK Renal Registry (UKRR) collects routine biochemical data from clinical information systems in renal centres in England, Wales and Northern Ireland. Annual cross sectional analyses are undertaken on some of these variables to determine centre level performance against national (Renal Association) clinical performance measures [1]. This enables UK renal centres to compare their own performance against each other and to the UK average performance [2]. The UK Renal Association Clinical Practice Guidelines were revised and the final version of the 4th edition of these guidelines was published in November 2007 [1]. Audit measures for kidney disease increasingly include tighter specification limits in conjunction with a growing evidence base. Out of range observations (e.g. hyperphosphataemia and hypophosphataemia) need to be interpreted cautiously as they may relate to different clinical problems or population characteristics. These will therefore require different strategies to improve centre performance of clinical audit measures. The format of data presentation has been revised compared to previous UKRR reports. To supplement these performance analyses, summary statistical data have been provided to enhance understanding of the population characteristics of each centre and longitudinal analyses demonstrate changes over time.

Methods

These analyses relate to biochemical variables in the prevalent dialysis cohort in England, Wales and Northern Ireland in 2009. The cohort studied were patients prevalent on dialysis treatment on 31/12/2009, excluding patients receiving dialysis for less than 90 days and those who had changed modality or renal centre in the last 90 days. HD and PD cohorts were analysed separately. A full definition of this cohort including inclusion and exclusion criteria is included in appendix B www.renalreg.com/Report-Area/Report 2010/Appendix-B.pdf.

The biochemical variables analysed were phosphate, calcium, parathyroid hormone, bicarbonate and cholesterol. The method of data collection and validation by the UKRR has been described elsewhere [3]. For each quarter of 2009 the UKRR extracted biochemical data electronically from clinical information systems in UK dialysis centres. The UKRR does not collect data regarding different assay methods mainly because a single dialysis centre may process samples in several different laboratories. For centres providing adjusted calcium values, these data were analysed directly as it is these values on which clinical decisions within centres are based. For centres providing unadjusted calcium values, a formula in widespread use was used to calculate adjusted calcium [4]. The audit measure for adjusted calcium in the 4th edition of the Renal Association Clinical Practice Guidelines depends on a local reference range [1]. The UKRR has used adjusted calcium between 2.2–2.5 mmol/L as an audit measure. There are also a variety of methods and reference ranges in use to measure parathyroid hormone. To enable some form of comparative audit the UKRR has chosen 2–4 times the median upper laboratory value as the audit measure. This equates to 16–32 pmol/L and is comparable to KDOQI (15–31 pmol/L) [5]. The audit measure used for serum bicarbonate in the HD cohort was 20–26 mmol/L and in the PD cohort was 22–30 mmol/L. A summary of the current Renal Association audit measures and conversion factors to SI units are given in table 10.1.

Quarterly values were extracted from the database for the last two quarters for calcium and phosphate, the last three quarters for PTH and the entire year for cholesterol. Patients who do not have these data were excluded from the analyses. The completeness of data were analysed at centre and country level. All patients were included in analyses but centres with less than 50% completeness were excluded from plots showing centre performance. Data were also excluded from plots when there were less than 20 patients with data both at centre or country level. These data were analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges). Where applicable, the percentage achieving the Renal Association or other surrogate clinical performance measure was also calculated.

Centres report several biochemical variables with different levels of accuracy, leading to problems in comparative evaluation. For example, in the case of serum bicarbonate, data can be submitted as integer values but some centres submit data to one

Table 10.1. Summary of clinical audit measures and conversion factor from SI units

Biochemical variable	Clinical audit measure	Conversion factor from SI units
Phosphate	1.1–1.8 mmol/L	mg/dl = mmol/L × 3.1
Calcium	Normal range (ideally <2.5 mmol/L)	mg/dl = mmol/L × 4
Parathyroid hormone	2–4 times upper limit of normal	ng/L = pmol/L × 9.5
Bicarbonate	HD patients: 20–26 mmol/L PD patients: 22–30 mmol/L	mg/dl = mmol/L × 6.1
Cholesterol	No audit measure	mg/dl = mmol/L × 38.6

decimal place. All data has this year been rounded up in an attempt to make all centres more comparable. This has resulted in significant changes in target attainment for some centres and an overall increase in the percentage of patients achieving the treatment target.

The number preceding the centre name in each figure indicates the percentage of missing data for that centre [6]. Funnel plot analysis was used to identify 'outlying centres'. The percentage achieving each standard was plotted against centre size along with the upper and lower 95% and 99.9% limits. Centres can be identified on these plots by looking up the number of patients treated in each centre provided in the relevant table and finding this value on the x-axis. Longitudinal analyses were performed for some data to calculate overall changes in achievement of a performance measure annually from 2000 to 2009 and were recalculated for each previous year using the rounding procedure. All data were unadjusted for case-mix.

Results and Discussions

Mineral and bone variables

Phosphate

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'Serum phosphate in dialysis patients (measured before a "short gap" dialysis session in HD patients) should be maintained between 1.1 and 1.8 mmol/L.' (Module 2: Complications) [1]

The data for serum phosphate were 96% complete for HD patients and 98% complete for PD patients overall although there was considerable variation between centres (tables 10.2 and 10.4). The individual centre means and standard deviations are shown in tables 10.2 and 10.4. Sixty-one percent (CI 61–62%) of HD patients and 70% (CI 68–71%) of PD patients achieved a phosphate between 1.1–1.8 mmol/L (tables 10.3 and 10.5). The proportion of HD patients with hyperphosphataemia was 24% compared to 28% in 2008 and the proportion with hypophosphataemia was 15% compared to 2008 when it was 18% (table 10.3, figures 10.1 and 10.2). The proportion of PD patients with hyperphosphataemia was 23% compared to 24% in 2008 and the proportion with hypophosphataemia was 8% compared to 13% in 2008 (table 10.3, figures 10.3 and 10.4). The changes in the percentages above, below and within range for the period 2000 to 2009 for England, Northern Ireland and Wales combined, are shown in figure 10.5.

There was significant between centre variation in the proportion of patients below, within and above the range specified by the clinical performance measure (figures 10.1–10.4). The latest version of the Renal Association Clinical Practice Guidelines [7], finalised in 2010, suggests maintenance of serum phosphate between 1.1–1.7 mmol/L and this audit standard will be used in next year's report.

Table 10.2. Summary statistics for phosphate in haemodialysis patients in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99.2	120	1.5	0.5	1.4	1.1	1.8
B Heart	95.3	387	1.7	0.5	1.6	1.3	1.9
B QEH	96.9	782	1.6	0.5	1.5	1.2	1.8
Bangor	100.0	74	1.6	0.5	1.5	1.2	1.8
Basldn	98.5	131	1.5	0.5	1.4	1.2	1.8
Belfast	98.7	226	1.5	0.5	1.4	1.1	1.8
Bradfd	94.3	166	1.4	0.5	1.4	1.1	1.8
Brightn	99.7	291	1.6	0.5	1.5	1.2	1.9
Bristol	100.0	403	1.7	0.5	1.7	1.4	2.0
Camb	70.1	230	1.5	0.5	1.5	1.2	1.8
Cardff	97.8	436	1.6	0.5	1.5	1.3	1.9
Carlis	100.0	57	1.5	0.5	1.4	1.2	1.8
Carsh	97.9	599	1.6	0.5	1.6	1.3	1.9
Chelms	100.0	109	1.4	0.4	1.3	1.1	1.6
Clwyd	100.0	74	1.7	0.5	1.6	1.3	2.1
Colchr	99.0	101	1.6	0.4	1.5	1.3	1.8

Table 10.2. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Covnt	98.1	308	1.5	0.5	1.5	1.2	1.9
Derby	100.0	236	1.5	0.5	1.5	1.2	1.8
Derry	100.0	60	1.6	0.4	1.5	1.3	1.9
Donc	100.0	109	1.5	0.5	1.5	1.2	1.8
Dorset	99.5	214	1.5	0.5	1.4	1.2	1.7
Dudley	84.6	121	1.6	0.6	1.6	1.2	2.0
Exeter	99.7	301	1.5	0.5	1.5	1.2	1.8
Glouc	100.0	173	1.6	0.5	1.6	1.3	1.9
Hull	99.7	300	1.6	0.6	1.5	1.2	1.8
Ipswi	99.0	96	1.5	0.5	1.5	1.2	1.7
Kent	98.4	309	1.7	0.5	1.6	1.3	2.0
L Barts	99.7	646	1.7	0.6	1.6	1.3	1.9
L Guys	96.7	519	1.4	0.5	1.4	1.1	1.7
L Kings	99.7	370	1.5	0.5	1.5	1.2	1.8
L Rfree	82.4	509	1.5	0.5	1.4	1.1	1.8
L St.G	98.4	243	1.5	0.5	1.4	1.1	1.7
L West	96.7	1,155	1.3	0.5	1.2	1.0	1.6
Leeds	98.9	463	1.6	0.5	1.5	1.2	1.8
Leic	99.6	703	1.6	0.5	1.5	1.3	1.8
Liv Ain	69.9	95	1.5	0.4	1.4	1.2	1.8
Liv RI	99.2	367	1.6	0.5	1.5	1.2	1.8
M Hope	87.8	288	1.6	0.6	1.5	1.2	2.0
M RI	60.2	245	1.6	0.6	1.5	1.2	2.0
Middlbr	98.5	264	1.6	0.5	1.5	1.2	1.9
Newc	100.0	252	1.6	0.6	1.5	1.2	1.9
Newry	98.9	93	1.5	0.5	1.5	1.1	1.9
Norwch	99.7	294	1.6	0.5	1.5	1.3	1.8
Nottm	100.0	379	1.5	0.5	1.4	1.2	1.8
Oxford	99.7	334	1.6	0.6	1.6	1.2	1.9
Plymth	99.1	112	1.5	0.5	1.4	1.2	1.8
Ports	99.8	440	1.6	0.5	1.6	1.3	2.0
Prestn	99.3	445	1.6	0.5	1.5	1.2	1.9
Redng	99.6	248	1.5	0.4	1.5	1.2	1.7
Sheff	99.8	570	1.6	0.5	1.6	1.3	1.9
Shrew	99.5	181	1.6	0.5	1.5	1.2	1.8
Stevng	99.2	349	1.6	0.5	1.6	1.3	2.0
Sthend	98.4	119	1.5	0.4	1.6	1.2	1.8
Stoke	99.6	276	1.5	0.5	1.5	1.2	1.8
Sund	96.4	159	1.7	0.6	1.6	1.3	2.0
Swanse	100.0	322	1.5	0.4	1.5	1.2	1.8
Truro	98.6	137	1.8	0.5	1.7	1.4	2.1
Tyrone	98.8	85	1.5	0.5	1.4	1.1	1.7
Ulster	100.0	86	1.4	0.4	1.4	1.1	1.7
Wirral	97.1	165	1.6	0.5	1.5	1.2	1.8
Wolve	99.7	286	1.6	0.5	1.5	1.2	1.9
Wrexm	100.0	71	1.4	0.5	1.4	1.1	1.7
York	98.8	167	1.4	0.5	1.3	1.1	1.6
England	**96.0**	**16,203**	**1.6**	**0.5**	**1.5**	**1.2**	**1.8**
N Ireland	**99.1**	**670**	**1.5**	**0.5**	**1.4**	**1.1**	**1.8**
Wales	**99.0**	**977**	**1.6**	**0.5**	**1.5**	**1.2**	**1.8**
E, W & NI	**96.3**	**17,850**	**1.6**	**0.5**	**1.5**	**1.2**	**1.8**

Table 10.3. Percentage of haemodialysis patients within, below and above the range specified in the RA audit measure for phosphate (1.1–1.8 mmol/L) in 2009

							Change from 2008		
Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.8 mmol/L	% within range	95% LCL	95% UCL
Antrim	120	53.3	44.4	62.1	22.5	24.2	−1.3	−17.9	15.3
B Heart	387	62.0	57.1	66.7	7.5	30.5	0.7	−8.4	9.8
B QEH	782	66.5	63.1	69.7	11.4	22.1	−1.0	−7.2	5.3
Bangor	74	73.0	61.8	81.9	8.1	18.9	13.6	−6.7	33.8
Basldn	131	63.4	54.8	71.2	16.0	20.6	−0.4	−15.9	15.2
Belfast	226	61.1	54.6	67.2	16.4	22.6	7.1	−4.9	19.0
Bradfd	166	60.2	52.6	67.4	21.7	18.1	4.5	−9.5	18.5
Brightn	291	57.7	52.0	63.3	13.4	28.9	−2.7	−13.5	8.1
Bristol	403	56.3	51.4	61.1	6.5	37.2	1.5	−7.5	10.5
Camb	230	63.5	57.1	69.5	16.1	20.4	5.8	−6.9	18.4
Cardff	436	60.3	55.7	64.8	12.2	27.5	−4.9	−13.4	3.6
Carlis	57	68.4	55.4	79.1	8.8	22.8	−3.4	−24.4	17.6
Carsh	599	64.9	61.0	68.7	9.4	25.7	7.0	−0.4	14.4
Chelms	109	60.6	51.1	69.3	23.9	15.6	−5.8	−23.2	11.6
Clwyd	74	56.8	45.3	67.5	13.5	29.7	0.5	−21.3	22.3
Colchr	101	74.3	64.9	81.8	5.9	19.8	6.9	−9.8	23.6
Covnt	308	56.8	51.2	62.2	18.2	25.0	0.4	−10.2	10.9
Derby	236	67.0	60.7	72.7	13.6	19.5	3.4	−8.1	14.8
Derry	60	71.7	59.1	81.6	3.3	25.0	8.2	−14.6	31.1
Donc	109	63.3	53.9	71.8	15.6	21.1	−3.4	−22.0	15.3
Dorset	214	70.6	64.1	76.3	11.7	17.8	4.6	−7.4	16.7
Dudley	121	57.0	48.1	65.5	14.1	28.9	−3.6	−20.8	13.6
Exeter	301	62.8	57.2	68.1	13.0	24.3	−3.3	−13.6	7.1
Glouc	173	63.6	56.2	70.4	9.3	27.2	−3.6	−17.5	10.4
Hull	300	59.0	53.3	64.4	16.7	24.3	4.3	−6.2	14.8
Ipswi	96	62.5	52.4	71.6	20.8	16.7	0.0	−18.0	18.0
Kent	309	62.1	56.6	67.4	7.1	30.7	3.7	−6.7	14.0
L Barts	646	57.3	53.4	61.0	11.8	31.0	−2.0	−9.3	5.3
L Guys	519	58.0	53.7	62.2	22.7	19.3	−1.0	−9.1	7.1
L Kings	370	64.9	59.9	69.6	14.9	20.3	1.9	−7.2	10.9
L Rfree	509	56.8	52.4	61.0	20.2	23.0	−2.3	−10.2	5.7
L St.G	243	60.5	54.2	66.5	19.3	20.2	−0.9	−12.9	11.1
L West	1,155	56.3	53.4	59.1	31.7	12.0	−0.4	−6.1	5.3
Leeds	463	61.1	56.6	65.5	14.9	24.0	3.6	−4.9	12.0
Leic	703	66.6	63.0	70.0	9.7	23.8	4.3	−2.3	11.0
Liv Ain	95	66.3	56.3	75.1	14.7	19.0	7.1	−10.4	24.5
Liv RI	367	64.3	59.3	69.0	14.2	21.5	−0.3	−9.6	8.9
M Hope	288	57.6	51.9	63.2	13.5	28.8	6.8	−4.5	18.1
M RI	245	54.7	48.4	60.8	16.7	28.6	0.5	−10.7	11.8
Middlbr	264	59.1	53.1	64.9	12.9	28.0	−1.5	−12.6	9.7
Newc	252	58.3	52.2	64.3	13.1	28.6	−1.9	−13.2	9.4
Newry	93	49.5	39.5	59.5	23.7	26.9	−12.2	−31.2	6.9
Norwch	294	64.6	59.0	69.9	12.2	23.1	9.3	−1.2	19.8
Nottm	379	62.3	57.3	67.0	16.6	21.1	0.6	−8.7	9.9
Oxford	334	59.0	53.6	64.1	12.9	28.1	−0.9	−10.8	9.0
Plymth	112	57.1	47.8	66.0	17.9	25.0	5.8	−11.5	23.0
Ports	440	58.9	54.2	63.4	9.8	31.4	4.2	−4.5	13.0
Prestn	445	60.5	55.8	64.9	11.7	27.9	3.1	−5.6	11.8
Redng	248	66.9	60.8	72.5	16.5	16.5	2.8	−8.3	14.0
Sheff	570	61.6	57.5	65.5	9.0	29.5	1.9	−5.6	9.4
Shrew	181	64.1	56.9	70.7	13.3	22.7	1.0	−12.3	14.3
Stevng	349	57.3	52.1	62.4	11.5	31.2	−7.3	−16.9	2.4

Table 10.3. Continued

Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.8 mmol/L	Change from 2008 % within range	Change from 2008 95% LCL	Change from 2008 95% UCL
Sthend	119	64.7	55.7	72.8	13.5	21.9	−3.4	−19.1	12.4
Stoke	276	65.2	59.4	70.6	13.8	21.0	3.0	−8.0	14.0
Sund	159	58.5	50.7	65.9	10.1	31.5	7.8	−6.9	22.5
Swanse	322	69.3	64.0	74.1	11.2	19.6	8.6	−1.2	18.3
Truro	137	56.9	48.5	65.0	2.2	40.9	−7.0	−22.3	8.2
Tyrone	85	65.9	55.2	75.2	17.7	16.5	−4.7	−23.1	13.7
Ulster	86	66.3	55.7	75.5	19.8	14.0	5.5	−13.8	24.9
Wirral	165	66.1	58.5	72.9	10.3	23.6	11.8	−2.3	25.9
Wolve	286	62.9	57.2	68.3	11.9	25.2	3.8	−6.9	14.4
Wrexm	71	60.6	48.8	71.2	23.9	15.5	12.7	−8.7	34.1
York	167	65.3	57.8	72.1	22.8	12.0	3.1	−12.4	18.7
England	**16,203**	**61.3**	**60.5**	**62.0**	**14.5**	**24.2**	**1.3**	**−0.1**	**2.7**
N Ireland	**670**	**60.3**	**56.5**	**63.9**	**17.9**	**21.8**	**1.4**	**−5.6**	**8.4**
Wales	**977**	**64.0**	**60.9**	**66.9**	**12.5**	**23.5**	**2.6**	**−3.1**	**8.3**
E, W & NI	**17,850**	**61.4**	**60.7**	**62.1**	**14.5**	**24.1**	**1.4**	**0.0**	**2.7**

Table 10.4. Summary statistics for phosphate in peritoneal dialysis patients in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100.0	14					
B Heart	96.3	26	1.4	0.4	1.4	1.1	1.6
B QEH	84.6	121	1.5	0.4	1.5	1.2	1.8
Bangor	100.0	29	1.5	0.3	1.5	1.4	1.5
Basldn	100.0	25	1.4	0.4	1.4	1.1	1.5
Belfast	100.0	34	1.8	0.6	1.8	1.4	2.1
Bradfd	100.0	31	1.7	0.4	1.7	1.4	2.0
Brightn	100.0	76	1.4	0.4	1.4	1.2	1.7
Bristol	100.0	68	1.7	0.5	1.6	1.4	2.0
Camb	100.0	31	1.4	0.3	1.4	1.2	1.6
Cardff	100.0	95	1.5	0.4	1.5	1.3	1.7
Carlis	100.0	13					
Carsh	99.1	110	1.6	0.4	1.6	1.3	1.8
Chelms	100.0	31	1.4	0.3	1.4	1.2	1.6
Clwyd	85.7	6					
Covnt	94.5	69	1.4	0.3	1.4	1.2	1.7
Derby	100.0	82	1.4	0.3	1.4	1.2	1.6
Derry	100.0	3					
Donc	96.7	29	1.5	0.4	1.5	1.2	1.8
Dorset	96.3	52	1.5	0.4	1.5	1.2	1.8
Dudley	98.0	49	1.7	0.5	1.7	1.4	1.9
Exeter	100.0	64	1.5	0.4	1.5	1.3	1.8
Glouc	100.0	39	1.7	0.4	1.7	1.5	1.9
Hull	98.4	62	1.6	0.4	1.6	1.3	1.8
Ipswi	100.0	42	1.8	0.5	1.7	1.4	2.0
Kent	100.0	64	1.5	0.3	1.5	1.3	1.7
L Barts	98.8	164	1.6	0.4	1.6	1.2	1.9
L Guys	100.0	44	1.6	0.4	1.6	1.3	1.9
L Kings	100.0	68	1.6	0.4	1.5	1.3	1.9
L Rfree	98.4	63	1.6	0.3	1.6	1.3	1.8
L St.G	96.6	56	1.5	0.4	1.3	1.2	1.6
L West	100.0	31	1.6	0.5	1.5	1.4	1.8
Leeds	100.0	86	1.6	0.5	1.6	1.3	1.9

Table 10.4. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Leic	98.0	145	1.6	0.4	1.6	1.3	1.8
Liv Ain	28.6	2					
Liv RI	98.8	79	1.5	0.4	1.4	1.3	1.7
M Hope	96.4	108	1.7	0.5	1.7	1.3	2.0
M RI	97.8	87	1.7	0.5	1.6	1.3	2.0
Middlbr	93.8	15					
Newc	100.0	48	1.7	0.5	1.7	1.5	1.9
Newry	100	12					
Norwch	87.3	48	1.5	0.5	1.5	1.3	1.8
Nottm	100.0	101	1.6	0.4	1.5	1.3	1.9
Oxford	100.0	93	1.7	0.4	1.6	1.4	1.9
Plymth	100.0	38	1.6	0.4	1.5	1.3	1.7
Ports	95.1	77	1.7	0.5	1.6	1.3	1.9
Prestn	100.0	65	1.7	0.4	1.6	1.3	1.9
Redng	100.0	73	1.4	0.3	1.4	1.3	1.7
Sheff	100.0	68	1.5	0.4	1.6	1.2	1.7
Shrew	96.3	26	1.6	0.4	1.7	1.4	2.0
Stevng	96.4	27	1.5	0.4	1.4	1.2	1.7
Sthend	94.1	16					
Stoke	98.6	68	1.5	0.4	1.4	1.3	1.7
Sund	100.0	24	1.6	0.4	1.7	1.5	1.9
Swanse	100.0	52	1.5	0.4	1.4	1.3	1.8
Truro	100.0	21	1.7	0.5	1.7	1.3	1.9
Tyrone	90.9	10					
Ulster	100.0	2					
Wirral	69.2	18					
Wolve	100.0	40	1.6	0.5	1.4	1.2	1.8
Wrexm	95.5	21	1.7	0.4	1.6	1.3	2.0
York	100.0	15					
England	**97.4**	**2,898**	**1.6**	**0.4**	**1.5**	**1.3**	**1.8**
N Ireland	**98.7**	**75**	**1.7**	**0.5**	**1.6**	**1.4**	**1.9**
Wales	**99.0**	**203**	**1.5**	**0.4**	**1.5**	**1.3**	**1.7**
E, W & NI	**97.5**	**3,176**	**1.6**	**0.4**	**1.5**	**1.3**	**1.8**

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

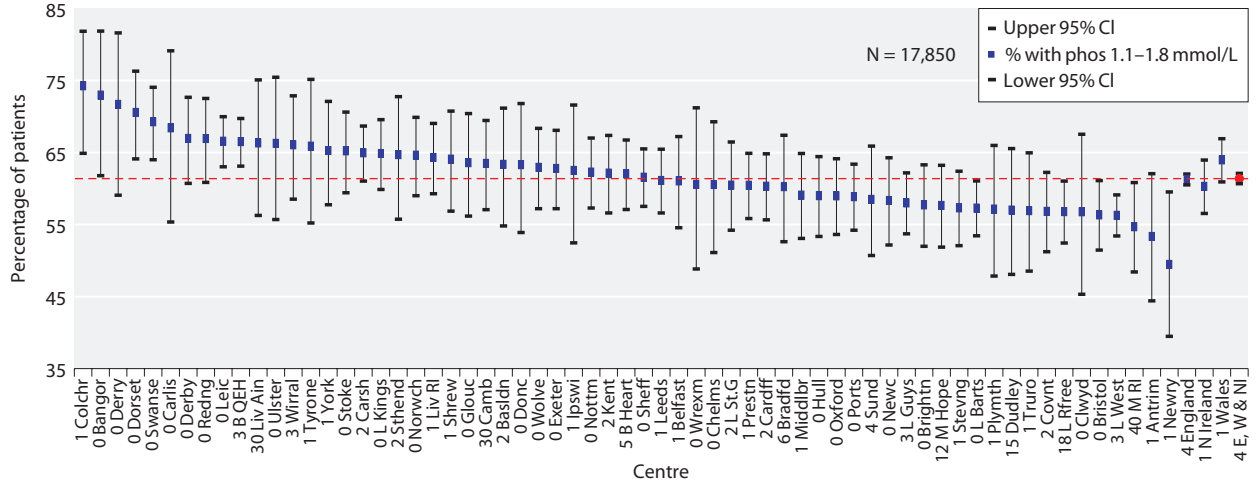

Fig. 10.1. Percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.8 mmol/L) by centre in 2009

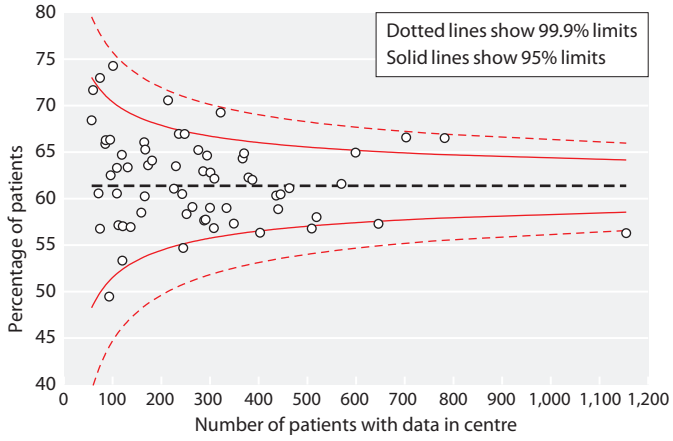

Fig. 10.2. Funnel plot of percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.8 mmol/L) by centre in 2009

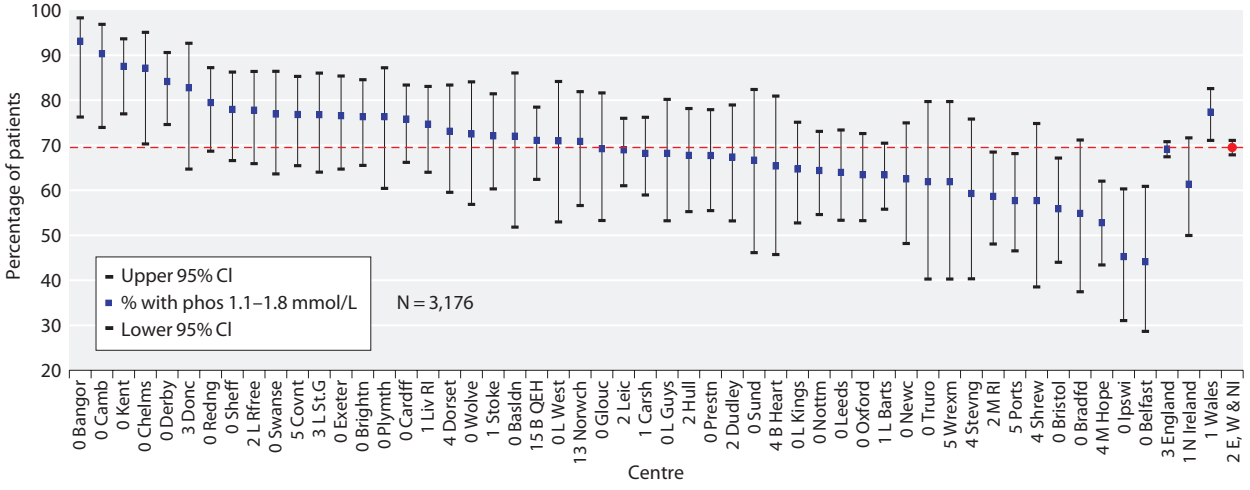

Fig. 10.3. Percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.8 mmol/L) by centre in 2009

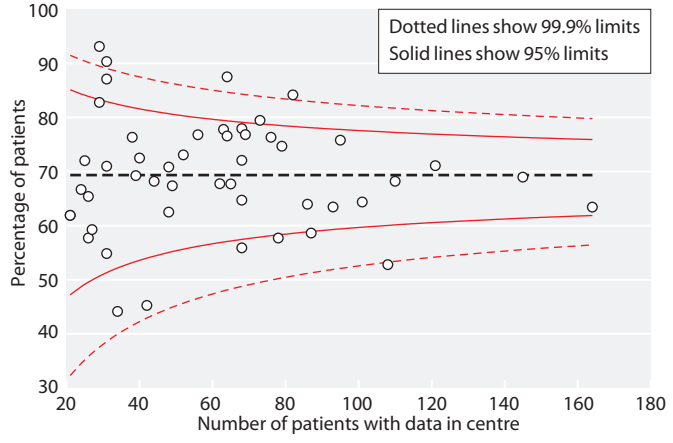

Fig. 10.4. Funnel plot of percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.8 mmol/L) by centre in 2009

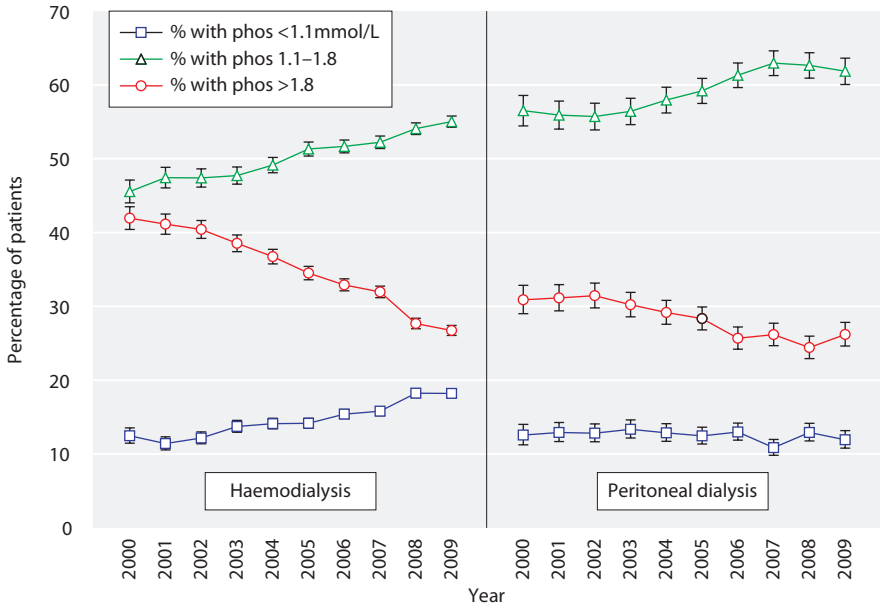

Fig. 10.5. Longitudinal change in percentage of patients with phosphate <1.1 mmol/L, 1.1–1.8 mmol/L and >1.8 mmol/L by dialysis modality 2000–2009

Table 10.5. Percentage of peritoneal dialysis patients within, below and above the range specified in the RA audit measure for phosphate (1.1–1.8 mmol/L) in 2009

							Change from 2008		
Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.8 mmol/L	% within range	95% LCL	95% UCL
B Heart	26	65.4	45.7	80.9	19.2	15.4	−16.8	−47.2	13.7
B QEH	121	71.1	62.4	78.5	9.1	19.8	4.1	−11.8	20.0
Bangor	29	93.1	76.3	98.3	0.0	6.9	17.2	−6.6	41.1
Basldn	25	72.0	51.8	86.0	16.0	12.0	−4.7	−35.2	25.9
Belfast	34	44.1	28.6	60.8	11.8	44.1	−10.2	−39.2	18.8
Bradfd	31	54.8	37.4	71.1	12.9	32.3	−19.4	−50.1	11.4
Brightn	76	76.3	65.5	84.5	9.2	14.5	8.8	−9.6	27.3
Bristol	68	55.9	44.0	67.2	8.8	35.3	−9.4	−30.6	11.8
Camb	31	90.3	73.9	96.9	9.7	0.0	14.0	−8.5	36.5
Cardff	95	75.8	66.2	83.4	6.3	17.9	0.6	−15.2	16.3
Carsh	110	68.2	58.9	76.2	8.2	23.6	−2.0	−17.9	13.9
Chelms	31	87.1	70.3	95.1	9.7	3.2	10.2	−13.1	33.5
Covnt	69	76.8	65.4	85.3	8.7	14.5	4.7	−15.1	24.5
Derby	82	84.2	74.6	90.6	7.3	8.5	9.2	−7.4	25.7
Donc	29	82.8	64.7	92.6	3.5	13.8	15.2	−11.7	42.1
Dorset	52	73.1	59.5	83.4	3.9	23.1	−16.7	−36.1	2.7
Dudley	49	67.4	53.2	78.9	4.1	28.6	−10.4	−34.0	13.1
Exeter	64	76.6	64.7	85.4	3.1	20.3	8.8	−12.0	29.6
Glouc	39	69.2	53.3	81.6	2.6	28.2	−6.5	−33.6	20.6
Hull	62	67.7	55.2	78.2	8.1	24.2	−5.1	−25.7	15.4
Ipswi	42	45.2	31.0	60.3	7.1	47.6	−15.2	−42.1	11.7
Kent	64	87.5	76.9	93.6	3.1	9.4	11.0	−6.0	28.1
L Barts	164	63.4	55.8	70.4	7.3	29.3	0.9	−12.1	13.9
L Guys	44	68.2	53.2	80.2	6.8	25.0	−9.4	−33.1	14.4
L Kings	68	64.7	52.7	75.1	10.3	25.0	−7.1	−27.4	13.2
L Rfree	63	77.8	65.9	86.4	3.2	19.1	7.1	−12.0	26.3
L St.G	56	76.8	64.0	86.0	8.9	14.3	14.8	−8.1	37.7
L West	31	71.0	53.0	84.2	6.5	22.6	1.9	−26.0	29.9
Leeds	86	64.0	53.3	73.4	7.0	29.1	−0.7	−19.8	18.4

Table 10.5. Continued

Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.8 mmol/L	Change from 2008 % within range	Change from 2008 95% LCL	Change from 2008 95% UCL
Leic	145	69.0	61.0	76.0	7.6	23.5	7.4	−6.7	21.5
Liv RI	79	74.7	64.0	83.1	7.6	17.7	8.8	−9.5	27.1
M Hope	108	52.8	43.4	62.0	10.2	37.0	−8.8	−26.0	8.3
M RI	87	58.6	48.0	68.5	6.9	34.5	0.4	−18.7	19.4
Newc	48	62.5	48.2	74.9	6.3	31.3	4.4	−22.1	30.9
Norwch	48	70.8	56.6	81.9	12.5	16.7	−5.5	−28.0	16.9
Nottm	101	64.4	54.6	73.1	8.9	26.7	−7.5	−24.0	9.1
Oxford	93	63.4	53.2	72.6	5.4	31.2	−9.4	−26.5	7.8
Plymth	38	76.3	60.4	87.2	7.9	15.8	5.2	−19.7	30.1
Ports	78	57.7	46.5	68.1	10.3	32.1	2.0	−19.1	23.0
Prestn	65	67.7	55.5	77.9	4.6	27.7	1.0	−21.0	23.0
Redng	73	79.5	68.7	87.2	12.3	8.2	3.5	−14.2	21.1
Sheff	68	77.9	66.6	86.2	7.4	14.7	16.0	−3.8	35.7
Shrew	26	57.7	38.5	74.8	7.7	34.6	−9.0	−42.4	24.5
Stevng	27	59.3	40.3	75.8	18.5	22.2	−15.0	−46.0	15.9
Stoke	68	72.1	60.3	81.4	10.3	17.7	−4.3	−23.4	14.7
Sund	24	66.7	46.1	82.4	8.3	25.0	2.4	−38.9	43.7
Swanse	52	76.9	63.6	86.4	7.7	15.4	0.7	−20.1	21.4
Truro	21	61.9	40.3	79.7	0.0	38.1	0.4	−36.4	37.1
Wolve	40	72.5	56.8	84.1	7.5	20.0	2.9	−21.3	27.0
Wrexm	21	61.9	40.3	79.7	0.0	38.1	0.0	−38.7	38.7
England	**2,898**	**69.1**	**67.4**	**70.8**	**8.0**	**22.9**	**0.5**	**−2.6**	**3.6**
N Ireland	**75**	**61.3**	**49.9**	**71.6**	**9.3**	**29.3**	**−6.1**	**−25.6**	**13.4**
Wales	**203**	**77.3**	**71.1**	**82.6**	**4.9**	**17.7**	**3.5**	**−7.3**	**14.2**
E, W & NI	**3,176**	**69.5**	**67.8**	**71.1**	**7.8**	**22.7**	**0.5**	**−2.5**	**3.4**

Adjusted Calcium

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'Serum calcium, adjusted for albumin concentration should be maintained within the normal reference range for the laboratory used (measured before a "short gap" dialysis session in HD patients) and ideally kept below 2.5 mmol/L.' (Module 2: Complications) [1]

The current guideline is based upon adjusted serum calcium. A variety of formulae have been proposed to permit calculation of the 'adjusted' total calcium (i.e. an estimation of the expected total calcium were the serum albumin normal) from the total calcium and albumin concentration, but there are no data to support the use of mathematical corrections of serum calcium among patients with ERF. There are significant problems with comparison of adjusted serum calcium as the calculated result is heavily dependent upon the methods of albumin and calcium measurement and the formula used for adjustment. Laboratories should derive the correct formula for the two methods they use but it is apparent that this is not always done and a variety of formulae are in use, the most common being adjusted calcium = total calcium + 0.02(40-albumin) according to a recent review by the Welsh External Quality Assessment Scheme (WEQAS, 2011, personal communication to A. Dawnay). This formula was used by approximately 50% of laboratories, while at least 22 other equations were used by the remainder. WEQAS proposes the establishment of master equations for the three calcium methods and two albumin methods in use across the eight analytical platforms in current use in the UK. This will facilitate achievement of measurement uniformity between laboratories and national harmonisation to an adjusted calcium reference range of 2.2–2.6 mmol/L (http://www.pathologyharmony.co.uk/graphics/Pathology%20Harmony%20II%20%20for%20web.pdf).

The two most common assays for measuring albumin yield discordant results, the bromocresol purple (BCP) method generally providing lower albumin values than bromocresol green (BCG). The deviation of albumin assayed by BCP and BCG dye-binding methods also appears to differ between dialysis patients and those with

normal renal function due to differing interferences with the dye-binding, bringing into question the applicability of adjustment formulae that were derived for the general population. This impacts on the adjusted calcium result and is important in multicentre and comparative studies but such studies have often compounded the problem by incorrectly applying a single formula to both BCG and BCP measurements [8]. There are data which suggest that in this situation it may be better to use uncorrected serum calcium rather than adjusted serum calcium [9, 10].

The impact of laboratory method biases and changes in formulae was highlighted in last year's report and centres with excessive proportions of patients outside the limits were advised to consult their local laboratories. The problem is illustrated by the following. For the last two years Bristol was one of the lowest achieving centres for the adjusted calcium standard and as a result an investigation took place. Local data from Bristol, Exeter, Gloucester and Truro showed that when uncorrected rather than corrected calciums were compared, Bristol changed from being lowest to the highest achiever. As many centres use BCG to measure albumin and some others routinely correct their BCP albumin to BCG before correcting calcium, an analysis was undertaken to explore the effect of converting the Bristol BCP albumins to BCG equivalents: 5.5 g/L was added to the BCP albumin to convert it to an equivalent BCG albumin before adjusting the calcium [11]. With this adjustment, Bristol's ranking on the caterpillar plots for the percentage of patients with corrected calcium >2.5 mmol/L improved from 37/52 to 22/52 for PD patients and from 63/64 to 29/64 for HD patients. This investigation highlights the importance in the calculation and interpretation of adjusted serum calcium, of the method of albumin measurement and the adjustment formula used. While such adjustment of data cannot be condoned it does serve to highlight potential problems. The solution for centres is to work with their laboratories to ensure that the calcium results are adjusted correctly for the method in use. The current guideline for control of serum calcium does not discuss these problems or take them into account. These problems must be borne in mind when trying to interpret the following figures which compare serum adjusted calcium achieved in different renal units. These issues raise the question as to whether these comparisons between centres of achievement of the calcium guidelines are of value, and also raises questions about the guidelines themselves.

The audit measure for calcium in the 4th edition of the Renal Association Clinical Practice Guidelines does not specify a lower limit for calcium and advises that adjusted calcium should ideally be within the normal range. The guideline does however recommend that adjusted calcium should be <2.5 mmol/L. The UKRR used 2.2–2.5 mmol/L as the audit measure for adjusted calcium in 2009. The data for adjusted calcium were 94% complete for HD patients and 97% complete for PD patients overall, although there was between centre variation (tables 10.6 and 10.8). Seventy-four percent (CI 74–75%) of HD patients and 75% (CI 74–77%) of PD patients achieved adjusted calcium between 2.2–2.5 mmol/L (tables 10.7 and 10.9). The proportion of

Table 10.6 Summary statistics for adjusted calcium in haemodialysis patients in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	120	2.3	0.17	2.3	2.2	2.4
B Heart	95	387	2.3	0.18	2.3	2.2	2.4
B QEH	68	550	2.3	0.20	2.3	2.2	2.4
Bangor	100	74	2.3	0.17	2.35	2.3	2.4
Basldn	99	131	2.5	0.15	2.5	2.4	2.6
Belfast	99	226	2.3	0.17	2.3	2.2	2.4
Bradfd	95	167	2.4	0.15	2.4	2.3	2.5
Brightn*	73	214	2.3	0.17	2.3	2.2	2.4
Bristol	100	403	2.5	0.18	2.5	2.4	2.6
Camb	70	230	2.3	0.19	2.3	2.2	2.4
Cardff*	98	436	2.4	0.18	2.4	2.3	2.5
Carlis	100	57	2.3	0.20	2.3	2.2	2.4
Carsh	98	599	2.3	0.20	2.3	2.2	2.4
Chelms	100	109	2.4	0.14	2.4	2.3	2.5
Clwyd	100	74	2.3	0.19	2.3	2.2	2.4

Table 10.6 Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Colchr*	94	96	2.5	0.23	2.5	2.4	2.6
Covnt*	98	309	2.3	0.19	2.2	2.1	2.4
Derby	100	236	2.4	0.14	2.4	2.3	2.5
Derry	100	60	2.4	0.15	2.4	2.3	2.5
Donc	100	109	2.4	0.17	2.4	2.3	2.5
Dorset	100	215	2.4	0.18	2.4	2.3	2.5
Dudley	85	121	2.4	0.22	2.4	2.3	2.6
Exeter	100	301	2.4	0.19	2.4	2.2	2.5
Glouc	100	173	2.4	0.15	2.4	2.3	2.5
Hull	100	300	2.4	0.16	2.4	2.3	2.5
Ipswi	100	97	2.4	0.16	2.4	2.3	2.5
Kent	98	309	2.5	0.18	2.5	2.4	2.6
L Barts	100	646	2.2	0.19	2.2	2.1	2.3
L Guys	97	519	2.3	0.18	2.2	2.1	2.4
L Kings	100	370	2.3	0.22	2.3	2.2	2.4
L Rfree	83	511	2.2	0.19	2.2	2.1	2.4
L St.G	100	247	2.4	0.16	2.4	2.3	2.5
L West	97	1,155	2.4	0.16	2.4	2.3	2.5
Leeds	99	463	2.4	0.17	2.4	2.3	2.5
Leic	100	703	2.4	0.17	2.3	2.3	2.5
Liv Ain	70	95	2.5	0.15	2.5	2.4	2.6
Liv RI	99	367	2.4	0.20	2.4	2.3	2.5
M Hope	88	288	2.3	0.19	2.3	2.15	2.4
M RI	60	245	2.2	0.20	2.2	2.1	2.4
Middlbr	99	264	2.3	0.20	2.3	2.2	2.5
Newc*	100	252	2.4	0.15	2.4	2.3	2.5
Newry	99	93	2.2	0.18	2.2	2.1	2.3
Norwch	100	294	2.4	0.15	2.4	2.4	2.5
Nottm	100	379	2.4	0.17	2.4	2.3	2.5
Oxford	100	334	2.4	0.16	2.4	2.3	2.5
Plymth	99	112	2.3	0.19	2.35	2.25	2.5
Ports	100	440	2.3	0.17	2.3	2.3	2.5
Prestn*	93	415	2.3	0.19	2.3	2.2	2.4
Redng	100	248	2.3	0.17	2.35	2.2	2.4
Sheff	100	570	2.3	0.16	2.3	2.2	2.4
Shrew	100	182	2.4	0.17	2.4	2.3	2.4
Stevng	99	348	2.4	0.17	2.4	2.3	2.5
Sthend	98	119	2.4	0.18	2.4	2.3	2.5
Stoke	100	277	2.3	0.17	2.4	2.2	2.5
Sund*	96	159	2.4	0.18	2.4	2.3	2.5
Swanse	100	322	2.3	0.17	2.3	2.2	2.4
Truro	99	138	2.4	0.15	2.4	2.3	2.5
Tyrone	99	85	2.4	0.17	2.5	2.3	2.6
Ulster	100	86	2.4	0.15	2.4	2.3	2.5
Wirral	97	165	2.4	0.15	2.4	2.3	2.5
Wolve	100	287	2.3	0.19	2.3	2.2	2.4
Wrexm	100	71	2.4	0.18	2.4	2.3	2.6
York	88	149	2.4	0.15	2.4	2.3	2.5
England	**94**	**15,854**	**2.3**	**0.19**	**2.3**	**2.2**	**2.5**
N Ireland	**99**	**670**	**2.3**	**0.19**	**2.3**	**2.2**	**2.5**
Wales	**99**	**977**	**2.3**	**0.18**	**2.3**	**2.2**	**2.4**
E, W & NI	**94**	**17,501**	**2.3**	**0.19**	**2.3**	**2.2**	**2.5**

*These centres supplied uncorrected calcium and were corrected using the formula: adjusted calcium = unadjusted calcium + [(40-albumin) × 0.02]

Table 10.7. Percentage of haemodialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2009

							Change from 2008		
Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	adjusted Ca >2.5 mmol/L	% within range	95% LCL	95% UCL
Antrim	120	77.5	69.2	84.1	15.8	6.7	0.2	−13.8	14.1
B Heart	387	71.8	67.2	76.1	21.7	6.5	3.3	−5.3	11.8
B QEH	550	69.1	65.1	72.8	23.3	7.6	−3.2	−9.9	3.4
Bangor	74	82.4	72.1	89.5	9.5	8.1	2.7	−14.2	19.6
Basldn	131	70.2	61.9	77.4	3.8	26.0	−16.9	−29.8	−4.0
Belfast	226	77.4	71.5	82.4	17.7	4.9	−2.7	−12.6	7.3
Bradfd	167	88.0	82.2	92.1	5.4	6.6	9.7	−0.8	20.2
Brightn	214	78.5	72.5	83.5	13.6	7.9	9.5	−1.5	20.4
Bristol	403	62.0	57.2	66.7	3.0	35.0	2.1	−6.7	10.9
Camb	230	72.6	66.5	78.0	13.0	14.4	−2.3	−13.6	9.1
Cardff	436	74.8	70.5	78.6	11.9	13.3	−2.8	−10.3	4.7
Carlis	57	68.4	55.4	79.1	19.3	12.3	7.9	−14.0	29.7
Carsh	599	73.3	69.6	76.7	17.5	9.2	1.8	−5.0	8.6
Chelms	109	84.4	76.3	90.1	8.3	7.3	16.0	0.8	31.2
Clwyd	74	74.3	63.2	83.0	18.9	6.8	−2.2	−21.2	16.7
Colchr	96	58.3	48.3	67.8	0.0	41.7	−16.4	−33.8	0.9
Covnt	309	64.7	59.2	69.9	27.2	8.1	−11.0	−20.6	−1.4
Derby	236	80.9	75.4	85.5	4.7	14.4	5.1	−4.8	14.9
Derry	60	83.3	71.7	90.8	1.7	15.0	−3.2	−20.6	14.2
Donc	109	77.1	68.3	84.0	4.6	18.4	−7.7	−22.7	7.4
Dorset	215	75.4	69.2	80.7	6.1	18.6	6.4	−5.2	17.9
Dudley	121	60.3	51.4	68.6	9.1	30.6	−11.4	−27.8	5.0
Exeter	301	72.1	66.8	76.9	10.3	17.6	2.0	−7.8	11.8
Glouc	173	82.1	75.6	87.1	4.1	13.9	4.9	−6.9	16.8
Hull	300	77.3	72.3	81.7	4.7	18.0	6.3	−3.1	15.6
Ipswi	97	77.3	67.9	84.6	5.2	17.5	−6.0	−20.7	8.7
Kent	309	69.6	64.2	74.5	4.2	26.2	0.7	−9.0	10.5
L Barts	646	64.6	60.8	68.2	30.7	4.8	−2.5	−9.5	4.6
L Guys	519	68.8	64.7	72.6	27.0	4.2	−7.6	−14.9	−0.4
L Kings	370	81.4	77.1	85.0	13.5	5.1	−1.5	−8.7	5.8
L Rfree	511	66.9	62.7	70.9	28.4	4.7	−1.7	−9.2	5.9
L St.G	247	77.3	71.7	82.1	5.3	17.4	3.6	−7.0	14.1
L West	1,155	79.7	77.2	81.9	8.8	11.5	−1.7	−6.2	2.8
Leeds	463	74.1	69.9	77.9	5.4	20.5	−0.4	−7.9	7.2
Leic	703	79.2	76.1	82.1	9.8	11.0	2.9	−2.9	8.7
Liv Ain	95	72.6	62.8	80.6	2.1	25.3	−4.2	−20.0	11.6
Liv RI	367	73.0	68.3	77.3	9.3	17.7	4.3	−4.5	13.1
M Hope	288	68.1	62.5	73.2	25.0	6.9	−4.0	−14.3	6.4
M RI	245	60.4	54.2	66.3	35.5	4.1	−11.3	−21.9	−0.6
Middlbr	264	71.2	65.5	76.4	16.7	12.1	−3.7	−13.8	6.4
Newc	252	80.6	75.2	85.0	7.9	11.5	4.3	−5.2	13.7
Newry	93	61.3	51.1	70.6	36.6	2.2	−13.1	−30.9	4.7
Norwch	294	73.5	68.1	78.2	2.7	23.8	−2.1	−11.4	7.3
Nottm	379	75.5	70.9	79.5	5.8	18.7	6.7	−1.8	15.3
Oxford	334	79.0	74.3	83.1	6.6	14.4	7.4	−1.2	16.1
Plymth	112	75.9	67.1	82.9	11.6	12.5	−3.9	−18.3	10.5
Ports	440	81.1	77.2	84.5	10.2	8.6	2.8	−4.3	10.0
Prestn	415	71.3	66.8	75.5	18.6	10.1	3.5	−4.7	11.8
Redng	248	82.7	77.4	86.9	11.7	5.7	−0.7	−9.5	8.2
Sheff	570	79.8	76.3	82.9	14.2	6.0	1.8	−4.5	8.0
Shrew	182	84.1	78.0	88.7	4.4	11.5	10.1	−1.1	21.3
Stevng	348	75.3	70.5	79.5	7.2	17.5	−0.7	−9.2	7.8
Sthend	119	76.5	68.0	83.2	5.0	18.5	0.0	−14.2	14.2
Stoke	277	77.3	72.0	81.8	15.2	7.6	−3.1	−12.4	6.2

Table 10.7. Continued

Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	adjusted Ca >2.5 mmol/L	Change from 2008		
							% within range	95% LCL	95% UCL
Sund	159	74.8	67.5	81.0	5.7	19.5	6.1	−7.3	19.4
Swanse	322	70.5	65.3	75.2	23.6	5.9	−7.1	−16.1	1.8
Truro	138	83.3	76.2	88.7	5.1	11.6	8.3	−4.3	20.9
Tyrone	85	69.4	58.9	78.3	4.7	25.9	−2.4	−20.4	15.7
Ulster	86	76.7	66.7	84.5	2.3	20.9	−11.9	−26.8	3.1
Wirral	165	80.0	73.2	85.4	6.1	13.9	2.2	−9.6	14.0
Wolve	287	70.4	64.8	75.4	23.3	6.3	−4.0	−13.7	5.8
Wrexm	71	66.2	54.5	76.2	7.0	26.8	1.4	−19.2	22.0
York	149	82.6	75.6	87.8	4.0	13.4	−3.3	−15.7	9.0
England	**15,854**	**74.3**	**73.6**	**74.9**	**13.2**	**12.5**	**0.4**	**−0.9**	**1.7**
N Ireland	**670**	**74.6**	**71.2**	**77.8**	**14.9**	**10.5**	**−4.7**	**−10.6**	**1.3**
Wales	**977**	**73.3**	**70.4**	**76.0**	**15.8**	**11.0**	**−3.4**	**−8.5**	**1.7**
E, W & NI	**17,501**	**74.2**	**73.6**	**74.9**	**13.4**	**12.4**	**0.0**	**−1.2**	**1.2**

Table 10.8. Summary statistics for adjusted calcium in peritoneal dialysis patients in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	14					
B Heart	96	26	2.3	0.17	2.3	2.2	2.4
B QEH	85	121	2.3	0.15	2.3	2.2	2.4
Bangor	100	29	2.4	0.15	2.4	2.3	2.5
Basldn	100	25	2.5	0.13	2.5	2.4	2.6
Belfast	100	34	2.3	0.10	2.3	2.2	2.4
Bradfd	100	31	2.4	0.13	2.4	2.3	2.5
Brightn*	100	76	2.4	0.14	2.4	2.3	2.5
Bristol	100	68	2.5	0.16	2.5	2.4	2.6
Camb	100	31	2.3	0.19	2.3	2.2	2.4
Cardff*	100	95	2.4	0.19	2.4	2.3	2.5
Carlis	100	13					
Carsh	99	110	2.4	0.15	2.4	2.2	2.4
Chelms	100	31	2.5	0.17	2.5	2.3	2.6
Clwyd	86	6					
Covnt*	99	72	2.3	0.14	2.25	2.2	2.4
Derby	100	82	2.4	0.11	2.4	2.4	2.5
Derry	100	3					
Donc	97	29	2.5	0.16	2.5	2.4	2.6
Dorset	98	53	2.4	0.17	2.4	2.3	2.5
Dudley	98	49	2.4	0.17	2.4	2.3	2.5
Exeter	100	64	2.3	0.18	2.3	2.2	2.4
Glouc	100	39	2.4	0.15	2.4	2.3	2.5
Hull	98	62	2.5	0.12	2.5	2.4	2.5
Ipswi	100	42	2.4	0.14	2.4	2.3	2.5
Kent	100	64	2.5	0.14	2.5	2.4	2.6
L Barts	99	164	2.4	0.20	2.3	2.2	2.45
L Guys	100	44	2.4	0.16	2.3	2.2	2.5
L Kings	100	68	2.3	0.15	2.3	2.2	2.4
L Rfree	98	63	2.3	0.20	2.3	2.2	2.4
L St.G	97	56	2.5	0.12	2.5	2.4	2.6
L West	100	31	2.4	0.14	2.4	2.3	2.5
Leeds	100	86	2.4	0.15	2.4	2.4	2.5

Table 10.8. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Leic	97	144	2.4	0.17	2.4	2.3	2.5
Liv Ain	29	2					
Liv RI	99	79	2.4	0.18	2.4	2.3	2.5
M Hope	96	108	2.3	0.19	2.3	2.2	2.4
M RI	98	87	2.3	0.15	2.3	2.2	2.4
Newc*	100	48	2.5	0.17	2.45	2.4	2.6
Newry	100	12					
Norwch	89	49	2.5	0.10	2.5	2.4	2.5
Norwch	89	49					
Nottm	100	101	2.5	0.15	2.5	2.5	2.6
Oxford	100	93	2.5	0.17	2.5	2.4	2.6
Plymth	100	38	2.4	0.17	2.4	2.3	2.5
Ports	95	77	2.4	0.18	2.4	2.3	2.5
Prestn*	89	58	2.3	0.14	2.3	2.2	2.4
Redng	100	73	2.4	0.15	2.4	2.3	2.5
Sheff	100	68	2.3	0.15	2.3	2.2	2.4
Shrew	100	27	2.3	0.16	2.3	2.3	2.4
Stevng	96	27	2.4	0.16	2.4	2.3	2.5
Sthend	94	16					
Stoke	99	68	2.4	0.16	2.4	2.3	2.5
Sund*	100	24	2.6	0.31	2.4	2.4	2.7
Swanse	100	52	2.2	0.13	2.2	2.1	2.3
Truro	100	21	2.4	0.20	2.4	2.3	2.6
Tyrone	91	10					
Ulster	100	2					
Wirral	69	18					
Wolve	100	40	2.3	0.21	2.3	2.2	2.4
Wrexm	95	21	2.5	0.15	2.5	2.4	2.6
York	100	15					
England	**97**	**2,896**	**2.4**	**0.18**	**2.4**	**2.3**	**2.5**
N Ireland	**99**	**75**	**2.3**	**0.14**	**2.4**	**2.2**	**2.4**
Wales	**99**	**203**	**2.4**	**0.18**	**2.4**	**2.2**	**2.5**
E, W & NI	**97**	**3,174**	**2.4**	**0.18**	**2.4**	**2.3**	**2.5**

Blank cells denote centres excluded from the analysis due to low patient numbers or poor data completeness
*These centres supplied uncorrected calcium and were corrected using the formula: adjusted calcium = unadjusted calcium + [(40-albumin) × 0.02]

Table 10.9. Percentage of peritoneal dialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2009

							Change from 2008		
Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	adjusted Ca >2.5 mmol/L	% within range	95% LCL	95% UCL
B Heart	26	69.2	49.5	83.8	19.2	11.5	−5.8	−37.3	25.7
B QEH	121	77.7	69.4	84.2	14.1	8.3	2.0	−12.5	16.5
Bangor	29	65.5	46.9	80.3	10.3	24.1	−24.1	−51.2	2.9
Basldn	25	68.0	47.8	83.1	0.0	32.0	−12.0	−42.6	18.6
Belfast	34	91.2	76.0	97.1	5.9	2.9	17.3	−3.6	38.2
Bradfd	31	90.3	73.9	96.9	6.5	3.2	9.7	−13.2	32.5
Brightn	76	79.0	68.4	86.7	2.6	18.4	−9.8	−24.9	5.3

Table 10.9. Continued

Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	adjusted Ca >2.5 mmol/L	Change from 2008		
							% within range	95% LCL	95% UCL
Bristol	68	67.7	55.7	77.7	1.5	30.9	6.5	−14.3	27.4
Camb	31	74.2	56.3	86.5	19.4	6.5	−10.0	−35.4	15.4
Cardff	95	74.7	65.1	82.5	8.4	16.8	−7.2	−22.2	7.9
Carsh	110	81.8	73.5	88.0	7.3	10.9	7.3	−6.9	21.4
Chelms	31	67.7	49.7	81.7	3.2	29.0	−1.5	−30.3	27.4
Covnt	72	75.0	63.8	83.6	23.6	1.4	−10.3	−27.5	6.9
Derby	82	87.8	78.8	93.3	0.0	12.2	6.5	−8.4	21.4
Donc	29	65.5	46.9	80.3	3.5	31.0	−4.8	−34.7	25.2
Dorset	53	77.4	64.2	86.7	5.7	17.0	−8.3	−28.0	11.3
Dudley	49	81.6	68.3	90.2	2.0	16.3	6.1	−15.8	27.9
Exeter	64	75.0	63.0	84.1	17.2	7.8	3.8	−16.8	24.5
Glouc	39	76.9	61.3	87.5	7.7	15.4	1.2	−24.8	27.1
Hull	62	77.4	65.4	86.2	1.6	21.0	1.7	−17.3	20.8
Ipswi	42	81.0	66.3	90.2	4.8	14.3	−2.4	−23.3	18.5
Kent	64	60.9	48.6	72.1	1.6	37.5	3.0	−19.0	24.9
L Barts	164	75.6	68.5	81.6	10.4	14.0	−0.3	−11.9	11.2
L Guys	44	88.6	75.5	95.2	4.6	6.8	13.1	−7.0	33.2
L Kings	68	77.9	66.6	86.2	14.7	7.4	−9.4	−25.9	7.1
L Rfree	63	65.1	52.6	75.8	22.2	12.7	−9.6	−29.8	10.6
L St.G	56	73.2	60.2	83.2	0.0	26.8	5.2	−17.7	28.1
L West	31	80.7	63.1	91.0	6.5	12.9	6.8	−18.5	32.2
Leeds	86	76.7	66.7	84.5	4.7	18.6	−5.0	−21.1	11.1
Leic	144	77.1	69.5	83.2	4.2	18.8	0.2	−12.4	12.7
Liv RI	79	77.2	66.7	85.2	3.8	19.0	1.9	−15.2	19.1
M Hope	108	73.2	64.0	80.7	19.4	7.4	1.7	−13.8	17.3
M RI	87	79.3	69.5	86.6	19.5	1.2	2.4	−13.6	18.4
Newc	48	64.6	50.2	76.7	4.2	31.3	−23.8	−45.6	−2.0
Norwch	49	77.6	63.8	87.1	0.0	22.5	8.5	−13.8	30.7
Nottm	101	56.4	46.6	65.8	2.0	41.6	4.6	−13.1	22.3
Oxford	93	63.4	53.2	72.6	3.2	33.3	−5.5	−22.9	12.0
Plymth	38	68.4	52.2	81.1	7.9	23.7	−13.8	−38.2	10.6
Ports	77	71.4	60.4	80.4	6.5	22.1	−7.4	−25.7	10.8
Prestn	58	84.5	72.8	91.7	5.2	10.3	−1.5	−18.6	15.6
Redng	73	89.0	79.6	94.4	4.1	6.9	7.7	−7.2	22.7
Sheff	68	79.4	68.2	87.4	14.7	5.9	0.5	−17.2	18.3
Shrew	27	81.5	62.5	92.1	7.4	11.1	4.8	−22.9	32.5
Stevng	27	70.4	51.0	84.4	7.4	22.2	−1.1	−31.1	29.0
Stoke	68	72.1	60.3	81.4	7.4	20.6	−5.7	−24.6	13.2
Sund	24	58.3	38.3	75.9	4.2	37.5			
Swanse	52	69.2	55.5	80.2	28.9	1.9	−8.7	−30.3	12.9
Truro	21	47.6	27.9	68.2	14.3	38.1	−25.5	−61.4	10.5
Wolve	40	77.5	62.1	87.9	17.5	5.0	6.1	−17.0	29.2
Wrexm	21	71.4	49.2	86.6	0.0	28.6	14.3	−23.4	52.0
England	**2,896**	**75.0**	**73.4**	**76.5**	**8.2**	**16.9**	**−0.6**	**−3.5**	**2.3**
N Ireland	**75**	**86.7**	**77.0**	**92.7**	**6.7**	**6.7**	**11.1**	**−4.6**	**26.8**
Wales	**203**	**71.9**	**65.4**	**77.7**	**12.8**	**15.3**	**−7.8**	**−18.5**	**2.9**
E, W & NI	**3,174**	**75.1**	**73.5**	**76.6**	**8.4**	**16.5**	**−0.8**	**−3.6**	**1.9**

HD patients with hypercalcaemia was 12% compared to 13% in 2008 and the proportion with hypocalcaemia was 13% compared to 12% in 2008. The proportion of PD patients with hypercalcaemia was 17% similar to 2008 (16%) and the proportion with hypocalcaemia was 8% the same as in 2008 (tables 10.7 and 10.9, figures 10.6 to 10.9). The changes in the percentages above, below and within range for the period 2000 to 2009 for England, Northern Ireland and Wales combined are shown in figure 10.10. The percentage of patients achieving the audit standard for calcium seems to have reached a plateau for both HD and PD patients.

As for phosphate, there was significant between centre variation in unadjusted analyses for the proportion of patients below, within and above the range specified by the clinical performance measure (figures 10.6–10.10). There was greater variation in the proportion of patients within range for adjusted calcium than phosphate, most notably for HD patients. The funnel plot shows a greater number of centres outlying the 3SD limit indicating over dispersion in the data possibly due to differences in calcium analysis between centres. The latest guidance from the Renal Association [7], finalised in December 2010, continues to suggest maintenance of serum calcium within the normal range and ideally between 2.2 and 2.5 mmol/L, avoiding hypercalcaemic episodes and calcium concentrations below 2.2 mmol/L; hence the audit measure will remain unchanged for next year's report.

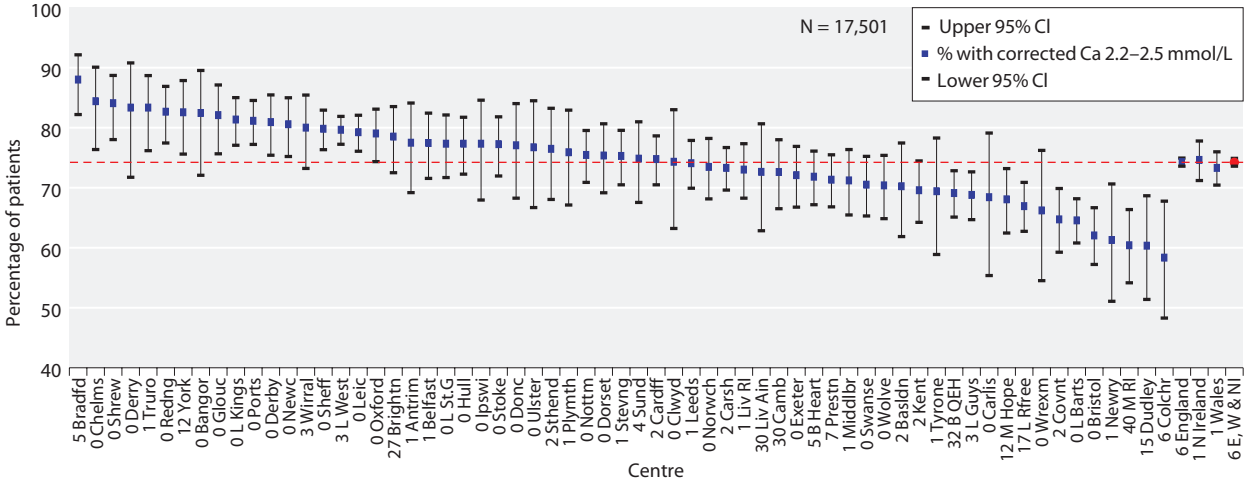

Fig. 10.6. Percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2009

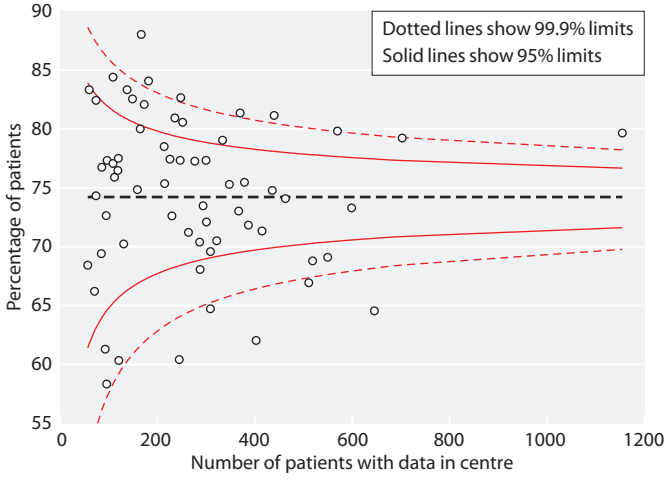

Fig. 10.7. Funnel plot of percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2009

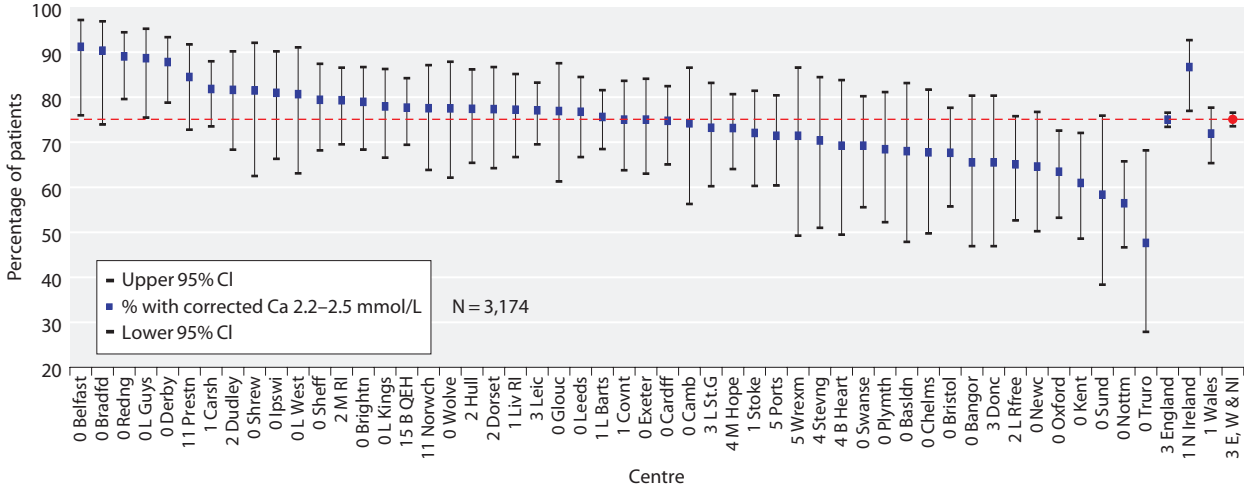

Fig. 10.8. Percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2009

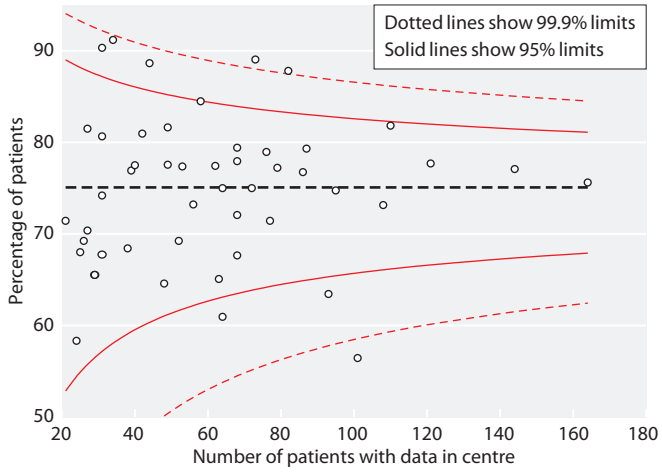

Fig. 10.9. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2009

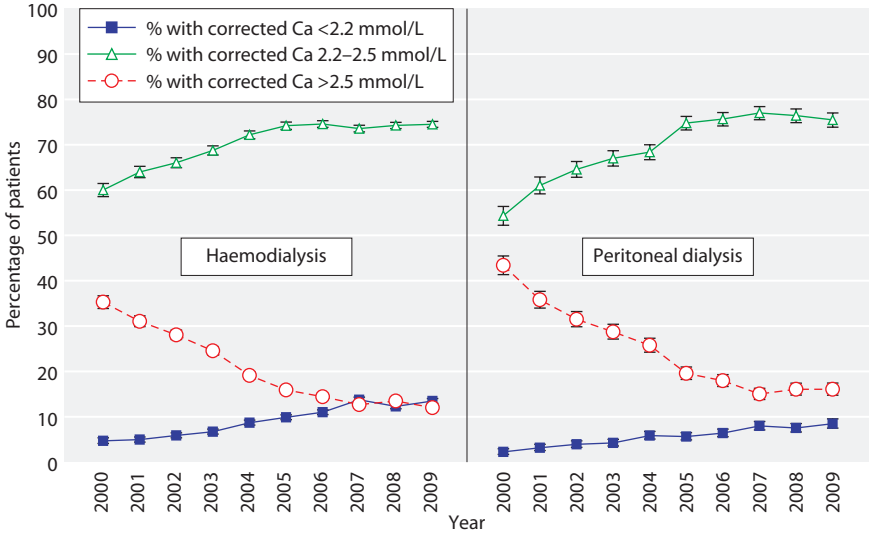

Fig. 10.10. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.5 mmol/L and >2.5 mmol/L by dialysis modality 2000–2009

Parathyroid hormone

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'The target range for parathyroid hormone measured using an intact PTH assay should be between 2 and 4 times the upper limit of normal for the intact PTH assay used. The same target range should apply when using the whole molecule PTH assay.' (Module 2: Complications) [1]

The data for parathyroid hormone were 85% complete for HD patients and 87% complete for PD patients overall, although there was between centre variation (tables 10.10 and 10.12). Twenty-eight percent (CI 27–29%) of HD patients and 32% (30–33%) of PD patients achieved a parathyroid hormone between 16–32 pmol/L (tables 10.11 and 10.13). The proportion of HD patients with a parathyroid hormone above the upper limit of the range was 41% and the proportion with parathyroid hormone below the lower limit of the range was 31%. The proportion of PD patients with parathyroid hormone above the upper limit of the range was 38% and the proportion with parathyroid hormone below the lower limit of the range was 31% (tables 10.11 and 10.13, figures 10.11 to 10.14). Again there was significant between centre variation in unadjusted analyses for the proportion of patients below, within and above the range specified by the clinical performance measure.

Table 10.10. Summary statistics for PTH in haemodialysis patients in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	120	26	23	19	11	32
B Heart	89	362	37	36	27	13	47
B QEH	65	523	21	14	21	9	33
Bangor	100	74	31	48	19	10	28
Basldn	99	131	30	27	21	11	43
Belfast	95	217	40	43	28	12	49
Bradfd	91	160	34	38	21	11	44
Brightn	83	241	37	38	26	10	51
Bristol	97	391	32	35	21	11	41
Camb	47	155					
Cardff	96	428	36	35	26	13	48
Carlis	100	57	34	28	27	15	47
Carsh	5	29					
Chelms	100	109	49	40	34	22	64
Clwyd	93	69	30	28	21	10	41
Colchr	99	101	35	31	25	13	46
Covnt	97	306	37	44	24	13	46
Derby	99	234	30	33	22	13	37
Derry	97	58	50	36	40	23	66
Donc	98	107	38	37	24	14	54
Dorset	98	210	30	36	19	7	41
Dudley	73	104	37	48	19	10	40
Exeter	98	297	21	23	14	5	26
Glouc	99	172	24	22	19	9	33
Hull	97	293	49	71	30	12	60
Ipswi	98	95	39	36	29	17	48
Kent	0	1					
L Barts	99	639	47	48	32	16	60
L Guys	93	500	46	52	28	11	62
L Kings	98	362	43	37	34	15	62
L Rfree	80	496	37	40	27	15	47
L St.G	94	231	47	42	34	17	64
L West	89	1,059	56	61	35	17	75
Leeds	97	456	29	30	20	10	38
Leic	97	685	43	44	31	13	58
Liv Ain	57	77	40	44	24	10	50
Liv RI	97	358	39	37	28	14	50

Table 10.10. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
M Hope	75	247					
M RI	50	205	43	37	34	16	57
Middlbr	93	250	44	48	31	15	51
Newc	98	246	33	30	25	13	44
Newry	98	92	37	33	28	17	46
Norwch	96	283	31	29	25	14	39
Nottm	100	379	36	43	25	13	43
Oxford	96	323	47	40	37	15	67
Plymth	98	111	19	20	14	5	26
Ports	90	398	42	50	23	10	53
Prestn	87	391	33	33	23	12	42
Redng	100	248	29	28	23	13	37
Sheff	98	558	40	34	31	16	56
Shrew	96	175	36	46	20	11	42
Stevng	97	340	60	52	48	29	76
Sthend	90	109	53	46	40	20	70
Stoke	95	263	46	47	31	18	61
Sund	95	157	46	37	35	19	65
Swanse	72	232	43	42	30	17	59
Truro	98	136	26	29	18	8	35
Tyrone	99	85	36	26	30	21	41
Ulster	100	86	26	24	19	10	31
Wirral	63	107	32	31	23	13	41
Wolve	97	278	19	25	12	6	23
Wrexm	99	70	22	19	19	8	32
York	76	129	37	33	26	14	53
England	**85**	**14,274**	**39.0**	**39.3**	**27.4**	**13.8**	**51.0**
N Ireland	**97**	**658**	**35.0**	**34.0**	**26.0**	**13.0**	**45.0**
Wales	**88**	**873**	**36.0**	**38.0**	**26.0**	**13.0**	**46.0**
E, W & NI	**85**	**15,805**	**38.1**	**38.0**	**27.0**	**13.8**	**49.5**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
M Hope excluded due to technical difficulties with data extraction

Table 10.11. Percentage of haemodialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2009

							Change from 2008		
Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	% within range	95% LCL	95% UCL
Antrim	120	33.3	25.5	42.2	42.5	24.2	−0.3	−16.0	15.5
B Heart	362	26.2	22.0	31.0	30.1	43.7	3.3	−5.0	11.7
B QEH	523	33.8	29.9	38.0	39.6	26.6	−3.9	−12.0	4.2
Bangor	74	37.8	27.6	49.3	41.9	20.3	11.8	−8.2	31.7
Basldn	131	31.3	24.0	39.7	36.6	32.1	−0.4	−15.5	14.8
Belfast	217	25.8	20.4	32.0	31.3	42.9	0.4	−10.4	11.1
Bradfd	160	22.5	16.7	29.6	41.3	36.3	−7.0	−19.7	5.7
Brightn	241	27.0	21.8	32.9	31.5	41.5	3.1	−6.7	13.0
Bristol	391	30.7	26.3	35.4	36.6	32.7	−2.3	−10.9	6.3
Cardff	428	29.0	24.9	33.5	30.6	40.4	1.2	−6.9	9.3
Carlis	57	28.1	18.0	41.0	28.1	43.9	−5.7	−26.8	15.4
Chelms	109	29.4	21.6	38.6	16.5	54.1	−2.6	−19.3	14.2
Clwyd	69	21.7	13.6	33.0	40.6	37.7	−2.5	−21.5	16.6

Table 10.11. Continued

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	Change from 2008		
							% within range	95% LCL	95% UCL
Colchr	101	31.7	23.4	41.4	32.7	35.6	1.6	−15.6	18.7
Covnt	306	27.5	22.7	32.7	31.7	40.9	3.8	−5.5	13.2
Derby	234	37.6	31.6	44.0	32.1	30.3	1.9	−9.6	13.5
Derry	58	22.4	13.5	34.9	15.5	62.1	−16.8	−39.4	5.8
Donc	107	31.8	23.7	41.2	30.8	37.4	−0.2	−18.5	18.2
Dorset	210	26.7	21.1	33.1	42.4	31.0	2.4	−9.2	14.0
Dudley	104	23.1	16.0	32.1	43.3	33.7	−7.6	−24.2	9.0
Exeter	297	28.3	23.5	33.7	53.2	18.5	1.6	−8.1	11.3
Glouc	172	27.9	21.7	35.1	44.8	27.3	−17.1	−31.1	−3.1
Hull	293	20.1	15.9	25.1	31.4	48.5	−6.3	−15.5	3.0
Ipswi	95	34.7	25.9	44.8	23.2	42.1	−1.1	−18.9	16.8
L Barts	639	25.7	22.4	29.2	24.6	49.8	2.1	−4.3	8.5
L Guys	500	22.6	19.2	26.5	31.4	46.0	−3.3	−10.5	3.8
L Kings	362	21.6	17.6	26.1	27.1	51.4	−6.9	−15.1	1.4
L Rfree	496	33.1	29.1	37.3	26.8	40.1	2.6	−5.0	10.2
L St.G	231	28.1	22.7	34.3	20.4	51.5	−3.1	−14.6	8.3
L West	1,059	24.1	21.6	26.8	23.3	52.6	1.6	−3.4	6.6
Leeds	456	29.4	25.4	33.7	39.5	31.1	0.1	−7.8	8.0
Leic	685	22.8	19.8	26.1	28.9	48.3	0.1	−5.9	6.0
Liv Ain	77	28.6	19.6	39.6	32.5	39.0	−4.4	−23.1	14.3
Liv RI	358	27.9	23.5	32.8	26.8	45.3	1.4	−7.3	10.1
M Hope	247								
M RI	205	22.4	17.2	28.7	23.9	53.7	0.1	−10.5	10.7
Middlbr	250	27.2	22.0	33.1	26.0	46.8	0.4	−10.0	10.9
Newc	246	28.9	23.5	34.8	34.2	37.0	−2.7	−13.4	8.0
Newry	92	37.0	27.7	47.2	21.7	41.3	0.5	−18.2	19.2
Norwch	283	39.9	34.4	45.8	26.9	33.2	2.7	−8.0	13.3
Nottm	379	31.1	26.7	36.0	29.6	39.3	0.4	−8.5	9.2
Oxford	323	20.4	16.4	25.2	25.1	54.5	−1.8	−10.2	6.6
Plymth	111	27.9	20.4	37.0	52.3	19.8	0.4	−15.2	16.0
Ports	398	21.6	17.8	25.9	36.4	42.0	1.2	−6.3	8.6
Prestn	391	34.8	30.2	39.6	31.7	33.5	5.9	−2.6	14.4
Redng	248	36.3	30.5	42.5	31.5	32.3	−2.6	−14.0	8.8
Sheff	558	27.6	24.1	31.5	24.2	48.2	−0.5	−7.5	6.4
Shrew	175	28.6	22.4	35.7	38.9	32.6	1.1	−11.5	13.7
Stevng	340	22.4	18.2	27.1	10.3	67.4	−10.5	−19.3	−1.6
Sthend	109	30.3	22.4	39.5	13.8	56.0	7.1	−8.3	22.6
Stoke	263	30.8	25.5	36.6	20.5	48.7	6.4	−3.9	16.8
Sund	157	26.1	19.8	33.5	19.8	54.1	−2.9	−16.1	10.4
Swanse	232	29.7	24.2	35.9	23.7	46.6	3.9	−6.1	14.0
Truro	136	28.7	21.7	36.8	44.9	26.5	−0.9	−15.2	13.3
Tyrone	85	38.8	29.1	49.5	16.5	44.7	−0.5	−19.8	18.9
Ulster	86	37.2	27.7	47.9	40.7	22.1	−11.5	−31.4	8.3
Wirral	107	35.5	27.0	45.0	33.6	30.8	−0.8	−17.9	16.4
Wolve	278	24.8	20.1	30.2	60.1	15.1	2.0	−7.4	11.4
Wrexm	70	32.9	22.9	44.6	45.7	21.4	9.0	−10.8	28.7
York	129	30.2	22.9	38.7	27.9	41.9	1.8	−13.7	17.3
England	**14,027**	**27.6**	**26.9**	**28.3**	**30.9**	**41.5**	**−0.4**	**−1.8**	**1.0**
N Ireland	**658**	**31.6**	**28.2**	**35.3**	**29.9**	**38.5**	**−2.6**	**−9.3**	**4.1**
Wales	**873**	**29.7**	**26.7**	**32.8**	**31.7**	**38.6**	**3.2**	**−2.3**	**8.7**
E, W & NI	**15,558**	**27.9**	**27.2**	**28.6**	**30.9**	**41.2**	**−0.3**	**−1.6**	**1.0**

M Hope excluded due to technical difficulties with data extraction

Table 10.12. Summary statistics for PTH in peritoneal dialysis patients in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	14					
B Heart	81	22	41	36	29	19	56
B QEH	73	104	19	14	16	6	27
Bangor	100	29	22	22	18	9	32
Basldn	100	25	32	30	21	13	49
Belfast	97	33	53	40	36	23	77
Bradfd	87	27	51	61	28	9	78
Brightn	97	74	35	36	25	15	39
Bristol	91	62	32	35	26	8	40
Camb	100	31	33	21	26	17	44
Cardff	99	94	44	37	32	17	67
Carlis	85	11					
Carsh	4	4					
Chelms	100	31	40	27	36	21	50
Clwyd	86	6					
Covnt	90	66	33	35	23	10	48
Derby	100	82	20	14	17	11	25
Derry	100	3					
Donc	100	30	42	29	43	20	57
Dorset	81	44	19	20	9	6	26
Dudley	86	43	31	43	14	6	42
Exeter	100	64	25	21	21	10	31
Glouc	87	34	29	33	18	9	35
Hull	84	53	29	25	22	12	37
Ipswi	100	42	42	29	34	23	51
Kent	0	0					
L Barts	98	163	33	31	24	12	43
L Guys	95	42	41	36	29	16	58
L Kings	100	68	53	40	44	21	80
L Rfree	98	63	28	20	23	11	41
L St.G	93	54	37	35	27	14	41
L West	100	31	50	33	45	20	71
Leeds	99	85	32	25	26	15	40
Leic	92	136	33	31	25	11	46
Liv Ain	0	0					
Liv RI	95	76	26	26	23	10	35
M Hope	79	89					
M RI	98	87	43	36	33	18	60
Middlbr	63	10					
Newc	98	47	24	27	15	7	34
Newry	100	12					
Norwch	76	42	31	34	18	11	38
Nottm	100	101	36	35	24	10	49
Oxford	94	87	44	40	35	16	59
Plymth	97	37	32	30	23	13	37
Ports	78	63	49	53	36	17	62
Prestn	98	64	28	25	21	15	30
Redng	99	72	28	37	16	9	38
Sheff	87	59	39	30	31	21	55
Shrew	100	27	44	41	32	10	66
Stevng	86	24	53	31	48	29	76
Sthend	76	13					
Stoke	86	59	48	37	39	22	61
Sund	88	21	25	26	22	9	30
Swanse	94	49	37	19	35	23	46

Table 10.12. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Truro	90	19					
Tyrone	100	11					
Ulster	100	2					
Wirral	58	15					
Wolve	100	40	20	18	15	8	26
Wrexm	95	21	26	16	24	15	29
York	93	14					
England	**86**	**2,557**	**35.3**	**31.6**	**26.6**	**13.9**	**47.3**
N Ireland	**99**	**75**	**42.0**	**38.0**	**28.0**	**19.0**	**46.0**
Wales	**97**	**199**	**36.0**	**30.0**	**30.0**	**16.0**	**48.0**
E, W & NI	**87**	**2,831**	**34.3**	**30.2**	**26.1**	**13.8**	**46.0**

Blank cells denote centres excluded from analyses due to small numbers or poor data completeness
M Hope excluded due to technical difficulties with data extraction

Table 10.13. Percentage of peritoneal dialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2009

							Change from 2008	
Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	% within range	95% LCL	95% UCL
B Heart	22	45.5	26.5	65.9	18.2	36.4	5.5	−31.8	42.7
B QEH	104	35.6	27.0	45.2	47.1	17.3	7.5	−9.8	24.7
Bangor	29	27.6	14.4	46.2	48.3	24.1	−6.9	−38.1	24.4
Basldn	25	32.0	16.9	52.2	36.0	32.0	−8.0	−41.3	25.3
Belfast	33	36.4	21.9	53.7	12.1	51.5	9.1	−18.6	36.8
Bradfd	27	18.5	7.9	37.5	37.0	44.4	1.3	−25.2	27.7
Brightn	74	43.2	32.5	54.7	25.7	31.1	4.6	−16.2	25.3
Bristol	62	27.4	17.8	39.8	38.7	33.9	7.4	−12.0	26.8
Camb	31	32.3	18.3	50.3	19.4	48.4	0.7	−28.4	29.8
Cardff	94	28.7	20.5	38.7	22.3	48.9	10.5	−5.1	26.0
Chelms	31	29.0	15.9	47.1	12.9	58.1	−0.7	−29.3	27.9
Covnt	66	27.3	17.9	39.2	37.9	34.9	−8.3	−29.7	13.1
Derby	82	52.4	41.7	63.0	36.6	11.0	10.3	−10.1	30.7
Donc	30	23.3	11.6	41.5	16.7	60.0	−17.3	−47.3	12.7
Dorset	44	25.0	14.4	39.7	59.1	15.9	3.6	−19.9	27.0
Dudley	43	14.0	6.4	27.8	51.2	34.9	−5.6	−26.6	15.4
Exeter	64	37.5	26.6	49.9	39.1	23.4	4.2	−18.3	26.6
Glouc	34	23.5	12.2	40.5	41.2	35.3	−3.7	−31.2	23.7
Hull	53	28.3	17.8	41.8	37.7	34.0	2.4	−19.4	24.2
Ipswi	42	40.5	26.9	55.7	2.4	57.1	5.1	−21.4	31.5
L Barts	163	30.7	24.1	38.2	33.1	36.2	−1.1	−13.6	11.4
L Guys	42	35.7	22.8	51.1	23.8	40.5	11.2	−13.6	36.0
L Kings	68	20.6	12.6	31.8	16.2	63.2	−9.0	−27.8	9.9
L Rfree	63	27.0	17.5	39.2	34.9	38.1	−15.3	−36.2	5.6
L St.G	54	31.5	20.6	44.9	29.6	38.9	12.7	−9.1	34.6
L West	31	19.4	9.0	36.9	12.9	67.7	−18.8	−45.4	7.9
Leeds	85	38.8	29.1	49.5	25.9	35.3	−3.4	−22.9	16.2
Leic	136	29.4	22.4	37.6	33.1	37.5	8.0	−5.5	21.5
Liv RI	76	34.2	24.5	45.5	38.2	27.6	6.7	−12.3	25.8
M Hope	89								
M RI	87	31.0	22.2	41.5	18.4	50.6	7.7	−9.5	24.9
Newc	47	23.4	13.5	37.5	51.1	25.5	−13.2	−38.3	11.9
Norwch	42	33.3	20.8	48.7	40.5	26.2	7.8	−17.7	33.2
Nottm	101	23.8	16.5	33.0	38.6	37.6	0.9	−14.3	16.1

Table 10.13. Continued

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	Change from 2008 % within range	Change from 2008 95% LCL	Change from 2008 95% UCL
Oxford	87	24.1	16.3	34.2	24.1	51.7	−1.6	−18.1	14.8
Plymth	37	40.5	26.1	56.8	29.7	29.7	16.9	−10.5	44.3
Ports	63	25.4	16.2	37.5	19.1	55.6	9.0	−9.7	27.7
Prestn	64	50.0	38.0	62.0	28.1	21.9	7.1	−16.3	30.6
Redng	72	23.6	15.2	34.8	47.2	29.2	−19.6	−39.3	0.1
Sheff	59	42.4	30.5	55.2	15.3	42.4	26.7	6.4	47.1
Shrew	27	25.9	12.9	45.3	29.6	44.4	−3.1	−33.4	27.2
Stevng	24	29.2	14.6	49.8	8.3	62.5	3.4	−28.0	34.7
Stoke	59	30.5	20.1	43.3	8.5	61.0	−1.7	−23.7	20.3
Sund	21	33.3	16.8	55.3	47.6	19.1			
Swanse	49	32.7	21.1	46.8	10.2	57.1	−3.1	−27.0	20.8
Wolve	40	32.5	19.9	48.3	52.5	15.0	−14.7	−40.7	11.4
Wrexm	21	47.6	27.9	68.2	28.6	23.8	32.6	−2.2	67.5
England	**2,468**	**31.2**	**29.4**	**33.1**	**31.7**	**37.1**	**1.5**	**−1.8**	**4.9**
N Ireland	**75**	**40.0**	**29.6**	**51.4**	**18.7**	**41.3**	**4.3**	**−15.6**	**24.2**
Wales	**199**	**32.2**	**26.0**	**39.0**	**24.6**	**43.2**	**7.3**	**−4.1**	**18.7**
E, W & NI	**2,742**	**31.6**	**29.8**	**33.3**	**30.8**	**37.7**	**2.0**	**−1.1**	**5.2**

Blank cells denote a centre with low patient numbers last year precluding calculation of the change in target attainment
M Hope excluded due to technical difficulties with data extraction

Mineral and bone variables – discussion

There are convincing observational data that hyperphosphataemia is associated with increased mortality in dialysis patients but the data linking calcium and parathyroid hormone to patient survival are less clear [12–16]. A recent cohort study has demonstrated that simultaneous achievement of all three audit measures does appear to be associated with better outcomes [17].

The UKRR has consistently demonstrated between centre variation in achievement of audit measures for bone and mineral parameters but little is understood about the causes of this 'centre effect'. The complexity of the clinical processes required to manage mineral and bone disorders is probably further confounded by case-mix. Finally it is important to consider data quality and the potential for measurement bias particularly in light of the variability in assay methods for parathyroid hormone where substantial differences exist in both calibration and in the detection of the various fragments that accumulate in renal failure. However, detecting these centre level differences is an important step in understanding the factors associated with exceptional

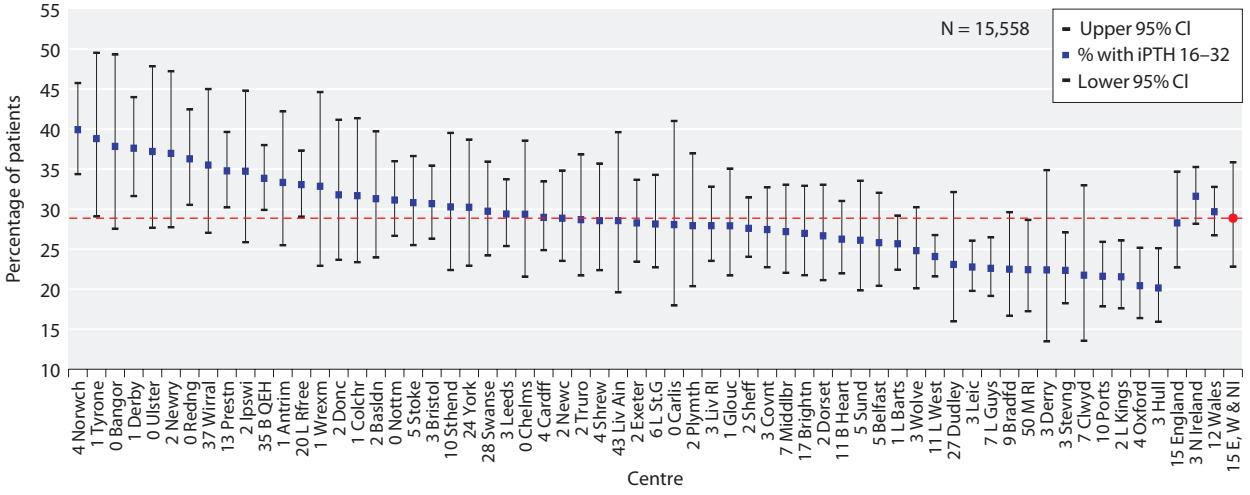

Fig. 10.11. Percentage of haemodialysis patients with PTH within range (16–32 pmol/L) by centre in 2009

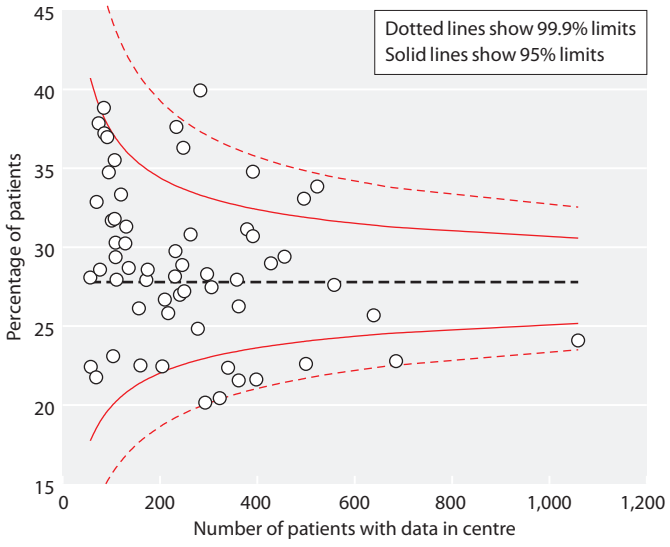

Fig. 10.12. Funnel plot of percentage of haemodialysis patients with PTH within range (16–32 pmol/L) by centre in 2009

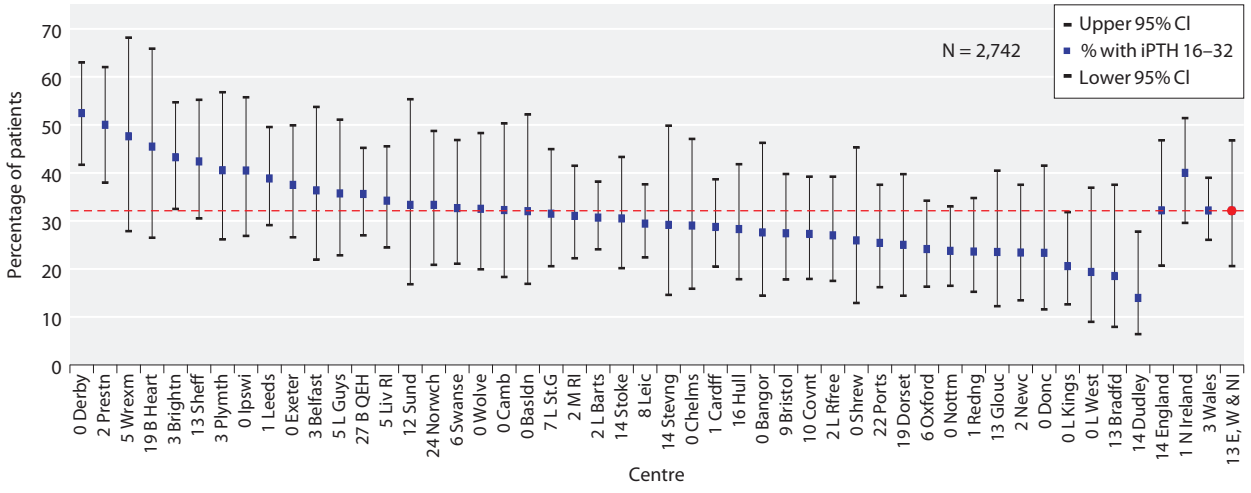

Fig. 10.13. Percentage of peritoneal dialysis patients with PTH within range (16–32 pmol/L) by centre in 2009

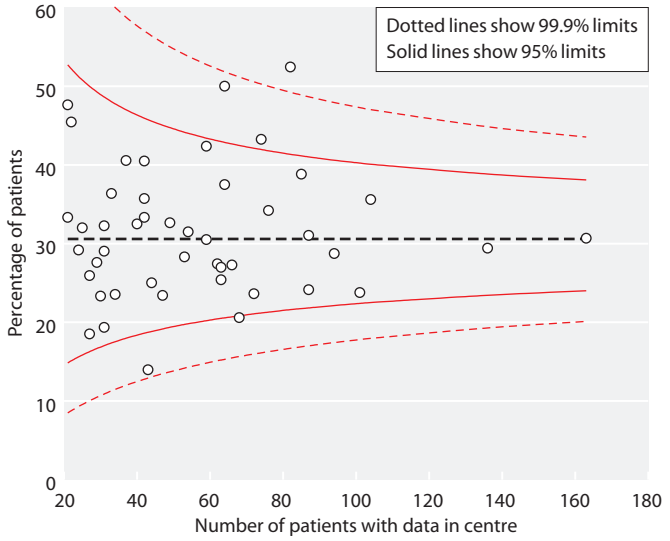

Fig. 10.14. Funnel plot of percentage of peritoneal dialysis patients with PTH within range (16–32 pmol/L) by centre in 2009

performance. The latest version of the Renal Association Clinical Practice Guidelines, finalised in December 2010, suggests the maintenance of serum PTH between 2 and 9 times the upper limit of the normal range. There is some evidence of changing practice in this regard already with a rise in the percentage of HD patients with a PTH >32 pmol/L over the last 4 years.

Bicarbonate

The 4th edition of the Renal Association Clinical Practice Guidelines state:

'For HD patients pre-dialysis serum bicarbonate concentrations measured with minimum delay after venepuncture and before a "short gap" dialysis session should be between 20 and 26 mmol/L. (Module 3a: Haemodialysis)

For PD patients, Plasma bicarbonate should be maintained within the normal range.' (Module 3b: Peritoneal dialysis) [1]

Bicarbonate data were 85% complete for HD patients and 87% complete for PD patients (tables 10.14 and 10.16). Seventy-two percent (CI 71–72%) of HD patients and 83% (CI 82–84%) of PD patients achieved the audit measure for bicarbonate and there was significant inter-centre variation for both HD and PD (tables 10.15 and 10.17, figures 10.15 and 10.16). There was even greater between centre variation in the proportion of patients with bicarbonate values above and below the specified range for the audit measure (tables 10.15 and 10.17). The UKRR has previously conducted a limited survey into the possible underlying causes of this variation. The study predominantly looked at measures of sample

Table 10.14. Summary statistics for serum bicarbonate in haemodialysis patients by centre in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	99	120	24	3	25	23	26
B Heart	82	334	24	3	24	23	26
B QEH	97	780	24	3	24	23	26
Bangor	100	74	24	3	24	22	26
Basldn	99	131	23	3	23	21	25
Belfast	99	226	23	2	23	21	24
Bradfd	95	167	24	4	23	22	26
Brightn	97	283	22	3	22	20	23
Bristol	100	403	23	3	23	22	25
Camb	67	220	24	3	24	22	26
Cardff	85	380	22	3	22	20	24
Carlis	100	57	23	3	23	21	25
Carsh	97	595	24	3	24	22	26
Chelms	100	109	26	2	26	24	27
Clwyd	100	74	21	3	21	19	23
Colchr	99	101	26	2	26	25	28
Covnt	94	296	24	4	25	22	27
Derby	100	236	21	3	21	19	23
Derry	100	60	21	2	22	20	23
Donc	100	109	22	2	22	21	24
Dorset	100	215	23	3	23	21	24
Dudley	77	110	25	3	25	22	26
Exeter	99	300	23	2	23	21	24
Glouc	100	173	26	3	26	24	27
Hull	99	298	22	2	22	20	23
Ipswi	99	96	22	3	21	19	24
Kent	100	313	21	2	21	19	22
L Barts	100	645	24	3	24	22	26
L Guys	83	446	23	3	23	21	25
L Kings	100	370	25	3	25	23	27
L Rfree	82	506	24	3	23	22	26
L St.G	100	247	28	3	28	26	30
L West	0	1					
Leeds	99	463	22	3	22	20	24

Table 10.14. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Leic	99	702	24	3	24	22	26
Liv Ain	70	95	24	3	23	22	25
Liv RI	99	367	24	4	24	21	26
M Hope	4	14					
M RI	59	241	24	4	24	21	26
Middlbr	98	262	26	3	26	24	28
Newc	100	252	25	3	25	22	27
Newry	99	93	22	2	22	21	24
Norwch	99	293	22	3	22	20	24
Nottm	81	308	24	3	24	22	26
Oxford	99	333	25	4	25	22	27
Plymth	100	113	22	3	22	20	23
Ports	100	440	23	3	23	22	25
Prestn	82	366	23	3	24	21	25
Redng	100	248	26	3	26	24	27
Sheff	100	570	25	3	25	23	27
Shrew	100	182	23	3	23	21	25
Stevng	99	348	23	3	23	22	25
Sthend	98	119	24	3	24	22	26
Stoke	0	0					
Sund	99	163	23	3	23	21	24
Swanse	100	322	25	3	25	23	27
Truro	98	136	22	2	22	21	23
Tyrone	99	85	25	3	24	23	26
Ulster	100	86	20	2	20	18	21
Wirral	98	167	24	3	24	22	26
Wolve	100	286	20	3	20	18	22
Wrexm	100	71	22	3	22	20	24
York	95	160	23	3	23	21	25
England	**84**	**14,169**	**24**	**3**	**24**	**21**	**26**
N Ireland	**99**	**670**	**23**	**3**	**23**	**21**	**25**
Wales	**93**	**921**	**23**	**4**	**23**	**21**	**26**
E, W & NI	**85**	**15,760**	**24**	**3**	**24**	**21**	**26**

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

Table 10.15. Percentage of haemodialysis patients within, below and above the range for bicarbonate (20–26 mmol/L) by centre in 2009

							Change from 2008		
Centre	N	% bicarb 20–26 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <20 mmol/L	% bicarb >26 mmol/L	% within range	95% LCL	95% UCL
Antrim	120	80.0	71.9	86.2	1.7	18.3	−4.0	−16.8	8.8
B Heart	334	74.6	69.6	78.9	4.2	21.3	7.2	−1.7	16.1
B QEH	780	76.0	72.9	78.9	4.9	19.1	2.1	−3.8	8.1
Bangor	74	70.3	59.0	79.6	6.8	23.0	−0.7	−20.4	18.9
Basldn	131	77.9	70.0	84.2	9.9	12.2	−1.2	−14.5	12.1
Belfast	226	85.0	79.7	89.1	8.9	6.2	4.9	−4.3	14.1
Bradfd	167	70.1	62.7	76.5	10.8	19.2	−0.2	−13.2	12.7
Brightn	283	76.3	71.0	80.9	20.5	3.2	−3.0	−12.2	6.2
Bristol	403	81.4	77.3	84.9	10.4	8.2	−0.7	−7.6	6.3
Camb	220	72.3	66.0	77.8	5.0	22.7	−2.6	−14.3	9.1
Cardff	380	69.7	64.9	74.2	22.1	8.2	−4.1	−12.6	4.4
Carlis	57	84.2	72.4	91.6	3.5	12.3	6.8	−11.1	24.6

Table 10.15. Continued

Centre	N	% bicarb 20–26 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <20 mmol/L	% bicarb >26 mmol/L	Change from 2008		
							% within range	95% LCL	95% UCL
Carsh	595	72.4	68.7	75.9	5.9	21.7	6.6	−0.4	13.6
Chelms	109	59.6	50.2	68.4	0.9	39.5	−7.7	−25.1	9.6
Clwyd	74	66.2	54.8	76.0	31.1	2.7	−16.6	−35.3	2.1
Colchr	101	59.4	49.6	68.5	0.0	40.6	1.5	−16.6	19.7
Covnt	296	64.5	58.9	69.8	7.1	28.4	n/a	n/a	n/a
Derby	236	71.6	65.5	77.0	26.7	1.7	−10.3	−20.4	−0.3
Derry	60	75.0	62.6	84.3	21.7	3.3	1.9	−19.5	23.4
Donc	109	83.5	75.3	89.3	11.9	4.6	4.9	−10.7	20.5
Dorset	215	84.7	79.2	88.9	9.3	6.1	6.8	−3.3	16.9
Dudley	110	69.1	59.9	77.0	6.4	24.6	−1.9	−18.5	14.8
Exeter	300	84.7	80.1	88.3	9.0	6.3	4.6	−3.6	12.8
Glouc	173	62.4	55.0	69.3	0.6	37.0	−11.1	−24.7	2.4
Hull	298	82.6	77.8	86.5	16.4	1.0	3.6	−4.8	12.0
Ipswi	96	64.6	54.6	73.5	27.1	8.3	−10.4	−27.4	6.6
Kent	313	68.7	63.3	73.6	29.1	2.2	−6.0	−15.4	3.5
L Barts	645	75.2	71.7	78.4	6.2	18.6	−2.5	−8.8	3.8
L Guys	446	78.3	74.2	81.8	8.5	13.2	−4.4	−11.3	2.6
L Kings	370	61.6	56.6	66.4	3.5	34.9	−20.4	−28.7	−12.1
L Rfree	506	71.2	67.0	74.9	9.1	19.8	−1.9	−9.2	5.3
L St.G	247	31.6	26.1	37.6	0.8	67.6	−11.5	−23.3	0.3
Leeds	463	71.3	67.0	75.2	21.2	7.6	−4.8	−12.3	2.7
Leic	702	70.9	67.5	74.2	7.1	21.9	5.8	−0.7	12.3
Liv Ain	95	82.1	73.1	88.6	7.4	10.5	3.4	−11.0	17.8
Liv RI	367	67.0	62.1	71.7	9.3	23.7	−3.6	−12.7	5.4
M RI	241	68.9	62.8	74.4	8.3	22.8	1.2	−9.4	11.8
Middlbr	262	52.3	46.2	58.3	1.9	45.8	−0.5	−11.9	10.9
Newc	252	55.2	49.0	61.2	9.9	34.9	−16.6	−27.6	−5.7
Newry	93	85.0	76.2	90.9	12.9	2.2	15.2	−0.8	31.1
Norwch	293	77.5	72.3	81.9	16.7	5.8	6.6	−2.8	16.0
Nottm	308	75.0	69.9	79.5	4.6	20.5	9.5	−0.4	19.3
Oxford	333	59.2	53.8	64.3	8.7	32.1	−8.0	−17.7	1.7
Plymth	113	75.2	66.5	82.3	20.4	4.4	4.6	−10.8	20.0
Ports	440	80.7	76.7	84.1	8.0	11.4	1.7	−5.4	8.8
Prestn	366	74.6	69.9	78.8	10.1	15.3	−2.7	−11.1	5.7
Redng	248	63.3	57.1	69.1	1.2	35.5	−8.5	−19.4	2.5
Sheff	570	66.0	62.0	69.7	3.9	30.2	−6.1	−13.1	1.0
Shrew	182	79.1	72.6	84.4	11.0	9.9	8.5	−3.4	20.4
Stevng	348	83.9	79.7	87.4	6.0	10.1	7.7	−0.1	15.6
Sthend	119	72.3	63.6	79.6	10.9	16.8	0.0	−15.0	15.0
Sund	163	81.6	74.9	86.8	11.7	6.8	7.8	−4.4	19.9
Swanse	322	61.8	56.4	67.0	1.9	36.3	−7.9	−17.5	1.8
Truro	136	86.0	79.1	90.9	13.2	0.7	26.8	13.4	40.1
Tyrone	85	74.1	63.8	82.3	3.5	22.4	14.1	−4.3	32.5
Ulster	86	50.0	39.6	60.4	50.0	0.0	12.0	−7.8	31.8
Wirral	167	75.5	68.4	81.4	5.4	19.2	13.8	0.5	27.0
Wolve	286	58.0	52.2	63.6	40.6	1.4	−7.8	−18.3	2.8
Wrexm	71	74.7	63.3	83.4	19.7	5.6	−1.4	−20.1	17.2
York	160	74.4	67.1	80.5	10.0	15.6	2.3	−12.2	16.7
England	**14,169**	**71.6**	**70.9**	**72.4**	**9.7**	**18.7**	**−0.6**	**−2.0**	**0.8**
N Ireland	**670**	**77.3**	**74.0**	**80.3**	**13.9**	**8.8**	**6.2**	**0.0**	**12.4**
Wales	**921**	**67.1**	**64.0**	**70.1**	**14.3**	**18.6**	**−5.9**	**−11.4**	**−0.3**
E, W & NI	**15,760**	**71.6**	**70.9**	**72.3**	**10.2**	**18.2**	**−0.6**	**−2.0**	**0.7**

n/a data unavailable for last year due to low patient numbers

Table 10.16. Summary statistics for serum bicarbonate in peritoneal dialysis patients by centre in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	93	13					
B Heart	93	25	26	2	26	24	27
B QEH	76	108	25	3	25	23	27
Bangor	100	29	26	3	26	24	28
Basldn	100	25	26	2	26	25	27
Belfast	100	34	24	3	24	23	27
Bradfd	100	31	27	2	27	24	29
Brightn	93	71	24	3	24	21	26
Bristol	99	67	24	3	24	22	26
Camb	100	31	27	3	27	26	29
Cardff	99	94	23	3	22	20	25
Carlis	100	13					
Carsh	92	102	27	3	27	26	29
Chelms	100	31	26	3	27	25	28
Clwyd	86	6					
Covnt	93	68	25	3	26	24	28
Derby	100	82	25	3	25	23	27
Derry	100	3					
Donc	87	26	25	3	25	23	28
Dorset	96	52	24	3	24	22	27
Dudley	96	48	25	3	25	23	27
Exeter	100	64	26	4	26	24	28
Glouc	100	39	26	3	26	25	28
Hull	98	62	25	3	26	24	28
Ipswi	100	42	24	3	24	23	26
Kent	100	64	23	3	23	21	25
L Barts	98	162	26	3	26	25	28
L Guys	100	44	24	3	24	22	26
L Kings	100	68	26	3	26	24	28
L Rfree	98	63	25	3	25	23	28
L St.G	97	56	28	3	29	27	30
L West	0	0					
Leeds	100	86	25	3	25	23	27
Leic	97	144	27	3	27	25	29
Liv Ain	29	2					
Liv RI	99	79	24	3	24	22	26
M Hope	7	8					
M RI	99	88	26	3	26	24	27
Middlbr	94	15					
Newc	98	47	25	3	25	24	28
Newry	92	11					
Norwch	89	49	23	3	23	21	25
Nottm	44	44					
Oxford	68	63	25	4	25	22	28
Plymth	100	38	24	2	24	22	25
Ports	85	69	26	3	26	24	27
Prestn	89	58	25	3	25	22	27
Redng	100	73	26	3	26	25	29
Sheff	100	68	26	3	26	24	28
Shrew	100	27	27	3	27	26	30
Stevng	89	25	25	3	26	23	27
Sthend	94	16					
Stoke	7	5					
Sund	100	24	24	3	24	23	25
Swanse	100	52	27	3	27	25	29
Truro	95	20	26	4	26	23	30

Table 10.16. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Tyrone	91	10					
Ulster	100	2					
Wirral	65	17					
Wolve	100	40	24	3	24	23	26
Wrexm	95	21	25	2	25	24	27
York	100	15					
England	**86**	**2,564**	**25**	**3**	**26**	**23**	**28**
N Ireland	**96**	**73**	**24**	**3**	**25**	**23**	**27**
Wales	**99**	**202**	**24**	**3**	**25**	**22**	**27**
E, W & NI	**87**	**2,839**	**25**	**3**	**25**	**23**	**28**

Blank cells denote low patient numbers or poor data completeness

Table 10.17. Percentage of peritoneal dialysis patients within, below and above the range for bicarbonate (22–30 mmol/L) by centre in 2009

							Change from 2008		
Centre	N	% bicarb 22–30 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <22 mmol/L	% bicarb >30 mmol/L	% within range	95% LCL	95% UCL
B Heart	25	96.0	76.5	99.4	4.0	0.0	6.7	−11.4	24.9
B QEH	108	80.6	72.0	87.0	15.7	3.7	−7.5	−20.6	5.7
Bangor	29	79.3	61.0	90.4	10.3	10.3	−2.8	−29.8	24.1
Basldn	25	100.0	0.0	100.0	0.0	0.0	16.7	−0.9	34.2
Belfast	34	88.2	72.5	95.5	11.8	0.0	5.6	−14.6	25.9
Bradfd	31	100.0	0.0	100.0	0.0	0.0	22.6	3.2	42.0
Brightn	71	66.2	54.5	76.2	32.4	1.4	−5.6	−25.2	14.0
Bristol	67	79.1	67.8	87.2	20.9	0.0	−6.8	−23.5	9.8
Camb	31	87.1	70.3	95.1	0.0	12.9	−5.0	−24.2	14.2
Cardff	94	63.8	53.7	72.9	36.2	0.0	−6.7	−23.8	10.5
Carsh	102	82.4	73.7	88.6	3.9	13.7	1.4	−12.3	15.2
Chelms	31	90.3	73.9	96.9	6.5	3.2	13.4	−8.8	35.6
Covnt	68	86.8	76.5	93.0	10.3	2.9	3.4	−14.0	20.9
Derby	82	85.4	76.0	91.5	13.4	1.2	5.4	−10.2	21.0
Donc	26	88.5	69.7	96.2	11.5	0.0			
Dorset	52	75.0	61.6	84.9	25.0	0.0	−20.9	−38.0	−3.8
Dudley	48	81.3	67.7	90.0	14.6	4.2	−11.9	−29.5	5.6
Exeter	64	84.4	73.3	91.4	10.9	4.7	11.5	−7.5	30.5
Glouc	39	92.3	78.7	97.5	5.1	2.6	7.5	−12.0	27.0
Hull	62	90.3	80.1	95.6	9.7	0.0	10.6	−5.2	26.4
Ipswi	42	83.3	69.0	91.8	16.7	0.0	−2.1	−21.9	17.7
Kent	64	60.9	48.6	72.1	39.1	0.0	−8.2	−29.5	13.2
L Barts	162	85.2	78.9	89.9	4.9	9.9	1.1	−8.7	10.8
L Guys	44	75.0	60.3	85.6	20.5	4.6	−6.6	−28.7	15.4
L Kings	68	89.7	79.9	95.0	5.9	4.4	−0.4	−13.6	12.7
L Rfree	63	81.0	69.4	88.9	15.9	3.2	−1.7	−18.8	15.3
L St.G	56	76.8	64.0	86.0	1.8	21.4	−5.2	−25.4	15.0
Leeds	86	90.7	82.5	95.3	7.0	2.3	5.3	−7.6	18.2
Leic	144	83.3	76.3	88.6	5.6	11.1	−1.2	−12.3	9.8
Liv RI	79	82.3	72.3	89.2	15.2	2.5	3.0	−12.8	18.7
M RI	88	87.5	78.8	92.9	8.0	4.6	−0.4	−13.1	12.3
Newc	47	91.5	79.4	96.8	6.4	2.1	7.8	−10.2	25.7
Norwch	49	69.4	55.3	80.6	30.6	0.0	20.3	−4.0	44.6
Oxford	63	79.4	67.6	87.6	14.3	6.4	−2.3	−20.0	15.4
Plymth	38	84.2	69.0	92.7	15.8	0.0	−0.2	−20.9	20.4
Ports	69	89.9	80.2	95.1	8.7	1.5	−1.5	−14.9	11.8

Table 10.17. Continued

Centre	N	% bicarb 22–30 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <22 mmol/L	% bicarb >30 mmol/L	Change from 2008		
							% within range	95% LCL	95% UCL
Prestn	58	82.8	70.8	90.5	12.1	5.2	−0.2	−19.3	18.9
Redng	73	84.9	74.8	91.5	8.2	6.9	−7.1	−20.6	6.4
Sheff	68	86.8	76.5	93.0	5.9	7.4	−2.0	−16.3	12.4
Shrew	27	88.9	70.7	96.4	0.0	11.1	1.4	−20.3	23.1
Stevng	25	84.0	64.3	93.9	12.0	4.0	−7.2	−29.9	15.5
Sund	24	83.3	63.1	93.6	16.7	0.0			
Swanse	52	88.5	76.6	94.7	5.8	5.8	3.7	−12.9	20.3
Truro	20	85.0	62.4	95.1	10.0	5.0	0.4	−27.1	27.9
Wolve	40	87.5	73.3	94.7	12.5	0.0	−3.4	−20.2	13.4
Wrexm	21	95.2	72.9	99.3	4.8	0.0	−4.8	−16.7	7.2
England	**2,564**	**83.5**	**82.0**	**84.9**	**11.7**	**4.8**	**0.1**	**−2.6**	**2.8**
N Ireland	**73**	**84.9**	**74.8**	**91.5**	**15.1**	**0.0**	**3.4**	**−12.4**	**19.1**
Wales	**202**	**75.7**	**69.4**	**81.2**	**21.3**	**3.0**	**−3.5**	**−13.9**	**7.0**
E, W & NI	**2,839**	**83.0**	**81.6**	**84.3**	**12.5**	**4.5**	**−0.1**	**−2.6**	**2.5**

Blank cells denote low patient numbers last year precluding calculation of change in target attainment

processing and of dialysis treatment. It did not adjust for case-mix and was unable to detect any significant differences between centres. However, it is possible that there may be unmeasured processes including dialysis and oral bicarbonate prescription that might account for the variation observed [18].

Total cholesterol

There is no audit standard for total cholesterol in the 4th edition of the Renal Association Clinical Practice Guidelines. Current guidance on lipid management states:

'Three hydroxy-3 methylglutaryl-Co-enzyme A reductase inhibitors (statins) should be considered for primary prevention in all CKD including dialysis patients with a 10-year risk of cardiovascular disease, calculated as >20% according to the Joint British Societies' Guidelines (JBS 2), despite the fact that these calculations have not been validated in patients with renal disease. The

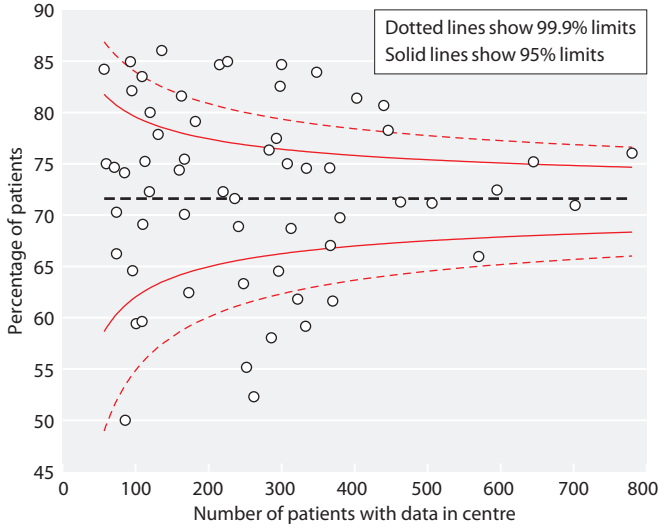

Fig. 10.15. Funnel plot for percentage of haemodialysis patients within the range for bicarbonate (20–26 mmol/L) by centre in 2009

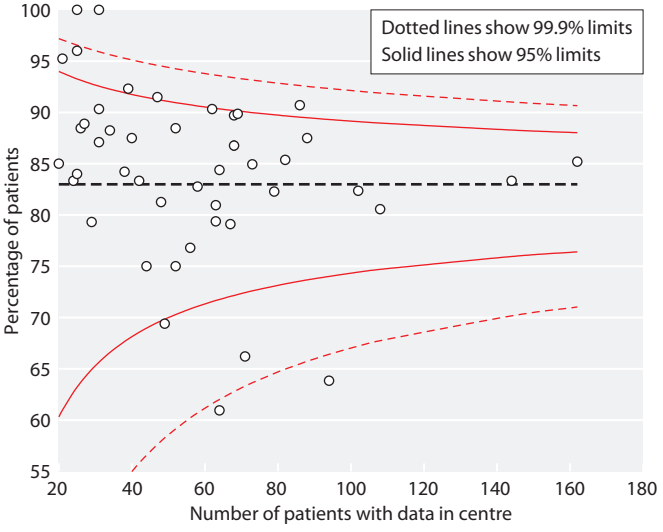

Fig. 10.16. Funnel plot for percentage of peritoneal dialysis patients within the range for bicarbonate (22–30 mmol/L) by centre in 2009

target total cholesterol should be <4 mmol/L or a 25% reduction from baseline, and a fasting low density lipoprotein (LDL)-cholesterol of <2 mmol/L or a 30% reduction from baseline, should be achieved, whichever is the greatest reduction in all patients (Evidence in CKD 1–3, Good Practice in CKD 4–5 and dialysis patients). Statins should not be withdrawn from patients in whom they were previously indicated and should continue to be prescribed when such patients start renal replacement therapy (RRT) or change modality. (Good Practice).' (Module 2: Complications) [1]

Total cholesterol data were 84% complete for HD patients and 82% complete for PD patients. As there are no specific audit measures for total cholesterol, summary data are presented for each dialysis centre (tables 10.18 and 10.19, figures 10.17 and 10.18). There are a number of case-mix factors (comorbidity, inflammation,

Table 10.18. Summary statistics for total cholesterol in haemodialysis patients by centre in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	121	3.6	1.1	3.4	3.0	4.1
B Heart	93	377	4.2	1.1	4.1	3.5	4.8
B QEH	78	633	3.9	1.0	3.7	3.2	4.5
Bangor	95	70	4.2	1.1	4.2	3.4	5.0
Basldn	99	131	3.8	1.2	3.6	3.0	4.5
Belfast	82	187	3.9	1.0	3.8	3.2	4.3
Bradfd	88	154	4.1	1.0	4.0	3.5	4.6
Brightn	14	41					
Bristol	93	376	4.0	1.2	3.9	3.2	4.7
Camb	68	223	3.8	1.1	3.6	2.9	4.5
Cardff	92	411	3.9	1.1	3.8	3.1	4.6
Carlis	100	57	4.3	1.0	4.3	3.7	4.8
Carsh	80	489	4.2	1.1	4.1	3.4	4.8
Chelms	90	98	3.7	1.0	3.6	2.9	4.3
Clwyd	100	74	3.9	0.8	3.8	3.3	4.4
Colchr	88	90	3.9	1.2	3.7	3.1	4.5
Covnt	0	0					
Derby	89	209	3.9	1.1	3.7	3.2	4.4
Derry	100	60	3.6	0.8	3.7	3.1	4.0
Donc	98	107	3.9	1.1	3.7	3.1	4.4
Dorset	94	202	4.0	1.0	3.9	3.3	4.5
Dudley	67	96	3.6	0.9	3.6	3.1	4.2
Exeter	93	280	4.0	1.2	3.9	3.2	4.6
Glouc	91	157	3.9	1.0	3.8	3.1	4.6
Hull	90	271	4.1	1.1	3.9	3.2	4.8
Ipswi	87	84	4.0	1.1	3.8	3.3	4.5
Kent	97	306	3.9	1.0	3.8	3.2	4.6
L Barts	100	646	4.1	1.1	3.9	3.3	4.7
L Guys	92	494	4.0	1.1	3.9	3.3	4.6
L Kings	97	360	4.1	1.0	4.0	3.4	4.6
L Rfree	83	511	4.0	1.1	3.8	3.2	4.6
L St.G	98	243	4.0	1.0	3.9	3.3	4.7
L West	97	1,159	3.6	0.9	3.5	3.0	4.1
Leeds	98	458	3.9	1.0	3.8	3.2	4.5
Leic	90	634	3.9	1.1	3.8	3.2	4.4
Liv Ain	40	55					
Liv RI	7	27					
M Hope	82	270	3.7	1.0	3.6	3.1	4.3
M RI	51	206	3.9	1.0	3.8	3.2	4.6
Middlbr	98	262	4.2	1.2	4.0	3.4	5.0
Newc	100	252	3.8	1.0	3.6	3.1	4.4
Newry	99	93	3.5	1.3	3.3	2.7	3.9

Table 10.18. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Norwch	99	293	4.0	1.0	3.8	3.3	4.6
Nottm	99	377	4.0	1.0	3.9	3.3	4.6
Oxford	87	290	3.8	1.0	3.8	3.0	4.4
Plymth	89	100	4.1	1.1	3.9	3.5	4.6
Ports	65	288	4.1	1.3	3.9	3.1	4.8
Prestn	98	440	4.0	1.0	3.9	3.3	4.5
Redng	96	238	3.8	0.9	3.8	3.2	4.4
Sheff	92	524	3.9	1.1	3.7	3.1	4.5
Shrew	99	181	4.0	1.0	3.9	3.3	4.5
Stevng	18	63					
Sthend	96	116	4.0	1.1	3.9	3.3	4.7
Stoke	99	274	3.8	0.9	3.8	3.1	4.4
Sund	97	160	3.8	1.0	3.7	3.1	4.5
Swanse	93	300	4.1	1.1	4.0	3.3	4.8
Truro	99	138	3.9	1.1	3.8	3.2	4.4
Tyrone	100	86	3.8	0.9	3.8	3.1	4.5
Ulster	100	86	3.6	0.8	3.7	3.0	4.1
Wirral	86	147	3.9	1.0	3.8	3.1	4.5
Wolve	96	276	4.1	1.1	4.0	3.4	4.7
Wrexm	85	60	4.0	0.9	4.0	3.5	4.6
York	88	149	4.5	1.0	4.4	3.8	5.2
England	**83**	**14,012**	**3.9**	**1.1**	**3.8**	**3.2**	**4.5**
N Ireland	**94**	**633**	**3.7**	**1.0**	**3.6**	**3.0**	**4.2**
Wales	**93**	**915**	**4.0**	**1.1**	**3.9**	**3.2**	**4.7**
E, W & NI	**84**	**15,560**	**3.9**	**1.1**	**3.8**	**3.2**	**4.5**

Blank cells denote low patient numbers or poor data completeness

Table 10.19. Summary statistics for total cholesterol in peritoneal dialysis patients by centre in 2009

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	14					
B Heart	96	26	4.8	1.21	4.55	3.9	5.4
B QEH	85	121	4.57	1.2	4.4	3.6	5.4
Bangor	100	29	4.87	1.22	4.6	3.8	5.8
Basldn	100	25	4.34	0.9	4.3	3.8	4.7
Belfast	100	34	4.46	1.14	4.19	3.9	4.9
Bradfd	94	29	4.3	1.25	3.9	3.7	5
Brightn	33	25					
Bristol	88	60	4.74	1.94	4.5	3.8	5.05
Camb	97	30	4.11	0.99	3.9	3.4	4.8
Cardff	96	93	4.46	1.22	4.2	3.6	5.3
Carlis	100	13					
Carsh	28	31					
Chelms	90	28	4.18	1.03	3.94	3.38	4.86
Clwyd	71	5					
Covnt	0	0					
Derby	84	69	4.49	1.18	4.5	3.6	5.3
Derry	100	3					
Donc	37	11					
Dorset	89	48	4.33	1.14	4.15	3.55	5
Dudley	68	34	3.97	1.24	3.65	3.1	4.7
Exeter	95	61	4.53	1.37	4.3	3.8	5
Glouc	79	31	4.4	1.15	4.2	3.5	4.9

Table 10.19. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Hull	81	51	5.01	1.83	4.8	4.2	6
Ipswi	100	42	3.98	0.98	3.85	3.25	4.78
Kent	100	64	4.68	1.18	4.75	3.8	5.35
L Barts	99	164	4.62	1.16	4.4	3.9	5.3
L Guys	93	41	4.72	1.05	4.6	4	5.2
L Kings	100	68	4.42	0.75	4.4	3.9	4.9
L Rfree	98	63	4.37	0.97	4.3	3.6	4.9
L St.G	91	53	4.91	1.67	4.5	3.8	5.6
L West	100	31	4.68	0.96	4.7	4	5.3
Leeds	97	83	4.41	1.27	4.2	3.6	5
Leic	94	139	4.37	1.19	4.2	3.6	5
Liv Ain	0	0					
Liv RI	0	0					
M Hope	78	87	4.46	1.25	4.3	3.5	5.3
M RI	94	84	4.53	1.23	4.5	3.75	5
Middlbr	44	7					
Newc	100	48	4.42	1.24	4.2	3.45	5.3
Newry	100	12					
Norwch	91	50	4.85	1.26	4.8	4	5.9
Nottm	97	98	4.52	1.17	4.4	3.7	5.1
Oxford	87	81	4.59	1.17	4.6	3.7	5.3
Plymth	97	37	4.9	1.4	4.5	3.9	5.5
Ports	77	62	4.39	1.39	4.07	3.47	5.23
Prestn	97	63	4.31	0.97	4.35	3.78	4.86
Redng	99	72	4.67	1.38	4.4	3.75	5.4
Sheff	65	44	4.23	1.11	4.1	3.4	5
Shrew	93	25	5.02	1.31	4.9	4.3	5.7
Stevng	64	18					
Sthend	76	13					
Stoke[a]	100	69					
Sund	75	18					
Swanse	86	43	4.38	1.09	4.3	3.6	4.9
Truro	86	18					
Tyrone	64	7					
Ulster	100	2					
Wirral	62	16					
Wolve	95	38	4.4	1.1	4.1	3.5	5.3
Wrexm	95	21	4.4	1.1	4.2	3.6	5.3
York	93	14					
England	**81**	**2,150**	**4.5**	**1.2**	**4.3**	**3.7**	**5.2**
N Ireland	**95**	**72**	**4.4**	**1.3**	**4.2**	**3.6**	**4.9**
Wales	**93**	**191**	**4.5**	**1.2**	**4.3**	**3.6**	**5.2**
E, W & NI	**82**	**2,370**	**5.1**	**1.4**	**4.9**	**4.2**	**5.9**

Blank cells denote low patient numbers or poor data completeness
[a]Stoke excluded due to technical difficulties extracting data

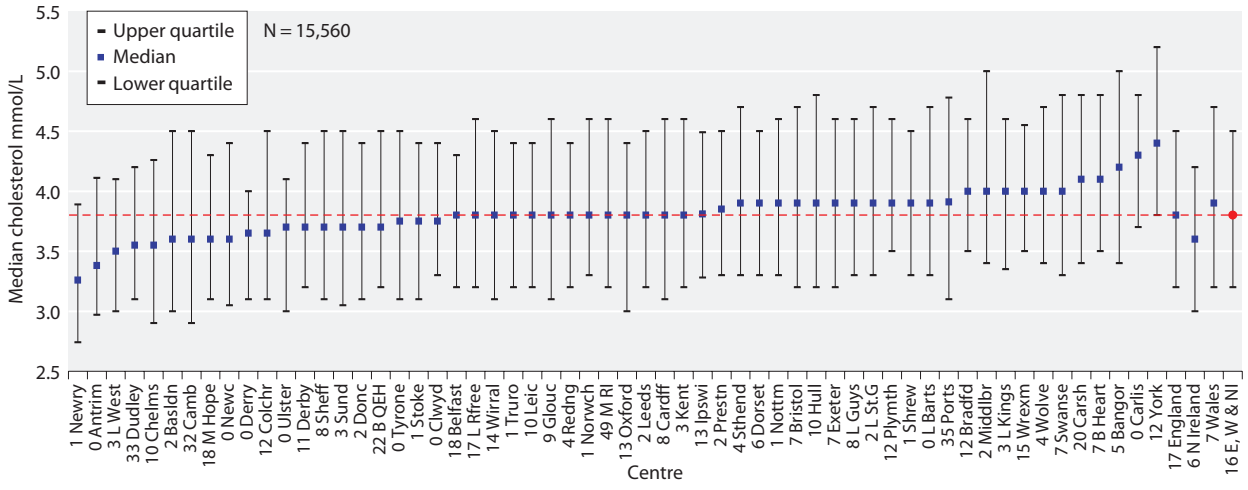

Fig. 10.17. Median total cholesterol in haemodialysis patients by centre in 2009

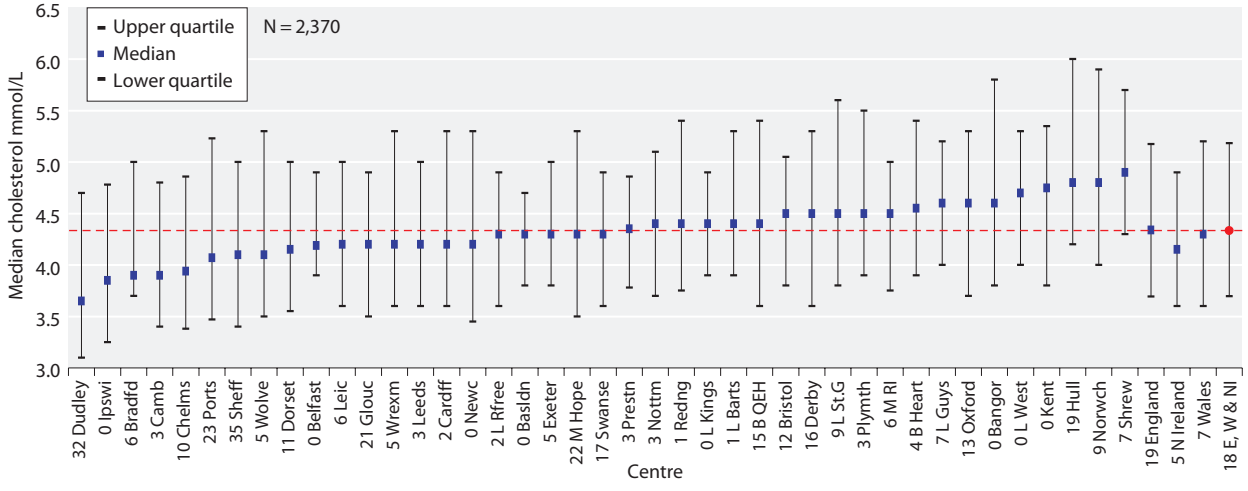

Fig. 10.18. Median total cholesterol in peritoneal dialysis patients by centre in 2009

malnutrition) which may account for any inter-centre variation in addition to differences in prescription of lipid lowering medication and other therapies known to influence serum lipid concentration e.g. steroids, sevelamer etc.

Conflicts of interest: none

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Chapter 11
Blood Pressure Profile of Prevalent Patients receiving Renal Replacement Therapy in England, Wales and Northern Ireland in 2009: national and centre-specific analyses

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Key Words
Diastolic blood pressure · Epidemiology · Established renal failure · Haemodialysis · Peritoneal dialysis · Pulse pressure · Systolic blood pressure · Transplant

Summary

- Data completeness was better for HD patients (67% for pre-HD measurements) than for PD patients (44%) or transplant recipients (37%).
- In 2009, the median pre- and post-HD SBP were 142 mmHg and 129 mmHg respectively. The median SBP of patients on PD was 137 mmHg. Transplant recipients had a median SBP of 134 mmHg. Median DBP were 74 mmHg (pre-HD), 68 mmHg (post-HD), 79 mmHg (PD) and 79 mmHg (transplant).
- In England, Wales and Northern Ireland, only 26.7% of PD patients achieved the Renal Association guideline of SBP <130 mmHg **and** DBP <80 mmHg.
- In England, Wales and Northern Ireland, only 27.2% of transplant patients achieved the Renal Association guideline of SBP <130 mmHg **and** DBP <80 mmHg.

Introduction

The controversies over the management of blood pressure (BP) amongst patients on renal replacement therapy (RRT) have been extensively discussed in previous reports from the UKRR [1, 2] and elsewhere [3–6]. Uncertainty in how best to manage fluid balance and BP, particularly in haemodialysis (HD) patients, stems from several factors:

- the association between low BP and premature mortality [7–11], almost certainly the result of pre-existing conditions that cause both low BP and a high risk of subsequent mortality, e.g. cardiac failure;
- the complex, non-linear relationship between volume status and BP [12–14];
- the fact that BP varies markedly during the dialysis cycle, and that neither pre-dialysis nor post-dialysis BP gives reliable estimates of inter-dialytic mean BP [15];
- the fact that calcification of conduit arteries causes decreased arterial compliance, changing the relationship between peripheral and central pressure and increasing the risk of sub-endocardial ischaemia at low diastolic pressures;
- the linkage between nutritional intake and inter-dialytic weight gain, confounding analyses of inter-dialytic fluid overload and outcome [16, 17];
- the complex balance between the harm associated with extracellular volume expansion and the risk of acute dialysis-related hypotension [18] and associated myocardial stunning [19, 20] with rapid ultrafiltration [21];
- the balance between the contribution of BP-lowering drugs to the risk of intra-dialytic hypotension and their possible cardio-protective effects.

Some of these problems also contribute to uncertainty about the optimal management of BP in peritoneal dialysis (PD) [22, 23] and transplant patients.

Since the last UKRR Report, two meta-analyses of the effects of BP lowering treatment in dialysis patients have been published [24, 25]. Both studies concluded that there is clear evidence of better outcomes amongst patients randomised to receive BP lowering drug treatment, but do not give reliable evidence on the appropriate 'target' BP range amongst patients on dialysis.

The utility of the UKRR database to inform practice in this area is limited by the absence of reliable and complete information on the use of BP lowering drugs and in HD patients, on intra-dialytic weight gain and the frequency of intra-dialytic hypotension. Analyses are therefore limited to systolic and diastolic BP (measured pre-dialysis and post-dialysis in HD patients).

Due to these uncertainties, the Renal Association currently does not set an audit standard for BP in HD patients. The guideline in operation during the period during which the audit data in this chapter were collected [26] stated:

Guideline 1.8 C-CVD: Hypertension in dialysis patients

Pre- and post-dialysis blood pressure (measured after completion of dialysis, including washback) should be recorded and intra-dialytic blood pressure measured to enable management of the haemodialysis session.

Measurement of inter-dialytic blood pressure should be encouraged as a routine aid to management in haemodialysis patients (Good Practice).

Blood pressure in peritoneal dialysis patients should be <130/80 mmHg (Good Practice).

Hypertension on dialysis should be managed by ultrafiltration in the first instance (Good practice).

Guideline 1.9 C-CVD: Hypertension in renal transplant patients

The target blood pressure for renal transplant patients is <130/80 mmHg (Good practice).

These guidelines are consistent with international guidelines [6, 27].

In previous UKRR annual reports, the BP chapter contained numerous separate analyses of pre-dialysis and post-dialysis systolic BP (SBP), diastolic BP (DBP), and pulse pressure (PP), together with analyses of the proportion of patients in each centre meeting BP 'goals'. There was considerable overlap in centre performance against each of these measures. For this report the relationship between these various measures using Rose-Day plots have been analysed, reducing the number of 'caterpillar' plots depicting centre performance.

Methods

All adult patients in England, Wales and Northern Ireland receiving RRT (HD, PD and transplant recipients) on 31st December 2009 were considered for inclusion in the analyses.

The method of data extraction employed is described in chapter 15 of the 11th UKRR Annual Report [28]. The UKRR extracts quarterly laboratory, clinical and demographic data for all patients receiving RRT in the 63 renal centres in England, Northern Ireland and Wales. Data on some variables from the nine Scottish renal centres are sent annually from the Scottish Renal Registry. However, BP measurements are not received from Scotland and therefore Scottish renal centres are excluded from all BP analyses.

Patients who had been on the same modality and at the same renal centre for 3 months and with a valid BP reading in either the fourth or the third quarter of 2009 were included. This included incident patients starting RRT during 2009 who were still alive on 31st December 2009. Analyses used the last recorded BP from quarter 4, however, if this was missing, the last recorded BP from quarter 3 was used instead.

Analyses were performed on each RRT modality (HD, PD and transplant). Most UK renal centres manage HD, PD and transplant patients. However, Colchester had no PD patients and four centres (Bangor, Colchester, Liverpool Aintree, Wirral) had no transplant patients under their care.

All patients meeting the criteria above were included in the overall national analyses, but renal centres with less than 50% data completeness for any modality, or fewer than 20 patients with results, were excluded from the centre-level analysis for that modality. The number preceding the centre name in each figure corresponds to the percentage of missing data in each centre.

Patients on HD were analysed both by pre-dialysis and post-dialysis BP. The BP components analysed included SBP, DBP and PP. The data were analysed to produce summary statistics (mean, median, maximum, minimum). Standard deviation and quartile ranges were also calculated. Median BP and inter-quartile ranges (IQRs) are presented for each analysis as caterpillar plots. In addition to this, the percentage of PD and transplant patients attaining Renal Association Standards for BP (***<130/80 mmHg***) in individual renal centres and each nation were calculated and are presented with 95% confidence intervals in caterpillar plots.

For the pre- and post-dialysis BP in HD patients, Rose-Day plots are used to show the relationship between the BP mean (SBP and DBP) and the percentage of patients below a given threshold (***pre-HD BP <140/90 mmHg and post-HD <130/80 mmHg***) in each centre. Squared correlation coefficients (R^2), indicating the strength of the relationship between the two measurements are given. The value of R^2 can be between 0 and 1 (the better the correlation, the closer the value of R^2 to 1).

Chi-squared tests were used in the analyses of the 2009 BP data to test for statistically significant differences between renal centres and between nations. All statistical analyses were performed using SAS version 9.2.

Results

Data completeness

Data extracts were received from all 63 centres in England, Wales and Northern Ireland, four of which do not manage any transplant patients and one centre does not manage PD patients. Data completeness is summarised in table 11.1. Overall, completeness is very similar to that in the previous UKRR Report. However, there were large improvements in data completeness for HD from three centres (Cambridge, London West, Oxford), for PD patients from four centres (Gloucester, Hull, Newry, Swansea) and for transplant patients from seven centres (Derby, Gloucester, Newry, Southend, Sunderland, Swansea, Truro).

BP on each modality

Figure 11.1 gives the median and IQR for SBP, DBP and PP in prevalent HD patients (pre- and post-dialysis), PD and transplant patients.

In 2009, the median pre- and post-HD SBP were 142 mmHg and 129 mmHg respectively. The median SBP of patients on PD was 137 mmHg. Transplant recipients had a median SBP of 134 mmHg. Median DBP were 74 mmHg (pre-HD), 68 mmHg (post-HD), 79 mmHg (PD) and 79 mmHg (Transplant).

Relationship between the centre mean and the proportion above a threshold BP in that centre

Rose and Day observed in 1990 that, with a normally distributed variable, the population mean will predict the number of 'deviant' individuals in the population – for instance, the number of people with a serum cholesterol >5 mmol/L within a given population is a linear function of the mean cholesterol within that population (29). If this is true for BP amongst patients on RRT, then plots of centre-specific mean BP will give very similar information to plots of the proportion of patients in each centre with BP above a certain threshold, for instance SBP>140 mmHg. The distribution of BP in each centre was close to a normal distribution (data not shown).

Figure 11.2 demonstrates that the mean pre-dialysis SBP in a given centre accurately predicted the proportion of individuals in that centre whose pre-dialysis BP was <140 mmHg. Figure 11.3 shows a very similar relationship between mean SBP and the proportion of individuals with pre-dialysis SBP <140 mmHg **and** DBP <90 mmHg.

Figure 11.4 shows the relationship between mean pre-dialysis DBP and the proportion of individuals with DBP <90 mmHg.

Figures 11.5, 11.6 and 11.7 give the equivalent analyses for post-dialysis BP measurements. Again, there was a close relationship between mean achieved BP in a given centre and the proportion of patients whose BP was below a given threshold value.

Table 11.1. Percentage of patients in each renal centre for whom BP readings were extracted by the UKRR, by modality

Centre	% completed data				Centre	% completed data			
	Pre-HD	Post-HD	PD	Transplant		Pre-HD	Post-HD	PD	Transplant
Antrim	88	69	93	95	Leic	99	98	93	37
B Heart	93	93	0	0	Liv Ain	97	97	0	n/a
B QEH	0	0	0	2	Liv RI	91	91	18	71
Bangor	97	97	100	n/a	M Hope	62	62	0	0
Basldn	99	99	100	2	M RI	22	28	0	0
Belfast	97	93	29	56	Middlbr	98	95	75	51
Bradfd	9	0	94	74	Newc	0	0	0	0
Brightn	0	0	0	0	Newry	99	99	100	98
Bristol	100	100	100	74	Norwch	97	77	5	63
Camb	94	93	100	97	Nottm	100	100	99	92
Cardff	4	1	8	97	Oxford	98	97	53	16
Carlis	100	100	0	0	Plymth	1	0	0	0
Carsh	77	77	1	1	Ports	100	100	62	10
Chelms	100	100	94	88	Prestn	19	0	0	0
Clwyd	96	96	71	82	Redng	96	0	99	98
Colchr	100	100	n/a	n/a	Sheff	100	97	100	98
Covnt	99	99	95	73	Shrew	99	98	30	29
Derby	100	98	100	99	Stevng	98	96	4	0
Derry	97	95	100	91	Sthend	97	97	0	76
Donc	100	94	100	97	Stoke	97	97	0	0
Dorset	99	98	100	89	Sund	99	98	4	97
Dudley	80	78	8	44	Swanse	100	100	100	99
Exeter	99	99	100	75	Truro	98	98	33	96
Glouc	100	100	97	99	Tyrone	99	99	82	85
Hull	5	5	94	0	Ulster	99	98	50	100
Ipswi	100	100	100	97	Wirral	89	35	35	n/a
Kent	98	95	16	11	Wolve	100	100	100	93
L Barts	0	0	0	0	Wrexm	97	96	0	2
L Guys	0	0	0	0	York	95	69	100	81
L Kings	0	0	0	0	**England**	**67**	**63**	**44**	**32**
L Rfree	0	0	0	0	**N Ireland**	**96**	**91**	**63**	**70**
L St.G	2	3	2	0	**Wales**	**55**	**54**	**45**	**87**
L West	90	90	0	0	**E, W & NI**	**67**	**64**	**44**	**37**
Leeds	98	96	99	84					

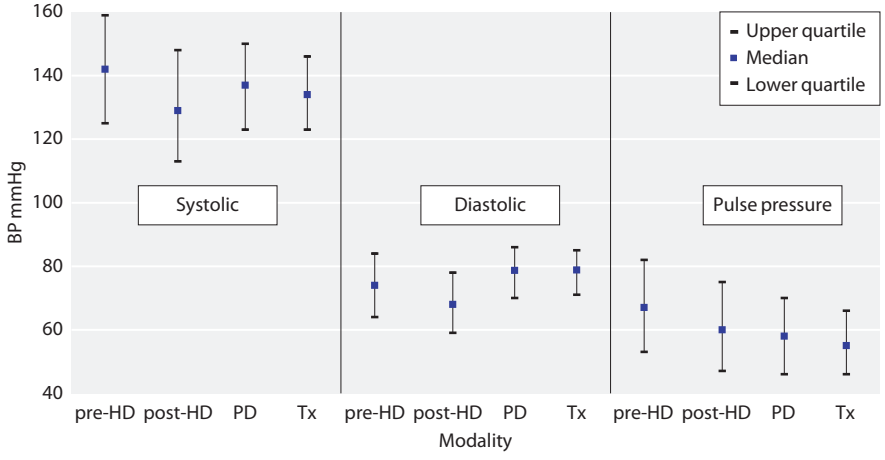

Fig. 11.1. Summary of BP achievements

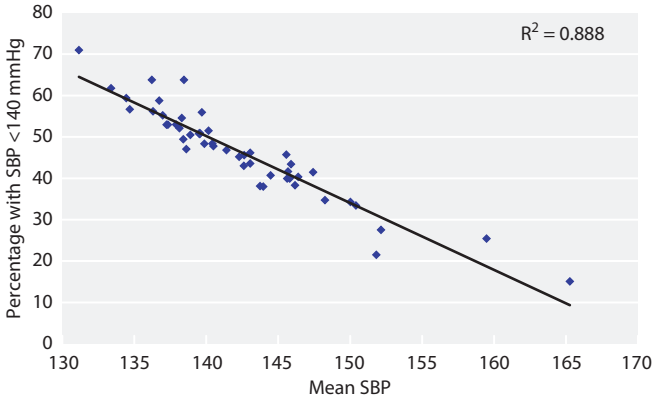

Fig. 11.2. Plot of mean SBP and percentage with SBP<140 mmHg by centre: pre-HD

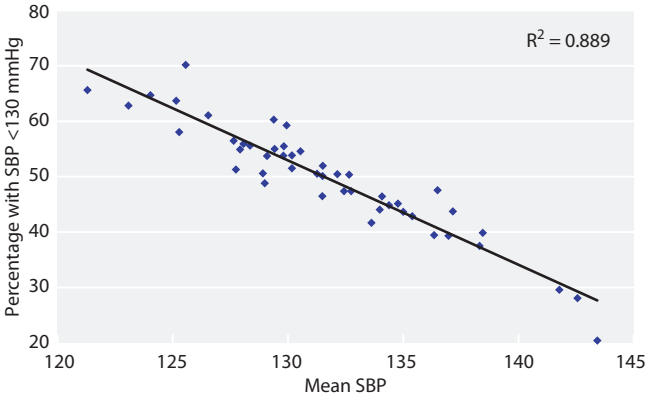

Fig. 11.5. Plot of mean SBP and percentage with SBP <130 mmHg by centre: post-HD

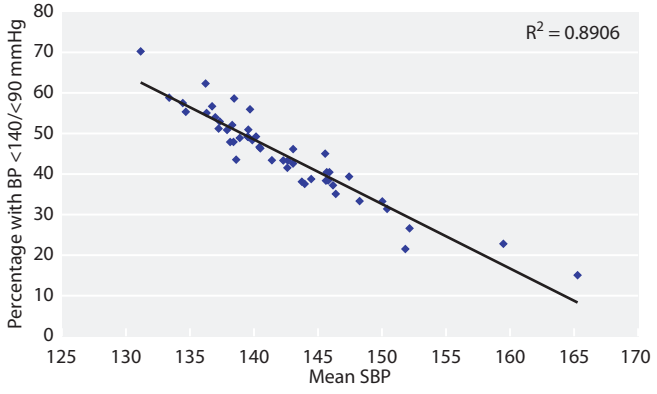

Fig. 11.3. Plot of mean SBP and percentage with BP <140 mmHg systolic and <90 mmHg diastolic by centre: pre-HD

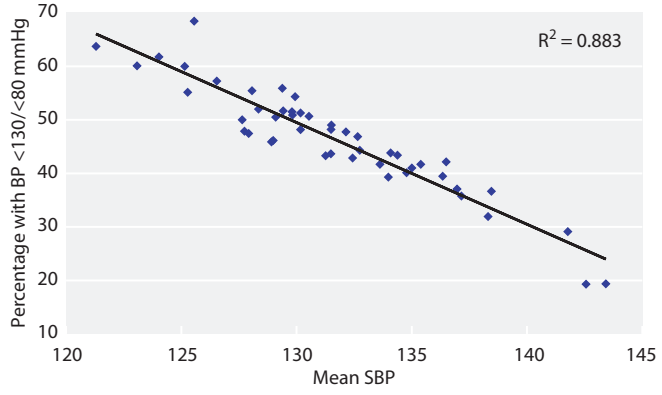

Fig. 11.6. Plot of mean SBP and percentage with BP <130 mmHg systolic and <80 mmHg diastolic by centre: post-HD

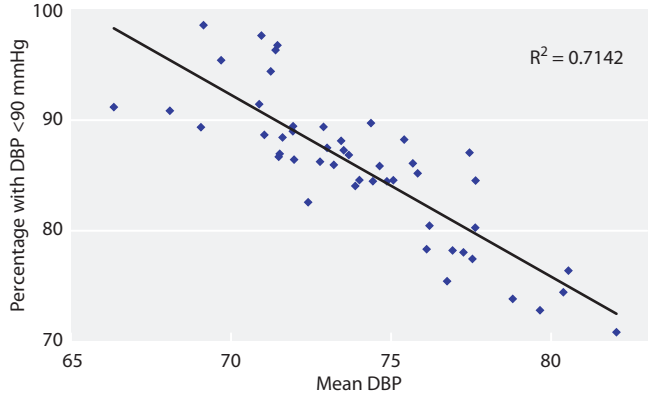

Fig. 11.4. Plot of mean DBP and percentage with DBP <90 mmHg by centre: pre-HD

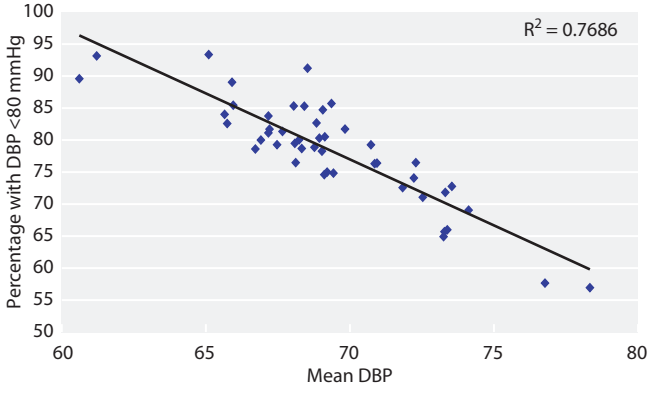

Fig. 11.7. Plot of mean DBP and percentage with DBP <80 mmHg by centre: post-HD

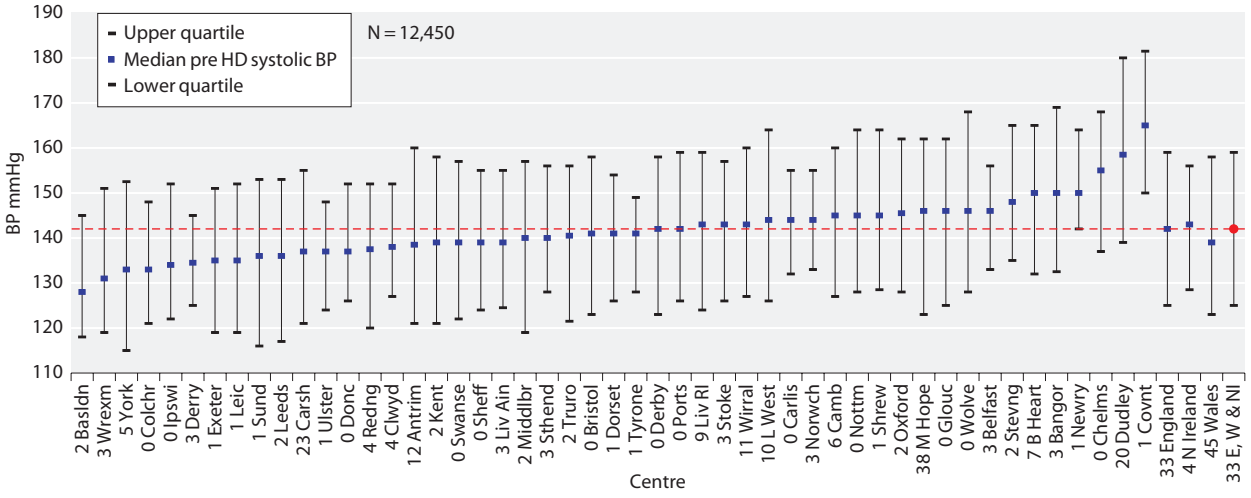

Fig. 11.8. Median systolic BP: pre-HD

These analyses show that it is redundant to show both mean (or median) BP and the proportion of patients whose BP was below a given value.

Centre-specific analyses of BP in haemodialysis patients

Figures 11.8 and 11.9 illustrate the median and IQR pre-dialysis SBP and DBP in each centre supplying data on >50% of patients. Figures 11.10 and 11.11 illustrate the equivalent analyses for post-dialysis BP. Figures for the proportion of patients with pre-dialysis BP <140/90 and for post-dialysis BP <130/80 are not included in this chapter since these audit measures were dropped from the Renal Association standards several years ago and it is clear from the Rose-Day plots in the preceding section, that they add little useful information.

There remained marked centre variation: the difference between the centres with the lowest and highest median SBP was >30 mmHg. Comparison with previous UKRR Reports showed that in general, the same centres can be found at roughly the same place in the distribution from year to year, suggesting differences in centre practice.

Centre-specific analyses of BP in peritoneal dialysis patients

Figures 11.12 and 11.13 illustrate the median and IQR SBP and DBP in each centre supplying data on >50% of eligible patients. Figure 11.14 gives the proportion of patients meeting the audit standard of BP <130/80 mmHg.

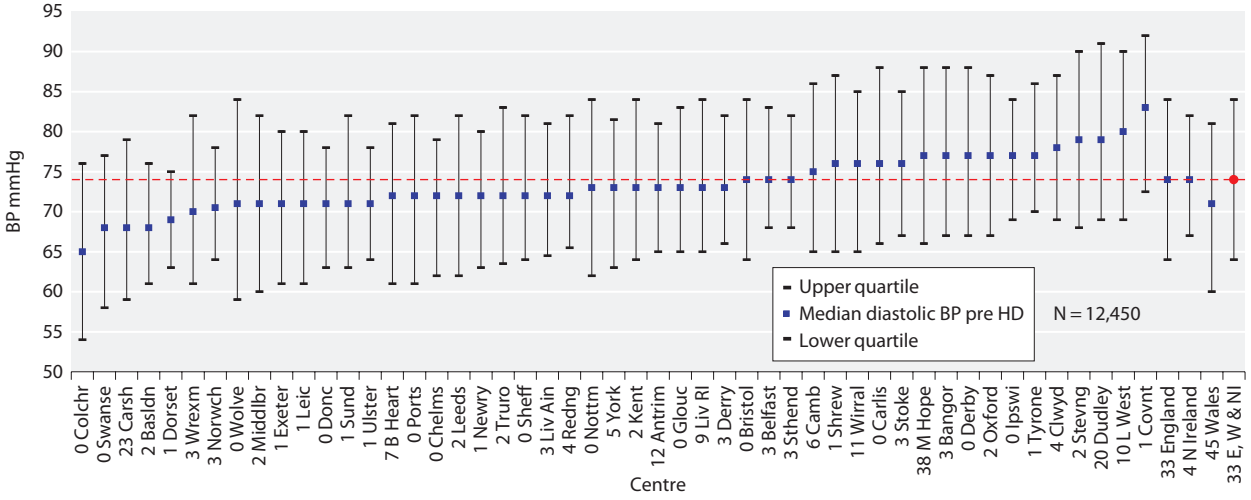

Fig. 11.9. Median diastolic BP: pre-HD

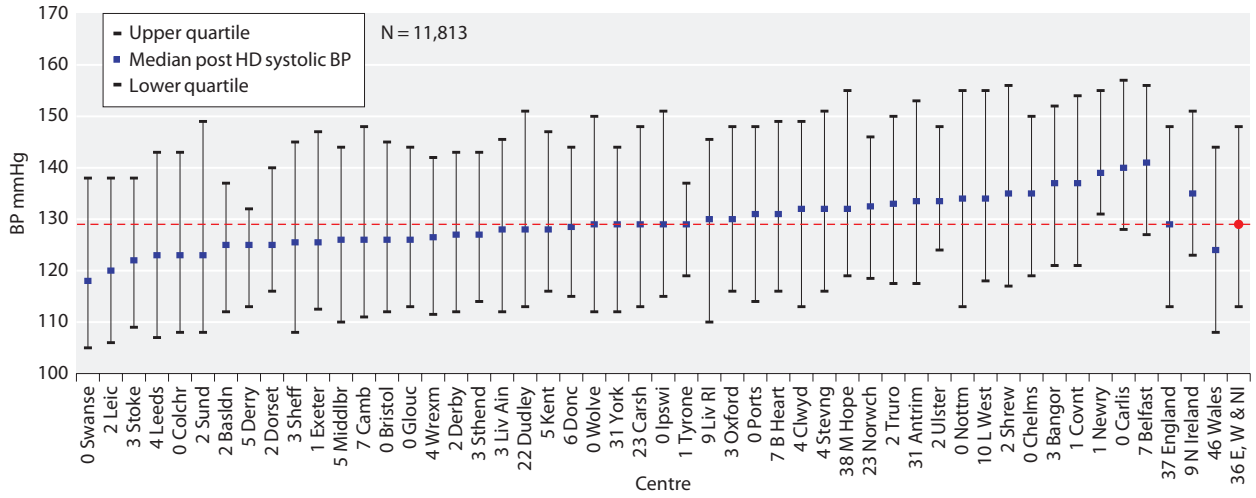

Fig. 11.10. Median systolic BP: post-HD

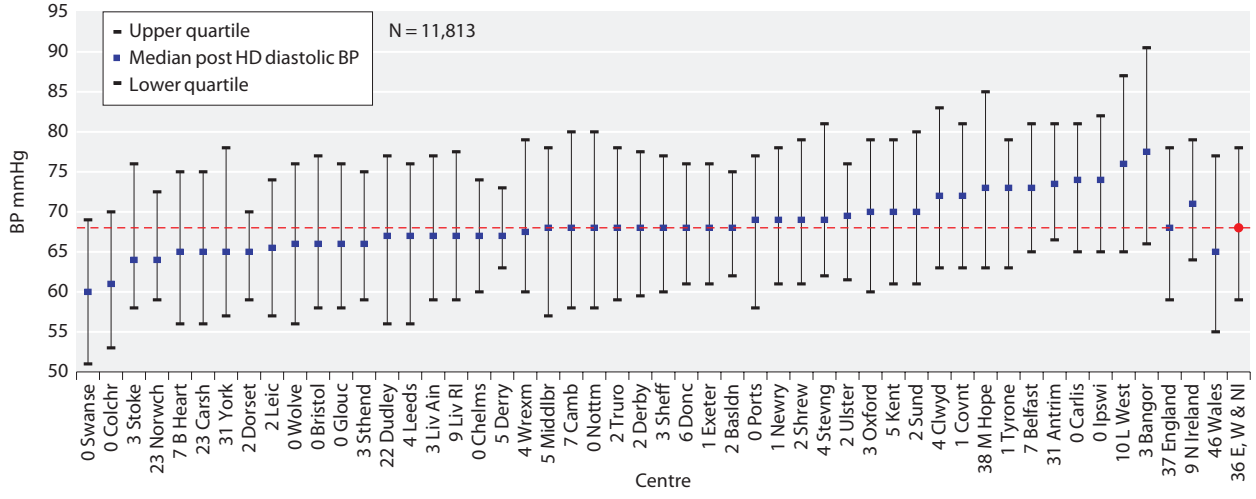

Fig. 11.11. Median diastolic BP: post-HD

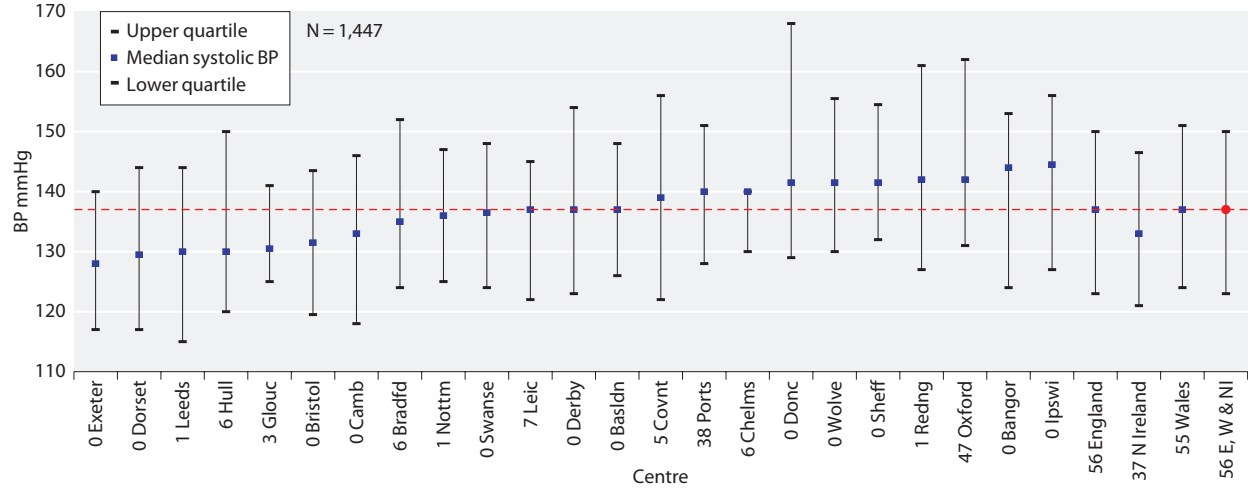

Fig. 11.12. Median systolic BP: PD

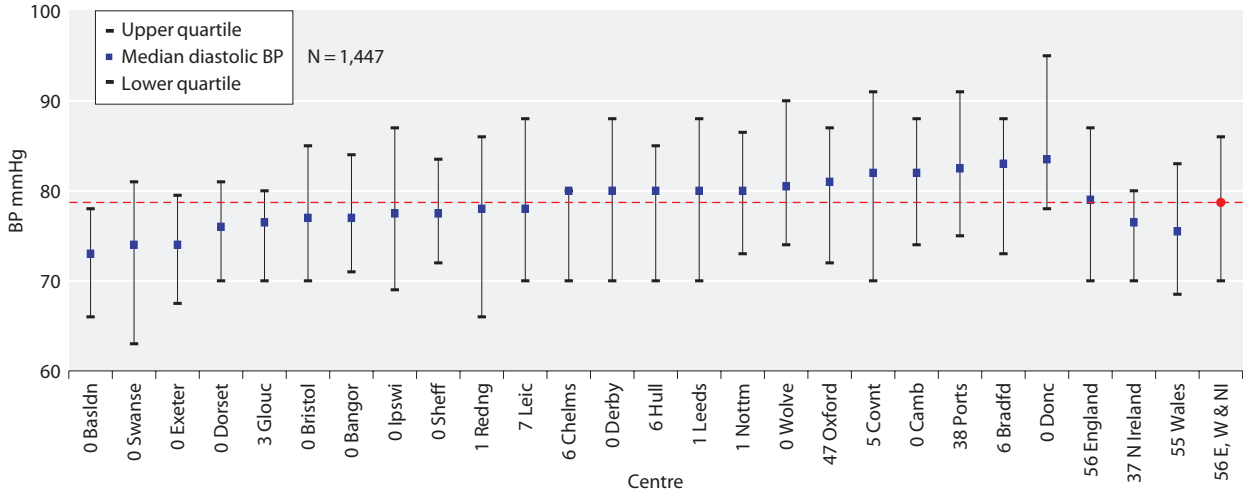

Fig. 11.13. Median diastolic BP: PD

The possibility of information bias in these analyses cannot be excluded, since BP data are extracted from the routine clinical record. For instance, BP might only be recorded during acute illness or unscheduled clinic visits. However, it is unlikely that >80% completeness of data returns would be achieved if this were the case.

Centre-specific analysis of BP in transplant patients

Figures 11.15 and 11.16 illustrate the median and IQR SBP and DBP in each centre supplying data on >50% of eligible patients and figure 11.17 illustrates the proportion of patients meeting the audit standard of BP <130/80 mmHg.

As with PD, the possibility of information bias in these analyses cannot be excluded.

Discussion

Blood pressure control in UK patients on RRT remained poor. Amongst patients on HD, this can be explained partly by the uncertainties highlighted in the Introduction. However, amongst patients on PD and those with functioning kidney transplants, there was evidence of an important gap between accepted best

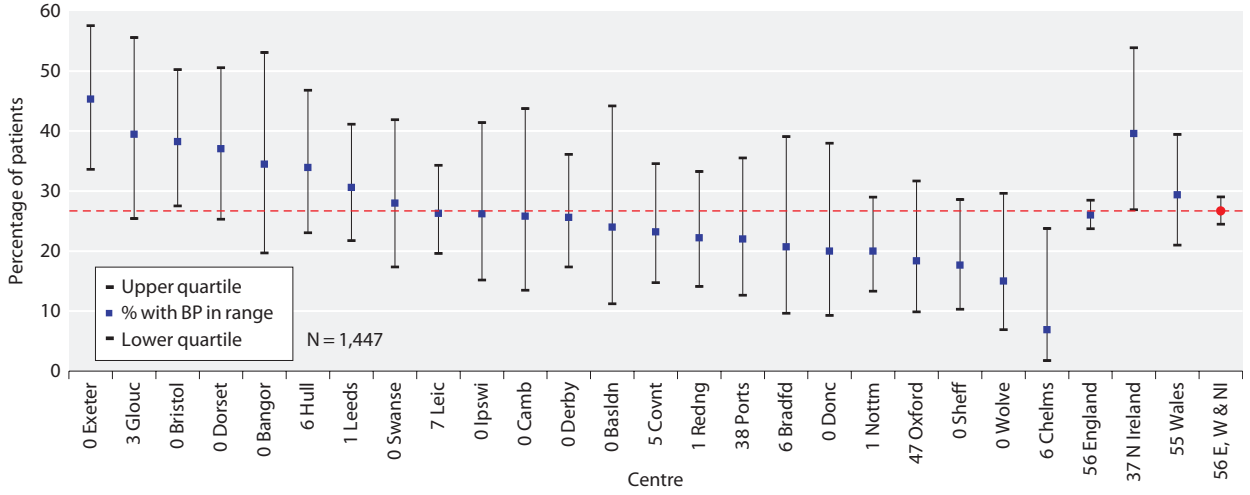

Fig. 11.14. Percentage of patients with BP <130 mmHg systolic and <80 mmHg diastolic: PD

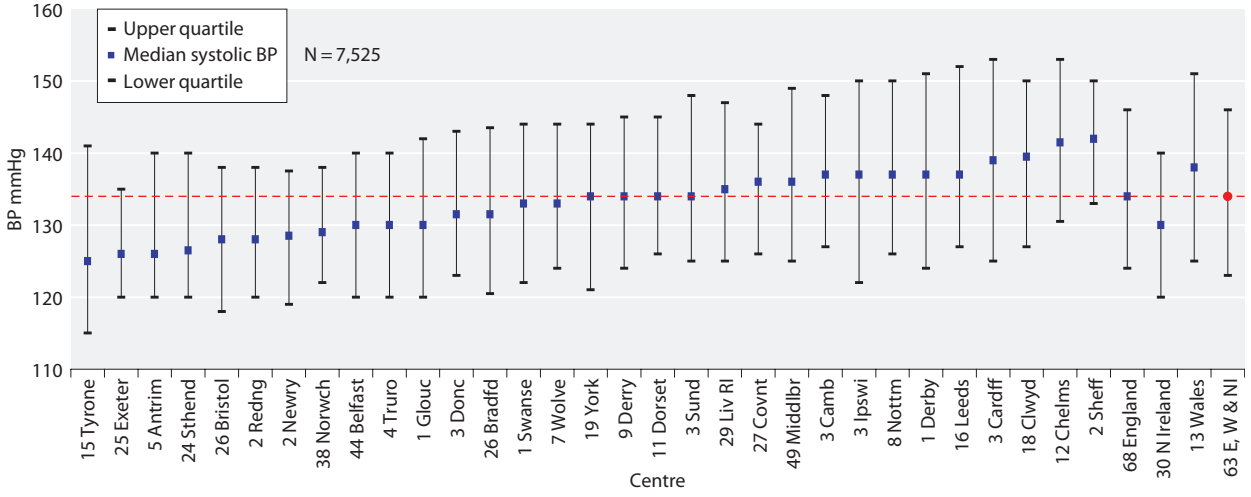

Fig. 11.15. Median systolic BP: Transplant

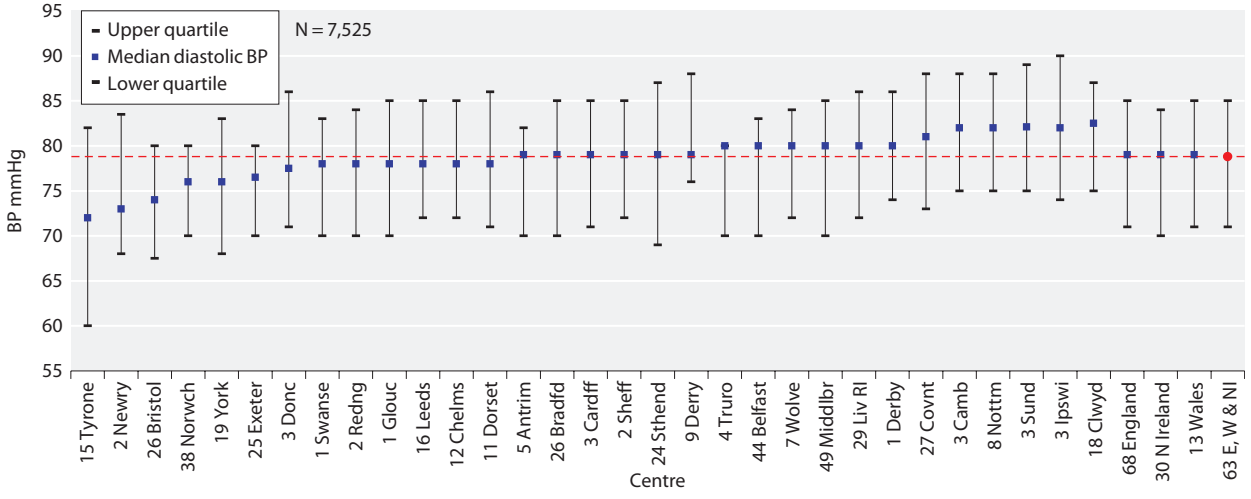

Fig. 11.16. Median diastolic BP: Transplant

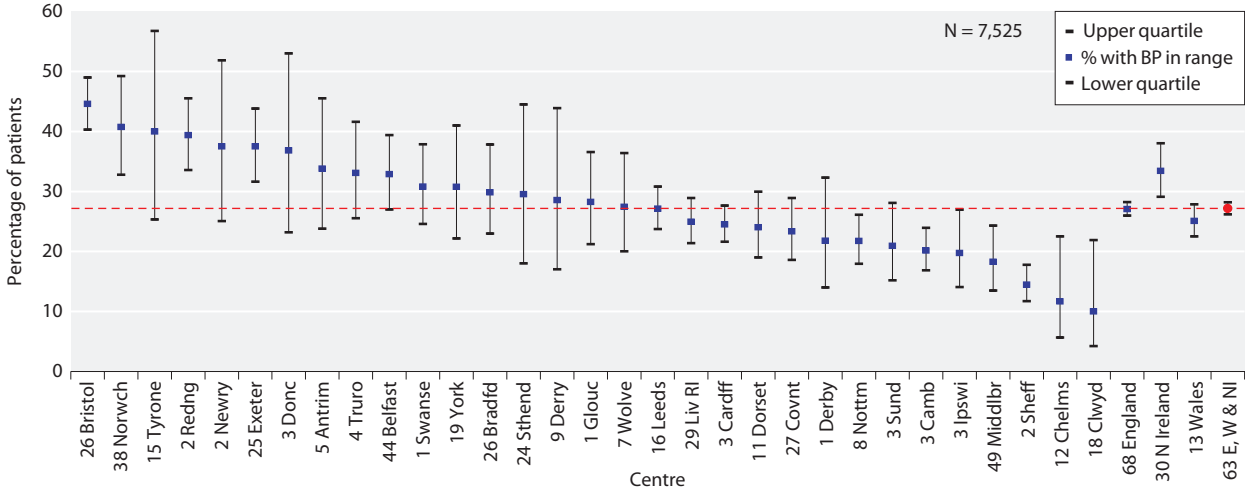

Fig. 11.17. Percentage of patients with BP <130 mmHg systolic and <80 mmHg diastolic: Transplant

practice and current achievement. The reasons for this gap remain to be understood.

Conflicts of interest: none

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Chapter 12
Clinical, Haematological and Biochemical Parameters in Patients receiving Renal Replacement Therapy in Paediatric Centres in the UK in 2009: national and centre-specific analyses

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Key Words
Biochemical variables · Children · Dialysis · ERF · Haemoglobin · Height · Quality improvement · Transplant · Weight

Summary

- Median weight z-score for children on dialysis was −1.0 whereas children with a functioning transplant had normal weights.
- Median height z-score for children on dialysis was −2.0 and for children with a functioning transplant −1.4.
- 73% of transplant patients and 52% of dialysis patients had a systolic blood pressure within the 90th percentile standard.
- 44% of transplant patients, 83% of HD patients and 38% of PD patients had a haemoglobin within the age appropriate standard.
- Transplant patients with eGFR <45 mls/min/1.73 m^2 and those using MMF had significantly worse haemoglobin standard attainment.
- 49% of HD patients and 61% of PD patients achieved the audit standard for phosphate.

Introduction

The British Association for Paediatric Nephrology (BAPN) registry was established in 1996 in parallel with the establishment of the UK Renal Registry (UKRR). The data to be collected was agreed by the registry committee of the BAPN and data collection forms distributed to each of the participating centres. Data returns have been a mixture of electronic and paper returns as progress has been made towards a merger of the adult and paediatric registries with paediatric returns coming from hospital renal information systems. When complete this will allow more detailed analysis of laboratory parameters. Currently, only one annual dataset is recorded for each patient.

This year the Paediatric Renal Registry report focuses on the following variables for the prevalent paediatric dialysis and transplantation cohort on 31st December 2009:

1. Report on the completeness of data returns to the renal registry
2. Overview of anthropometric characteristics in children with established renal failure (ERF)
3. Overview of blood pressure control in children with ERF
4. Anaemia
5. Key biochemical findings in this population

Analyses of prevalent paediatric patients receiving renal replacement therapy for the year 2009 and for the period 1999–2009 inclusive are reported. Due to low numbers of patients in each cohort no incident cohort analyses have been undertaken. Centre specific data for each paediatric nephrology centre in the UK has also been provided.

Methods

There were 13 centres providing care for children requiring renal replacement therapy in the UK, 10 of which also provided surgical renal transplant services. All 13 centres provide outpatient and in-patient follow up for children who have received kidney transplants. Centres are listed in table 12.1 and appendix K.

Data collection

The data presented in this report relate to the annual census date of 31st December 2009.

The paediatric centres with access to renal IT systems submitted encrypted electronic data directly to the UKRR. The software routines to extract the data were run with the assistance of staff at the UKRR.

Paper or electronic returns in the original BAPN database format were sent to the UKRR for entry onto the original BAPN database as in previous years from those centres without access to renal IT systems and then data were amalgamated. Complete transfer to the UKRR encrypted database is still awaited.

Governance, reporting and standardisation

Information governance, reporting and standardisation were all performed in an identical manner to previous analyses to allow comparison [1]. As before, with the value of many clinical parameters in childhood varying with age and size, data are presented as z-scores.

Anthropometry

The reference range for height (Ht), weight (Wt) and body mass index (BMI) in childhood varies with gender and age. BMI was calculated using the formula BMI = Wt (kg)/Ht $(m)^2$. Height, weight and BMI were all adjusted for age and z-scores were calculated based on the British 1990 reference data for height and weight [2].

Blood pressure (BP)

The reference range for blood pressure varies with gender, age and height. The data is therefore presented as z-scores based on data from the Fourth report of the National High Blood Pressure Education Programme (NHBPEP) working group in the United States [3].

Laboratory values

Haemoglobin (Hb), ferritin (Ferr), calcium (Ca) and phosphate (Phos) were analysed using age related laboratory reference ranges as in table 12.2. Data analysis is presented for each centre individually and at a national level for each variable.

Table 12.1. Paediatric renal centres, their abbreviations and IT systems

Paediatric centre	Abbreviation	Renal IT system
Belfast	Blfst_P	None
Birmingham	Bham_P	CCL Proton
Bristol	Brstl_P	CCL Proton
Cardiff	Cardf_P	CCL Proton
Glasgow	Glasg_P	None
Leeds	Leeds_P	CCL Proton
Liverpool	Livpl_P	None
London Evelina	L Eve_P	None
London Great Ormond Street	L GOSH_P	CCL Proton*
Manchester	Manch_P	None
Newcastle	Newc_P	CCl clinical vision
Nottingham	Nottm_P	CCL Proton
Southampton	Soton_P	Bespoke**

*GOSH has a link to the CCL PROTON system in Bristol but with no lab links

**Recent implementation of a bespoke renal IT system has enabled transmission of a limited dataset from Southampton this year

Table 12.2 Summary of relevant biochemical clinical audit measures

	Age			
Parameter	<1 year	1–5 years	6–12 years	>12 years
Haemoglobin (g/dl) in transplant patients – unless eGFR <40 (then as per anaemia – see below)	10.5–13.5	12–14	11.5–14.5	13–17.0
Anaemia* (g/dl) (NICE guidelines for dialysis patients only)	<10.0 for <2 yr Maintain 10–12 for <2 yr	<11.0 for >2 yr Maintain 10.5–12.5 for >2 yr	<11.0 for >2 yr Maintain 10.5–12.5 for >2 yr	<11.0 for >2 yr Maintain 10.5–12.5 for >2 yr
eGFR (transplant patients)	Estimated GFR (eGFR) as per Schwartz formula: (height × k)/plasma creatinine The value for k is that in use at the reporting centre			
Ferritin (μg/L)	200–500	200–500	200–500	200–500
Corrected calcium (mmol/L)	2.24–2.74	2.19–2.69	2.19–2.69	2.15–2.55
Phosphate (mmol/L)	1.1–1.95	1.05–1.75	1.05–1.75	1.05–1.75
Parathyroid hormone (individual centre units)	Within twice the normal range Levels may be maintained within normal range if growing appropriately			

*For transplant patients the reference range used is the normal range for age

Statistical analysis

Data were analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges). Where applicable, the percentage achieving the audit standard was also calculated. Patients without data were excluded from that analysis.

Longitudinal analyses of attainment of standards over time were also performed. This was based on a single data point per ERF patient per year collected as described previously. Changing audit standards over time and variable data return for previous years encourages cautious interpretation of these analyses. All analyses were done using SAS 9.2.

Standards

Standards are from the Treatment of Adults and Children with Renal Failure, Renal Association 2002 guidelines unless otherwise stated [4].

Anthropometry

'Height and weight should be monitored at each clinic visit. Measures of supine length or standing head circumference should be measured during each visit up to two years of age and 6 monthly up to 5 years of age. All measurements should be plotted on European reference growth charts for healthy children.'

Blood Pressure

'Blood pressure varies throughout childhood and should be maintained within 2 standard deviations of the mean for normal children of the same height and sex. Systolic blood pressure during PD or post-HD should be maintained at <90th percentile for age, gender and height.'

The analyses of blood pressure in this report present the achievement of blood pressures at or below the 90th percentiles.

Anaemia

Guidance on the management of anaemia in adults and children with chronic kidney disease was published by the National Institute for Clinical Excellence (NICE) in 2006 (Clinical Guideline 39) [5]. The recommendation in this guidance is that in children with chronic kidney disease, treatment should maintain stable haemoglobin levels between 10 and 12 g/dl in children below 2 years of age and between 10.5 and 12.5 g/dl in children above 2 years of age. For the purposes of this report, the NICE standards have been adopted.

Calcium, phosphate and parathyroid hormone levels

Phosphate and calcium should be kept within the normal range [4]. For analyses of calcium and phosphate

the age related ranges as described previously have been used [1].

Results

Data completeness

Tables 12.3 to 12.6 show the completeness of data returns for transplant and dialysis patients for 2009 and the 1999–2009 period. Each patient was assessed with regard to the completeness of data for each year between 1999 and 2009. Thus the total does not represent the number of patients treated but the number of patient treatment years assessed for each modality.

No data was submitted from Southampton in 2008 pending the establishment of data extraction routines.

Overall completeness is good, however in 2009, height, weight and blood pressure data from GOSH were less complete due to problems with the entry of timeline events without which these parameters cannot be calculated. The data items shown in these tables are those used in this chapter to aid interpretation.

Height, weight and BMI

Figures 12.1 and 12.4 show that children receiving renal replacement therapy were short for their age. The height deficit was greater in children on dialysis than in those who had a functioning kidney transplant.

Children with a functioning kidney transplant had a normal weight (figure 12.2). Those on dialysis had a weight below that of healthy children (figure 12.5) with a UK median z-score of −1.

Body mass index in children with a functioning transplant in 2009 showed inter-centre variation with a median UK z-score of 0.8 (figure 12.3). The UK median z-score in those on dialysis was 0.2 (figure 12.6). The most likely explanation for this is the short stature seen in this group.

Figure 12.7 shows that the UK average median z-score for height and the percentage of children receiving growth hormone each year has not changed since 1999. However the group of children who were receiving growth hormone appear to have more severe height restriction since 2006. More detailed analysis dividing patients into those on dialysis and those with allografts, together with analysis according to primary diagnosis and comorbidity will be required to establish the reason for this.

Blood pressure

Analyses of blood pressure management have shown that blood pressure is higher in children receiving renal replacement therapy than in healthy children (figures 12.8 and 12.9). There was wide inter-centre variation in systolic blood pressure, particularly in dialysis patients in 2009 with a UK median z-score of 0.9 for dialysis patients and 0.5 for transplant patients.

Children receiving peritoneal dialysis had higher blood pressures than children with kidney transplants or those on haemodialysis (table 12.7). In the UK as a whole in 2009, 75.6% of children on haemodialysis

Table 12.3. Percentage data completeness for transplant patients by centre for each biochemical, blood pressure and growth variable and total number of patients per centre in 2009

Centre	Transplant patients N	Height	Weight	BMI	Systolic BP	Hb	eGFR	Ferritin
Blfst_P	17	94	94	94	88	100	94	12
Bham_P	54	96	96	96	94	98	94	32
Brstl_P	38	97	100	97	90	97	92	63
Cardf_P	20	95	95	95	95	15	15	10
L GOSH_P	138	0	0	0	0	100	0	99
Glasg_P	54	98	100	98	98	100	98	82
L Eve_P	80	99	100	99	99	100	98	90
Leeds_P	61	95	100	95	95	100	95	25
Livpl_P	28	100	100	100	100	100	100	89
Manch_P	37	100	100	100	100	100	100	19
Newc_P	35	97	100	97	97	97	97	74
Nottm_P	15	87	93	87	67	87	80	80
UK	**577**	**74**	**75**	**74**	**72**	**96**	**80**	**56**

Table 12.4. Percentage data completeness for dialysis patients by centre for each variable and total number of patients per centre in 2009

Centre	Dialysis patients N	Height	Weight	BMI	Systolic BP	Hb	PTH	Ca	Phos	Ferritin
Blfst_P	10	80	90	80	80	100	70	80	80	80
Bham_P	38	95	95	95	95	100	89	100	100	82
Brstl_P	7	71	71	86	71	100	86	100	100	71
Cardf_P	7	100	100	100	86	29	29	29	29	29
L GOSH_P	41	15	15	15	15	100	100	100	100	100
Glasg_P	14	86	100	86	86	100	100	100	100	93
L Eve_P	21	100	100	100	100	100	100	100	100	100
Leeds_P	17	94	100	94	94	100	100	100	100	100
Livpl_P	5	100	100	100	100	100	100	100	100	80
Manch_P	23	100	100	100	100	100	52	100	100	100
Newc_P	6	83	100	83	83	100	100	100	83	100
Nottm_P	17	82	88	82	71	100	71	100	100	94
UK	**206**	**77**	**88**	**85**	**82**	**94**	**83**	**92**	**91**	**86**

Table 12.5. Data completeness for each variable for each transplant patient per year from 1999–2009

Centre	Transplant patient years	Height	Weight	Systolic BP	Hb	eGFR	Ferritin
Blfst_P	134	95	95	94	100	95	31
Bham_P	398	99	99	99	99	98	23
Brstl_P	370	98	98	95	96	95	21
Cardf_P	196	88	91	92	89	80	57
L GOSH_P	945	74	76	75	96	73	55
Glasg_P	386	95	97	97	99	95	49
L Eve_P	677	95	98	98	100	94	57
Leeds_P	340	94	95	77	95	92	25
Livpl_P	287	96	98	99	99	95	52
Manch_P	655	98	99	98	99	97	3
Newc_P	232	97	98	98	98	97	35
Nottm_P	566	92	93	92	97	91	39
UK	**5,241**	**93**	**95**	**93**	**97**	**92**	**37**

*Blood pressure data from Leeds from 2008 was subject to a downloading issue

Table 12.6. Data completeness for each variable and total number of dialysis patients in each centre from 1999–2009

Centre	Dialysis patient years	Height	Weight	Systolic BP	Hb	PTH	Ca	Phos	Ferritin
Blfst_P	71	89	99	94	100	76	96	94	65
Bham_P	256	98	98	97	100	82	100	100	74
Brstl_P	144	94	98	97	97	92	98	98	63
Cardf_P	33	88	97	94	85	73	85	85	76
L GOSH_P	304	77	83	82	99	72	99	98	84
Glasg_P	122	84	97	95	98	86	98	99	85
L Eve_P	113	86	96	90	98	82	86	97	81
Leeds_P	143	86	91	78	94	72	92	93	87
Livpl_P	73	89	100	99	99	81	96	96	84
Manch_P	216	91	93	89	98	56	97	97	74
Newc_P	72	92	96	96	99	81	99	97	85
Nottm_P	176	76	86	76	98	61	98	98	77
UK	**1,741**	**87**	**94**	**91**	**97**	**76**	**95**	**96**	**78**

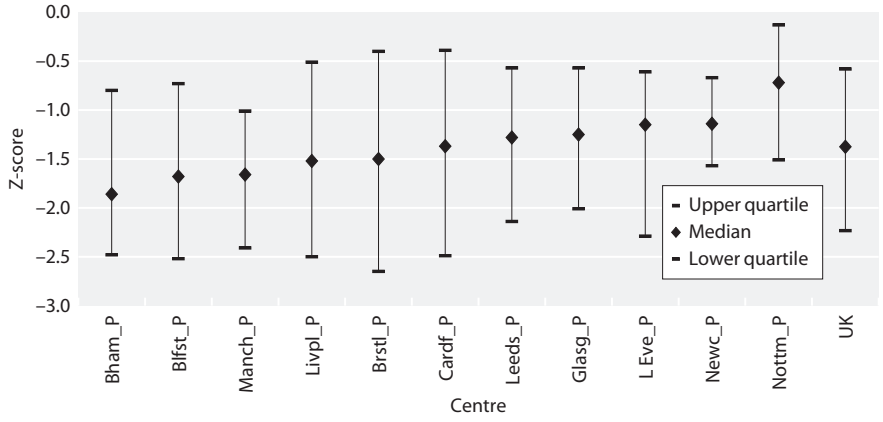

Fig. 12.1. Median height z-scores for transplant patients in 2009

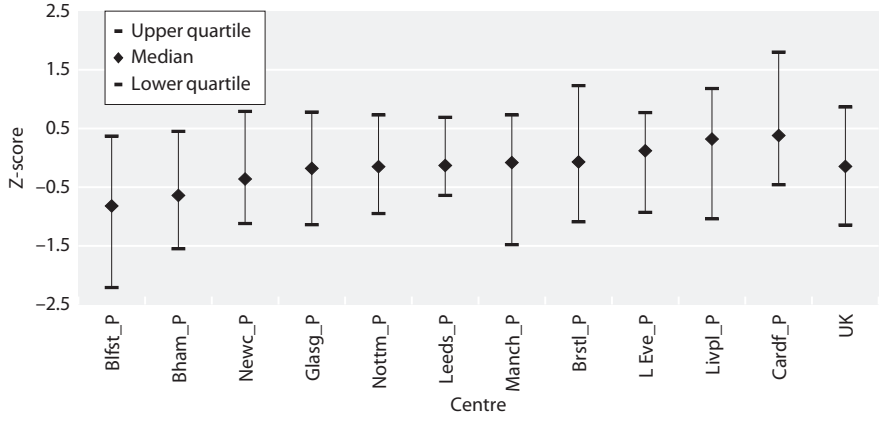

Fig. 12.2. Median weight z-scores for transplant patients in 2009

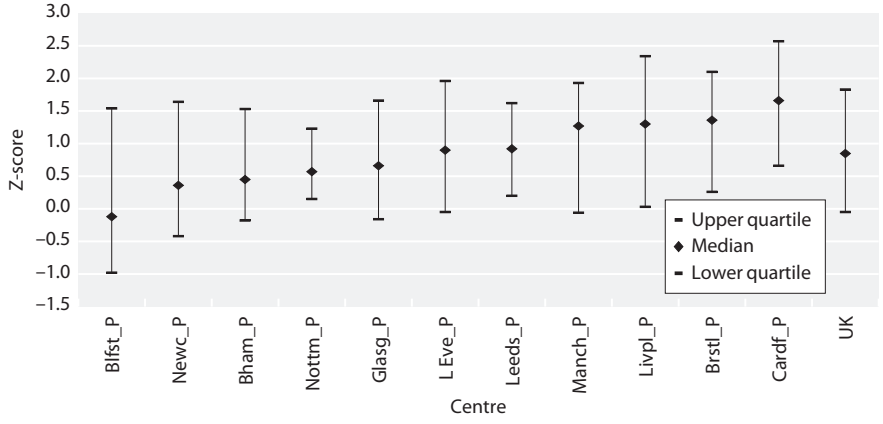

Fig. 12.3. Median BMI z-scores for transplant patients in 2009

had a systolic BP <90th percentile while only 51.7% of children receiving peritoneal dialysis achieved this (table 12.7). For children with a functioning kidney transplant 73.2% had a systolic BP <90th percentile and this was similar to last year when 77% of such children achieved the target (table12.7).

Haemoglobin

For technical reasons, data extraction of laboratory variables from Cardiff was incomplete and is therefore excluded from the following tables.

The analyses in this report show that many children receiving renal replacement therapy are anaemic.

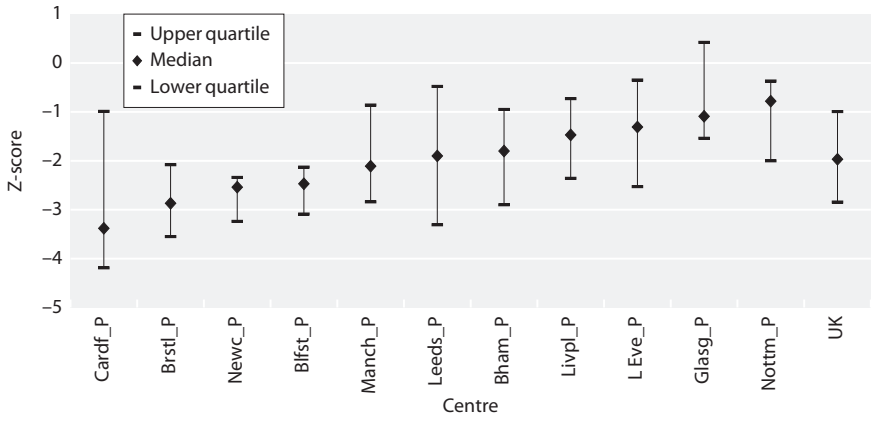

Fig. 12.4. Median height z-scores for dialysis patients in 2009
*Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

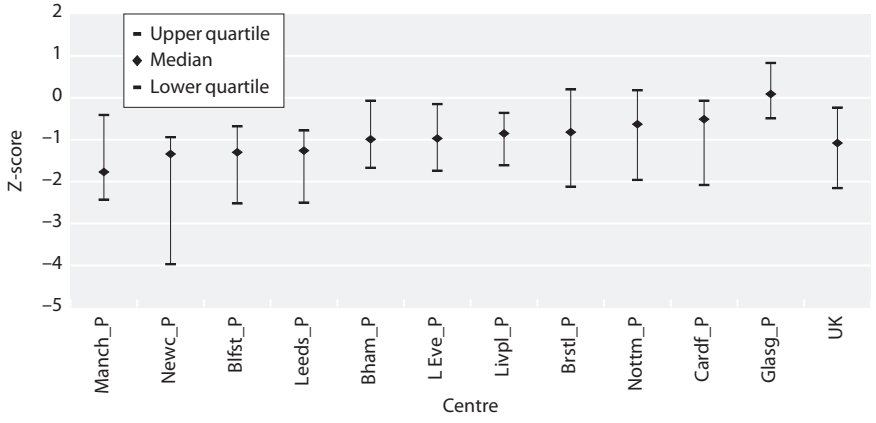

Fig. 12.5. Median weight z-scores for dialysis patients in 2009
*Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

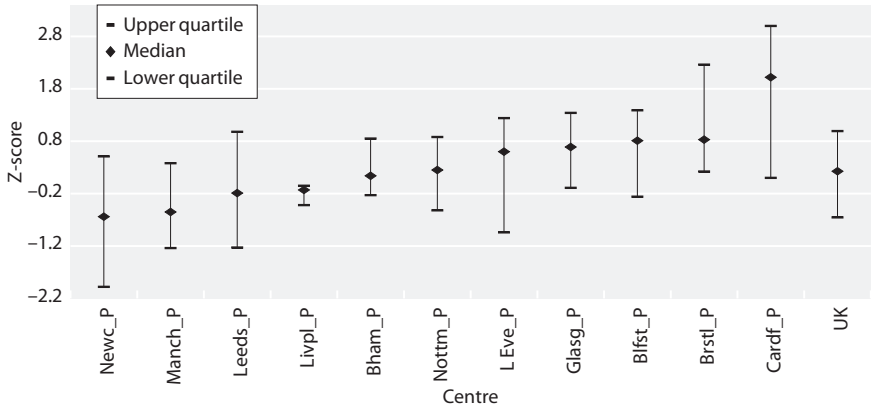

Fig. 12.6. Median BMI z-scores for dialysis patients in 2009

Forty-seven percent (range 33–61%) of children with a functioning transplant achieved the haemoglobin standard (table 12.8). However the children with poor graft function (CKD 3bT or lower) were assessed using the same standard as those with well functioning grafts rather than to the standards used for dialysis patients and so these results may look worse than centres themselves recognise. This use of different standards depending on the graft function will be incorporated separately into next year's report. Fifty-four percent of haemodialysis patients and 21% of peritoneal dialysis patients had haemoglobin below the standard. A significant percentage of children also had haemoglobin concentrations above the recommended standard (19%

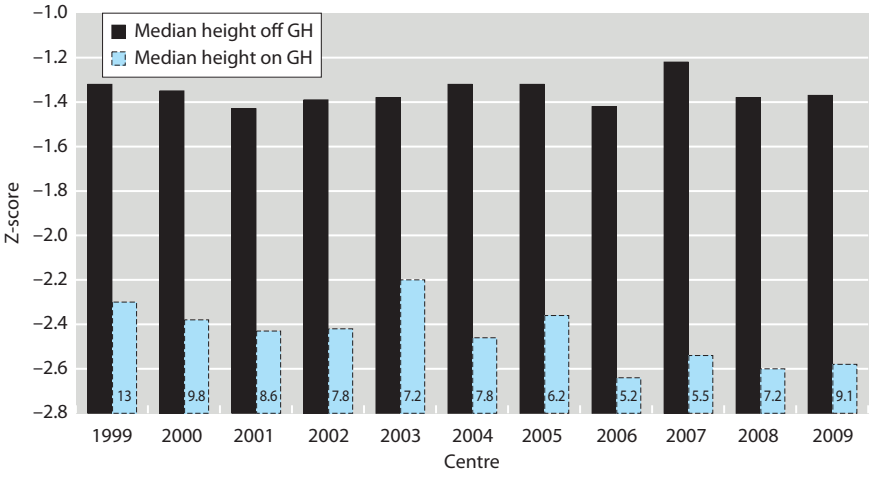

Fig. 12.7. Median height z-scores in paediatric patients receiving RRT from 1999 to 2009, with the percentage of children using growth hormone each year
Numbers represent % patients on GH

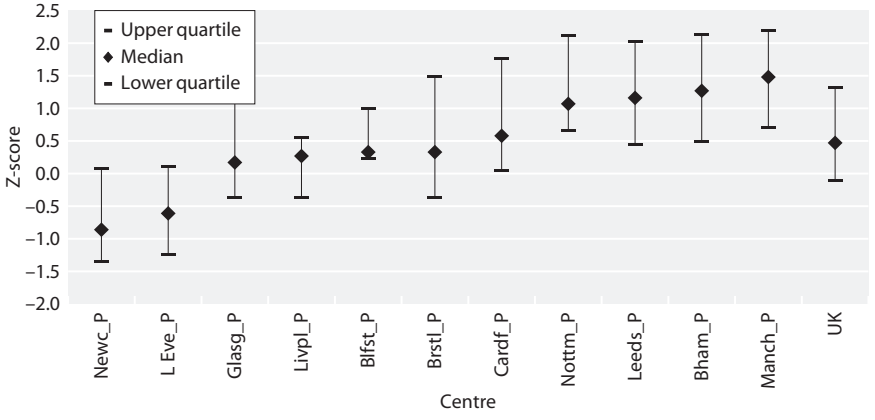

Fig. 12.8. Median systolic blood pressure z-scores for transplant patients in 2009
Centres with less than 50% data completeness were excluded from the centres specific analysis but were included in the UK totals

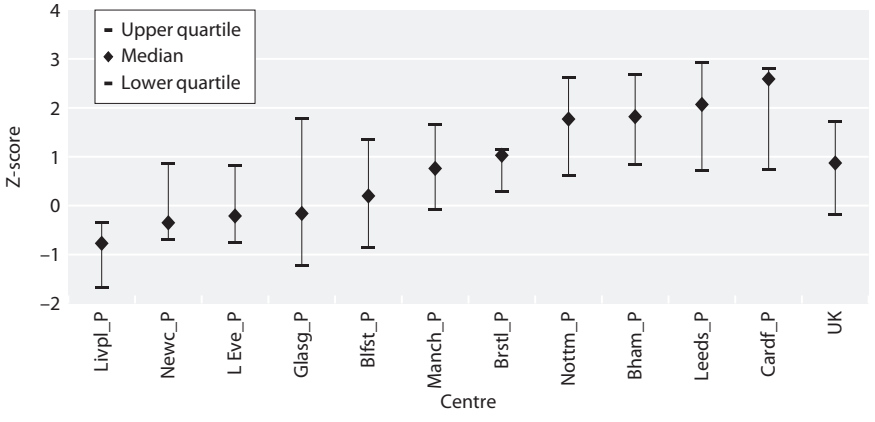

Fig. 12.9. Median systolic blood pressure z-scores for dialysis patients in 2009
Centres with less than 50% data completeness were excluded from the centres specific analysis but were included in the UK totals

for HD and 32% for PD). The importance of this in the paediatric population, with a very different spectrum of comorbidity from adults, is not known.

The 10 year trend data suggests some improvement over time with regards to anaemia and ferritin (figure 12.10), although with scope for further improvement.

The attainment of the haemoglobin standard in transplant patients was assessed for different levels of graft function (figure 12.11), in the presence of hyperparathyroidism (figure 12.12) and with the use of MMF as immunosuppressant therapy (figure 12.13). Figure 12.11 demonstrates that haemoglobin standard attainment

Table 12.7. Percentage of patients achieving the standards for systolic blood pressure in 2009

	Transplant patients		HD patients		PD patients	
Centre	Patients with data N	Below 90th percentile	Patients with data N	Below 90th percentile	Patients with data N	Below 90th percentile
Blfst_P	15	80.0	5	80.0	3	66.7
Bham_P	51	51.0	17	29.4	19	31.6
Brstl_P	34	70.6	1	100.0	4	75.0
Cardf_P	19	73.7	2	100.0	4	0.0
Glasg_P	53	94.9	4	75.0	8	62.5
L Eve_P	79	79.3	11	72.7	10	90.0
Leeds_P	58	58.6	10	50.0	6	0.0
Livpl_P	28	92.9	1	100.0	4	100.0
Manch_P	37	43.2	2	100.0	21	52.4
Newc_P	34	100.0	2	100.0	3	66.7
Nottm_P	10	60.0	4	75.0	8	25.0
UK	**418**	**73.2**	**63**	**75.6**	**92**	**51.7**

Table 12.8. Percentage of patients achieving the haemoglobin standard in 2009

	Transplant patients				Haemodialysis patients				Peritoneal dialysis patients			
Centre	Patients with data N	% achieving standard	% lower than standard	% above standard	Patients with data N	% achieving standard	% lower than standard	% above standard	Patients with data N	% achieving standard	% lower than standard	% above standard
Blfst_P	17	58.8	41.2	0.0	6	33.3	33.3	33.3	4	75.0	0.0	25.0
Bham_P	53	35.9	62.3	1.9	18	50.0	33.3	16.7	20	55.0	30.0	15.0
Brstl_P	37	46.0	54.1	0.0	2	0.0	50.0	50.0	5	0.0	40.0	60.0
L GOSH_P	138	44.9	54.4	0.7	21	38.1	28.6	33.3	20	50.0	20.0	30.0
Glasg_P	54	46.3	51.9	1.9	4	0.0	75.0	25.0	10	30.0	20.0	50.0
L Eve_P	80	50.0	47.5	2.5	11	27.3	36.4	36.4	10	30.0	40.0	30.0
Leeds_P	61	47.5	52.5	0.0	10	20.0	60.0	20.0	7	57.1	28.6	14.3
Livpl_P	28	46.4	53.6	0.0	1	0.0	100.0	0.0	4	50.0	0.0	50.0
Manch_P	37	35.1	64.9	0.0	2	0.0	100.0	0.0	21	52.4	28.6	19.1
Newc_P	34	58.8	41.2	0.0	2	100.0	0.0	0.0	4	25.0	25.0	50.0
Nottm_P	13	61.5	38.5	0.0	6	50.0	33.3	16.7	11	36.4	18.2	45.5
UK	**552**	**44.3**	**46.8**	**0.6**	**83**	**26.6**	**45.8**	**19.3**	**117**	**38.4**	**20.9**	**32.4**

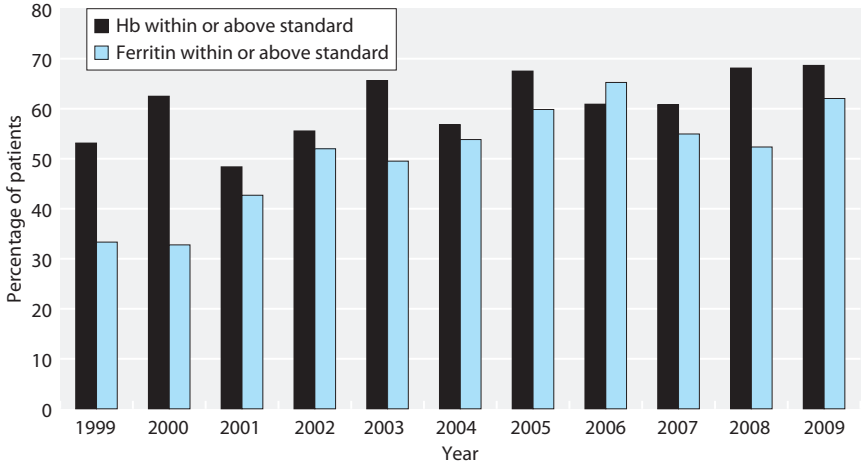

Fig. 12.10. The percentage of paediatric dialysis patients achieving the treatment standards for haemoglobin and ferritin from 1999–2009

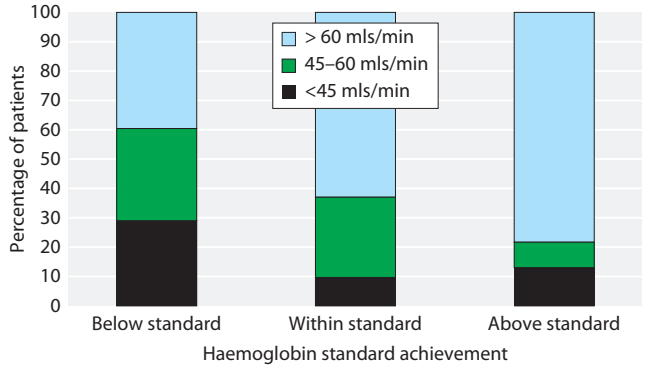

Fig. 12.11. The achievement of haemoglobin treatment standards in paediatric transplant patients, by the level of graft function
*This figures combines all data from 1999–2009

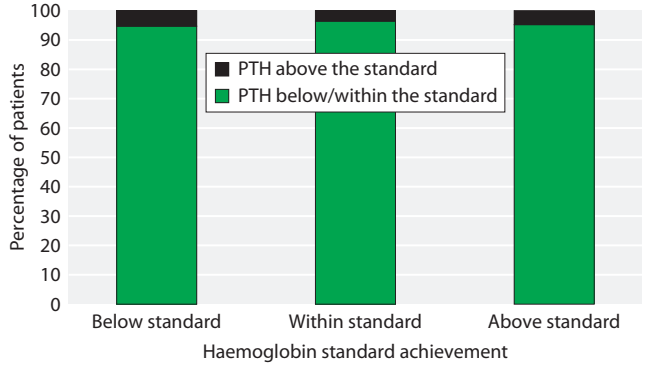

Fig. 12.12. The achievement of haemoglobin treatment standards in paediatric transplant patients, by PTH concentration
*This figure combines all data from 1999–2009

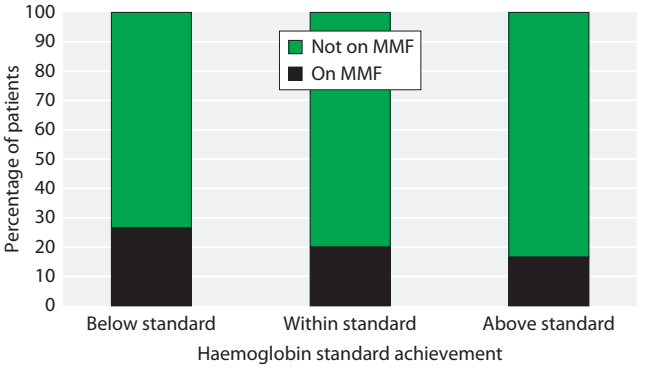

Fig. 12.13. The achievement of haemoglobin treatment standards in paediatric transplant patients, by use of MMF
*This figure combines all data from 1999–2009

was worse for patients with transplant dysfunction (29% of patients with Hb below the standard also had an eGFR <45 whilst only 10% of patients with an Hb within the standard had an eGFR <45, $p < 0.001$). PTH concentration appeared to have little effect on haemoglobin standard attainment in this analysis. However it should be borne in mind that with an observational analysis like this, the true relationship between PTH and haemoglobin concentration may be masked by unmeasured factors. Figure 12.13 shows that patients using MMF as immunosuppressant therapy were more likely to have haemoglobin concentrations below the standard, $p = 0.01$.

Calcium, phosphate and PTH

In 2009 in the UK as a whole, 49% of haemodialysis patients and 61% of peritoneal dialysis patients had a phosphate within the target range (table 12.9). The

Table 12.9. Achievement of the phosphate standard in dialysis patients in 2009

	Haemodialysis				Peritoneal dialysis			
Centre	Patients with data N	% within standard	% below standard	% above standard	Patients with data N	% within standard	% below standard	% above standard
Blfst_P	5	40	20	40	3	100	0	0
Bham_P	18	56	0	44	20	60	20	20
Brstl_P	2	100	0	0	5	40	40	20
L GOSH_P	21	38	10	52	20	55	15	30
Glasg_P	4	0	0	100	10	50	0	50
L Eve_P	11	55	18	27	10	80	0	10
Leeds_P	10	70	0	30	7	43	0	57
Livpl_P	1	0	0	100	4	50	0	50
Manch_P	2	50	0	50	21	67	5	29
Newc_P	2	0	0	100	3	33	33	33
Nottm_P	6	83	0	17	11	55	9	36
UK	**83**	**49**	**4**	**47**	**115**	**61**	**1**	**28**

Table 12.10. Achievement of the adjusted calcium standard in dialysis patients in 2009

	Haemodialysis				Peritoneal dialysis			
Centre	Patients with data N	% within standard	% below standard	% above standard	Patients with data N	% within standard	% below standard	% above standard
Blfst_P	3	60	20	20	2	100	0	0
Bham_P	18	61	6	33	20	45	0	55
Brstl_P	2	100	0	0	5	40	0	60
L GOSH_P	21	33	14	52	20	60	0	40
Glasg_P	4	75	0	25	10	60	20	20
L Eve_P	10	100	0	0	8	90	0	10
Leeds_P	10	80	0	20	7	43	14	43
Livpl_P	0	100	0	0	4	75	0	25
Manch_P	2	50	0	50	21	86	5	10
Newc_P	2	100	0	0	2	50	0	50
Nottm_P	6	67	0	33	11	73	0	27
UK	**78**	**77**	**3**	**20**	**111**	**68**	**3**	**28**

achievement of the standard for calcium was better with 77% of children on haemodialysis and 68% of children on peritoneal dialysis having a calcium level within the target range (table 12.10). Fifty-six percent of children on HD and 63% on PD had a PTH within the target range with wide inter-centre variation and a median value for the whole UK of 16 pmol/L (table 12.11). Caution should be exercised in the interpretation of

Table 12.11. Achievement of the PTH standard in dialysis patients in 2009

	Haemodialysis			Peritoneal dialysis		
Centre	Patients with data N	% within standard	% above standard	Patients with data N	% within standard	% above standard
Blfst_P	6	17	83	4	50	50
Bham_P	18	33	67	20	50	50
Brstl_P	2	100	0	5	80	20
L GOSH_P	21	62	38	20	70	30
Glasg_P	4	75	25	10	80	20
L Eve_P	11	73	27	10	60	40
Leeds_P	10	40	60	7	43	57
Livpl_P	1	0	100	4	25	75
Newc_P	2	100	0	4	100	0
Nottm_P	6	50	50	11	64	36
UK	**84**	**56**	**44**	**99**	**63**	**37**

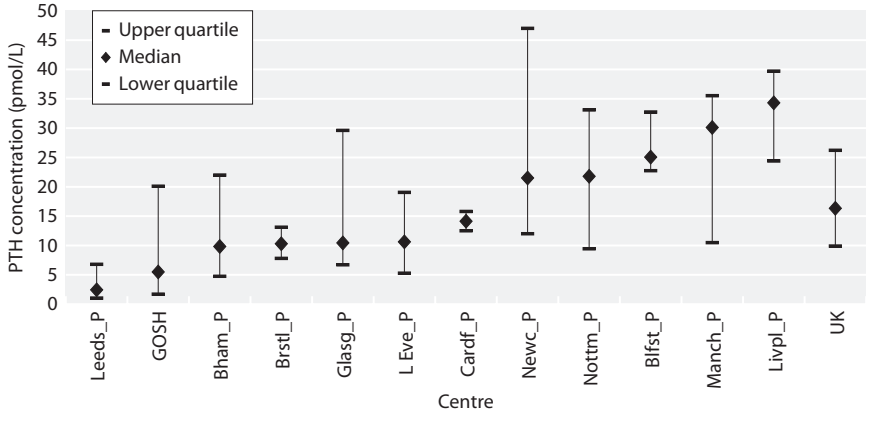

Fig. 12.14. Median PTH concentration in dialysis patients in 2009, by centre

these analyses as it was not always possible to identify which units were used to measure PTH, for instance, if bloods were taken at different laboratories and also some variation exists between the different PTH assays available.

Discussion

Whilst the move to electronic reporting with multiple data submissions per annum remained incomplete, interpretation of annual census data with regard to haematological, biochemical and blood pressure parameters, needs to be made with caution. Over the whole UK there were only a small number of children on any specific modality of dialysis at one time point and within the course of a year parameters such as calcium, phosphate and PTH may vary greatly within any individual. The ability to look at annual average values for different parameters in the future will be a great advance. That said a number of recurring themes are evident from this report.

Anthropometry

As in previous reports the paediatric renal failure population was shorter than the UK average. This is not surprising and year by year there is unlikely to be any rapid shift towards normality. Patients requiring dialysis fare worse than transplanted patients. Overall, neither malnutrition nor obesity afflicted the majority of patients in the populations. Further work needs to be undertaken to look at the effect of steroid free immunosuppression regimes on transplanted patients as increasing number of centres are using these regimes. Duration of dialysis and height attainment and the use of growth hormone also require analysis in the future – particularly with the paucity of deceased donor kidneys available. Some sub-analysis of both the dialysis populations to exclude either primary diseases or comorbid conditions leading to inevitable short stature would help clarify the situation with regard to those with isolated renal failure at the outset.

Blood pressure

Achieving targets for blood pressure remained a problem. This is one area where there are apparent centre differences. Further work to assess whether this was related to the demography of the patient group within each centre or to the zeal of the team caring for these patients may be beneficial. Looking at a trend of blood pressure readings over a year together with anti-hypertensive usage and stratifying according to primary disease will be considered in future analyses. However, an audit of blood pressure control amongst paediatric transplant patients carried out for the BAPN found no relationship between ethnicity or primary renal disease and achievement of blood pressure targets [6]. Cardiovascular disease was a major cause of mortality and morbidity in patients with renal failure and clinical teams need to continue to focus on their on-going efforts to improve overall BP control in this high risk population.

Anaemia

As with previous reports the management of anaemia remained imperfect. It appears that ferritin levels are improving and it is hoped that with time, this will lead to more patients having haemoglobin concentrations within the target range. As is already being seen to some extent, the normal distribution of haemoglobin will mean that if a shift of the curve to the right to get more patients with low haemoglobin into range will result in more patients with relatively higher haemoglobins. Whilst this is a definite risk factor in adult patients with established cardiovascular disease there is no data to say whether this will be a problem in children or not. This subject requires further study whilst accepting that trials in adult with both pre-dialysis and dialysis dependent CKD, comparing effects of treatment of anaemia to different targets, have reported higher rates of adverse events in subjects in whom higher targeted Hb levels was sought [7, 8].

Biochemistry

Bone disease remained a major problem in children with ERF. The percentage achieving desired targets remained too low. Again, more robust analysis will be possible when annual patient trends rather than isolated values can be reported. The management of renal osteodystrophy is changing – particularly with the advent of new phosphate binders and calcimimetics which may in time improve achievement of audit standards.

The data presented in this report provide a snap shot picture of the care of children receiving renal replacement therapy in the UK in 2009. In time, increased use of renal IT systems will enable greater insight to be gained by allowing the study of a greater number of time-points during the year. In addition to this it is hoped that the seamless transfer of this data within

the registry as young patients move to adult centres will soon allow the long term assessment of whether the current goals are the right ones.

Conflicts of interest: none

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Chapter 13
Centre Variation in Access to Renal Transplantation in the UK (2004–2006)

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Key Words
Centre variation · Comorbidity · Donor after brain stem death · Donor after cardiac death · Equity of access · Living kidney donor · Outcomes · Patient factors · Quality improvement · Renal transplantation · Transplant waiting-list

Summary

- A patient starting dialysis in a non-transplanting renal centre was less likely to be registered for transplantation [OR (odds ratio) 0.90, 95% CI 0.82–0.99] compared with a patient treated in a transplanting renal centre.
- A patient starting dialysis in a non-transplanting renal centre was less likely to receive a transplant from a donor after cardiac death or a living kidney donor (OR 0.69, 95% CI 0.60–0.79) compared with a patient treated in a transplanting renal centre.
- Once registered for kidney transplantation, patients in both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brain stem death (OR 0.92, 95% CI 0.78–1.08).
- After adjustment for case mix, this analysis identified significant centre differences for the probability of being activated on the kidney transplant waiting-list ($p < 0.0001$) and the probabilities of receiving a renal transplant from a donor after brain stem death ($p = 0.0002$) or a donor after cardiac death/living kidney donor ($p < 0.0001$).

Introduction

For suitable patients with established renal failure (ERF), renal transplantation is accepted as the optimal modality of renal replacement therapy. However, deciding which patients are 'suitable' for renal transplantation requires an individualised assessment of the risks of transplantation as well as the likely benefit. The probability of receiving a transplant from a donor after brain stem death, once a patient is on the waiting-list, is predominantly under the influence of national organ allocation algorithms. Conversely, the probability of receiving a transplant from a living kidney donor is predominantly influenced by individual centres' policies and patterns of practice (transplant and non-transplanting centres are listed in chapter 3). The latter is also true for the probability of receiving a kidney from a donor after cardiac death, as during the time of this study the retrieving centre had the major influence on the distribution of such organs.

Many patient specific factors including age, gender, ethnicity and comorbidity have been reported to influence access to kidney transplantation. Time on dialysis is recognised as an important prognostic factor which adversely influences graft and patient survival following transplantation; patients who have been longer on dialysis have poorer outcomes. The time taken to register a suitable patient on the transplant waiting-list is mainly influenced by a centre's practice patterns; that is, the efficiency of the pathway from diagnosis of ERF to activation of the patient on the transplant list. Furthermore, the current organ allocation algorithm considers time spent on the national transplant waiting-list as an important factor when prioritising the allocation of deceased donor kidneys in the UK. Therefore, patients who are activated on the list at an early stage accrue more waiting time credit than do patients listed later in their dialysis treatment. Consequently, centres that achieve earlier listing for transplantation provide an advantage for their patients compared with centres that take longer.

This analysis aims to evaluate whether equity of access to the renal transplant list exists for patients with ERF across the UK, whether centres differ in the time taken to activate suitable patients on the waiting-list and whether equity exists in the receipt of a renal transplant once the patient is on the transplant list (that is, the conversion efficiency from being on the waiting-list to receiving a transplant). Patient specific and independent variables that influenced access to the waiting-list or transplantation were analysed.

Methods

Study population

All patients starting renal replacement therapy (n = 17,597) between 1st January 2004 and 31st December 2006 in renal centres returning data to the UK Renal Registry (n = 65) were considered for inclusion. For the analysis of the proportion of a centre's patients included on the waiting-list, patients aged 65 years or above (n = 8,944), patients with inappropriate activation and early suspension as described below (n = 125) and patients listed for multi-organ transplants other than pancreas (n = 26) were excluded, resulting in a final cohort of 8,502 patients. These patients were followed to 31st December 2008 or until they were put on the waiting-list for kidney transplant alone, kidney plus pancreas transplant, or death, whichever was earliest. For the analysis of the proportion transplanted, all patients from the incident cohort who were activated on the waiting-list before 31st December 2007 (n = 4,446) were followed until 31st December 2009, to estimate the proportion transplanted with a kidney alone or kidney plus pancreas within two years of inclusion on the waiting-list.

Centre exclusions

Only centres contributing data to the UKRR were considered for inclusion (65 centres) because there was no reliable mechanism for identifying or recording the patient level data needed for patients starting renal replacement therapy in centres (Colchester, Derry, Doncaster, Kent, London St George's, Manchester Royal Infirmary, Stoke) who at that time were not linked to the registry.

Patients who were suspended for more than 30 days within 90 days of first activation were excluded. This avoided any potential bias from centres that may activate patients on the transplant list and then immediately suspend them before more permanent activation at a later date after more formal medical assessment of the patient's fitness.

Data analysed

Information on start date of renal replacement therapy and relevant patient level data including age (grouped as 18–29, 30–39, 40–49, 50–59 and 60–64), gender, ethnicity (white, non-White and missing) and PRD (primary renal diagnosis, classified as patient with diabetes, patient without diabetes and missing) came from the UKRR. The date of activation on the kidney transplant waiting-list, date of transplantation, or both came from the UK Transplant Registry held by the Organ Donation and Transplantation Directorate of NHS Blood and Transplant.

Statistical methods

A logistic regression model was developed to identify the influence of patient specific variables including age, gender, ethnicity and primary renal diagnosis, on the probability of access to the transplant list and receipt of a transplant once on the waiting-list. After adjusting for patient specific variables, the percentage of patients activated on the transplant list and the percentage of patients on the waiting-list who achieved a transplant in each centre were determined. The overall affect of the centre associated with each analysis was assessed by including renal centre as a random effect in the risk-adjusted logistic regression model. The extent of variation between centres was determined by

using a log likelihood ratio test that provided the change in the value of −2Log L on inclusion of the random centre effect. SASv9.1 was used for analyses; a p value of less than 5% was considered significant.

To analyse access to the transplant list, the proportion of incident patients with ERF in each centre who were subsequently activated on the waiting-list within two years of starting renal replacement therapy was identified. All patients who achieved live donor transplantation without prior activation on the national transplant waiting-list were assumed to been activated for the purposes of this analysis. Time to activation on the waiting-list was defined as the interval between the start of RRT and the date of activation on the waiting-list. Patients achieving pre-emptive deceased donor transplantation were considered to have been activated on the same day as starting RRT i.e. a time to activation of 0 days. Patients achieving pre-emptive live donor transplantation without prior activation on the national transplant list were considered to have been 'active' on the list for an arbitrary time of 6 months. This was to take into account an average of 6 months required by most centres to complete live donor fitness evaluation and hence the likelihood that the intended recipient was considered fit for transplantation (and by inference suitable to be active on the waiting-list) for that duration. This was done to account for different centre practices with regard to listing patients on the deceased donor list prior to receiving a living donor transplant.

The median time to activation was estimated from the Kaplan-Meier plot for patients at each renal centre, with the event as the date of activation and censoring at death or on 31st December 2008, whichever was earlier. Data from patients who did not achieve activation were included in the calculation of median times using this method, thus providing a meaningful estimate of the true time to activation. Including only those patients activated would produce a biased estimate. The overall centre effect associated with time to activation was calculated by including renal centre as a variable in a risk-adjusted Cox regression model.

To analyse the differences between centres in achieving a renal transplant, the percentage of patients activated on the waiting-list who received a renal transplant within two years of being activated was estimated (conversion efficiency). The conversion efficiency for receiving a transplant from a donor after brain stem death or a donor after cardiac death/living kidney donor were analysed separately. Receipt of a kidney from a donor after brain stem death is predominantly influenced by national allocation policy, whereas receipt from a donor after cardiac death/live donor kidney is much more dependent on local transplant centre practices. For the cohort under consideration, donor after cardiac death transplantation was predominantly a locally managed service.

Funnel plots are used to present the results for each outcome of interest, providing a visual comparison of each centre's performance compared with its peers. Where relevant, the funnel plots are adjusted for patient specific variables influencing that outcome. The solid black straight line in each funnel plot shows the overall average together with the 95% and 99.8% confidence intervals, which correspond to two and three standard deviations from the mean. Each point on the plot represents one renal centre. With 65 centres included, for each outcome of interest, two or three centres would be predicted to fall between the 95% and 99.8% confidence intervals (one above and one below) and no centre should fall outside the 99.8% confidence interval. Centres with fewer than 10 patients starting dialysis (n = 1) or fewer than 10 patients activated on the waiting-list (n = 4) are not included in the funnel plots.

The analysis methodology described above is identical to a recent independent peer reviewed publication [1].

Results

The results of the logistic regression model analysis of patient characteristics influencing access to the waiting-list are presented in table 13.1. Ethnicity data were missing for 20.7% of patients and PRD for 4.1% of patients.

Tables 13.2 and 13.3 show the results of the logistic regression analysis of factors influencing the likelihood

Table 13.1. Factors influencing activation on the national kidney transplant waiting-list within two years of RRT start

Factor	Category (at baseline)	Patients N	Odds ratio	95% CI	P value
Age	(18–29)	779	1.00	ref	n/a
	30–39	1,283	0.66	0.54–0.82	0.0002
	40–49	2,035	0.45	0.37–0.54	<0.0001
	50–59	2,647	0.23	0.19–0.28	<0.0001
	60–64	1,758	0.12	0.10–0.15	<0.0001
Ethnicity	(White)	5,242	1.00	ref	n/a
	Non-White	1,497	0.90	0.80–1.03	0.12
	Missing	1,763	0.68	0.61–0.76	<0.0001
Gender	(Male)	5,159	1.00	ref	n/a
	Female	3,343	1.00	0.91–1.10	0.97
PRD	(Non-diabetic)	6,168	1.00	ref	n/a
	Diabetic	1,989	0.43	0.38–0.48	<0.0001
	Missing	345	0.43	0.34–0.54	<0.0001

ref = reference category, n/a = not applicable

Table 13.2. Factors affecting the probability of receiving a transplant from a donor after brain stem death within two years of registration on the national kidney transplant waiting-list

Factor	Category (at baseline)	Patients N	Odds ratio	95% CI	P value
Age	(18–29)	626	1.00	ref	n/a
	30–39	898	1.24	0.96–1.58	0.1
	40–49	1,229	0.88	0.69–1.12	0.3
	50–59	1,174	0.50	0.38–0.64	<0.0001
	60–64	519	0.27	0.19–0.39	<0.0001
Ethnicity	(White)	2,859	1.00	ref	n/a
	Non-White	818	0.45	0.36–0.57	<0.0001
	Missing	769	0.84	0.69–1.04	0.11
Gender	(Male)	2,683	1.00	ref	n/a
	Female	1,763	0.82	0.70–0.96	0.01
PRD	(Non-diabetic)	3,593	1.00	ref	n/a
	Diabetic	730	3.36	2.80–4.03	<0.0001
	Missing	123	0.95	0.57–1.59	0.85

ref = reference category, n/a = not applicable

of receiving a transplant from a donor after brain stem death and the analysis of factors influencing receipt of a transplant from a donor after cardiac death or a living kidney donor. Ethnicity data were missing for 17.3% of patients and PRD for 2.8% of patients.

A patient starting dialysis in a non-transplanting renal centre was less likely to be registered for transplantation [OR (odds ratio) 0.90, 95% CI 0.82–0.99] or receive a transplant from a donor after cardiac death or a living kidney donor (OR 0.69, 95% CI 0.60–0.79) compared with patients managed in transplanting renal centres. Once registered for kidney transplantation, patients in both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brain stem death (OR 0.92, 95% CI 0.78 to 1.08).

After adjusting for patient specific variables that were shown to influence outcome (age, ethnicity, gender and PRD), significant centre effects were identified for the probability of being activated on the waiting-list (figure 13.1 and table 13.4) [change in $-2\text{Log L} = 157.2$, df (degrees of freedom) $= 1$, $p < 0.0001$].

After adjustment for patient variables, significant centre differences were seen in the probability of receiving a renal transplant from a donor after brain stem death (figure 13.2 and table 13.5) (change in $-2\text{Log L} = 14.1$, $df = 1$, $p = 0.0002$) or a donor after cardiac death/living kidney donor (figure 13.3 and table

Table 13.3. Factors affecting the probability of receiving a transplant from a donor after cardiac death or living kidney donor within two years of registration on the national kidney transplant waiting-list

Factor	Category (at baseline)	Patients N	Odds ratio	95% CI	P value
Age	(18–29)	626	1.00	ref	n/a
	30–39	898	0.57	0.46–0.71	<0.0001
	40–49	1,229	0.53	0.43–0.65	<0.0001
	50–59	1,174	0.35	0.28–0.43	<0.0001
	60–64	519	0.36	0.27–0.47	<0.0001
Ethnicity	(White)	2,859	1.00	ref	n/a
	Non-White	818	0.55	0.45–0.67	<0.0001
	Missing	769	0.81	0.67–0.97	0.02
Gender	(Male)	2,683	1.00	ref	n/a
	Female	1,763	0.90	0.79–1.04	0.15
PRD	(Non-diabetic)	3,593	1.00	ref	n/a
	Diabetic	730	0.36	0.29–0.46	<0.0001
	Missing	123	0.76	0.50–1.16	0.2

ref = reference category, n/a = not applicable

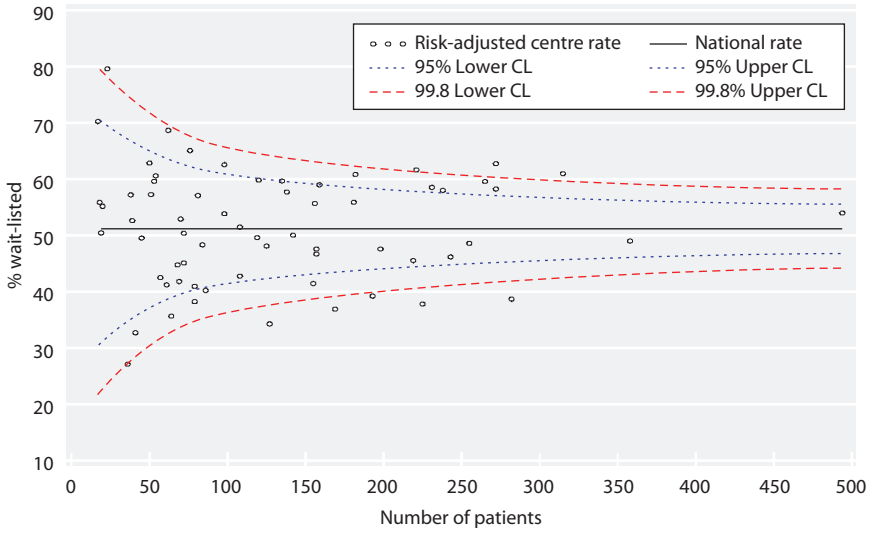


Fig. 13.1. The percentage of patients wait-listed for a kidney transplant by renal centre, prior to or within two years of starting dialysis (centres with <10 patients excluded)

Table 13.4. The percentage of patients wait-listed for a kidney transplant by renal centre, prior to or within two years of starting dialysis

Centre	RRT N	Registrations N	% wait-listed Unadjusted	% wait-listed Risk-adjusted	Centre	RRT N	Registrations N	% wait-listed Unadjusted	% wait-listed Risk-adjusted
Abrdn	81	42	51.9	57.1	L Guys	219	105	47.9	45.5
Airdrie	86	36	41.9	40.2	L Kings	198	103	52.0	47.6
Antrim	23	17	73.9	79.6	L Rfree	182	107	58.8	60.8
B Heart	142	66	46.5	50.1	L West	494	262	53.0	54.0
B QEH	282	115	40.8	38.7	Leeds	238	133	55.9	58.0
Bangor	41	14	34.1	32.7	Leic	315	197	62.5	61.0
Basldn	57	24	42.1	42.5	Liv Ain	36	10	27.8	27.1
Belfast	119	62	52.1	49.6	Liv RI	225	91	40.4	37.8
Bradfd	84	41	48.8	48.3	M Hope	181	113	62.4	55.9
Brightn	135	76	56.3	59.7	Middlbr	138	84	60.9	57.7
Bristol	231	136	58.9	58.5	Newc	157	82	52.2	47.6
Camb	193	82	42.5	39.2	Newry	17	12	70.6	70.3
Cardff	265	151	57.0	59.6	Norwch	108	44	40.7	42.8
Carlis	38	23	60.5	57.2	Nottm	169	63	37.3	36.9
Carsh	255	122	47.8	48.6	Oxford	272	169	62.1	62.7
Chelms	45	19	42.2	49.6	Plymth	76	47	61.8	65.1
Clwyd	18	9	50.0	55.9	Ports	221	141	63.8	61.6
Covnt	125	67	53.6	48.1	Prestn	157	76	48.4	46.7
D & Gall	20	8	40.0	55.2	Redng	98	66	67.3	62.6
Derby	98	48	49.0	53.9	Sheff	243	114	46.9	46.2
Dorset	70	36	51.4	52.9	Shrew	72	36	50.0	45.1
Dudley	64	23	35.9	35.7	Stevng	155	67	43.2	41.5
Dundee	68	29	42.6	44.8	Sthend	50	28	56.0	62.8
Dunfn	51	27	52.9	57.3	Sund	79	32	40.5	41.0
Edinb	159	88	55.3	59.0	Swanse	108	52	48.1	51.5
Exeter	120	66	55.0	59.8	Truro	62	38	61.3	68.7
Glasgw	272	139	51.1	58.2	Tyrone	19	10	52.6	50.5
Glouc	72	35	48.6	50.4	Ulster	3	2	66.7	68.2
Hull	156	77	49.4	55.7	Wirral	79	31	39.2	38.3
Inverns	53	31	58.5	59.6	Wolve	127	44	34.6	34.3
Ipswi	69	29	42.0	41.8	Wrexm	39	19	48.7	52.6
Klmarnk	61	21	34.4	41.2	York	54	34	63.0	60.6
L Barts	358	180	50.3	49.0					

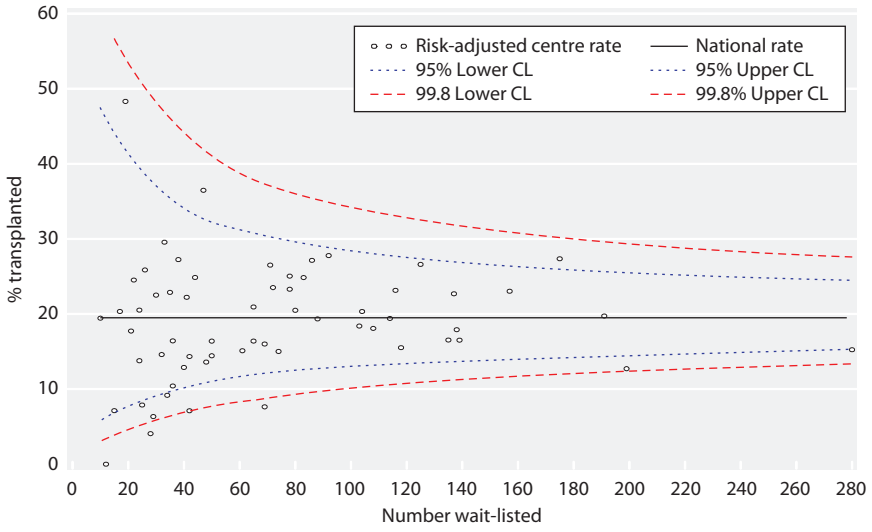


Fig. 13.2. The percentage of patients receiving a transplant from a donor after brain stem death by renal centre, within two years of transplant waiting-list registration (centres with <10 patients excluded)

Table 13.5. The percentage of patients receiving a transplant, by donor type and renal centre, within two years of transplant waiting-list registration

		Organ from donor after brain stem death			Organ from living kidney donor/donor after cardiac death		
			Transplant rate (%)			Transplant rate (%)	
Centre	Listed N	Transplanted N	Unadjusted	Risk-adjusted	Transplanted N	Unadjusted	Risk-adjusted
Abrdn	42	6	14.3	14.3	8	19.0	18.6
Airdrie	40	7	17.5	12.9	6	15.0	13.3
Antrim	15	1	6.7	7.1	1	6.7	6.1
B Heart	69	5	7.2	7.6	17	24.6	26.0
B QEH	116	24	20.7	23.2	35	30.2	28.8
Bangor	17	4	23.5	20.3	1	5.9	4.7
Basldn	25	2	8.0	7.9	10	40.0	36.1
Belfast	61	10	16.4	15.1	5	8.2	7.1
Bradfd	41	8	19.5	22.2	8	19.5	20.0
Brightn	78	18	23.1	23.3	20	25.6	24.2
Bristol	138	24	17.4	17.9	44	31.9	32.9
Camb	83	23	27.7	24.9	24	28.9	27.6
Cardff	157	38	24.2	23.0	47	29.9	30.3
Carlis	24	6	25.0	20.5	8	33.3	33.8
Carsh	125	32	25.6	26.6	36	28.8	29.6
Chelms	21	4	19.0	17.7	4	19.0	17.8
Clwyd	9	4	44.4	33.8	1	11.1	9.9
Covnt	69	11	15.9	16.0	29	42.0	39.2
D & Gall	7	1	14.3	18.7	2	28.6	27.9
Derby	48	7	14.6	13.6	5	10.4	11.7
Dorset	38	10	26.3	27.3	7	18.4	17.1
Dudley	24	4	16.7	13.8	8	33.3	30.0
Dundee	29	2	6.9	6.3	6	20.7	21.4
Dunfn	28	1	3.6	4.1	3	10.7	10.8
Edinb	88	16	18.2	19.3	21	23.9	23.9
Exeter	71	19	26.8	26.5	27	38.0	34.9
Glasgw	139	24	17.3	16.5	35	25.2	26.7
Glouc	36	7	19.4	16.4	12	33.3	34.9
Hull	78	21	26.9	25.1	18	23.1	23.6
Inverns	34	4	11.8	9.2	5	14.7	15.7

Table 13.5. Continued

		Organ from donor after brain stem death			Organ from living kidney donor/donor after cardiac death		
			Transplant rate (%)			Transplant rate (%)	
Centre	Listed N	Transplanted N	Unadjusted	Risk-adjusted	Transplanted N	Unadjusted	Risk-adjusted
Ipswi	32	5	15.6	14.6	13	40.6	39.7
Klmarnk	22	6	27.3	24.5	1	4.5	5.1
L Barts	191	32	16.8	19.7	46	24.1	26.8
L Guys	104	21	20.2	20.3	39	37.5	38.9
L Kings	103	16	15.5	18.4	30	29.1	31.0
L Rfree	108	15	13.9	18.1	25	23.1	27.7
L West	280	37	13.2	15.2	100	35.7	43.2
Leeds	135	20	14.8	16.5	50	37.0	35.8
Leic	199	24	12.1	12.7	62	31.2	32.2
Liv Ain	10	2	20.0	19.4	0	0.0	0.0
Liv RI	92	28	30.4	27.8	29	31.5	27.2
M Hope	114	19	16.7	19.4	17	14.9	13.9
Middlbr	80	18	22.5	20.5	23	28.8	27.0
Newc	86	26	30.2	27.2	35	40.7	36.9
Newry	12	0	0.0	0.0	0	0.0	0.0
Norwch	44	11	25.0	24.9	8	18.2	17.0
Nottm	65	12	18.5	16.4	14	21.5	19.9
Oxford	175	55	31.4	27.4	54	30.9	31.8
Plymth	47	17	36.2	36.5	20	42.6	40.8
Ports	137	34	24.8	22.7	34	24.8	23.6
Prestn	72	17	23.6	23.5	16	22.2	21.5
Redng	65	14	21.5	20.9	14	21.5	22.0
Sheff	118	19	16.1	15.5	29	24.6	23.4
Shrew	36	4	11.1	10.4	11	30.6	25.4
Stevng	74	12	16.2	15.0	27	36.5	36.7
Sthend	26	6	23.1	25.9	5	19.2	20.1
Sund	35	8	22.9	22.9	12	34.3	32.0
Swanse	50	8	16.0	16.4	13	26.0	26.4
Truro	42	3	7.1	7.1	20	47.6	49.5
Tyrone	8	0	0.0	0.0	1	12.5	12.4
Ulster	2	0	0.0	0.0	0	0.0	0.0
Wirral	30	7	23.3	22.5	7	23.3	20.2
Wolve	50	8	16.0	14.4	10	20.0	19.5
Wrexm	19	9	47.4	48.3	1	5.3	5.4
York	33	11	33.3	29.6	7	21.2	18.5

13.5) (change in $-2\text{Log L} = 60.9$, $df = 1$, $p < 0.0001$). As shown, several centres fall outside the 95% and 99.8% confidence intervals.

Figure 13.4 and table 13.6 show the unadjusted median time taken to activate patients on the transplant list for each renal centre.

The funnel plot is based on the assumption of an exponential distribution for time to activation. Although this assumption is broadly consistent with the data, the model based estimate of the national median was greater than that observed. This leads to an unusually large number of centres falling outside the lower 99.8% confidence limit for this national rate and perhaps too few occurring outside the upper limit. However, the plot highlights those centres that have significantly longer time to activation but small numbers of patients on the waiting-list. The Cox model giving a risk-adjusted analysis of time to activation identified a significant effect of centre (change in $-2\text{Log L} = 323.5$, $df = 64$, $p < 0.0001$). In general, centres with the longest unadjusted waiting times also had the longest risk-adjusted waiting times. The four centres lying outside the upper 99.8% confidence limit all had hazard ratios that indicated a significant delay in the chance of

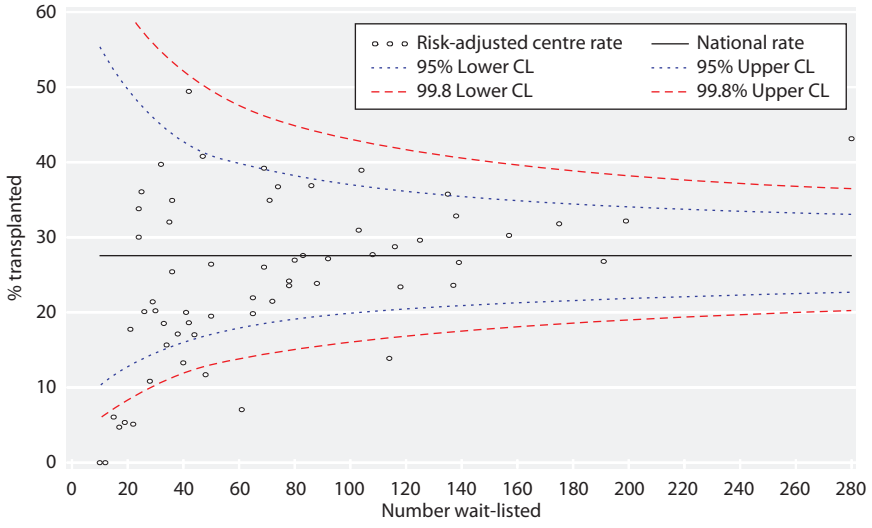


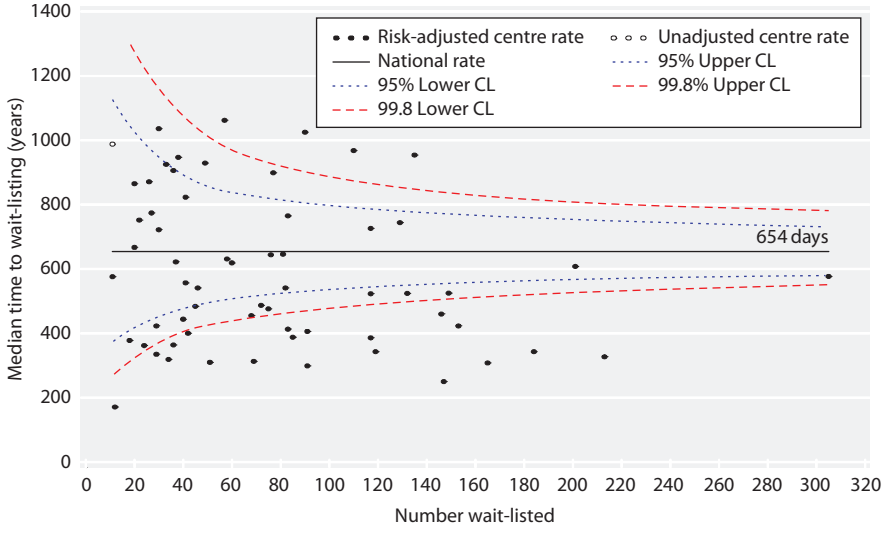
Fig. 13.3. The percentage of patients receiving a transplant from a living kidney donor/donor after cardiac death by renal centre, within two years of transplant waiting-list registration (centres with <10 patients excluded)

wait-listing compared with a baseline centre that had a median time comparable to the national median.

Discussion

The analyses indicate that there was a centre effect in relation to patients' access to the national renal transplant waiting-list in both the time taken to activate patients on the waiting-list and in the receipt of transplantation once activated on the waiting-list. Variations between renal centres persisted in the analyses adjusted for patient characteristics (case-mix), suggesting other factors were important. Inter-centre differences were more pronounced for both access to transplants from donors after cardiac death/living kidney donors and the time taken to activate patients on the transplant list. These are outcomes that are often predominantly influenced by individual centres' practices and policies.

Lack of comprehensive comorbidity data on all patients is a potential weakness of this study as it precluded definitive adjustment for case-mix and hence these results need to be interpreted with caution, as patient related factors other than those analysed as part of the study may be important in influencing access to renal transplantation. Some centres may take on 'sicker' patients with more comorbidity, explaining



The centre represented by an unfilled symbol has its final event time as the plotting position as the median time could not be estimated

Fig. 13.4. Median time to wait-listing for a kidney transplant, by renal centre (centres with <10 patients excluded)

Table 13.6. Median time to wait-listing for a kidney transplant, by renal centre (censoring at the earliest of death or 31st December 2008)

Centre	RRT N	Registrations N	Median (days)	Centre	RRT N	Registrations N	Median (days)
Abrdn	81	46	541	L Guys	219	117	726
Airdrie	86	41	823	L Kings	198	117	523
Antrim	23	18	378	L Rfree	182	117	386
B Heart	142	76	644	L West	494	305	577
B QEH	282	135	954	Leeds	238	146	460
Bangor	41	20	865	Leic	315	213	327
Basldn	57	27	774	Liv Ain	36	11	***988***
Belfast	119	68	455	Liv RI	225	110	968
Bradfd	84	45	484	M Hope	181	119	343
Brightn	135	83	413	Middlbr	138	85	388
Bristol	231	153	423	Newc	157	91	406
Camb	193	90	1,025	Newry	17	12	171
Cardff	265	165	308	Norwch	108	49	929
Carlis	38	24	362	Nottm	169	77	899
Carsh	255	132	524	Oxford	272	184	343
Chelms	45	22	752	Plymth	76	51	310
Clwyd	18	9	377	Ports	221	147	250
Covnt	125	72	487	Prestn	157	81	646
D & Gall	20	8	***422***	Redng	98	69	313
Derby	98	58	631	Sheff	243	129	744
Dorset	70	41	557	Shrew	72	40	444
Dudley	64	30	1,036	Stevng	155	83	765
Dundee	68	30	722	Sthend	50	29	423
Dunfn	51	29	335	Sund	79	38	947
Edinb	159	91	299	Swanse	108	60	619
Exeter	120	75	476	Truro	62	42	400
Glasgw	272	149	525	Tyrone	19	11	576
Glouc	72	37	622	Ulster	3	2	316
Hull	156	82	541	Wirral	79	36	906
Inverns	53	36	364	Wolve	127	57	1,062
Ipswi	69	33	925	Wrexm	39	20	667
Klmarnk	61	26	871	York	54	34	319
L Barts	358	201	608				

Results in ***bold italics*** are final event times as median times could not be estimated

some of the observed inter-centre variability. It would be expected that centres in which many patients have comorbidity will have fewer patients fit for transplantation, resulting in a smaller percentage of patients being wait-listed. Additionally, it may take longer to activate patients in these centres due to the need for more intensive investigation and medical optimisation prior to transplantation.

When interpreting the analyses in this chapter it is important to consider the potential impact of missing data on the results. Missing data occurs as a result of either a renal centre failing to complete relevant fields on their renal IT system or a failure to extract this data. Missing data may not be at random; sicker patients may die more quickly, allowing inadequate time for their physician to enter relevant comorbidity data. The very process of working up and listing a patient makes it less likely that data will be missing. It is therefore perhaps not surprising that patients activated on the national kidney transplant waiting-list are more likely to have ethnicity and PRD data reported ($p < 0.0001$) (table 13.1).

The finding that certain patient related variables such as increasing age have a negative association with access to transplantation is understandable, as the risk-benefit ratio of receiving a renal transplant alters with age. However, the effect of factors such as gender and ethnicity on access to transplantation is more difficult to understand. The importance given to HLA matching in the national allocation protocol at the time of this study may have favoured a predominantly white donor pool being matched with white recipients, which may explain the

effect of ethnicity on this outcome. This study has not analysed the interplay between factors such as social deprivation and ethnicity and whether the observed differences based on ethnicity are likely to persist after adjustment for social deprivation and varying co-morbidity burden in different ethnic groups. One possible explanation for the observed disparity between the sexes in receipt of a transplant from a donor after brain stem death could be pregnancy related HLA sensitisation in women, which in turn will limit offers of organs. The higher proportion of patients with diabetes receiving a transplant corresponds to an increase in the number of simultaneous kidney-pancreas transplants during the study period, as the allocation algorithm prioritised dual organ recipients.

This study highlights the presence of significant centre variation in access to transplantation with respect to the proportion of patients listed and the time taken to activate suitable patients, even after correction for available relevant patient related variables. To conclude that centres with a lower proportion of patients on the waiting-list are in some way performing less well would be simplistic. Such centres could be choosing patients more carefully to ensure that the scarce resource of donated organs is appropriately targeted to patients who are likely to benefit the most. Centres with the highest proportion of patients on the waiting-list could be including patients who have a higher risk of peri-operative morbidity or mortality. They may as a consequence have inferior post-transplant outcomes resulting in suboptimal use of the scarce resource of donated organs although there are no significant centre differences in post-transplant survival of patients and grafts to support this explanation. For these reasons it is not possible to offer a guideline on the minimum percentage of patients who should be activated on the renal transplant waiting-list in each centre. However significant inter-centre differences in the time taken to activate suitable patients for transplantation should not exist.

The UKRR is collaborating with other researchers in the National Institute for Health research (NIHR) funded Access to Transplant and Transplant Outcome Measures (ATTOM) research project to study access to kidney transplantation in greater detail. This will allow those practices identified in the better performing centres to be disseminated to other centres, thereby facilitating equity of access to transplantation across the UK.

Conflicts of interest: none

Reference

1 Ravanan R, Udayaraj U, Ansell D, Collett D, Johnson R, O'Neill J, Tomson CR, Dudley CR. BMJ. 2010 Jul 20;341:c3451. doi: 10.1136/bmj.c3451

Chapter 14
Enhancing Access to UK Renal Registry Data through Innovative Online Data Visualisations

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Summary

- It is now possible to interactively interrogate, analyse and produce displays of UK Renal Registry data online at http://www.renalreg.com/n_portal/pages/main/registryportal.php. This enables any individual to interrogate the validated anonymised UKRR datasets.
- This bespoke web-based interactive data portal provides a focussed point of access to a variety of graphical display formats and analyses of UKRR data.
- Centre-specific reports can be produced – including a colour-coded dashboard summary as well as both funnel plots and longitudinal statistical process control charts for a range of clinical parameters.
- Interactive flash-based longitudinal Statistical Process Control charts are available on a per-centre and per-parameter basis allowing for a more detailed review of performance over time.
- There are Rosling/Gapminder-style motion charts on a per-parameter basis simultaneously detailing performance and activity data from multiple centres interactively over time (more details below).
- There is an interactive graphical pivot chart solution using OLAP (online analytical processing) technology allowing users to design and export their own charts/analyses in real-time using UKRR data.
- The portal will empower the UK renal community in the comparative analysis of delivered renal care ultimately hopefully leading to enhanced quality improvement over time.

Background

The UK Renal Registry (UKRR) has grown from strength-to-strength since its inception in 1997 and now receives data from every renal centre in England, Wales and Northern Ireland with a more limited dataset being contributed annually by the Scottish Renal Registry. Each year the report provides detailed comparisons of the activity and performance of each of the submitting centres across a range of clinical parameters. Whilst this data and its associated analyses are valued by a wide range of stakeholders (the renal centres themselves, the NHS Renal healthcare Commissioners and allied patient-related groups e.g. the National Kidney Federation), it is recognised that as the volume of data and analyses grows with time, so does the need to present this increasingly complex information in an accessible and clinically informative manner which is responsive to, and reflects the nature of, the enquiries made by those seeking to access the data. In particular, the need to reflect changes in activity and performance over time (longitudinal data) as opposed to the predominantly 'snapshot' cross-sectional data contained in the annual report is essential if the UKRR is to achieve its goal of monitoring renal care in the UK thus leading to improvements in the quality and efficiency of this very same care.

Online Interactive Geographical Maps

It was in this context that in 2009 the UKRR launched the world's first interactive maps (figure 14.1 and table 14.1) detailing the achievement of quality measures in the care of dialysis patients spanning a five-year period. Initially these maps were confined to a variety of haematological and biochemical parameters (table 14.2) based around healthcare commissioning geographies. They were soon followed by the addition of national public health datasets (cardiovascular mortality, indices of social deprivation and ethnic distributions courtesy of the East Midlands Public Health Observatory, table 14.2) based on these same geographies allowing for a limited exploration of correlations between these parameters and UKRR data. Renal centre-based maps displaying UKRR data alone are now also available (table 14.2).

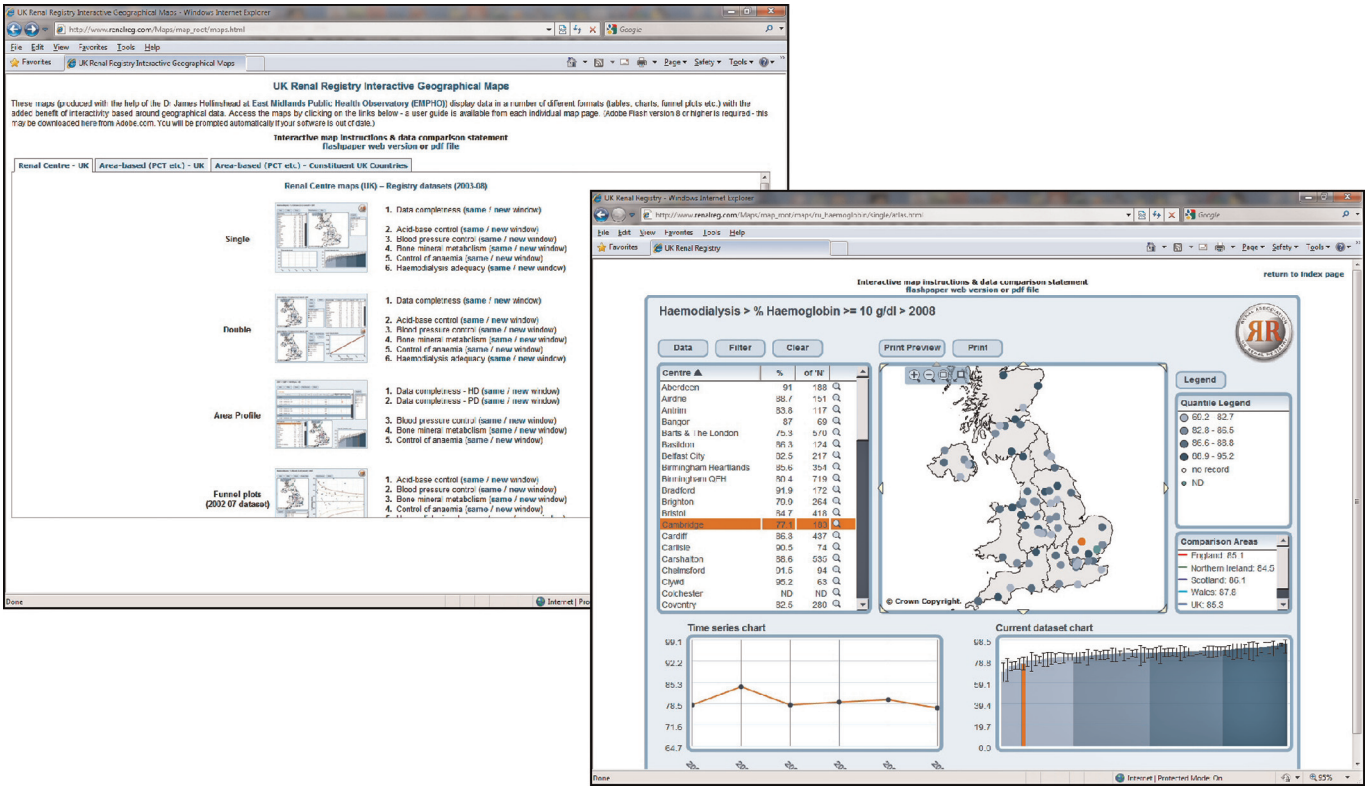

Fig. 14.1. Interactive Geographical Maps – http://www.renalreg.com/Maps/map_root/maps.html

Table 14.1. UK Renal Registry online interactive map types

Geography basis	Type	Description
Area-based Centre-based	Single	View containing a thematic map, table and chart indicating spatial/ geographical patterns and temporal trends for a specific indicator of interest.
Area-based Centre-based	Double	View containing two thematic maps allowing for the comparison of patterns and relationships between two indicators for the same geography type.
Area-based Centre-based	Area Profile	View allowing users to select a geographical 'area' and to chart a cross-section of selected key indicators. This provides an 'at-a-glance' assessment of the selected 'area' in comparison with other 'areas', including regional and/or national geography regions.
Centre-based	Funnel Plot	View of cross-sectional data containing a thematic map, table and chart indicating spatial/geographical patterns as well as a funnel plot with upper and lower 95% and 99.9% confidence intervals.

The Statistical Comparison of Data

Historically many of the graphs in the various UKRR reports describing, for example, the proportion of patents in a given centre achieving a given biochemical standard, have been presented in the form of a 'caterpillar' plot with centres listed on the x-axis in order of the percentage achievement. At the same time it was recognised that these types of plots perhaps encouraged inappropriate statistical comparisons between centres. In the context of the online maps, the guidance states:

Table 14.2. UK Renal Registry online interactive map datasets

Country	Geography	UKRR data	Public Health Data
England	Primary Care Trust	RRT incidence and prevalence rates Bone mineral metabolism (Ca, PO_4, PTH) Control of anaemia (Hb, ferritin) Haemodialysis adequacy	Circulatory disease mortality 2005–2007[a] Index of Multiple Deprivation 2007[b] Ethnicity – Office of National Statistics 2006[c]
Northern Ireland	Local District	RRT incidence and prevalence rates Bone mineral metabolism (Ca, PO_4, PTH) Control of anaemia (Hb, ferritin) Haemodialysis adequacy	Circulatory disease mortality 2005–2007[d] Northern Ireland Multiple Deprivation Index 2005[d] Ethnicity – 2001 Census[c]
Scotland	Health Board	RRT incidence and prevalence rates	Circulatory disease mortality 2006–2008[e] Scottish Index of Multiple Deprivation 2009[e] Ethnicity – 2001 Census[c]
Wales	Local Health Board	RRT incidence and prevalence rates Bone mineral metabolism (Ca, PO_4, PTH) Control of anaemia (Hb, ferritin) Haemodialysis adequacy	Circulatory disease mortality 2002–2004[f] Welsh Index of Multiple Deprivation 2008[g] Ethnicity – 2001 Census[c]
All	Renal Centre	As maps above, plus (where data is available): Data 'completeness' Acid-base control (Bicarbonate) Blood pressure control	No data aggregated by renal centre available

Data Sources:
[a] Compendium of Clinical and Health Indicators
[b] National Statistics, Department of Communities and Local Government
[c] Office for National Statistics
[d] The Northern Ireland Statistics and Research Agency
[e] ScotPHO
[f] National Public Health Service for Wales
[g] Welsh Assembly Government

'Caution should be used when comparing data between many areas using maps such as these. Unless you have a priori comparisons in mind and make only those specific comparisons then there will be problems.

. . . The funnel plots allow for the identification of renal centres which fall outside of the upper or lower 95% and 99.9% confidence intervals. These compare all centres with the average rather than being centre to centre comparisons like you are tempted to make from the 'caterpillar' style plots. You are still making multiple comparisons (comparing each of about 70 centres with the average) but using the 99.9% intervals instead of the 95% ones makes some adjustment for this.'

More recently therefore the UKRR has made increased use of funnel plots for presenting such data in the annual report.

Contemporaneously with the introduction of these maps, Dr Alex Hodsman, Renal Registry Research Fellow, was advancing the application of additional robust and well-validated statistical analytical techniques to UKRR data. One area of focus in her research was the use of statistical process control charts, originally developed by Dr Walter Shewart for the Bell Telephone Company in 1924 (see: http://en.wikipedia.org/wiki/Walter_A._Shewhart).

Dr Shewart realised that variation in data can occur for a number of reasons. Assuming that data collection and processing is robust then there are principally two types of variation: 'common cause' and 'special cause' variation. All processes demonstrate some degree of random variation, which is known as 'common cause' variation and a particular process is said to be 'in control'/'stable' if it demonstrates only 'common cause' variation. However, unexpected events or situations arising in a process can result in 'special cause' variation. In such circumstances, a process is said to be 'out of control'/'unstable'. Variation of this type needs to be identified and, if genuine, investigated further.

Statistical process control (SPC) charts can be used to differentiate between these two types of variation (using a variety of 'rules') and can be plotted as either cross-sectional or longitudinal charts using either static (a snapshot in time) or dynamic (a series of data points over time) data respectively. Funnel plots are a means of displaying cross-sectional/static data whilst longitudinal run charts can be used to display longitudinal/dynamic data (see: http://www.indicators.scot.nhs.uk/SPC/Main.html).

The UK Renal Registry Online Data Portal

Following on from:

- considerable positive feedback regarding the interactive maps,
- a desire to extend the statistical rigor applied to UKRR data (as outlined above), and
- feedback from many centres about their own accessibility to UKRR data with increasingly frequent requests for timely access

the UKRR now wishes to report the extension of this online interactive strategy to the deployment of a bespoke interactive data portal (Summer 2011). The aim of the portal is to provide a focussed point of access to a variety of graphical display formats and analyses of UKRR data, with figures 14.2A, B, C and D showing the different data presentation options:

A. Centre-specific reports – a distillation of annual UKRR data including a colour-coded dashboard summary as well as both funnel plots and longitudinal statistical process control charts for a range of clinical parameters. The dashboard describes for each clinical parameter:
   - the centre's performance (percentage achievement of standard) for that year
   - a numerical and colour-coded comparison with the previous year
   - whether or not the centre is an outlier on a funnel plot in that year
   - whether or not the centre's performance exhibits 'special cause' variation over time on a longitudinal SPC
   - the mean percentage achievement of all centres in the same region for that year
   - a colour coded median rank (with 95% confidence intervals) amongst all centres for that parameter based upon a standard statistical simulation model.

B. Interactive flash-based longitudinal SPC charts on a per-centre and per-parameter basis allowing for a more detailed review of performance over time. These charts are the interactive correlates of those available in the centre-specific reports.

C. Rosling/Gapminder-style motion charts on a per-parameter basis simultaneously detailing performance and activity data from multiple centres interactively over time (more details below).

Fig. 14.2. Interactive Online Data Portal – http://www.renalreg.com/n_portal

D. An interactive graphical pivot chart solution using OLAP technology allowing users to design and export their own charts/analyses in real-time using UKRR data.

Rosling Motion Charts

Hans Rosling, Professor of International Health at the Karolinska Institute, co-founded the Gapminder Foundation (see: http://www.gapminder.org/) which developed the motion chart software system. This was most notably popularised in a much admired talk given by Professor Rosling at the Technology, Entertainment and Design Conference in 2006. (See: http://www.ted.com/talks/hans_rosling_shows_the_best_stats_you_ve_ever_seen.html)

A motion chart graphical system is now freely available for use as part of the Google visualisation programming interface and it is this system which has been utilised in the UKRR data portal. Motion charts are a potentially very powerful graphing system able to display up to five parameters at any one time (represented by: ubble graphic size, colour/appearance, x-position, y-position and time, respectively). This enables complex data interplays to be explored and investigated in an intuitive manner far in excess of what can usually be achieved with a two dimensional static scatterplot type of chart.

OLAP Pivot Charts

An OLAP (online analytical processing) cube is a data structure that allows for the rapid analysis of data categorised by a number of *dimensions*. Each of the elements of a dimension can be described using a hierarchy which is a series of parent–child relationships in a generational type structure. So, each parent is derived by the aggregation of its child members and in turn, parent members at any one level may be further aggregated as the children of another parent at the next higher level. As an example, September 2003 can be aggregated into Quarter 3 2003, which in turn can be aggregated into Year 2003 – all of these members belong to the 'Time' dimension.

The numerical data in the cube goes to form the *measures* of the cube. These are usually summary calculations (e.g. minimum, maximum, mean, total etc.) for the various data points aggregated across the dimensions of the cube at the level of the hierarchy selected (e.g. the mean percentage attainment of a given standard for all centres in Quarter 3 2003).

One of the strengths of an OLAP cube is the ability to drill-up and to drill-down through the hierarchical levels of one or more dimensions (e.g. starting by looking at data aggregated by year, then drilling down to data aggregated by quarter and so on). Another is the ability to rapidly re-orientate the cube so as to look at the same data but from an entirely different perspective e.g. instead of looking at data through the 'Time' dimension, the data could be viewed from the perspective of the 'Location' dimension which might start with the four Home countries of the UK, drilling down to a regional level and then down to the level of the individual renal centres themselves. In reality, data is usually explored and aggregated simultaneously across multiple dimensions (e.g. geographical region, time, RRT modality etc.) – but the power of the OLAP cube means that changes in the selected dimensions/hierarchies are reflected in the displayed graphic within seconds rather than in the minutes or hours that might be needed if aggregating this data via a traditional relational database query.

In the implementation of an OLAP cube used in this data portal, the OLAP processing is done in the Flash/Adobe Flex front end client running on the local computer following transfer of all the raw data from a MySQL database on the UKRR web server. A more efficient strategy would be for the OLAP processing to take place on the UKRR's server following submission of a query and for only the results of the query to be passed to the requesting client. This is to be considered in a future development.

At present the power of the OLAP cube is tied to an interactive pivot chart style of front end where the user may 'drag and drop' parameters and in addition, may select individual members of different hierarchies in order to generate their own personalised charts from validated UKRR datasets. These charts may then be exported in either a jpg of pdf format for use locally.

Future Plans and Summary

All of the online interactive visualisations use the same validated UKRR datasets as those used in each respective year's annual report. Currently (Summer 2011), the online maps house data from the 2003–2008 UKRR datasets (except for the funnel plots which house the 2002–2007 datasets). The centre-specific reports in the online portal are derived from the 2007 dataset whilst the SPC charts, the motion charts, and the OLAP pivot chart all use data from the 2002–2007 datasets.

Over the next few months more of the UKRR's annual datasets will be uploaded into portal. More complex comparisons will be developed to take advantage of the power of the motion charts and as the volume of data grows so the technical structure of the OLAP charting system will be revised to improve the responsiveness of the system as outlined above. In addition, the aim is to more fully integrate the geographical maps into the data portal itself. Further refinements will also be made in response to the feedback received from users of the portal.

We believe that this work – 'Enhancing Access To Registry Data Through Innovative Online Data Visualisations' – builds strongly on the wealth of information arising from the high-quality validated UKRR datasets, and that both the maps and the portal will empower and engage the UK renal community in the comparative analysis of delivered renal care ultimately leading to enhanced quality improvement over time.

Conflicts of interest: none

Chapter 15
RRT Incidence and use of Home Dialysis Modalities

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Key Words
Dialysis · End stage renal disease · Guidelines · Haemodialysis · Incidence · Peritoneal dialysis · Personnel · Primary care · Renal replacement therapy · Service delivery · Treatment modality

Summary

- There were 406.4 whole time equivalent nephrologists working in the UK in 2010 with a mean of 7.4 nephrologists per million population (range 2 pmp–19 pmp, SD 2.7); there was a 9-fold variation between renal centres.
- There were 195.9 whole time equivalent home team nurses employed in the UK in 2010, resulting in a mean of 2.9 per centre (range 0.0–12.6, SD 0.5) and a median of 1.8 (range 0.0–8.0, IQR 0.6–2.7) per 100 incident patients.
- A median of 20% of over 75 year old patients with CKD 5 known to UK renal centres were considered to be undergoing conservative care (IQR 10–30).
- The median percentage of patients presenting to renal services within three months of requiring RRT was 22.5% (IQR 16.3–29.0) range 3–67%.
- Sixty-four centres (89%) offered home haemodialysis to their patients.
- A mean (SD) of 22% (8) of prevalent dialysis patients were treated with either peritoneal dialysis (PD) or home haemodialysis (HHD) with a 13-fold variation between centres.
- There was no evidence that centre use of PD was associated with centre use of HHD ($R^2 = 0.0004$, $p = 0.9$).
- The median (IQR) percentage of prevalent dialysis patients using HHD was 2.9% (1.3–3.9).

Introduction

The optimal rate of dialysis initiation and home dialysis usage is not known, but the principle that access to renal treatment should be equal for all suitable patient groups is one of the tenets of the UK Renal Registry.

Variation in RRT incidence in the UK is in part related to the age, ethnicity, socio-economic (SES) and health status of each renal centre's population [1, 2]. Variation in the proportion of patients treated with a home dialysis modality might also be influenced by these factors, although to a lesser degree [3, 4].

This chapter presents the results of a nationwide renal survey which was undertaken to identify renal centre characteristics and practice patterns which might explain:

1. Variation in RRT incidence
2. Variation in the proportion of patients treated with a home dialysis modality.

Methods

The survey instrument was developed in a multistep process.

1. Systematic literature review

A search of MEDLINE (1950 to June 2009), SCOPUS and EconLit (2000 to June 2009) was performed in conjunction with the Aberdeen Health Economics Unit, followed by hand searching the references lists and a search of citing articles using OVID OSP. Abstracts were viewed and resulted in 20 references relating to RRT incidence and 26 relating to home modality use. Tested or untested hypotheses arising from these articles were used as the potential characteristics of renal centre organisation or clinical practice patterns that the renal consensus panel were asked to score. These factors are presented below in figure 15.1 to show the proposed pathways and barriers to both RRT initiation and use of home dialysis as a treatment modality.

2. Modified Delphi consensus generating process

A purposively sampled group, consisting of 7 nephrologists, 3 general practitioners with an interest in CKD, 3 renal commissioners/network managers, 3 senior renal nurses and 3 renal patient representatives, was asked to participate in a 2-stage modified Delphi process. This is a consensus generating procedure which attempts to allow equal weighting to each participant's opinion. In stage 1, the group was requested to score each characteristic extracted from the literature search on its ability to predict a) RRT incidence, b) PD usage or c) Home HD usage. They were also requested to suggest additional characteristics which might influence these outcomes. In stage 2, each group member was asked to re-score each original characteristic (knowing the average score it had received in stage 1) and to provide a score for the characteristics suggested in stage 1. The highest scoring items were then included in the national renal unit survey.

3. Survey design, piloting and distribution

SurveyGizmo™ 2.6 software was utilised to develop the online survey and ethical approval was obtained from the National Research Ethics Service and local approval from the Research and Innovation Department, Southmead Hospital, Bristol. In addition, approval for circulation of the survey was obtained from the Renal Association Clinical Affairs Board. Questions were written, tested and amended in an iterative process. The complete survey was then piloted for comprehension and accuracy by 4 nephrologists and amended as necessary. The survey was sent to two nephrologists at each renal centre in the

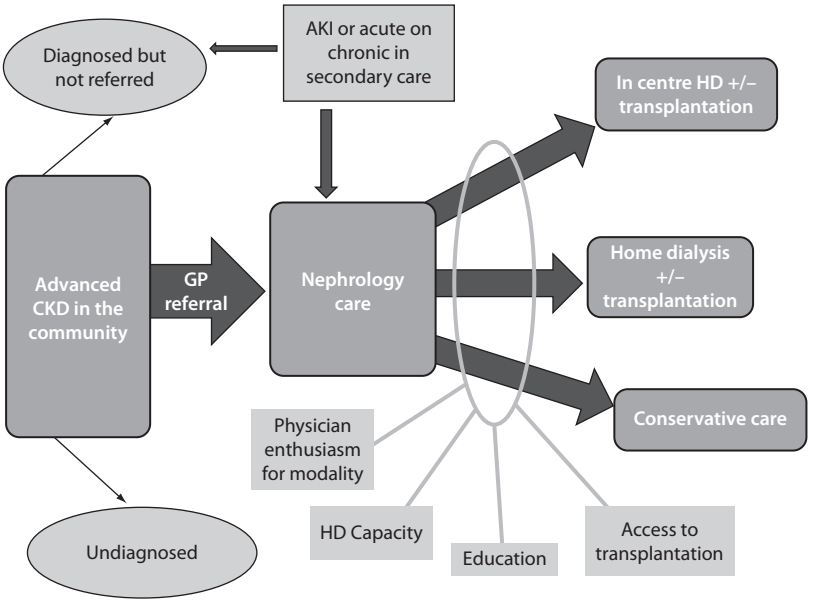

Fig. 15.1. Proposed pathways and barriers to RRT initiation and home dialysis utilisation
*CKD = chronic kidney disease; AKI = acute kidney injury

UK (n = 72 excluding Shetland as this centre had become a main unit within the past year). If there was no response from a centre after 4 weeks, the survey was then sent to an alternative nephrologist in the centre, if available.

Survey content

The survey consisted of 43 questions in 5 sections: demographics, staffing, referrals, service provision and decision making processes. To improve completion rates a personalised introductory letter explaining the nature of the research question, reminders to complete the survey, a link to the sponsoring university and coloured advertising images were used [5, 6]. To limit the potential for social desirability bias it was stated that individual responses would not be made available and a subset of questions were asked in the negative.

A variety of questions types were used: numeric, multiple choice, yes/no and scaled (using a 5-point Likert scale).

Statistical analyses

Centres with more than one responder were combined to provide a single mean response. Aggregate data were used to calculate means, standard deviations (SD), medians, interquartile ranges (IQR) and frequencies; chi squared tests were performed to compare groups and a p test for trend was used to explore relationships between variables. Centres were grouped into Strategic Health Authorities (SHAs) for English centres and into nations for Welsh, Scottish and Northern Irish centres as well as into transplanting and non-transplanting centres to allow comparisons to be made. Catchment area populations for each renal centre were used to calculate per million population rates. The methodology for this in England has been described in Chapter 1 UK RRT Incidence rates in 2009. Catchment populations were provided by personal communication, for Wales (Dr K Donovan, Dr A Williams) and for Northern Ireland (Dr D Fogarty). These populations were not available for Scotland and so Scottish centres were excluded from population rate analyses.

Results

Characteristics and practice patterns chosen

The highest scoring factors from the consensus group were included in the national survey. These are listed in table 15.1 with the proposed effect on RRT incidence or the proportion of patients using a home dialysis modality if known.

Response rate

There were responses from all of the 72 renal centres in the UK, 12 (17%) centres provided two responses and 1 (1.4%) centre provided three responses. Seventy-eight (88%) of the respondents were male.

Table 15.1. The relationships between renal centre characteristics and practice patterns and the rate of RRT and home dialysis uptake

Renal centre characteristic/practice pattern	Expected influence on RRT	Expected influence on home dialysis uptake
Number of nephrologists/education team/home dialysis team members	Increase	Increase
Consultant level responsibility for home dialysis patients (team vs. named consultant vs. overview)	NA	Increase with 'team' model
Educational outreach to primary care	Increase	NA
Late referral/non-referral rates	Decrease	
Intensity of out-patient review	NA	Increase
Availability of new patient appointments	Increase	
Intensity of in-patient review	Increase	NA
Availability of renal beds	Increase	NA
Use of ITU when renal bed unavailable	Decrease	NA
Proximity of high risk specialties (e.g. urology)	Increase	NA
Range of treatments offered	Increase	Increase
Availability of chronic HD slots	Increase	Decrease if good availability
Financial incentive to keep HD units full	Increase	Decrease
Pre-dialysis education programme (components/personnel/availability)	NA	?Increase
Conservative care (active management/uptake)	Decrease	NA
Home dialysis patient support	NA	Increase
PD access placement capacity	NA	Increase
Preparation for home HD (self care/training/adaptations)	NA	Increase
Practice patterns (survival/QoL/ideal modality mixture)	Either	Either

Incidence of RRT

There was an eight fold variation in RRT incidence between PCTs/health boards in the UK (29 pmp–240 pmp). The variation was 2.3 fold between renal centres (67 pmp–156 pmp).

Home dialysis usage

A mean (SD) of 22% (8) of prevalent dialysis patients were treated with either peritoneal dialysis (PD) or home haemodialysis (HHD) with a 13-fold variation between centres. There was no evidence that centre use of PD was associated with centre use of HHD ($R^2 = 0.0004$, $p = 0.9$).

Staffing

There were 406.4 whole time equivalent nephrologists working in the UK in 2010 with a mean of 7.4 nephrologists per million population (range 2 pmp–19 pmp, SD 2.7); this represents a 9-fold variation between renal centres. The mean number of doctors per 100 RRT patients was 1.1 (range 0.3–3.2, SD 0.5) with a lower doctor: patient ratio observed in transplanting centres (0.7 vs. 1.3, $p < 0.001$). Overall there was a mean of 1.7 doctors per 100 dialysis patients (range 0.5–3.7, SD 0.6).

There were 136.3 whole time equivalent education nurses/advisers employed in UK renal centres in 2010, resulting in a mean of 2 per centre (range 0.25–8.00 SD 1.6). This equates to a mean of 1.7 whole time equivalent education nurses per 100 incident dialysis patients (range 0.2–9.1, SD 1.7) and in England, Wales and Northern Ireland a mean of 3.5 pmp (range 0.5–19.2, SD 3.4).

There were 195.9 whole time equivalent home team nurses employed in the UK in 2010, resulting in a mean of 2.9 per centre (range 0.0–12.6, SD 0.5) and a median of 1.8 (range 0.0–8.0, IQR 0.6–2.7) per 100 incident patients. Two centres reported that they did not employ any home team nurses; one of these centres also had no home dialysis patients. There was a mean of 4.4 home team members per million population (range 0–14 pmp, SD 3.5) in England, Wales and Northern Ireland.

Renal centres

There are 72 main adult renal centres in the UK (52 in England, 5 in Wales, 9 in Scotland and 6 in Northern Ireland) and 207 satellite units (178 in England, 18 in Scotland and 11 in Wales) of which 76 were privately owned. No renal centres in Scotland had privately owned dialysis units however there were 8 in Wales, 67 in England and 1 in Northern Ireland.

The mean renal centre catchment population in England/Wales/Northern Ireland is 900,636 (range 176,500–2,317,660, SD 556,067). There were on average 90 haemodialysis machines per million population in England/Wales/Northern Ireland with a mean of 4.4 haemodialysis patients per machine in England (range 1.0–6.4, SD 1.1), 3.8 per machine in Wales (range 3.4–4.3, SD 0.4), 3.7 per machine in Scotland (range 2.5–6.6, SD 1.2) and 3.6 per machine in Northern Ireland (range 1.8–5.8, SD 1.4).

Characteristics and practice patterns influencing RRT incidence

In patient capacity

The capacity to transfer stable patients to the renal ward was assessed for patients who did not require immediate dialysis but who had been deemed to benefit from further investigation and treatment. Thirty-seven renal centres (51%) were able to transfer at least 50% of such patients on the same day with 20 further centres (28%) transferring at least 50% of such patients the next day and only 4 centres (6%) requiring 3 or more days to transfer the majority of these patients (figure 15.2). There was no difference in transfer time between transplanting and non-transplanting centres or between countries/SHAs.

Six centres (9%) reported that they were forced to use ITU beds to manage haemodynamically stable patients with single organ renal failure more than once per week, 28 centres (38%) used ITU in this way more than once per month and only 12 centres (17%) reported that this never occurred at their centre. There was no difference in the rate of this type of ITU use between SHAs/countries or between transplanting and non-transplanting centres.

Out-patient capacity

The methods employed to accommodate new patients into the chronic haemodialysis programme were examined. All centres responded that they frequently used existing empty dialysis slots, 15 centres (21%) responded that they frequently opened an extra dialysis session (e.g. twilight) in order to accommodate patients. Eight centres (11%) placed patients on a waiting list whilst a slot became available and 3 centres (0.4%) frequently used in-patient beds to accommodate their chronic haemodialysis patients. Seven centres (10%) responded that they converted some patients onto PD in order to accommodate new patients onto the HD programme

Table 15.2. Summary statistics for continuous variables

Variable	Total (N)	Mean (SD) Range	% missing
Number of nephrologists (WTE)	406.4	1.1 (0.5) 0.3–3.2 per 100 RRT patients 1.7 (0.5) 0.5–3.7 per 100 dialysis patients 7.4 (3.2) 2–19 per million population*	0.0
Education team members	136.3	2 (0.6) 1–8 per centre 1.6 (1.7) 0–9 per 100 incident patients 3.4 (3.5) 0.6–19.3 per million population*	6.0
Home team members	195.9	2.8 (2.5) 0–12.6 per centre 2.1 (1.9) 0–8 per 100 incident patients 4.2 (3.5) 0.6–14.4 per million population*	6.0
% >75years receiving conservative care	–	21 (14) 1–70	11.0
% late presentation**	–	23 (12) 3–67	12.0
HD machine	4695	4 (1.1) 1–6.6 HD patients per machine 92 (54) 5–311 per million population*	4.0
Percentage of prevalent patients on home dialysis	–	20 (7.6) 0–37	0.0
Variable		**Median (IQR) Range**	**% missing**
Training time for HHD (weeks)	–	10 (6–12) 2–52	19.6
Optimal treatment in <65 year old patients	–		7.0
In centre HD		40 (30–55) 0–75	
HHD		25 (15–30) 5–80	
PD		30 (23–35)10–80	
Optimal treatment in >65 year old patients	–		7.0
In centre HD		63 (50–70) 20–90	
HHD		10 (5–20) 5–50	
PD		25 (20–30) 5–60	

Abbreviations:
WTE – whole time equivalent, RRT – renal replacement therapy, fu – follow up
* England, Wales and Northern Ireland
** defined as less than 90 days between the date first seen by a nephrologist and the start of RRT

and 8 centres (11%) dialysed some patients twice a week in order to find space for new patients (figure 15.3). There were no significant differences in these responses by SHA/country. Transplanting centres were more likely to open extra sessions to accommodate patients (41% vs. 10%, $p = 0.01$) and to place patients in an HD unit that was not the closest to their home (71% vs. 23%, $p = 0.001$) whereas non-transplanting centres were more likely to place patients on a waiting list (15% vs. 4%, $p = 0.003$).

Conservative care

The emphasis on conservative care employed by each centre was assessed by asking about the percentage of over 75 year old patients with CKD 5 who opted for conservative management and the method of follow up for these patients. A median of 20% of over 75 year old patients with CKD 5 known to UK renal centres were considered to be undergoing conservative care (IQR 10–30). One centre responded that only 1% of these patients had opted for conservative care and 5 centres responded that over 50% of such patients did. There was no significant difference in the proportion of patients opting for conservative care according to SHA/country or transplanting status of the centre.

There was wide variation between centres in how patients opting for conservative care were followed up. Fifty-four centres (75%) followed these patients up in a nephrology clinic, either low clearance or general nephrology and 18 centres (28%) utilised a dedicated conservative care clinic. Fourteen centres (19%) employed renal palliative nurses to provide outreach community care to these patients. Twenty-nine centres (44%) referred such patients back to primary care (8 of these with outreach community renal nurse support) and 1 centre utilised the general palliative care clinic

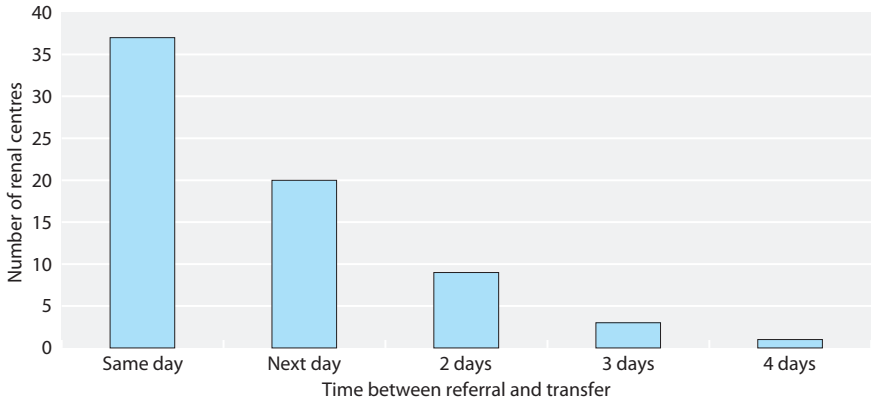

Fig. 15.2. The time between referral and transfer to a renal ward for investigation and management

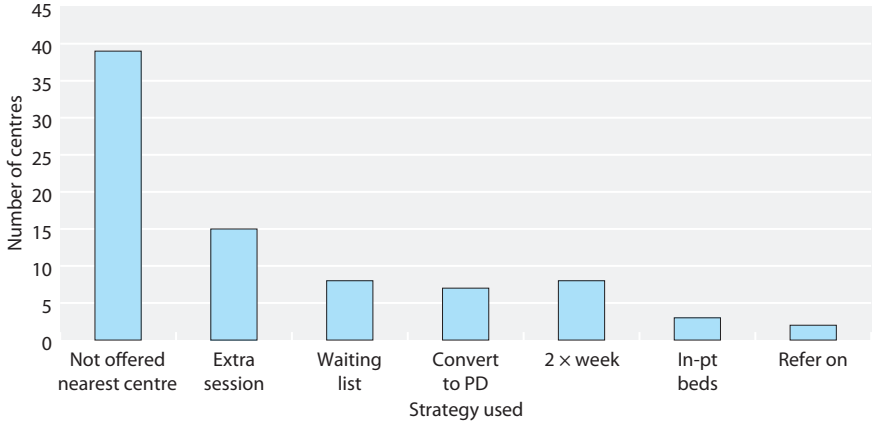

Fig. 15.3. The strategies used to incorporate new patients into chronic HD programmes
Extra session = an additional session (e.g. twilight) is opened to accommodate new patients
Refer on = patients are referred to a neighbouring centre
2 × week = patients are reduced to twice a week in order to accommodate new patients

for follow up (figure 15.4). There were no differences in these responses between SHAs/countries except that only centres in England and Scotland provided outreach community nursing support for these patients. There was no difference in patterns of follow up in transplanting and non-transplanting centres.

Interface with primary care

Engagement with primary care colleagues was assessed based on the types of communication methods used. Twenty-nine centres (40%) had advertised web-based local guidance on CKD management and referral to over 75% of their local GPs. Thirty-one centres (43%) had advertised the Renal Association guidance on CKD management and referral guidelines to over 75% of their local GPs, and 34 centres (47%) had emailed or posted written referral information to over 75% of local GPs. Twelve centres (17%) had reached over 75% of local GPs with a CKD talk and 45 centres had reached between 25% and 75% of GPs with a CKD talk (figure 15.5).

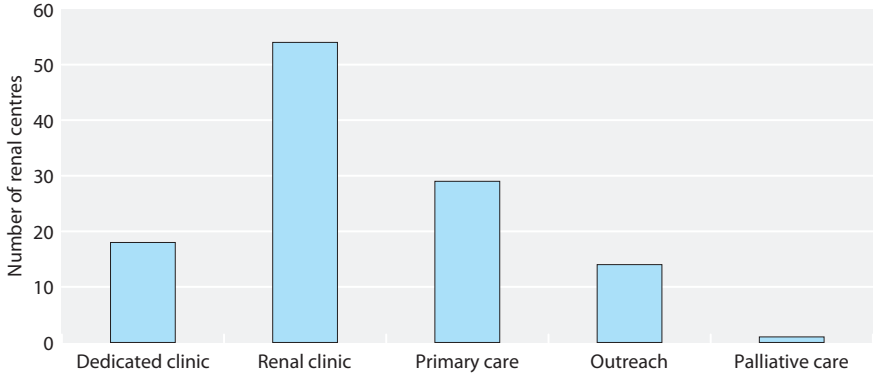

Fig. 15.4. The methods employed for follow up of conservative care patients

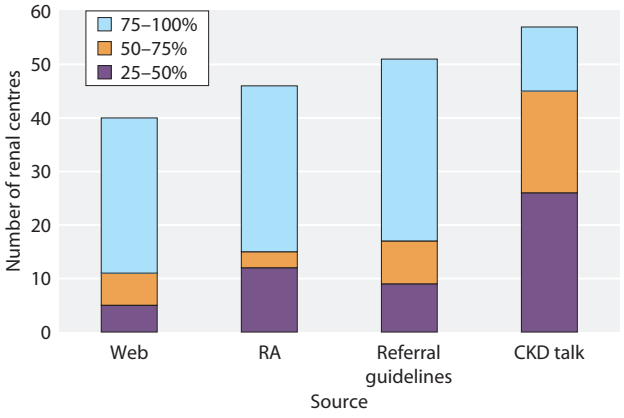

Fig. 15.5. The percentage of GPs receiving guidance from renal centres

Respondents were asked to rate the prevalence of non referral in their area. Only eight centres (11%) felt that the prevalence of non referral was either moderate or high with all other centres rating it as low or very low. The centres who felt that non referral was either moderate or high also reported that less than 50% of GPs had attended a talk on CKD. There were no differences in these responses between SHAs/countries or between transplanting and non-transplanting centres. The median (IQR) percentage of patients presenting to renal services within three months of requiring RRT was 22.5% (16.3–29.0) range 3–67%.

Interface with other areas in secondary care

The level of involvement in the care of acute kidney injury (AKI) in referring hospitals was determined.

Renal centres had a median of 3 hospitals referring patients to them (IQR 1–5) with 6 centres having no referrals from external hospitals. On average, transplant centres had more referring hospitals than non-transplanting centres (5.0 vs. 2.4, $p = 0.003$). As renal centres had differing numbers of referring hospitals the frequency with which patients were reviewed was condensed down into the most frequently stated response for each centre. Eleven centres (15%) provided telephone advice most frequently for patients referred from outlying hospitals, 13 centres (18%) reviewed these patients once per week, 17 centres (24%) reviewed patients 2–3 times per week and at 26 centres (36%) patients were reviewed daily or when asked (figure 15.6).

Characteristics and practice patterns influencing home dialysis usage

Home dialysis provision

Seventy-one renal centres in the UK offered peritoneal dialysis to their patients. The mean percentage of prevalent dialysis patients on PD was 18.8 (SD 7.7) with a range from 0–35%. Sixty-four centres (89%) offered home haemodialysis to their patients. Four of the centres who did not offer this therapy stated that suitable patients were referred to a neighbouring centre for home HD. It was not clear what arrangements were in

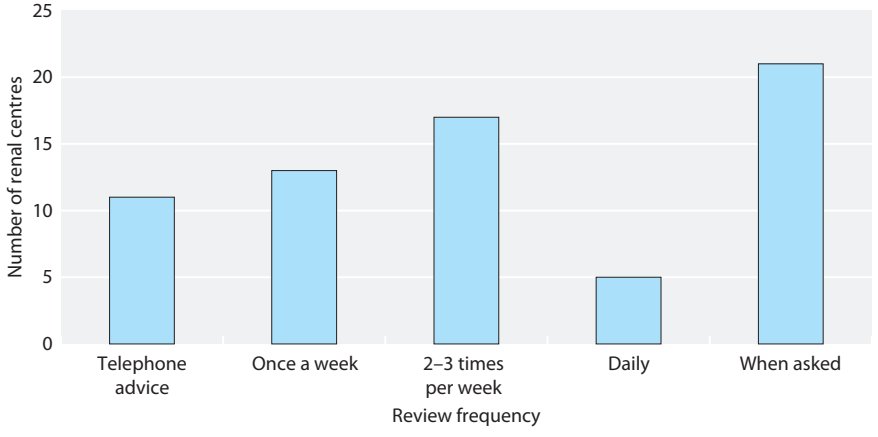

Fig. 15.6. Frequency of renal review of referred patients in outlying hospitals or wards

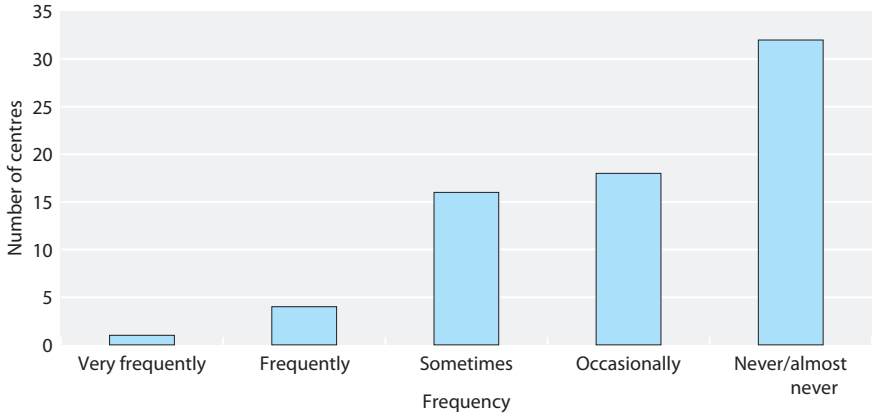

Fig. 15.7. Frequency of acute PD use

place in the remaining centres. The median (IQR) percentage of prevalent dialysis patients using HHD was 2.9% (1.3–3.9).

Access to therapies

The range of therapies that were on offer to patients at each centre was investigated. Forty-eight percent of patients reported as receiving home HD were dialysing more than three times per week with 47 centres able to provide frequent home HD. Six percent of home HD patients were dialysing overnight with 10 centres providing this therapy. There were 5 centres where patients could receive in centre HD overnight and there were 42 patients reported as receiving this therapy (0.002% all HD patients). Twenty-eight centres were providing more than thrice weekly in centre HD to some of their patients and among those centres a median of 1.2% of all HD patients were dialysing this frequently.

The median time required to train a patient for home HD was 10 weeks (IQR 5.5–12.0) with a range between 2 weeks and 52 weeks. Training time was defined as from the beginning of training to the first independent session at home, however some centres were unclear what constituted the beginning of training. The level of patient involvement in haemodialysis care was assessed by asking what percentage of HD patients connected their own lines, self-cannulated and weighed themselves during dialysis sessions. A median of 5% of patients connected their own lines (IQR 0.0–10.0), 5% self-cannulated (IQR 2.0–7.5) and 80% weighed themselves (IQR 50–100).

It was reported that 138 patients were receiving assisted automated PD, defined as a paid carer performing the exchanges, with 34 centres providing this therapy. Acute PD (defined as commencing exchanges less than 9 days after PD tube insertion) was initiated at least 'frequently' in 5 centres (7%) and 'never/almost never' in 33 centres (46%) (figure 15.7).

Pre-dialysis education

The content of the pre-dialysis education programme was ascertained by asking if certain services were provided to the majority of patients. Sixty-nine centres (96%) provided written information to their patients; this was translated into appropriate languages in 35 centres. Twenty-eight of the 52 renal centres with >2% non-white patients provided translated educational materials (54%). Fifty-nine centres (82%) provided video/DVD educational materials for patients to take home and 56 centres (78%) provided group education sessions for patients. Forty-two centres (58%) organised a current patient on HD to talk to pre-dialysis groups and 36 centres (50%) organised a current patient on home HD and PD to talk to pre-dialysis groups. Thirty-six centres (50%) routinely discussed all patients at a multidisciplinary team meeting before dialysis commencement. Thirty-five centres (49%) stated that there was a systematic 6–12 monthly review of dialysis modality after the start of RRT (figure 15.8). Three centres provided a computer based learning/decision tool to educate their patients pre-dialysis and only one centre used a commercial company to provide pre-dialysis education.

Access

To assess how easy it would be to initiate a patient on peritoneal dialysis questions were asked about PD tube placement. Twenty-five centres (35%) responded that it would be 'easy' or 'very easy' to insert a PD tube within one week and 20 centres (28%) responded that it would be 'difficult' or 'very difficult'. Nephrologists (or specialist nurses) inserted PD catheters at 23 centres

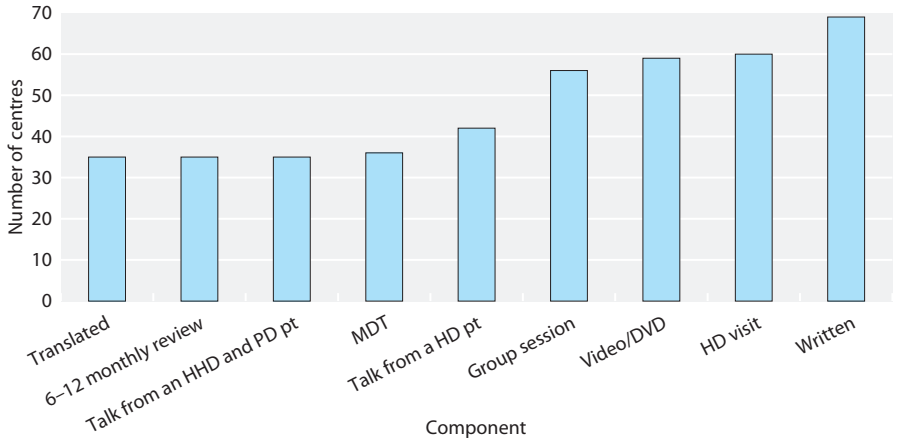

Fig. 15.8. Components of the pre-dialysis education programme

(32%) with one centre using Moncrief as well as Tenchk-off type catheters.

Clinical management style

Three separate clinical management styles were identified for home dialysis patients:

a) a team approach where all patients on a particular modality were managed by one consultant (or group of consultants in larger centres)
b) an overview approach where one consultant took an overview of all patients on a home modality but other aspects of patient care were managed by other consultants
c) a named consultant approach where patients are looked after by a particular consultant or by rotating consultants regardless of the dialysis modality they currently use.

For PD, 37 centres (51%) used a team approach, 25 centres (36%) used a named consultant approach and 9 centres (13%) used an overview approach. For HHD, 34 centres (47%) used a team approach, 23 centres (32%) used a named consultant approach and 9 centres used an overview approach (figure 15.9).

Physical limitations

To understand the barriers to initiating home HD, centres were asked if space limitation played a role and if so whether there were funding barriers to overcoming space limitations.

Twenty-one (33%) of the centres providing home HD responded that space within patients' homes was 'never/almost never' a factor preventing home HD and 8 centres (12%) responded that space was at least 'frequently' a factor preventing home HD (figure 15.10). Twenty-five centres (39%) responded that funding restrictions prevented a patient receiving home HD in at least some cases (figure 15.11).

Physician attitudes

To assess individual clinician attitudes towards home dialysis, centres were asked to describe the ideal proportion of patients on each modality given current transplantation rates and levels of co-morbidity (figures 15.12, 15.13). They were also asked about survival and quality of life benefits of each modality (figure 15.14). There was a positive association between the proportion of patients treated with PD in a centre and the respondent's ideal proportion on PD. In the under 65 year age group, 15% of the variation in PD usage could be explained by the clinician's enthusiasm for the modality ($R^2 = 0.15$, $p = 0.02$). There was a similar positive association between the proportion of patients treated with HHD in a centre and the respondent's ideal HHD use ($R^2 = 0.16$, $p = 0.001$).

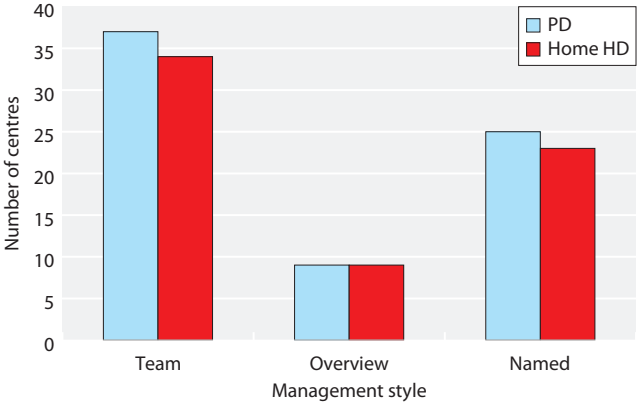

Fig. 15.9. Clinical management style used for home dialysis patients

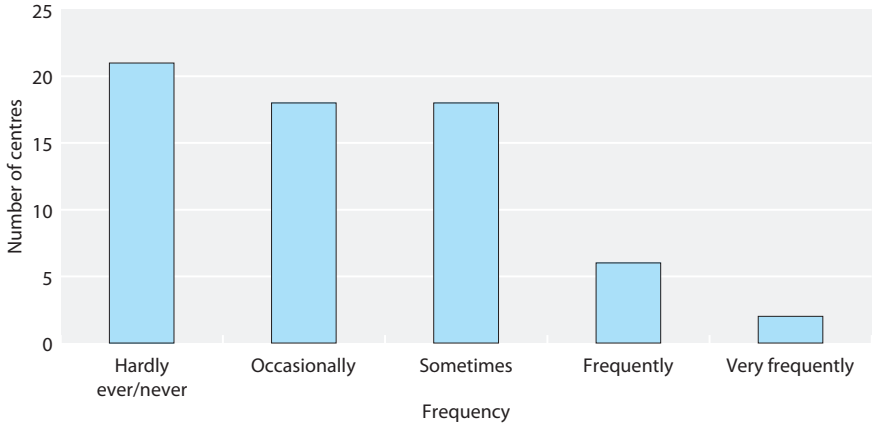

Fig. 15.10. The frequency that space within patients' homes prevents the use of HHD

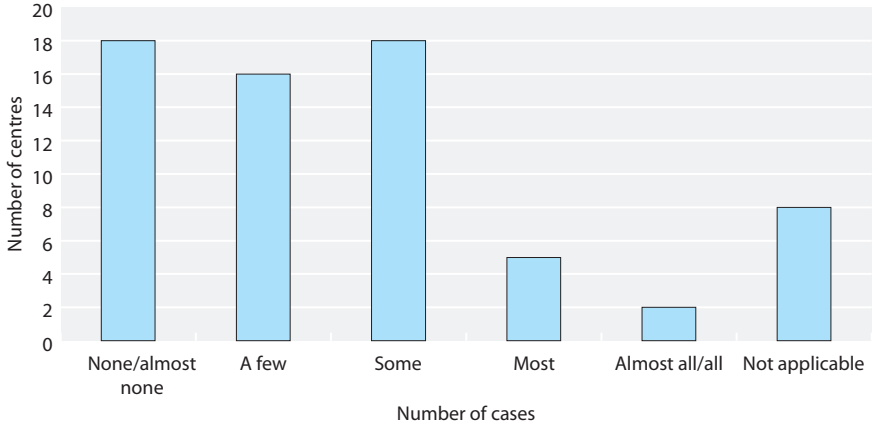

Fig. 15.11. The number of cases where the lack of funding for home adaptation prevents the use of HHD

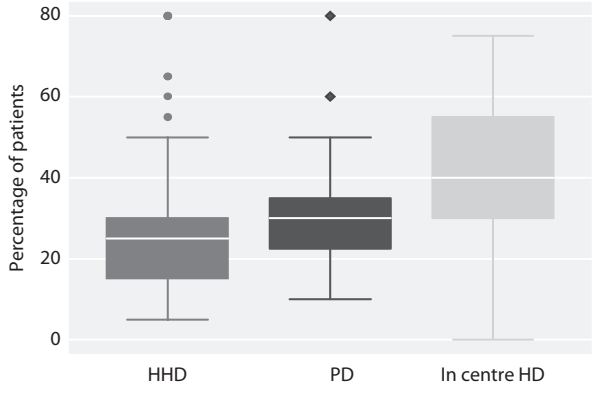

Fig. 15.12. Renal physicians' aspirations for modality use in patients aged less than 65 years

The line within the box represents the median response, box ends the inter-quartile range and the individual points outlying data

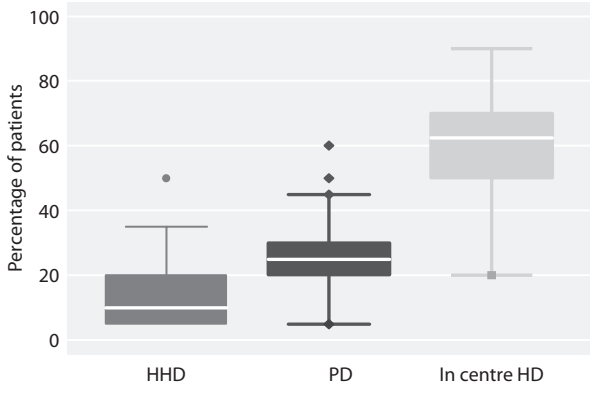

Fig. 15.13. Renal physicians' views on ideal modality usage in patients aged over 65 years

The line within the box represents the median response, box ends the inter-quartile range and the individual points outlying data

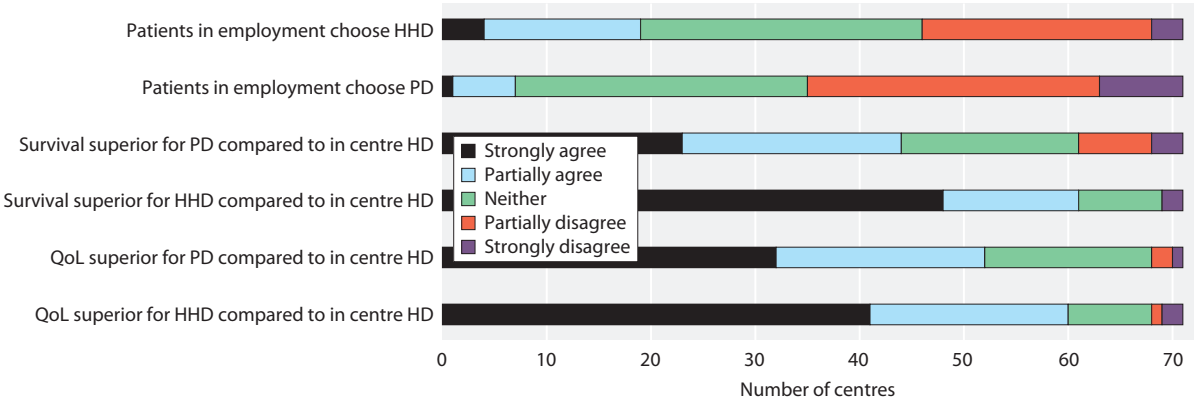

Fig. 15.14. Renal physicians' opinions regarding modality choice

Discussion

There was wide variation between renal centres in the incidence of RRT and in the proportion of patients using a home dialysis modality. Whilst the factors affecting these two outcomes are reported separately here, it is acknowledged that factors affecting home dialysis usage might also influence rates of RRT incidence and *vice versa*.

The rate of referral from primary care was considered one of the strongest determinants of RRT incidence rate by the consensus group. A great deal of work has been done in previous years to highlight the inequalities in RRT provision in the UK including the contribution of referral patterns – referral rates have been shown to be affected by both the geographical distance from a renal centre [7–11] and the level of resource available for RRT treatment [12]. Despite many recent advances in the provision of renal services in the UK and the now comparable rate of RRT incidence to that in most other Northern European countries [13], non-referral remained a concern amongst the consensus group. Although the gatekeeper function of general practitioners has been proposed as part of the explanation for the lower rates of ESRD treatment in the UK [14], a recent multivariable analysis of data from 46 countries found presence of a gatekeeper system not to be independently associated with RRT incidence [15]. This national survey revealed that only a minority (8) of renal centres considered non-referral to still be prevalent but there remained wide variation in late presentation rates between centres and this may translate into variation in pick up rate of advanced kidney disease.

The introduction of formal conservative care programmes was felt by the consensus group to be another important determinant of RRT incidence rate via differential enthusiasm for such programmes. The DOPPS sub-study into the organisation of renal services also considered rates of conservative care to be an important determinant of RRT incidence [16]. The survey demonstrated wide variation not only in the percentage of patients enrolled in conservative care programmes between renal centres but also in the organisation of these programmes.

It was hypothesised from the literature that a centre's capacity to accommodate patients into the chronic haemodialysis programme would affect RRT incidence rates [17, 18]. The consensus group agreed this would be influential in determining RRT incidence and the survey revealed that a sizeable minority of centres (13) did continue to have insufficient haemodialysis provision for their local needs.

The number of nephrologists per million population has been cited by several papers as being associated with RRT incidence [2, 12, 14, 16, 19], although the direction of the association has not been established. These results show that there was a wide variation both in the number of nephrologists per million population and in the number of patients nephrologists look after between UK renal centres.

It was hypothesised from the literature search and consensus group suggestions that a centre's capacity to transfer in-patients and the level of involvement of the renal team in the care of referred patients in other wards or hospitals would also affect RRT incidence, either by decreasing the number of cases of non-recoverable AKI or by greater referral of patients with established renal failure from other hospital teams increasing the incidence of RRT. The number of renal

beds available has been associated with RRT incidence [2, 18] although again it was unclear to what extent the number of patients on RRT determined the number of beds available and to what extent the greater provision of in-patient renal beds encourages referral and treatment of acute and chronic kidney disease. It is clear from this survey that a large number of hospitals without renal services received only telephone renal advice and that some centres find it much harder than others to transfer in-patients for investigation.

The wide variation between UK renal centres in the percentage of patients treated with a home dialysis modality is likely to be multifactorial. It has been shown that the percentage of patients deemed unsuitable for home dialysis varied with clinician practice patterns [4] but that when patients were given a fully informed choice, around 50% will choose a home dialysis modality over in-centre HD [20]. Indeed this survey has demonstrated that clinician enthusiasm for a particular modality is a strong determinant of how many patients are treated with that modality in a centre. There often appears to be a gap between clinicians' stated 'ideal' mix of dialysis modality usage for their patients and the actual proportions of patients using each type of treatment. Some of this discrepancy might be due to patient preference but the literature review and consensus group also revealed several additional factors which might account for this. Patients who presented within 3 months of requiring dialysis were less likely to receive a home dialysis treatment [21] and this survey revealed that in different centres, between 3% and 67% of patients were still presenting late.

The quality and quantity of pre-dialysis education [22–24] and the level of support, in the form of a team of specialist nurses, available for patients choosing a home modality (from the consensus group) was also felt to influence the number of patients choosing a home modality. This factor might be particularly important in areas of greater socio-economic deprivation where more time might be needed for this decision [25, 26]. This survey has revealed that there are differences in the constituents of pre-dialysis education programmes between centres and also in the number of staff employed to deliver such education.

The presence of a 'local champion' of a modality was felt by the consensus group to be an important determinant of its usage. This survey revealed that home dialysis patients were managed by a single consultant in around half of the UK renal centres. Clinicians' practice patterns and beliefs about patient survival, treatment effectiveness and quality of life when using each type of dialysis treatment were considered the most important factor in determining home dialysis usage in a centre by the consensus group. Lack of exposure to PD during training [27, 28, 29] and in one US study less recent completion of training [30] were found to bias clinicians against home dialysis therapies, whereas belief in a superior quality of life associated with home dialysis [31, 32] and the belief that rates of home dialysis use should increase [29, 33, 34] bias clinicians towards home therapies. This survey demonstrates that a broad range of opinions about dialysis modality-related patient survival and quality of life are held by UK nephrologists.

This survey has collected responses from all adult renal centres in the UK on a wide range of factors identified through a systemic literature search and consensus methods (including staff and patients). One limitation of this work lies in the necessary compromise made between the ease of completion of the survey for nephrologists and the availability, detail and accuracy of the data. Responses were provided by a small number of physicians in each centre and were therefore liable to reporting bias. In particular, the use of scales to grade practice is open to differences in interpretation between individuals though we have attempted to minimise the effect of this by comparing the extremes of the scales whenever possible.

Further work is ongoing to investigate which of these renal centre characteristics and practice patterns are associated with RRT incidence and with home dialysis usage after the effect of each centre's population demographics and health status have been taken into account.

Conflicts of interest: none

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Chapter 16
Memories of Changes in Renal Care over Three Decades – the Human Perspective on Registry Statistics

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Key Words
Childcare · Home dialysis · Kiil kidney · Lifestyle · Patient care · Renal replacement therapy · Transplantation

Summary

- These are personal reminiscences of 35 years of renal replacement therapy, augmented by recollections of other patients and staff from these early days.
- There have been major changes in the possibilities of care for children with established renal failure.
- Attitudes towards care and lifestyle possibilities have become more liberal for patients.
- Much has changed, mainly for the better and some old ideas have come back into fashion.
- Long-term patients have been through very difficult experiences and might have strongly formed opinions about their treatment as a result: perhaps staff should listen to these patients and learn from their wealth of experience.

Introduction

Having received a kidney transplant as a child over 30 years ago, following over two years of conservative treatment and two years of haemodialysis, I decided to look back at how the treatment and care of patients with renal failure had changed since those times.

Method

Patients and staff involved with renal care in the late 1970's and early 1980's were contacted and asked to give recollections of how diet, dialysis and transplants were managed then and these were compared with how things are done nowadays. This allowed not only the medical and surgical side of renal care to be examined but the psycho-social aspects as well.

Results

Diet

The lack of sodium, potassium and protein in the Giovanetti diet caused it to be bland and unpalatable. Diet sheets gave long lists of restricted food and without supplements led to stunted growth and renal rickets in children, osteomalacea in adults and malnutrition in both groups. After my transplant at the age of $12\frac{1}{2}$ years, my ideal weight was increased to 22.5 kg and my height was about 1.17 m. Development of supplements, especially 1-α and water soluble vitamins, along with the de-restriction of protein, have now mainly consigned these effects to history: in fact renal physicians are now finding a problem as their patients are often over weight or even obese.

Children

Children were rarely accepted onto renal programmes, with hospitals telling parents to 'take your child home and let them die in peace'! In forward thinking hospitals where a few children were accepted, children and adults were cared for together on the same ward. I was the only child on my shift and prior to dialysis I was taken on my own ward round to say 'hello!' to everyone else, but as the ward only housed around 10 to 12 patients it did not take that long. It was my job to talk to new patients, who were often placed in the bay beside mine, telling them it was not as bad as it seemed – sometimes I even let them borrow a teddy!

Paediatric nephrology was a thing of the future and those children who were accepted were treated as 'small adults' with treatment defined for adult use being roughly adjusted for children. Nowadays children have their own services with specialty staff, wards and even hospitals, allowing treatment to be precisely tailored for their size, age and intellect.

Transition from paediatric to adult care is now seen as a major hurdle to be overcome with young adults being reluctant to start taking responsibility for their own health. With care being continuously in the adult system there was no transition and children were encouraged from an early age to be involved with their own care and take responsibility in the same way as the adults treated alongside them.

Dialysis

Haemodialysis was the only method of regular dialysis available, using mainly Kiil Kidneys (figures 16.1a, 16.1b) which had to be stripped down, cleaned and rebuilt each time between dialysis. This was a long process and if when tested the machine failed, the whole process had to start again. When an operative was relatively new to the machine, failure would occur about 10–15% of the time reducing to approximately 5% with experience. Although the kidneys used now (figure 16.2) are far smaller, disposable and more efficient than the Kiil kidney, the average time spent on haemodialysis is still the same at 4 hours, three times a week. As a tiny child, due to small blood volume, I only dialysed on half a kidney with one 'layer' being clamped off and dialysed for 3 hours, three times a week.

Arterio-venous (AV) fistulas were still a fairly new development when I started dialysis in 1978, but, as is still the case, they were recognised as the preferred access method. Patients were taught how to put the needles in themselves as early as possible, allowing them to take more control of their own treatment, which is only just starting again. Today several other forms of access are used when the fistulas do not work or are not feasible, including neck lines (figure 16.3) and AV grafts, but in the 1970's and 80's Schribner shunts (figures 16.4, 16.5) were used as a temporary measure until fistulas were established. The advantages of the simplified shunt included a good flow of blood, without the need for 'needling' but the disadvantages were that the shunts tended to clot. They were declotted by streptokinase being injected into the shunt which extended the life of the shunt, but was extremely painful as the clot was broken down by the enzyme. The shunts

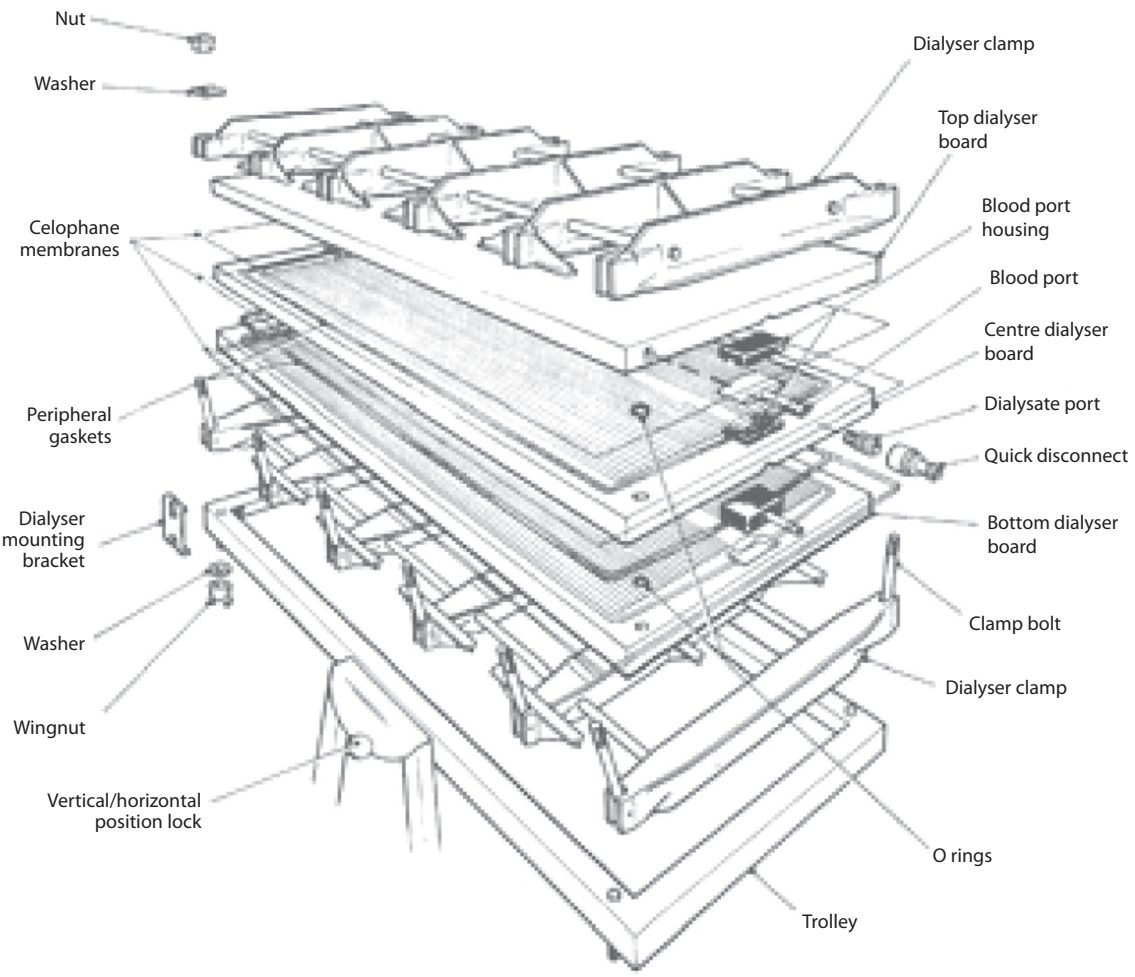

Fig. 16.1a. 1980: Schematic construction of a Kiil dialyser according to the original English drawings

Fig. 16.1b. 1980: Reusable Kiil kidney

Fig. 16.2. 2010: Disposable kidney

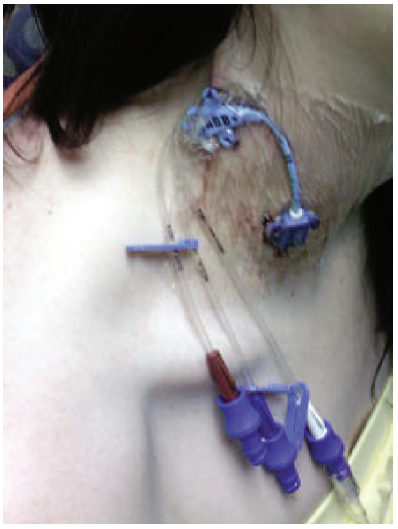

Fig. 16.3. Portacath neck line

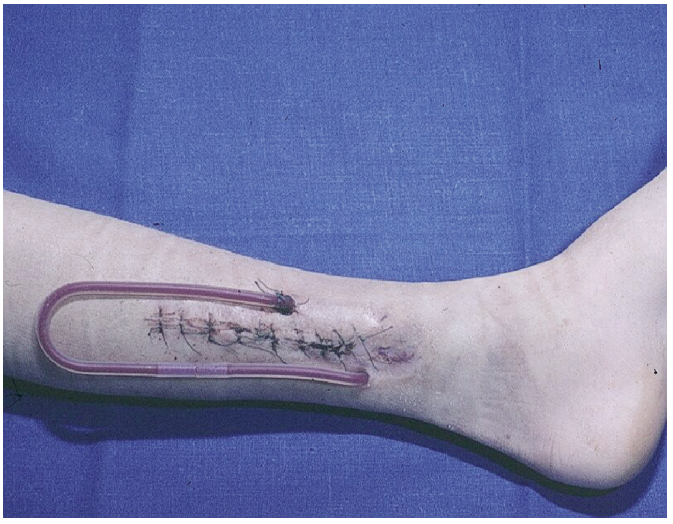

Fig. 16.4. Scribner shunt

also got infected, fell out although they were stitched in and some were pulled out by patients. They did not really provide a permanent access and when required for a longer period often had to be re-sited.

Peritoneal dialysis (PD) was used only as an emergency procedure but with no soft in-dwelling catheters was extremely painful, with each session lasting 24 hours. Insertion of a new stiff catheter each time PD was required caused a major difficulty as the peritoneum could become attached to the puncture site rendering further puncture almost impossible. The whole procedure often left both physical and mental scars on patients, especially children, who endured this treatment.

Various types of peritoneal dialysis are now available and used on a regular basis. Soft in-dwelling catheters have made it patient friendly and can now be successfully used by patients who perceive an increased freedom over haemodialysis.

Dialysis centres were few and far between and access to dialysis was very restricted. Patients therefore were encouraged to learn how to dialyse themselves and partners, parents, relatives were also taught so that patients could go onto home dialysis. This went out of fashion when more satellite dialysis units opened but recently interest in it has grown and more people are being encouraged to opt for this form of treatment.

Transplantation

In the 1970's transplantation was in its infancy and restricted to kidneys. A hospital stay started with 7–10 days barrier nursing, followed even in uncomplicated transplants by several more weeks or months in hospital. Patients nowadays are often out and home in 8 days or less.

Kidney donation from friends and even altruistic donors is now common place but used to be restricted to close relatives and they were subjected to large incisions and lengthy recovery periods, a far cry from the laparoscopic methods often now used.

Cadaveric donation was from heart beating, brain stem dead donors only and they had to be both young and healthy. With the increased number of patients requiring transplants and the number of heart beating donors declining, a wider range of donors are used. The use of extended criteria donors has seen non-heart beating donors being used and the average age of a donor has increased by 15 years in the last 15 years. To utilise these donors, dual and en bloc transplants of kidneys have been used.

Although kidney matching only consisted of HLA-A and -B tissue type plus blood group, matching was as close as possible. Today tissue typing includes HLA-C, -DR, -DP and -DQ as well as antibody screening of all listed patients, however due to the major advancements in techniques and immunosuppressive drugs, donors and recipients do not always have to be as closely matched with transplants possible across blood groups.

In the 1970's and 1980's kidney transplants were optimistically expected to last from 5 to 10 years, whereas now the estimated half life of a cadaveric transplant is 10 to 12 years and living donors 15 to 20 years with a few people around who have had their transplants for over 40 years and are still on the 'old' drug regime.

In 1980 immunosuppression was restricted to Azathioprine and steroids, but in the later 1980's Cyclosporine started to be used widely. More recently Cyclosporine is often replaced by Tacrolimus and Azathioprine by Mycophenolate: steroids are used in smaller doses and are either avoided or rapidly weaned in most cases. The immunosuppressive regime changes have coincided with increased graft survival.

With no transplant co-ordinators in the 1970's and 1980's, transplants were allocated by nephrologists selecting the patient and surgeons liaising with UKTS, retrieving kidneys, arranging surgery and organising transport for those kidneys to be exported, as well as carrying out the transplants. Now there are transplant co-ordinators who are specialised for cadaveric donor families, live donors and recipients.

Miscellaneous

Specialised staff consisted of medics, surgeons, nurses and dieticians. The multi-disciplinary team now available allows for a holistic care approach for both patients and their families.

One treat many patients looked forward to during their first half of haemodialysis was the consumption of food which was otherwise forbidden! The smell of bacon sandwiches and the sight of patients eating chocolate in the first hour or so of dialysis were not unusual, with patients making the most of this precious time.

Strict infection control policies followed several outbreaks of hepatitis B. One of the worst was in Edinburgh where about twenty patients died as well as four members of staff. There were other outbreaks in the UK and abroad. At that time the virus had not been identified and was referred to as the Australia Antigen. Access to both the dialysis and the transplant wards was through a locked door and all visitors had to put on a white surgical gown over their outdoor clothes. Nowadays there is free access with appropriate hand hygiene.

Low haemoglobin was normal, Hb 5 g/dl not being rare, as there was no EPO or ESA then, so patients, being used to it, were tired but had to cope. Where treatment was given, it was in the form of iron or a blood transfusion, both of which could cause problems. Oral or IV iron led to the risk of iron overload and blood transfusion was not as safe as it is today plus there was the risk of viral infection such as Hepatitis B and C.

Holidays whilst on dialysis were rare, as infection risks especially abroad, were deemed to be too great, plus with the very limited number of dialysis spaces there was not the room on dialysis units to take others on. Those on home dialysis could occasionally take on holiday a portable, disposable machine which was the precursor of the disposable kidneys used today, but this form of dialysis was in its infancy. Holidays could sometimes be taken by using holiday homes in the local region which had been set up with a specialised dialysis room, but

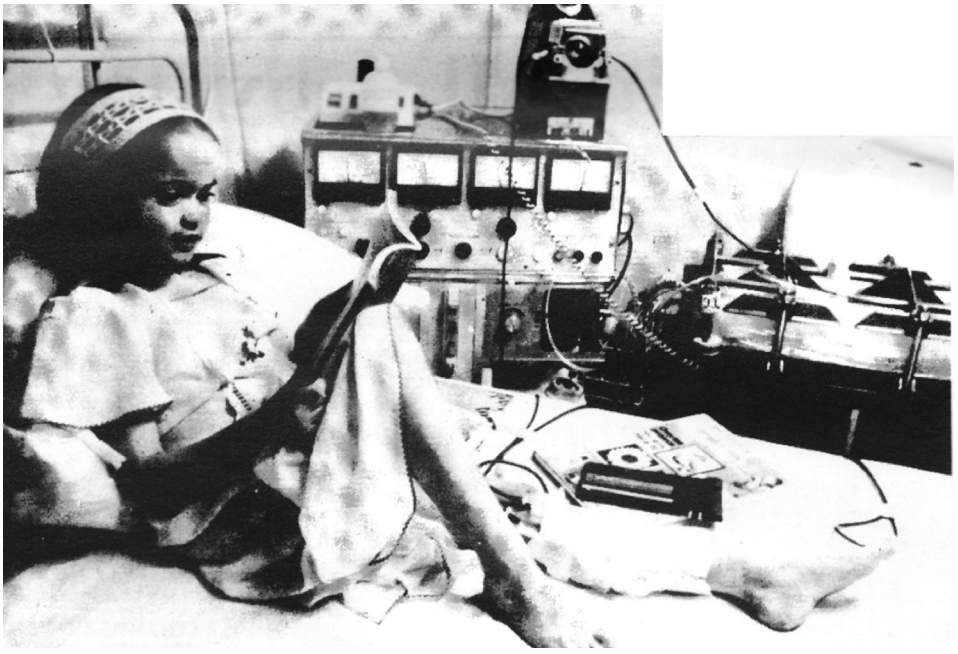

Fig. 16.5. Image of patient dialysing using a Scribner Shunt. Old style dialysis machine, pump and Kiil Kidney can also be seen

again only if you were on home dialysis and these holiday homes were few and far between. Today access to dialysis away from your local hospital is easier to organise in this country and can sometimes be organised abroad, but with special care taken where there is a high indigenous rate of hepatitis. The different forms of peritoneal dialysis also mean that travel and holidays can be more easily organised.

Patients remember supporting each other after results were posted on the ward for all to see. In those days a creatinine rise was very serious and often ultimately fatal. With patient confidentiality nowadays, patients do not get told each others results but the camaraderie is definitely still there.

The way to show that you wished to have your organs used for transplant was by signing a kidney donor card. Over the years as it became possible for other organs to be transplanted this changed to become an organ donor card and your willingness to donate can also be indicated on your driving licence. The donor register is a centralised database where donors can show their decision to donate and medical staff can check to see if they are signed up prior to speaking to relatives about any donation. The opt-in system that was put in place when transplantation began is still the system that is used today.

Conclusions

Much has changed, mainly for the better and some ideas, such as the use of home dialysis, have come back into fashion. Staff should remember that long-term patients have been through very difficult experiences and might have strongly formed opinions about their treatment as a result. Perhaps they should listen to these patients and learn from their wealth of experience.

Appendix A
The UK Renal Registry Statement of Purpose

A:1 Executive summary

1.1 The UK Renal Registry (UKRR) was established by the Renal Association to act as a resource in the development of patient care in renal disease.

1.2 The Registry acts as a source of comparative data for audit, benchmarking, planning, policy and research. The collection and analysis of sequential biochemical and haematological data is a unique feature of the UKRR.

1.3 The Renal Registry Data Set Specification (RRDSS) defines the data items that are required to be sent from participating renal centres for analysis by the UKRR.

1.4 Data is collected quarterly to maintain centre-level quality assurance, with the results being published in an annual report.

1.5 Activity is funded from commissioning agencies by a capitation fee on renal patients.

1.6 The UKRR is responsible, with the express agreement of participants, for providing data to Trusts, Primary Care Trusts (PCTs), commissioning authorities and the European Renal Association – European Dialysis and Transplant Association (ERA–EDTA) Registry.

1.7 The development of the UKRR is open to influence from all interested parties, including clinicians, Trusts, commissioning authorities and patient groups.

1.8 The UKRR is non-profit making and has a registered charitable status through the Renal Association.

A:2 Introduction

2.1 Registry-based national specialty comparative audit is one of the cornerstones of NHS development. The Renal National Service Framework (NSF), published in two sections in 2004 and 2005, recommended the participation of all renal centres in comparative audit through the UK Renal Registry, with co-temporaneous documents defining the necessary information strategies [1–4].

2.2 The shape of future national audit will be set not only by conventional medical criteria, but also by NSF recommendations, prompted through the Healthcare Commission (now renamed as the Healthcare Quality Improvement Partnership). The necessary detail is currently the subject of a formal scoping project, in which the Registry is represented. The final relationship of the Registry

to the Healthcare Quality Improvement Partnership has yet to be defined.

2.3 The Chief Executives of Trusts are responsible for clinical governance and audit will be an essential part of that agenda [5].

2.4 Demographic information on patients receiving renal replacement therapy (RRT) throughout Europe was collected from 1965 in the Registry of the ERA-EDTA. This voluntary exercise was conducted on paper and by post, demanded considerable effort and time from participating centres and eventually proved impossible to sustain. Latterly, the incompleteness of UK data returns to the ERA-EDTA made it impossible to build a picture of the activity of RRT in the UK for planning and policy purposes. Subsequently, five ad hoc national data collections from England & Wales were solicited from renal centres in 1992, 1996, 1999, 2002 and 2004 to fill this gap. The UKRR is well placed to put such surveys on a permanent and regular footing and progress towards the inclusion of Chronic Kidney Disease (CKD) is being made.

2.5 Together with the need to know the demographic and structural elements, the NHS has developed a need to underpin clinical activity more rigorously through the scientific evidence base (for example, the Cochrane Initiative) and by quality assurance activity through audit. These initiatives require comprehensive information about the structures, processes and outcomes of RRT, which go well beyond the detail previously compiled by the ERA-EDTA.

2.6 The Registry is recognised as one of the very few high-quality clinical databases available for general use [6]. The collection of data by download of electronic records from routine clinical databases is uncommon, has been highly successful and is being imitated worldwide.

2.7 The Renal Association continues to make progress in the area of audit by publishing guidelines in 'Renal Standards' documents. It was apparent during the development of the Standards that many of the desirable criteria of clinical performance were uncertain or unknown and that only the accumulated data of practicing renal centres could provide the evidence for advice on best practice and what might be achievable. A common data registration provides the simplest device for such an exercise.

2.8 The continuing emphasis on evidence-based practice is being supported by changes in research funding (Culyer Report and recent national statements), which lean towards collaborative projects and include both basic science and 'health services research' components. It is apparent that an RRT database is invaluable to a wide range of research studies.

2.9 It can be seen that the need for a Registry of RRT has developed for a variety of reasons: international comparisons, national planning, local Trust audits, PCT and health authority management information, standard setting, audit and research. The opportunity for data gathering arises partly from improvements in information technology. Although it was possible to see the need for a national renal database 20 years ago, the circumstances have become ideal for the maintenance of a data repository, supported by the clinical users and resourced for national benchmarking as a routine part of RRT management.

2.10 The provisional expectations of earlier Annual Reports can now be replaced by confident assertions, built on the experience of twelve years of publication, about the role and potential of the UKRR. The integration of the various elements of Renal Association strategy is being pursued through the Clinical Affairs Board (CAB).

A:3 Statement of intent

The UK Renal Registry provides a focus for the collection and analysis of standardised data relating to the incidence, clinical management and outcome of renal disease. Data will be accepted quarterly according to the RRDSS by automatic downloading from renal centre databases. There will be a core dataset, with optional elements of special interest that may be entered by agreement for defined periods. A report will be published annually to allow a comparative audit of facilities, patient demographics, quality of care and outcome measures. Participation is mandated in England through the recommendation in the Renal National Service Framework. There was an early concentration on RRT, including transplantation, with an extension to other nephrological activity over time. The UKRR will provide an independent source of data and analysis on national activity in renal disease.

A:4 Relationships of the UK Renal Registry

4.1 The Registry is a registered charity through the Renal Association (No. 2229663). It was established by a committee of the Renal Association, with additional representation from the British Transplantation Society, the British Association for Paediatric Nephrology, the Scottish Renal Registry, Wales and Northern Ireland. There is cross-representation with both the Renal Association Standards and Clinical Trials Committees and the Clinical Affairs Board. The Registry has a Chairman and Honorary Secretary nominated by the Renal Association. The Registry has an observer from the Department of Health, a participant from the National Kidney Federation (NKF) (patients' association), the Royal College of Nursing, the Association for Clinical Biochemistry and a member representing the Health Care Commissioners.

4.2 A number of sub-committees have been instituted as the database and renal centre participation developed, particularly for data analysis and interpretation for the Annual Report. Further specialised panels may be developed for publications and the dissemination of UKRR analyses.

4.3 The Scottish Renal Registry sends data to the UK Renal Registry for joint reporting and comparison.

4.4 The return of English, Welsh and Northern Ireland data to the EDTA-ERA Registry will be through the Renal Registry. The Scottish Renal Registry already sends data directly to the EDTA-ERA Registry.

4.5 A paediatric database has been developed in collaboration with the UKRR, and the two databases are compatible. These two databases are in the process of being integrated, which will allow long-term studies of renal cohorts over a wide age range.

4.6 Close collaboration has been achieved with the NHS Blood and Transplant organisation – (formerly UK Transplant) giving joint benefits. Data aggregation and integration has led to joint presentations and publications. The description of the entire patient journey in RRT by this means is a source of continuing insight and usefulness.

4.7 The basis of participation for renal centres nationally is an agreement to accept the RRDSS for the transmission and retention of data. This is currently increasing to a core dataset of approximately 400 items and further optional elements, which will be returned on a special understanding with the renal centres for a defined period of reporting.

4.8 The UKRR formed part of the team undertaking an investigation into the necessary scope of national audit for the Healthcare Quality Improvement Partnership, in the light of the NSF.

4.9 The retention of patient identifiable information, necessary in particular for the adequate tracing of patients, has been approved by the National Information Governance Board (previously the Patient Information Advisory Group (PIAG)), under Section 251 of the NHS Act 2006, (previously the Health and Social Care Act 2001). This is pending the introduction of mechanisms that will preserve patient anonymity through encryption of a unique patient identifier.

A:5 The role of the UK Renal Registry for patients

5.1 The goal of the UKRR is to improve care for patients with renal disease. The appropriate use of UKRR information should improve equity of access to care, adequacy of facilities, availability of important but high-cost therapies such as erythrocyte stimulating agents and the efficient use of resources. The continuing comparative audit of the quality of care should facilitate the improvement of care and outcomes of care. It is intended to identify and publish examples of good practice. In such ways, patients will be the ultimate beneficiaries of the exercise.

5.2 A leaflet has been provided, in collaboration with the NKF, by which patients may opt out of the collection of identifiable data by the UKRR if they wish.

5.3 Information from the UKRR will complement the individual records available on 'RenalPatientView' where it is accessible.

A:6 The role of the UK Renal Registry for nephrologists

6.1 The clinical community have become increasingly aware of the need to define and understand their activities, particularly in relation to national standards and in comparison with other renal centres.

6.2 The UKRR is run by a committee of the Renal Association and therefore by colleagues with similar concerns and experience.
6.3 The Renal Standards documents are designed to give a basis for centre structure and performance, as well as patient-based elements such as case mix and outcomes. It is anticipated that Standards will become increasingly based on research evidence and the Cochrane Collaboration resourced reviews of renal topics, which will support this conversion.
6.4 The UKRR data are available to allow the comparative review of many elements of renal centre practice. Centre data are presented to allow a contrast of individual centre activity and results against national aggregated data. Sophisticated analyses of patient survival for example, are a unique resource to exclude any anomalies of performance and standardise for centre caseload, etc.
6.5 Reports of demographic and treatment variables are available to the participating centres for distribution to Trusts, PCTs, Strategic Health Authorities and Commissioners, as well as renal networks, as required and agreed with the centre. Reports should facilitate discussion between clinicians, Trust officers and commissioners.
6.6 The Registry Committee welcome suggestions for topics of national audit or research that colleagues feel are of sufficiently widespread interest for the UKRR to undertake.
6.7 The database has been designed to provide research facilities for future participation in national and international trials. Members of the Renal Association and other interested parties are welcome to apply to the Registry Committee to conduct local or national audit and research using the database. All such projects will need the agreement of the Registry Committee and any costs involved will need to be met by the applicants.
6.8 These facilities will be sustainable only through cooperation between nephrologists and the UKRR. There is a need for high-quality and comprehensive data entry at source.
6.9 The sustaining of data collection, organisation and transmission from peripheral sites is not centrally resourced. Centres will need to develop an 'annual informatics plan', to review the maintenance and improvement of data collection, organisation and returns to the UKRR. This will help maintain the accuracy, timeliness and completeness of clinical data and also in parallel, support the career development of informatics staff.

A:7 The role of the UK Renal Registry for Trust managers

7.1 As the basis of the clinical governance initiative, the gathering and presentation of clinical data are regarded as essential parts of routine patient management in the health service.
7.2 One of the principles of health service informatics is that the best data are acquired from clinical information recorded at the point of health care delivery.
7.3 Renal services data entered on local systems by staff directly engaged with patients are likely to be of the highest quality and it is these that the UKRR intends to capture.
7.4 The UKRR provides a cost-effective source of detailed information on renal services.
7.5 The regular reports of the UKRR supply details of patient demographics, treatment numbers, treatment quality and outcomes. Data are compared with both national standards and national performance, for benchmarking and quality assurance. The assessment of contract activity and service delivery is possible through these data returns, without the need for further costly Trust or commissioner administrative activity. These data should be particularly valuable to contracts managers and those responsible for clinical governance.
7.6 Data are available on centre case mix, infrastructure and facilities.
7.7 Work is progressing on the data capture and analysis from patients with renal disease other than those requiring RRT and will become available in time (e.g. CKD).
7.8 It is anticipated that Trust interests may be served through the participation of a national Trust representative on the Registry Committee.

A:8 The role of the UK Renal Registry for Commissioners of health care

8.1 The commissioners of health care include Regional Specialty Commissioning Groups, the networks or

joint renal strategy groups supporting them and the Primary Care Trusts.

8.2 The use of information sources such as the UKRR is advised in the National Renal Review in order to promote benchmarking and quality assurance of renal programmes. The comprehensive tracking of relatively small but costly renal cohorts should be regarded as a routine part of speciality case management.

8.3 The UKRR provides validated, comparative reports of renal centre activity on a regular basis to participating centres. These allow assessment of centre performance across a wide range of variables relating to structure, process and outcome measures.

8.4 There are economies of scale in the performance of audit through the UKRR, since multiple local audits are not required.

8.5 The incidence of RRT treated locally, mortality and renal transplant rates should also be of interest. The assessment of referral and treatment patterns of patients with established (end stage) renal failure by postcode analysis indicates the geographical origin. This information also allows the expression of differences relating to geography, ethnicity and social deprivation. These data may also identify potential unmet need in the population and permit assessment on the equity of service provision. In the future, the UKRR database should also provide information on nephrology and pre-dialysis patients (CKD). This will allow a prediction of the need for RRT facilities, as well as indicating the opportunities for beneficial intervention.

8.6 UKRR data are used to track patient acceptance and prevalence rates over time, which allows the modelling of future demand and the validation of these predictions.

8.7 Information on the clinical diagnosis of new and existing RRT patients may help identify areas where possible preventive measures may have maximal effect.

8.8 The higher acceptance rates in the elderly, and the increasing demand from ethnic groups due to a high prevalence of renal, circulatory and diabetic disease, are measurable.

8.9 Comparative data are available in all categories for national and regional benchmarking.

8.10 The UKRR offers independent expertise in the analysis of renal services data and their interpretation, a resource that is widely required but difficult to otherwise obtain.

8.11 The 2010 cost of supporting the UKRR was £18 per registered patient per annum (2011 £19 per patient), which is less than 0.05% of the typical cost of a dialysis patient per annum. It is expected that this cost will need to be made explicit within the renal services contract.

8.12 The Registry Committee includes a representative from the health care commissioners. This allows an influence on the development of the UKRR and the topics of interest in data collection and analysis.

A:9 The role of the UK Renal Registry for national quality assurance agencies

9.1 The role of the UKRR in the national quality assurance programme of the Healthcare Quality Improvement Partnership, (previously the Healthcare Commission) will depend on the decisions on the role and responsibilities of that agency and their means to discharging them.

9.2 The demographic, diagnostic and outcomes data could support the investigation of clinical effectiveness.

9.3 The case mix information and comorbidity data that would allow better assessment of survival statistics remains incomplete. There is also some clinical scepticism whether 'correction' of outcome data would reflect the realities of clinical practice.

A:10 References

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Appendix B
Definitions and Analysis Criteria

B:1 Definition of the incident (take-on) population

The take-on population is defined as all patients over 18 who started RRT at UK renal centres and did not have a recovery lasting more than 90 days within 90 days of starting RRT.

The treatment timeline is used to define take-on patients as follows.

If a patient has timeline entries from more than one centre then these are all combined and sorted by date. Then, the first treatment entry gives the first date of when they were receiving RRT. This is defined as a 'start date'. However, in the following situations there is evidence that the patient was already receiving RRT before this 'start date' and these people are not classed as take-on patients:

- patients with an initial entry on the timeline of transferred in (modality codes 39 to 69)
- those with an initial entry of transferred out (modality code 38)
- those with an initial treatment of lost to follow up (modality code 95)
- those who had graft acute rejection (modality code 31) and did not have a transplant on the same day
- those with an initial entry of transfer to adult nephrology (modality code 37)
- those with an initial entry of graft functioning (modality code 72)
- those with an initial entry of nephrectomy transplant (modality code 76)

Where none of the above applies, the entry is defined as a take-on (providing there is no recovery of more than 90 days within 90 days of the start date).

If there is a recovery lasting more than 90 days which begins **more** then 90 days after starting RRT then the program looks at the modality codes after this date to see if the patient restarted RRT. If they did, then this is classed as another take-on.

For example, a patient may start RRT in 2005, recover and then restart RRT in 2005. Providing that they do not have a recovery lasting more than 90 days within 90 days of start on either occasion, such patients will be counted twice.

See the section: 'Start of established renal failure' in B:4 below for information on 'acute' codes such as 81: 'acute haemodialysis'.

Provided the Registry received a modality code 36 from the work-up centre, pre-emptive transplants were allocated to the work-up centre and not to the centre where the transplant took place.

Note: patients restarting dialysis after a failed transplant were not counted as a take-on patient.

B:2 Definition of the prevalent population for each year

The prevalent population for a year is defined as all RRT patients over 18, being treated at centres returning data to the UK Renal Registry (UKRR) for that year, who were alive on 31 December of that year. It includes both incident patients for that year and patients who have been on treatment for longer. Note that any patients over 18 who are still being treated at paediatric centres are excluded.

Patients were only included under their primary treatment centre.

Patients who had transferred out, recovered function, stopped treatment without recovery of function or been lost to follow up before the end of the quarter were excluded.

Further exclusions when analysing quarterly biochemistry or BP data

For these analyses, further restrictions were made to the prevalent cohort for each quarter.

Patients who had 'transferred in' to the centre in that particular quarter were excluded.

Patients who had changed treatment modality in that particular quarter were excluded.

Patients who had been on RRT for less than 90 days were excluded.

Note: the length of time on RRT is calculated from the most recent take on date. So if a patient starts, then recovers and then starts again, this second start date is used. Also, for patients who are not defined as take on patients because their start date is unknown (for example, if their first timeline entry is a transfer in code) it is assumed that they have been on RRT for longer than 90 days and they are included for every quarter.

B:3 Statistical definitions

Death rate calculation

A death rate per 100 patient years is calculated by counting the number of deaths and dividing by the person years exposed. This includes all patients, including those who died within the first 3 months of therapy. The person years at risk are calculated by adding up, for each patient, the number of days at risk (until they died or transferred out) and dividing by 365.

Odds ratio

This is the odds of an event in one group divided by the odds in a reference group. For example, if the event is death (within a certain time) and you are comparing phosphate groups then for phosphate group 1.8 to 2.1 mmol/L the odds of the event are:

$$\frac{\text{(probability of dying for someone with a phosphate of 1.8–2.1 mmol/L)}}{\text{(probability of surviving for someone with a phosphate of 1.8–2.1 mmol/L)}}$$

The odds ratio is then:

$$\frac{\text{(odds of dying if phosphate 1.8–2.1 mmol/L)}}{\text{(odds of dying for reference group)}}$$

Note that when the event being analysed is death, often the odds ratio would not be used but a 'survival analysis' used instead. This takes into account the time when the event occurs and also allows for censoring (for example if people are lost to follow up). Such an analysis gives hazard ratios (see below) rather than odds ratios.

Hazard function

The hazard function is the probability of dying in a short time interval, conditional on survival up to that point.

Hazard ratio

For the same example as above, the hazard ratio is the:

$$\frac{\text{(probability of dying in the next interval for a phosphate of 1.8–2.1 mmol/L)}}{\text{(probability of dying in the next interval for a phosphate in the reference range)}}$$

B:4 General and modality definitions

Definitions of analysis quarters

Quarter	Dates
1	1 January–31 March
2	1 April–30 June
3	1 July–30 September
4	1 October–31 December

The quarterly biochemistry data are extracted from renal centre systems as the last data item stored for that quarter. If the patient treatment modality was haemodialysis, the software will try to select a pre-dialysis value.

Home haemodialysis

Home haemodialysis patients cease to be classed as such if they need longer than two weeks of hospital dialysis when not an in-patient.

Satellite dialysis unit

A renal satellite unit is defined as a haemodialysis facility that is linked to a main renal centre, is not autonomous for medical decisions and provides chronic outpatient maintenance haemodialysis but with no acute or in-patient nephrology beds on site.

Start of established renal failure

Established renal failure (also known as end stage renal failure or end stage renal disease) was defined as

the date of the first dialysis (or of pre-emptive transplant).

A patient starting RRT on 'chronic' haemodialysis should be entered on the UKRR timeline on the date of the first HD episode.

If a patient started RRT with an episode of acute (or acute-on-chronic) kidney injury in which it was felt that kidney function had potential to recover, then 'acute haemodialysis' (or acute haemofiltration' where appropriate) should be entered on the UKRR timeline. If subsequently it is felt that kidney function is no longer likely to recover, the timeline modality should be changed to 'chronic haemodialysis' at the time when this becomes apparent (accepting that the timing of this change will vary between clinicians). The UKRR will interrogate the timeline of patients starting 'chronic' RRT and if there is evidence of recent 'acute' RRT, will backdate the date of start to the first episode of 'acute' RRT provided there has been less than 90 days recovery of kidney function between acute and chronic episodes.

If a patient was started on dialysis and dialysis was temporarily stopped for less than 90 days for any reason (including access failure and awaiting the formation of further access), the date of start of renal replacement therapy (RRT) in UKRR analyses remained the date of first dialysis.

The date of start of peritoneal dialysis is defined as the date of first PD fluid exchange given with the intention of causing solute or fluid clearance. This is in contrast with a flush solely for confirming or maintaining PD catheter patency. In general, exchanges which are part of PD training should be considered as the start of PD (unless earlier exchanges have already been given). However, if it is not planned that the patient starts therapy until a later date, exchanges as part of PD training need not necessarily be considered the start of RRT.

Change of modality from PD to HD

Sites are requested to log in their timeline changes from PD to HD if the modality switch is for longer than 30 days.

Date first seen by a nephrologist

This is the date the patient first attended clinic or was an inpatient under the care of a dialysing nephrologist (which ever is the earlier).

If a patient transfers into a renal centre from another renal centre then this date should be left blank by the new renal centre.

Date of CKD5

When a patient has 2 eGFRs recorded as <15 ml/min/1.73 m^2 over a time period of greater than 3 months apart without an intervening eGFR >15, then the earlier of these 2 dates is defined as the date the patient reached CKD5.

If the patient dies or goes onto RRT within the 3 month period of eGFR reaching <15, then the date of eGFR <15 is still the date of CKD5.

B:5 Comorbidity definitions

Angina

History of chest pain on exercise with or without ECG changes, ETT, radionucleotide imaging or angiography.

Previous MI within last 3 months

Detection of rise and/or fall of a biomarker (CK, CK-MB or Troponin) with at least one value above the 99th percentile together with evidence of myocardial ischaemia with at least one of either:

a. ischaemic symptoms,
b. ECG changes indicative of new ischaemia (new ST-T changes or new left bundle branch block),
c. development of pathological Q waves,
d. imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.

This definition is from the European Society of Cardiology and American College of Cardiology.

Previous MI >3 months ago

Any previous MI at least 3 months prior to start of renal replacement therapy.

Previous CABG or coronary angioplasty

Previous episode of heart failure

Whether or not due to fluid overload.

Cerebrovascular disease

Any history of strokes (whatever cause) and including transient ischaemic attacks caused by carotid disease.

Diabetes (not causing ESRF)

This includes diet controlled diabetics.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is characterised by airflow obstruction. The airflow obstruction is usually progressive, not fully reversible and does not change markedly over several months.

- Airflow obstruction is defined as a reduced FEV1 (forced expiratory volume in 1 second) and a reduced FEV1/FVC ratio (where FVC is forced vital capacity), such that FEV1 is less than 80% predicted and FEV1/FVC is less than 0.7.
- The airflow obstruction is due to a combination of airway and parenchymal damage.
- The damage is the result of chronic inflammation that differs from that seen in asthma and which is usually the result of tobacco smoke.

There is no single diagnostic test for COPD. Making a diagnosis relies on clinical judgement based on a combination of history, (exertional breathlessness, chronic cough, regular sputum production, frequent winter 'bronchitis', wheeze) physical examination and confirmation of the presence of airflow obstruction using spirometry, (source: British Thoracic Society guidelines).

Liver Disease

Persistent enzyme evidence of hepatic dysfunction or biospy evidence or HbeAg or hepatitis C antigen (polymerase chain reaction) positive serology.

Malignancy

Defined as any history of malignancy (even if curative) e.g. removal of melanoma, excludes basal cell carcinoma.

Claudication

Current claudication based on a history, with or without Doppler or angiographic evidence.

Ischaemic/neuropathic ulcers

Current presence of these ulcers.

Angioplasty, stenting, vascular graft (all non coronary)

This category now includes vascular grafts (e.g. aortic bifurcation graft) and renal artery stents.

Amputation for peripheral vascular disease

Smoking

Current smoker or history of smoking within the last year.

Appendix C
Renal services described for non-physicians

This appendix provides information on the issues discussed in this report, background information on renal failure and discusses the services available for its treatment.

The role of the kidneys

1.1 The kidneys are paired organs located behind the abdominal cavity, in the retroperitoneal space. Their primary function is to produce urine, which allows the removal of metabolism-related waste products from the blood. The kidneys also have a role in controlling fluid balance and blood pressure, red blood cell production and the maintenance of healthy bones.

Kidney diseases

1.2 Around 13,000 people die from kidney (renal) disease in the UK each year, though this is an underestimation as many deaths of patients with renal failure are not recorded as such in mortality statistics. Kidney diseases can occur suddenly ('acute') or over months and years ('chronic'). Chronic kidney disease is relatively common, with the majority of patients being elderly and having mild impairment of their renal function.

Acute kidney injury

1.3 Acute kidney injury (AKI) has replaced the previous term 'acute renal failure'. AKI, which is often a reversible process, occurs when there is a rapid loss of renal function due to kidney damage. The causes of AKI can be divided into 3 categories: pre-renal (interference with the renal blood supply), intrinsic (damage to the kidney itself) and post-renal (obstructive causes in the urinary tract). Some patients with AKI require dialysis for a few days or weeks until their renal function improves, though a small proportion of individuals never recover kidney function. AKI normally occurs in the context of other illness and patients are often unwell; approximately 50% of patients with AKI who receive dialysis do not survive.

Chronic kidney disease (CKD) and established renal failure (ERF)

1.4 Chronic kidney disease affects approximately 3 million people in the UK and occurs because of slow damage to the kidneys over a number of months or years. The incidence increases with age and is higher in certain ethnic groups, such as patients of South Asian and African descent. In the initial stages of CKD, patients are usually well and there is little to find on clinical examination. Early abnormal findings may include blood (haematuria) and protein (proteinuria) in the urine or elevated blood pressure (hypertension). However, the lack of symptoms means many patients present to medical services with advanced disease. In the latter stages of CKD, patients may complain of tiredness, a loss of appetite, feeling

sick (nausea) and itching (pruritus). Other symptoms, such as ankle swelling (oedema), may be present depending on the underlying condition causing CKD.

1.5 Other terms used for chronic kidney disease include chronic renal impairment, chronic renal insufficiency and chronic renal failure. Established renal failure (ERF) refers to kidney function that has deteriorated to a level where treatment is required to sustain life. Treatment options include dialysis and renal transplantation but some patients decide not to receive dialysis and opt for conservative management. This involves input from specialist nurses and palliative care services, and focuses on treating the complications of kidney disease and managing symptoms.

Causes of CKD

1.6 Most renal diseases that cause renal failure fall into five categories.

1. Generalised (systemic) disease. Diabetes mellitus is by far the most common systemic disease that affects the kidneys (around 20% of all renal disease). Diabetic patients often develop progressive kidney damage over many years, particularly if blood glucose levels and blood pressure are poorly controlled. Careful lifelong supervision of diabetes has a major impact in preventing kidney damage. Other systemic diseases that can cause kidney damage include autoimmune conditions (e.g. systemic lupus erythematous and vasculitis), amyloidosis and multiple myeloma.
2. Glomerulonephritis. This term describes conditions that damage the glomeruli (the filtering units of the kidneys that start the process of urine formation). There are many different causes of glomerulonephritis and treatment depends on the form of the disease. Some types of glomerulonephritis are relatively benign and unlikely to progress to established renal failure. Other forms are more aggressive with treatment making only a small impact on disease progression and the development of established renal failure.
3. High blood pressure (hypertension). Severe ('accelerated') hypertension causes chronic kidney disease, but early recognition and treatment of high blood pressure can halt – and to some extent reverse – the associated kidney damage. Hypertension is a common cause of renal failure in patients of African origin.
4. Obstruction. CKD can be a consequence of any pathology that obstructs the free flow of urine through the urinary system. Most often obstruction is secondary to enlargement of the prostate gland in elderly men, but other causes include kidney stones, bladder tumours, and congenital abnormalities of the renal tract.
5. Genetic disease. The commonest genetic disease causing CKD is polycystic kidney disease. This condition, along with many rare inherited diseases affecting the kidneys, accounts for about 8% of all kidney failure in the UK.

Prevention and management

1.8 Within the UK, risk factors for CKD, such as diabetes, obesity and hypertension are becoming more common. Consequently, the NHS is increasingly focusing on the prevention and early detection and treatment of CKD. Although many of the diseases causing CKD are not preventable, their recognition is important to allow appropriate treatment of any complications and preparation for renal replacement therapy. Some diseases, such as urinary obstruction, may be reversible to some extent and intervention is appropriate. Good diabetic control and blood pressure management may halt the rate of future renal function decline.

1.9 Clear guidelines are in place for the management of CKD by both general practitioners and hospital kidney specialists (nephrologists) [1]. Currently there is no general population screening for renal disease; instead, targeted screening of patients groups 'at-risk' of renal disease, such as diabetic or hypertensive patients, occurs. This normally involves testing the urine for the presence of blood or protein, plus blood tests for the level of substances normally excreted by the kidney such as creatinine and urea.

Complications and comorbidity

1.10 Patients with chronic kidney disease often have accompanying illnesses (comorbidities). Some are due to the primary disease, e.g. diabetes may cause blindness and diseases of the nerves and blood vessels. Others, such as anaemia, bone disease, and heart failure, are consequences of the renal failure. In addition, many patients with established renal failure, have diseases affecting the heart and blood vessels (vascular) particularly ischaemic heart disease and peripheral vascular disease. Comorbidity, can influence the choice of treatment for renal failure and may reduce its benefits. Early and aggressive management of CKD-related complications, such as bone mineral abnormalities (hyperparathyroidism), may reduce the incidence of vascular disease.

Renal replacement therapy

1.11 The term renal replacement therapy (RRT) encompasses the three treatments used in established renal failure: haemodialysis, peritoneal dialysis and kidney transplantation. Both forms of dialysis remove waste products from the blood, but the other complications of established renal failure, such as anaemia and abnormal bone metabolism (hyperparathyroidism), require treatment with medications. Patients under the age of around 70 may undergo kidney transplantation as a form of treatment. If successful, a kidney transplant returns an individual to good health and removes the need for dialysis.

Renal dialysis

1.12 Dialysis involves the removal of waste products from the blood by allowing these products to diffuse across a thin membrane into dialysis fluid, which is then discarded along with the toxic waste products. The fluid is chemically composed to draw or 'attract' excess salts and water from the blood to cross the membrane, without the blood itself being in contact with the fluid.

Haemodialysis

1.13 The method first used to achieve dialysis was the artificial kidney, or haemodialysis. This involves the attachment of the patient's circulation to a machine through which fluid is passed and exchange can take place. A disadvantage of this method is that some form of permanent access to the circulation must be produced to be used at every treatment. The majority of patients on haemodialysis receive three four-hour sessions a week, at either a hospital-based dialysis unit or a community-based unit (satellite unit) away from the main renal centre. A small number of patients perform their own dialysis at home (home haemodialysis) and the number and duration of treatments will vary.

Peritoneal dialysis

1.14 An alternative form of dialysis is peritoneal dialysis, most commonly in the form of continuous ambulatory peritoneal dialysis (CAPD). In this technique, dialysis fluid is inserted, via a plastic tube (catheter), into the peritoneal cavity (which lies around the bowel) for approximately 6 hours before being removed and replaced. The fluid must be sterile in order to avoid infection and inflammation of the peritoneum (peritonitis), which is the main complication of the treatment. Each fluid exchange takes 30 to 40 minutes to perform and is repeated three or four times daily.

Renal transplantation

1.15 Renal transplantation replaces all the kidneys' functions, so erythropoietin and vitamin D supplementation are unnecessary. Transplantation involves the placement of a single kidney in the pelvis, close to the bladder, to which the ureter is connected. The immediate problem is the body's immune system recognising the new organ as foreign tissue–a process known as rejection. Consequently, all patients receiving a kidney transplant require anti-rejection drugs, such as tacrolimus, cyclosporin, and Mycophenolate Mofetil, for the lifetime of the

transplant. These drugs, known as immunosuppressants, have many undesirable side effects, including the acceleration of vascular disease, increased risk of infection and higher rates of cancer (malignancy). This often means that myocardial infarctions and strokes are commoner in transplant patients than in healthy individuals of the same age. As transplants get older, there is a progressive loss of function due to chronic rejection (chronic allograft nephropathy). The average lifespan of a kidney transplant is between 10 and 15 years, which means some younger patients, will receive more than one transplant during their lifetime, often with periods of dialysis in-between.

1.16 For many patients, renal transplantation, from both live and deceased donors, is the best treatment in terms of survival and quality of life. Unfortunately, despite changes in policy and legislation there remains a shortage of kidneys for transplant; it appears likely that whatever social and medical structures are present, there will inevitably be a shortage of kidneys from humans.

Nature of renal services

1.17 The work of a nephrologist includes the early detection and diagnosis of renal disease and the long-term management of its complications such as high blood pressure, anaemia and bone disease. The nephrologist may share the management with the general practitioner or local hospital physician; relying on them to refer patients early for initial diagnosis and specific treatment. At any one time, perhaps only 5% of patients under their care are inpatients in wards with a further 20% attending the renal centre regularly for haemodialysis. However, inpatient nephrology and the care of patients receiving centre-based dialysis are specialised, complex and require experienced medical advice to be available on a 24 hour basis. Other renal work is sustained on an outpatient basis; this includes renal replacement therapy by dialysis and the care of transplant patients.

1.18 There are six major components to renal medicine.

1. Renal replacement therapy. The most significant element of work relates to the preparation of patients with advanced CKD for RRT and their medical supervision for the remainder of their lives. The patient population will present increasing challenges for renal staffing as more elderly and diabetic patients are accepted for treatment.
2. Emergency work. The emergency work associated with the specialty consists of:
   i. Treatment of acute renal failure, often involving multiple organ failure and acute-on-chronic renal failure. Close co-operation with other medical specialties, including critical care, is therefore a vital component of this aspect of the service.
   ii. Management of medical emergencies arising from an established renal failure programme. This workload is expanding as the number, age, and comorbidity of patients starting renal replacement therapy increases.
3. Routine nephrology. A substantial workload is associated with the immunological and metabolic nature of renal disease which requires investigative procedures in an inpatient setting. It is estimated that ten inpatient beds per million of the population are required for this work.
4. Investigation and management of fluid and electrolyte disorders. This makes up a variable proportion of the nephrologists work, depending on the other expertise available in the hospital.
5. Outpatient work. The outpatient work in renal medicine consists of the majority of general nephrology together with clinics for dialysis and renal transplant patients.
6. Research activities. Many nephrologists have clinical or laboratory-based research interests.

References

1 National Collaborating Centre for Chronic Conditions. Chronic kidney disease: national clinical guideline for early identification and management in adults in primary and secondary care. London: Royal College of Physicians, September 2008

Appendix D
Methodology used for Analyses of PCT/HB Incidence and Prevalence Rates and of Standardised Ratios

Described here are the methods for calculating the standardised acceptance ratios for the incident UK RRT cohort, the standardised prevalence ratios for the total UK RRT cohort and the ratios for prevalent transplant patients.

Patients

For the acceptance rate analyses, all new cases recorded by the UK Renal Registry (UKRR) as accepted on to RRT in each year were included. For the prevalence rates analyses, prevalent patients at the end of the year were included. The analyses used the patient postcode rather than the GP postcode. Each postcode was matched to a 2001 Census output area and hence to the relevant area code.

Years used

Analyses have been completed for each of the last 6 years. Combined analyses have also been done using the data from as many of the years as are available for each area. This combined analysis is especially useful for the acceptance rates and rate ratios analyses as there can be small numbers of incident patients particularly in the smaller areas.

Geography

The areas used were the 147 English primary care trusts (PCTs), the 5 English care trusts, the 7 Welsh Local Health Boards, the 14 Scottish Health Boards and the 5 Health and Social Care Trusts in Northern Ireland – these different types of area are collectively called PCT/HBs here. For Wales, Scotland and Northern Ireland this is the first report in which we have used these areas – previously local authorities/council areas/district council areas were used.

Areas included in the UK Registry 'covered' population

This year all renal centres are again sending data to the Registry so coverage of the UK is complete for 2008 and 2009. In previous years, not all renal centres were sending data to the UKRR. This meant estimates could not be obtained for all PCT/HBs but only for those which were covered by the Registry in the relevant year. The UKRR identified all areas which were estimated to have complete coverage and analyses were restricted to those areas. Whether an area was covered or not was dependant on whether the renal centre in the area was sending data to the UKRR and whether there were any overlapping areas with renal centres not yet connected to the UKRR.

Population data

Mid-2009 population estimates were obtained from the Office for National Statistics (ONS) website (www.statistics.gov.uk) by PCT/HB, gender and age group (for Wales and Northern Ireland the ONS population data were aggregated at the Registry from local authority to health board level). These 2009 estimates have been extrapolated by the ONS from the 2001 census data. The areas range in population size from 20,000 (Orkney) to 1.29 million (Hampshire). The population is between 80,000 and 850,000 for all but 6 of the areas (3 below and 3 above).

This 2009 population data is used for the analysis for each year. As the analyses only cover 6 years this was a reasonable approximation.

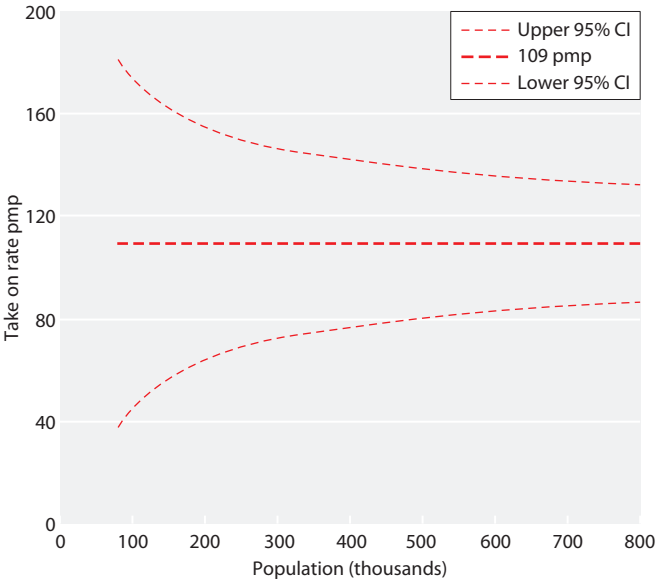

Fig. D.1. 95% confidence limits for take on rate of 109 pmp for population size 80,000–800,000

Calculation of rates and rate ratios

Crude rates

The crude rates, per million population (pmp), were calculated for each PCT/HB for each year:

$$1{,}000{,}000 \times (\text{observed number})/(\text{population size})$$

For the combined years analyses the observed cases are summed over the available years and the population is multiplied by the number of years that the area has been covered. For example, if area × (population 100,000) became an area covered for the first time in 2008 and had 14 new patients in 2008 and 19 in 2009 then the combined years crude acceptance rate would be $1{,}000{,}000 \times (14+19)/(2 \times 100{,}000) = 165$ pmp. Again, this is a rate per million population **per year**. It is an average over the available years.

Confidence intervals have not been calculated for these (single or combined years) rates but, if required, an assessment can be made of whether the rate for a given area is consistent with the rate in the whole covered population. This can be done by using the figures provided here showing the confidence intervals around the overall average rates for a range of PCT/HB population sizes. These are figures D.1 and D.2 for incidence rates, and D.3 and D.4 for prevalence rates.

Note that when using the confidence interval figures to assess how different an area's combined years crude rate is from the overall average, the population shown on the x-axis should be the area's population multiplied by the number of years of data that has been used (e.g. 2 for the example above). By doing this, the confidence intervals obtained become narrower as the analysis is now based on more than one year of data.

These confidence intervals have been obtained using the Normal approximation to the Poisson distribution. For the incident analyses, confidence intervals have only been calculated around the overall average for populations of over 80,000. This is because below this level the number of cases you would expect per area is

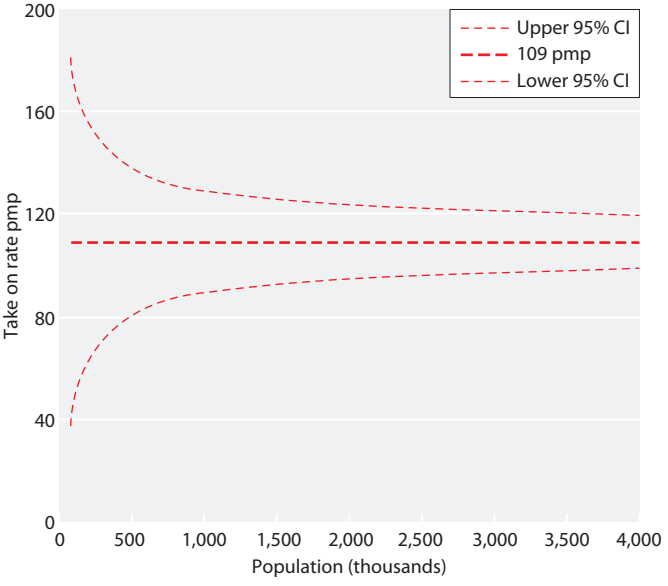

Fig. D.2. 95% confidence limits for take on rate of 109 pmp for population size 80,000–4 million

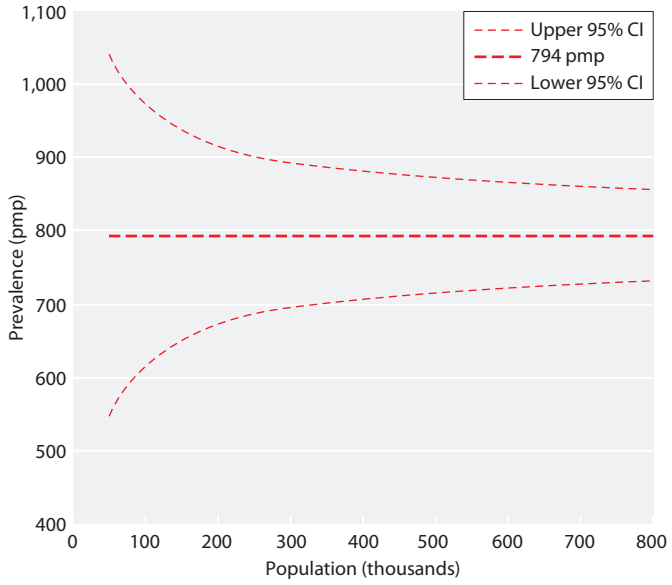

Fig. D.3. 95% confidence limits for prevalence of 794 pmp for catchment population size 50,000–800,000

low and so the Poisson distribution is skewed and the Normal approximation is not appropriate. Due to prevalence rates being higher, confidence intervals can be obtained using this method for lower population sizes.

Standardised acceptance/prevalence ratios (SAR/SPR or SR)

There are large differences in acceptance and prevalence rates for RRT between age and gender groups. As there are also differences in the age/gender breakdowns of the different areas it is useful to produce estimates standardised for age and gender. The method used is *indirect* standardisation.

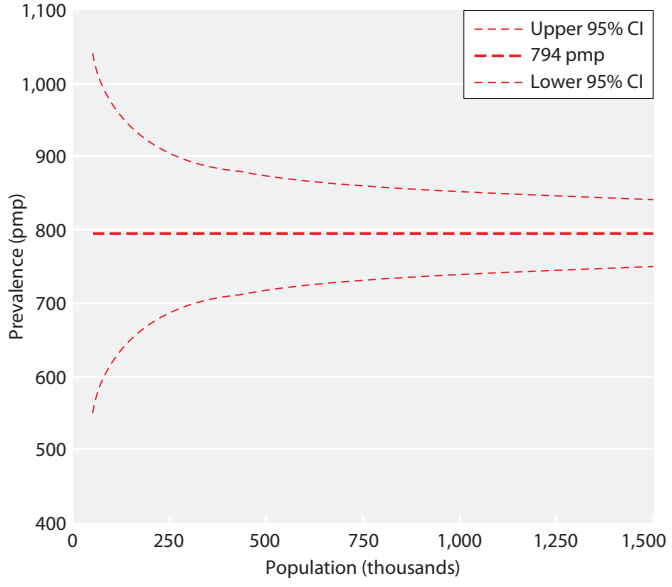

Fig. D.4. 95% confidence limits for prevalence of 794 pmp for catchment population size 50,000 – 1.5 million

Observed cases (O_i) were calculated by summing all cases in all age and gender bands for each PCT/HB. Expected cases (E_i) for each PCT/HB were calculated as follows:

Overall crude rates (for each year) were calculated for the whole covered population (the *standard population*) by summing the observed numbers, over the PCT/HBs, for each age/gender band and dividing this by the total covered population in that age/gender band. These crude rates (by age/gender band) were then multiplied by the population each PCT/HB has in each band to give the number of cases expected in that band if that PCT/HB had the same rates as the standard population.

These expected numbers were then summed over the age/gender bands to give an expected total number of cases in each PCT/HB. The age/gender standardised ratio for PCT/HB i is then O_i/E_i.

The expected number of cases is the number you would see if the rates seen in the standard population applied to that individual PCT/HB's age/gender breakdown. 95% confidence intervals were calculated for each area using an error factor (EF) as follows:

$$\mathrm{LCL} = \mathrm{SR}/\mathrm{EF}$$

$$\mathrm{UCL} = \mathrm{SR} \times \mathrm{EF}$$

where $\mathrm{EF} = \exp(1.96\sqrt{(O_i)})$.

A standardised ratio (SR) of 1 indicates that the area's rate was as expected if the age/gender rates found in the total covered population applied to the PCT/HB area's population structure; a value above 1 indicates that the observed rate was greater than expected given the area's population structure, if the lower confidence limit was above 1 this was statistically significant at the 5% level. The converse applies to standardised ratios under one.

The combined years analyses are similar to the above except that the observed and expected numbers are summed over the years.

Remaining variability between rates

Even after standardisation there remains a large amount of variability between PCT/HBs – as can be seen by the large numbers of significantly low or high standard ratios. This is partly because these ratios have only been adjusted for age and gender and have not

been adjusted for ethnicity. Much higher rates are expected in populations with a high percentage of patients from South Asian and Black backgrounds.

Caution needed when comparing a PCT/HB's standardised incidence or prevalence ratios over time

As the covered areas have changed over time, the 'total' population used for standardisation is different each year. For example, the rate ratios for 2005 and 2006 are not strictly comparable as they are standardised to different populations. However, for most years the change in numbers of covered areas is relatively small.

Appendix E
Methodology for Estimating Catchment Populations of Renal Centres in England for Dialysis Patients

This is primarily the work of Andrew Judge. Others who assisted include (listed alphabetically): David Ansell, Yoav Ben-Shlomo, Daniel Ford, Paul Roderick and Charlie Tomson.

Introduction

Providing accurate centre-level incidence and prevalence rates for patients receiving renal replacement therapy (RRT) in the UK has been limited in the past by the difficulty in estimating the catchment population from which the RRT population was derived. One reason for this is that the geographical boundaries separating renal centres are relatively arbitrary and dependent upon a number of factors including referral practice, patient choice and patient movement. Previously, incidence and prevalence rates have been calculated at Local Authority/Primary Care Trust/Health Board level where denominator data were available, but not at renal centre level.

Previous UK Renal Registry (UKRR) Annual Reports have suggested an estimate of the size of the catchment populations. These were extrapolated figures originally derived from data in the 1992 National Renal Survey undertaken by Paul Roderick.

The purpose of this appendix is to present an estimate of the dialysis catchment population for all renal centres in England. The document also contains a methodological description and discussion of the limitations of this estimate. These catchment population estimates have been used in this report (chapter 1: UK RRT Incidence in 2009: national and centre-specific analyses) to calculate RRT incidence rates by renal centre, rather than only by Primary Care Trust/HB.

Methods

The UKRR database of the UK prevalent dialysis population on 31st December 2007 was used to estimate the size of each renal centre's catchment population. This used the postal code address and dialysis centre for each individual UK dialysis patient.

An area was drawn around the geographical location of each dialysis patient, producing an overlapping polygonal area. The shape and size of this area was based upon the location of other dialysis patients surrounding them. Using these areas for individual patients, the total catchment area for each renal centre was merged and the Office for National Statistics (ONS) census-area statistics (CAS) wards overlaid upon the renal centre catchment area. Each CAS-ward was then assigned to the corresponding renal centre. If more than one renal centre catchment area corresponded to a CAS-ward, then only a percentage of the ward was assigned to each centre, proportionate to the area covered.

The ONS publishes the number of people living in each ward, based upon the April 2001 Census. This information is available on the ONS website. This

information was used to calculate the number of people living in the census ward allocated to each renal centre. If only a proportion of a ward was allocated to a centre, then the same proportion of the population was attributed to that centre's denominator.

The ONS annually estimates the increase in the UK population at national and Local Authority level. When the work detailed here was prepared the latest update available was to June 2008. The ONS also updates the population estimates at CAS-ward level. The latest update available at CAS-ward level was to June 2007. This information was not available on the ONS website but was provided by direct communication and permission granted for use in this analysis. It was necessary to use the ONS data at the CAS-ward level, therefore the June 2007 data were used for the latest UKRR analysis.

The allocation of catchment ward to renal centre was only undertaken for England and therefore estimated catchment populations for renal centres in Scotland, Wales and Northern Ireland have not been calculated.

This allocation exercise was performed before Colchester became a separate renal centre.

Results

The estimated dialysis catchment populations for renal centres in England are shown in table E.1. The table shows both calculations: firstly from the ONS Census from April 2001 and secondly from the updated ONS estimates of CAS-ward populations at June 2007.

Discussion

These results show the updated estimates for the size of the catchment areas for each of the renal centres in England. This is the first time that the UK Renal Registry

Table E.1. Estimated dialysis catchment populations of English renal centres based upon 2001 and mid-2007 ONS CAS-ward population estimates (rounded to nearest 1,000)

Centre	2001 estimate	Mid-2007 estimate	Centre	2001 estimate	Mid-2007 estimate
B Heart	704,000	725,000	Leeds	1,574,000	1,647,000
B QEH	1,585,000	1,624,000	Leic	2,180,000	2,318,000
Basldn	396,000	408,000	Liv Ain	295,000	290,000
Bradfd	546,000	579,000	Liv RI	1,198,000	1,199,000
Brightn	1,161,000	1,195,000	M Hope	1,403,000	1,420,000
Bristol	1,472,000	1,571,000	M RI	1,398,000	1,469,000
Camb*	1,181,000	1,266,000	Middlbr	981,000	1,012,000
Carlis	307,000	314,000	Newc	1,086,000	1,106,000
Carsh	1,852,000	1,916,000	Norwch	755,000	793,000
Chelms*	445,000	466,000	Nottm	1,091,000	1,138,000
Covnt	839,000	870,000	Oxford	1,598,000	1,680,000
Derby	611,000	647,000	Plymth	456,000	476,000
Donc**	210,000	214,000	Ports	1,926,000	2,003,000
Dorset	710,000	725,000	Prestn	1,475,000	1,512,000
Dudley	411,000	415,000	Redng	782,000	805,000
Exeter	969,000	1,028,000	Sheff	1,451,000	1,489,000
Glouc	558,000	575,000	Shrew	382,000	391,000
Hull	945,000	987,000	Stevng	1,047,000	1,088,000
Ipswi*	523,000	562,000	Sthend	309,000	316,000
Kent	1,112,000	1,163,000	Stoke	880,000	897,000
L Barts	1,608,000	1,680,000	Sund	585,000	589,000
L Guys	1,102,000	1,154,000	Truro	390,000	412,000
L Kings	932,000	970,000	Wirral	520,000	521,000
L Rfree	1,412,000	1,504,000	Wolve	606,000	606,000
L St G	553,000	585,000	York	478,000	505,000
L West	2,113,000	2,227,000	**England**	**49,104,000**	**51,050,000**

* some reduction required after the opening of Colchester renal centre
** population may be too low as centre has expanded

has been able to accurately estimate the catchment population for each English centre.

There are some limitations to these results. The first is that the ward allocated to each renal centre was based upon dialysis patients only. Therefore it is possible that non-dialysis patients may come from a different catchment population. This is more likely where a renal centre provides specialist services and especially likely for patients undergoing renal transplantation. The catchment population for renal transplant patients will depend largely upon the distribution of workload between the referral centre and the transplanting centre for pre-transplant work-up, donor nephrectomy work-up and post-transplant care (including if and when care is returned to the referring centre).

These estimates were performed before Colchester became a separate renal centre. Therefore it is likely that the catchment populations of the neighbouring renal centres: Chelmsford, Ipswich and Cambridge, are somewhat too high. It is thought that the catchment population of Colchester may be in the region of 200,000 people.

Despite these limitations, this is the most valid methodology to date to estimate the size of the catchment populations for renal centres in England. The results of this analysis allow the UKRR to calculate estimates of the incidence and prevalence rates of renal replacement therapy at renal centre level, rather than only at PCT/HB level.

These results also provide other opportunities for study of the catchment populations. The ONS provides data on gender, age and ethnicity of the population at ward level. It should be possible to use this information to consider centre differences in the demographics of patients commencing or receiving RRT with adjustment for the catchment population characteristics.

Appendix F
Additional Data Tables for 2009 new and existing patients

F:1 Patients starting renal replacement therapy in 2009

Table F.1.1. Take on totals for new patients on dialysis at 90 days in 2009

	Aged <65		Aged ⩾65	
	HD N	PD N	HD N	PD N
England	1,761	685	2,130	362
N Ireland	56	9	69	11
Scotland	185	42	198	29
Wales	100	37	167	21
UK	**2,102**	**773**	**2,564**	**423**

Table F.1.2. Number of patients per treatment modality at 90 days

	HD	PD	Transplant	Stopped treatment	Died
England	3,891	1,047	417	9	339
N Ireland	125	20	3	2	5
Scotland	383	71	17	0	56
Wales	267	58	16	1	22
UK	**4,666**	**1,196**	**453**	**12**	**422**

Table F.1.3. First treatment modality

Centre	% HD	% PD	% transplant	Centre	% HD	% PD	% transplant
Abrdn	83	17		L Rfree	79	8	13
Airdrie	83	17		L St.G	69	17	15
Antrim	95	5		L West	85	3	12
B Heart	87	10	3	Leeds	69	24	8
B QEH	75	17	8	Leic	73	17	10
Bangor	67	33		Liv Ain	89	11	
Basldn	88	12		Liv RI	71	24	5
Belfast	87	8	6	M Hope	69	31	1
Bradfd	76	24		M RI	63	17	20
Brightn	56	38	6	Middlbr	86	13	1
Bristol	79	12	9	Newc	72	16	12
Camb	82	7	11	Newry	90	10	
Cardff	80	14	6	Norwch	77	23	
Carlis	75	21	4	Nottm	70	27	3
Carsh	82	17	1	Oxford	61	29	11
Chelms	63	37		Plymth	62	23	15
Clwyd	100			Ports	64	30	7
Colchr	100			Prestn	77	21	2
Covnt	76	20	3	Redng	58	40	2

Table F.1.3. Continued

Centre	% HD	% PD	% transplant
D & Gall	88	12	
Derby	67	33	
Derry	94	6	
Donc	75	25	
Dorset	74	23	3
Dudley	74	26	
Dundee	94	6	
Dunfn	82	18	
Edinb	76	21	3
Exeter	86	13	1
Glasgw	87	10	3
Glouc	80	19	1
Hull	80	19	1
Inverns	89	11	
Ipswi	76	21	3
Kent	77	16	8
Klmarnk	78	22	
L Barts	65	29	6
L Guys	75	6	19
Sheff	80	16	4
Shrew	79	15	6
Stevng	80	9	10
Sthend	61	35	4
Stoke	81	16	4
Sund	75	23	2
Swanse	85	15	
Truro	76	24	
Tyrone	84	16	
Ulster	100		
Wirral	74	26	
Wolve	73	26	2
Wrexm	68	32	
York	93	7	
England	**75**	**19**	**7**
N Ireland	**90**	**8**	**2**
Scotland	**84**	**14**	**2**
Wales	**81**	**16**	**3**
UK	**76**	**18**	**6**

Table F.1.4. First treatment modality, patient numbers

	HD	PD	Transplant
England	4,175	1,037	367
N Ireland	126	11	3
Scotland	456	75	9
Wales	290	58	11
UK	**5,047**	**1,181**	**390**

Table F.1.5. Gender breakdown by treatment modality (at 90 days)

	HD			PD		
Centre	% male	% female	M:F ratio	% male	% female	M:F ratio
Abrdn	79	21	3.9	64	36	1.7
Airdrie	48	52	0.9	40	60	0.7
Antrim	30	70	0.4	50	50	1.0
B Heart	54	46	1.2	67	33	2.0
B QEH	54	47	1.2	56	44	1.3
Bangor	81	19	4.3	75	25	3.0
Basldn	71	29	2.4	75	25	3.0
Belfast	70	30	2.3	20	80	0.3
Bradfd	55	45	1.2	71	29	2.5
Brightn	59	41	1.4	70	30	2.4
Bristol	61	39	1.5	44	56	0.8
Camb	70	30	2.4	67	33	2.0
Cardff	59	41	1.4	63	37	1.7
Carlis	56	44	1.3	75	25	3.0
Carsh	62	38	1.7	56	44	1.3
Chelms	74	26	2.8	82	18	4.5
Clwyd	67	33	2.0	100		
Colchr	69	31	2.2	100		
Covnt	63	37	1.7	77	23	3.4
D & Gall	50	50	1.0		100	

Table F.1.5. Continued

	HD			PD		
Centre	% male	% female	M:F ratio	% male	% female	M:F ratio
Derby	56	44	1.3	78	22	3.6
Donc	44	57	0.8	86	14	6.0
Dorset	73	27	2.7	63	38	1.7
Dudley	51	49	1.1	69	31	2.2
Dundee	51	49	1.0	75	25	3.0
Dunfn	44	56	0.8	67	33	2.0
Edinb	62	38	1.7	64	36	1.7
Exeter	64	36	1.8	70	30	2.3
Glasgw	58	42	1.4	63	38	1.7
Glouc	53	47	1.1	75	25	3.0
Hull	64	36	1.8	57	43	1.3
Inverns	67	33	2.0	50	50	1.0
Ipswi	68	32	2.1	67	33	2.0
Kent	70	30	2.3	65	35	1.9
Klmarnk	55	46	1.2	86	14	6.0
L Barts	65	35	1.8	57	43	1.3
L Guys	57	43	1.3	46	55	0.8
L Kings	56	44	1.3	67	33	2.0
L Rfree	61	40	1.5	47	53	0.9
L St.G	61	39	1.6	70	30	2.3
L West	65	35	1.8	55	46	1.2
Leeds	59	41	1.5	59	41	1.4
Leic	60	41	1.5	57	43	1.3
Liv Ain	68	32	2.1	40	60	0.7
Liv RI	59	42	1.4	63	37	1.7
M Hope	45	55	0.8	54	47	1.2
M RI	64	36	1.8	66	34	1.9
Middlbr	63	37	1.7	44	56	0.8
Newc	71	30	2.4	75	25	3.0
Newry	59	41	1.4	50	50	1.0
Norwch	70	30	2.3	71	29	2.5
Nottm	57	44	1.3	58	42	1.4
Oxford	60	41	1.5	65	35	1.9
Plymth	77	23	3.4	47	53	0.9
Ports	65	35	1.8	73	27	2.7
Prestn	56	44	1.3	64	36	1.8
Redng	66	35	1.9	48	52	0.9
Sheff	64	36	1.8	69	31	2.2
Shrew	50	50	1.0	60	40	1.5
Stevng	66	34	2.0	63	38	1.7
Sthend	78	22	3.5	67	33	2.0
Stoke	58	42	1.4	59	41	1.4
Sund	61	39	1.6	42	58	0.7
Swanse	61	39	1.6	65	35	1.8
Truro	63	37	1.7	86	14	6.0
Tyrone	67	33	2.0	60	40	1.5
Ulster	60	40	1.5			
Wirral	62	38	1.6	67	33	2.0
Wolve	58	42	1.4	67	33	2.0
Wrexm	62	39	1.6	40	60	0.7
York	69	31	2.2	88	13	7.0
England	**61**	**39**	**1.6**	**63**	**37**	**1.7**
N Ireland	**59**	**41**	**1.5**	**40**	**60**	**0.7**
Scotland	**59**	**42**	**1.4**	**63**	**37**	**1.7**
Wales	**62**	**38**	**1.6**	**64**	**36**	**1.8**
UK	**61**	**39**	**1.6**	**62**	**38**	**1.7**

F:2 Prevalent patients on 31/12/2009

Table F.2.1. Treatment modalities for patients aged under and over 65

	Patients aged <65				Patients aged ⩾65			
Centre	% HD	% PD	% transplant	HD:PD	% HD	% PD	% transplant	HD:PD
Abrdn	30	7	63	4.2	76	6	18	13.0
Airdrie	44	5	51	9.7	77	3	20	23.3
Antrim	37	5	58	8.0	79	8	12	9.4
B Heart	58	5	37	12.1	83	6	11	14.0
B QEH	35	9	56	4.0	73	9	19	8.5
Bangor	76	24		3.2	68	32		2.1
Basldn	60	9	31	6.9	74	19	7	4.0
Belfast	26	4	69	6.1	61	8	31	7.7
Bradfd	37	8	55	4.7	65	9	27	7.5
Brightn	28	10	62	2.8	66	14	20	4.8
Bristol	24	6	70	4.0	61	7	32	9.3
Camb	21	4	74	5.3	70	4	26	15.9
Cardff	23	7	71	3.5	64	9	27	7.3
Carlis	22	7	72	3.2	54	9	38	6.2
Carsh	36	9	55	4.0	75	10	15	7.2
Chelms	40	13	47	2.9	69	20	11	3.4
Clwyd	45	5	49	8.4	67	4	29	17.0
Colchr	100				100			
Covnt	31	9	60	3.6	65	13	22	4.9
D & Gall	24	12	64	2.0	79	7	14	11.3
Derby	50	22	28	2.3	70	19	11	3.6
Derry	46	3	51	16.0	75	2	23	33.0
Donc	51	17	32	3.1	76	17	7	4.5
Dorset	29	7	64	4.4	56	15	29	3.7
Dudley	49	19	32	2.6	60	20	20	3.0
Dundee	29	9	62	3.2	71	4	25	16.3
Dunfn	38	7	54	5.2	68	14	18	4.7
Edinb	33	7	60	4.6	56	14	31	4.1
Exeter	27	9	64	3.2	73	11	16	6.5
Glasgw	32	4	65	8.0	69	4	27	16.4
Glouc	30	15	55	2.0	77	8	15	9.5
Hull	34	9	57	3.9	71	13	15	5.3
Inverns	25	6	69	4.2	70	18	12	4.0
Ipswi	26	11	63	2.4	55	20	25	2.8
Kent	29	8	63	3.6	71	11	18	6.4
Klmarnk	43	13	44	3.3	76	15	9	5.0
L Barts	37	10	53	3.7	62	16	22	3.9
L Guys	29	3	68	10.1	64	5	32	14.2
L Kings	41	11	48	3.6	70	10	20	7.1
L Rfree	30	4	66	7.5	70	6	25	12.1
L St.G	28	8	64	3.3	63	12	25	5.4
L West	33	1	66	25.8	74	1	24	52.6
Leeds	25	7	67	3.4	64	9	27	7.1
Leic	32	8	60	4.1	64	13	23	5.0
Liv Ain	94	6		15.0	97	3		32.0
Liv RI	25	6	68	3.9	53	9	37	5.7
M Hope	36	15	50	2.4	65	16	19	4.1
M RI	23	6	70	3.8	52	10	38	5.1
Middlbr	29	2	69	13.3	66	4	30	16.2
Newc	23	6	71	4.2	50	7	43	7.0
Newry	47	9	43	5.0	81	4	15	19.3
Norwch	35	10	55	3.5	76	10	15	7.8

Table F.2.1. Continued

	Patients aged <65				Patients aged ⩾65			
Centre	% HD	% PD	% transplant	HD:PD	% HD	% PD	% transplant	HD:PD
Nottm	30	11	59	2.6	73	12	15	5.9
Oxford	19	7	74	2.9	51	11	39	4.7
Plymth	17	8	76	2.2	48	12	40	4.0
Ports	26	6	69	4.5	61	11	28	5.6
Prestn	41	8	51	5.0	72	8	20	8.5
Redng	30	13	56	2.3	62	14	23	4.4
Sheff	37	5	58	7.2	71	7	22	9.7
Shrew	45	10	46	4.5	77	7	16	11.8
Stevng	52	6	42	8.4	85	3	12	25.3
Sthend	49	14	37	3.4	77	4	19	18.0
Stoke	36	10	53	3.5	66	13	21	5.2
Sund	39	7	54	5.2	71	8	21	8.8
Swanse	42	8	50	5.4	77	12	11	6.3
Truro	27	8	64	3.3	71	9	20	7.6
Tyrone	48	7	45	6.5	83	8	8	10.0
Ulster	61	5	34	12.5	96	0	4	0.0
Wirral	83	17		4.9	85	15		5.8
Wolve	50	11	39	4.6	81	10	8	7.8
Wrexm	26	6	67	4.1	46	23	31	2.0
York	52	5	43	10.7	72	5	23	13.8
England	**32**	**7**	**60**	**4.3**	**68**	**10**	**23**	**7.1**
N Ireland	**35**	**5**	**60**	**6.9**	**75**	**6**	**19**	**12.4**
Scotland	**33**	**6**	**61**	**5.2**	**69**	**8**	**23**	**8.7**
Wales	**30**	**7**	**63**	**4.1**	**67**	**12**	**21**	**5.4**
UK	**32**	**7**	**60**	**4.4**	**68**	**9**	**22**	**7.2**

Table F.2.2. Number of patients under and over 65 per treatment modality

	Patients aged <65			Patients aged ⩾65		
	HD	PD	Transplant	HD	PD	Transplant
England	8,754	2,016	16,247	9,437	1,337	3,171
N Ireland	312	45	529	414	33	101
Scotland	944	183	1,744	904	104	294
Wales	477	116	1,008	608	112	190
UK	**10,487**	**2,360**	**19,528**	**11,363**	**1,586**	**3,756**

Table F.2.3. Dialysis modalities for patients aged under 65

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Abrdn**	5	76	0	6	13	0
Airdrie**	0	91	0	4	6	0
Antrim*	4	84	0	2	9	0
B Heart	4	81	7	7	1	0
B QEH	3	18	59	8	12	0
Bangor	8	69	0	6	18	0
Basldn	0	87	0	4	9	0
Belfast*	5	82	0	3	11	1
Bradfd	0	70	12	6	11	0
Brightn	14	33	26	11	16	0
Bristol	9	19	52	10	10	0
Camb	5	37	42	0	0	16
Cardff	9	21	48	22	0	0
Carlis	0	50	26	8	16	0
Carsh	1	32	47	7	12	0
Chelms	0	75	0	16	9	0
Clwyd	2	87	0	6	4	0
Colchr	0	100	0			
Covnt	2	76	0	22	0	0
D & Gall**	0	67	0	15	19	0
Derby	4	66	0	24	6	0
Derry*	3	91	0	0	6	0
Donc	0	60	16	5	19	0
Dorset	1	22	58	7	11	0
Dudley	2	52	18	28	0	0
Dundee**	0	76	0	6	18	0
Dunfn**	0	84	0	1	15	0
Edinb**	3	79	0	6	11	0
Exeter	1	33	42	13	11	0
Glasgw**	7	66	16	8	3	0
Glouc	0	67	0	5	26	1
Hull	5	40	35	9	12	0
Inverns**	6	74	0	6	13	0
Ipswi	1	59	10	14	15	0
Kent	4	22	52	22	0	0
Klmarnk**	5	72	0	3	21	0
L Barts	1	30	47	7	14	0
L Guys	9	24	58	3	6	0
L Kings	0	32	46	5	16	0
L Rfree	3	39	46	2	9	0
L St.G	5	40	32	8	15	0
L West	2	32	63	1	3	0
Leeds	5	17	55	7	16	0
Leic	4	18	58	7	13	0
Liv Ain	4	8	83	1	5	0
Liv RI	4	42	33	6	15	0
M Hope	0	33	37	24	5	0
M RI	17	26	36	4	17	0
Middlbr	3	37	52	6	1	0
Newc	5	75	0	2	17	0
Newry*	4	80	0	0	17	0
Norwch	7	44	27	17	5	1
Nottm	4	46	22	7	20	0
Oxford	7	68	0	9	17	0
Plymth	4	64	0	17	14	0
Ports	0	27	55	18	0	0

Table F.2.3. Continued

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Prestn	7	24	53	5	11	0
Redng	1	57	12	31	0	0
Sheff	11	33	43	12	0	0
Shrew	3	42	37	18	0	0
Stevng	0	36	53	11	0	0
Sthend	0	77	0	23	0	0
Stoke	3	48	26	4	18	0
Sund	1	68	15	3	13	0
Swanse	8	52	25	12	4	0
Truro	3	42	32	7	17	0
Tyrone*	2	84	0	0	13	0
Ulster*	7	85	0	0	7	0
Wirral	3	39	42	4	12	0
Wolve	2	29	51	18	0	0
Wrexm	4	76	0	20	0	0
York	2	72	18	9	0	0
England	**4**	**39**	**39**	**9**	**9**	**0**
N Ireland*	**4**	**84**	**0**	**1**	**11**	**0**
Scotland**	**4**	**75**	**5**	**6**	**10**	**0**
Wales	**8**	**43**	**30**	**17**	**3**	**0**
UK	**4**	**43**	**34**	**9**	**9**	**0**

* There are no satellite centres in Northern Ireland
** All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

Table F.2.4. Dialysis modalities for patients aged over 65

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Abrdn**	1	92	0	6	1	0
Airdrie**	0	96	0	3	1	0
Antrim*	0	90	0	1	9	0
B Heart	2	84	7	7	0	0
B QEH	1	19	70	5	6	0
Bangor	2	66	0	17	15	0
Basldn	0	80	0	9	11	0
Belfast*	4	85	0	2	10	0
Bradfd	0	68	20	2	10	0
Brightn	4	42	37	9	8	0
Bristol	3	13	74	8	2	0
Camb	0	37	57	0	0	6
Cardff	3	16	69	12	0	0
Carlis	0	67	19	5	9	0
Carsh	0	30	57	5	8	0
Chelms	1	76	0	18	5	0
Clwyd	0	95	0	6	0	0
Colchr	0	100	0			
Covnt	0	83	0	17	0	0
D & Gall**	0	92	0	5	3	0
Derby	5	74	0	18	4	0
Derry*	0	97	0	0	3	0
Donc	0	61	21	3	16	0
Dorset	1	25	53	11	11	0

Table F.2.4. Continued

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Dudley	0	51	25	25	0	0
Dundee**	0	94	0	0	6	0
Dunfn**	0	83	0	3	14	0
Edinb**	2	79	0	8	12	0
Exeter	0	35	52	8	5	0
Glasgw**	1	75	18	4	2	0
Glouc	0	91	0	4	6	0
Hull	2	39	44	3	13	0
Inverns**	0	80	0	11	9	0
Ipswi	3	65	5	17	8	1
Kent	1	25	60	14	0	0
Klmarnk**	2	81	0	7	10	0
L Barts	0	28	52	10	11	0
L Guys	0	25	68	3	4	0
L Kings	0	25	62	6	6	0
L Rfree	1	35	56	3	5	0
L St.G	0	46	38	7	9	0
L West	0	28	70	1	0	0
Leeds	0	14	74	4	8	0
Leic	0	19	64	6	11	0
Liv Ain	0	9	88	2	2	0
Liv RI	0	45	40	10	5	0
M Hope	0	37	44	17	3	0
M RI	2	27	54	4	12	0
Middlbr	1	30	63	6	0	0
Newc	0	88	0	2	10	0
Newry*	3	92	0	0	5	0
Norwch	1	51	37	10	2	0
Nottm	1	51	33	6	9	0
Oxford	3	80	0	10	8	0
Plymth	0	80	0	15	5	0
Ports	0	20	65	15	0	0
Prestn	2	18	69	3	7	0
Redng	0	66	15	19	0	0
Sheff	3	38	50	9	0	0
Shrew	0	52	40	8	0	0
Stevng	0	35	61	4	0	0
Sthend	0	95	0	5	0	0
Stoke	0	52	31	7	9	0
Sund	0	65	25	9	1	0
Swanse	0	54	32	11	2	0
Truro	1	45	43	4	7	0
Tyrone*	0	91	0	0	9	0
Ulster*	0	100	0	0	0	0
Wirral	0	33	52	6	9	0
Wolve	0	22	67	11	1	0
Wrexm	2	65	0	31	2	0
York	0	54	39	6	1	0
England	**1**	**40**	**46**	**7**	**5**	**0**
N Ireland*	**2**	**91**	**0**	**1**	**7**	**0**
Scotland**	**1**	**83**	**6**	**5**	**5**	**0**
Wales	**2**	**41**	**42**	**13**	**2**	**0**
UK	**1**	**45**	**41**	**7**	**5**	**0**

* There are no satellite centres in Northern Ireland

** All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

Table F.2.5. Patient age ranges by centre (%)

Centre	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Abrdn	3	10	13	21	22	18	12	1
Airdrie	4	10	15	23	19	18	10	1
Antrim	1	4	14	15	16	27	18	5
B Heart	1	7	9	16	20	26	17	3
B QEH	3	7	15	21	20	18	13	2
Bangor	2	5	6	14	20	25	23	6
Basldn	1	8	10	16	20	21	18	7
Belfast	3	10	15	26	18	16	10	2
Bradfd	5	10	14	22	18	19	9	2
Brightn	1	7	12	16	20	23	17	3
Bristol	3	8	13	21	23	21	10	2
Camb	2	8	15	20	23	17	12	3
Cardff	3	7	16	22	22	17	11	2
Carlis	3	4	16	21	22	22	12	
Carsh	1	6	14	19	20	20	15	4
Chelms	2	6	8	15	26	20	19	5
Clwyd	3	4	10	22	26	19	13	3
Colchr	1	3	3	10	23	28	28	3
Covnt	1	6	18	20	18	22	12	3
D & Gall	3	3	16	18	24	16	18	3
Derby	1	6	10	18	21	25	18	3
Derry	1	6	19	14	21	22	16	1
Donc	3	4	8	16	28	22	16	4
Dorset	2	5	12	15	20	26	16	3
Dudley	2	3	11	18	26	25	12	2
Dundee	2	6	16	15	22	23	13	4
Dunfn	2	8	12	21	21	23	11	2
Edinb	2	7	17	24	22	17	10	1
Exeter	2	5	12	19	21	19	18	4
Glasgw	3	7	16	24	21	18	10	1
Glouc	1	5	12	16	22	21	19	5
Hull	2	7	15	20	24	18	11	2
Inverns	1	7	19	21	18	17	16	1
Ipswi	2	6	13	22	24	20	11	2
Kent	3	6	13	17	22	23	14	3
Klmarnk	1	5	15	21	24	15	15	4
L Barts	2	9	17	25	23	16	8	0
L Guys	3	8	18	25	20	15	10	2
L Kings	1	7	17	22	21	20	11	1
L Rfree	3	9	17	20	20	17	12	2
L St.G	2	6	15	20	23	20	12	2
L West	1	7	14	22	22	21	11	2
Leeds	4	9	16	20	21	18	11	2
Leic	2	6	15	19	23	20	13	2
Liv Ain	2	5	8	15	25	25	18	1
Liv RI	2	9	17	25	20	17	10	1
M Hope	2	8	18	21	22	18	10	1
M RI	5	8	18	25	21	15	8	0
Middlbr	2	7	16	21	20	21	12	2
Newc	4	7	13	22	26	17	10	1
Newry	3	8	10	16	20	26	14	4
Norwch	2	6	12	18	18	22	18	4
Nottm	5	7	15	21	22	17	12	1
Oxford	2	8	17	22	22	18	9	2
Plymth	1	6	13	22	21	23	11	2
Ports	3	7	15	21	23	17	12	1
Prestn	1	7	15	21	22	19	12	2

Table F.2.5. Continued

Centre	18–24	25–34	35–44	45–54	55–64	65–74	75–84	85+
Redng	1	6	12	18	22	21	16	4
Sheff	2	7	13	20	22	21	12	3
Shrew	4	5	13	19	19	22	17	2
Stevng	2	5	14	17	19	23	16	2
Sthend	1	6	10	14	24	24	16	5
Stoke	3	7	15	21	19	20	14	2
Sund	2	6	16	23	21	20	10	1
Swanse	2	5	10	13	24	25	19	4
Truro	1	6	12	14	20	22	20	5
Tyrone	4	8	14	15	16	23	16	4
Ulster	1	5	6	11	13	31	26	6
Wirral	2	5	10	17	16	25	21	4
Wolve	2	5	13	19	19	23	17	3
Wrexm	5	6	18	19	16	21	12	3
York	3	9	14	18	20	18	12	6
England	**2**	**7**	**15**	**21**	**21**	**19**	**12**	**2**
N Ireland	**3**	**8**	**14**	**20**	**18**	**21**	**14**	**3**
Scotland	**2**	**7**	**16**	**22**	**21**	**18**	**11**	**2**
Wales	**3**	**6**	**14**	**19**	**22**	**20**	**14**	**3**
UK	**2**	**7**	**15**	**21**	**21**	**19**	**12**	**2**

Table F.2.6. Dialysis modalities for non-diabetic patients (all ages)

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Abrdn**	4	82	0	6	8	0
Airdrie**	0	94	0	2	4	0
Antrim*	2	88	0	0	10	0
B Heart	3	81	8	8	1	0
B QEH	3	18	63	7	9	0
Bangor	4	67	0	12	16	0
Basldn	0	84	0	6	10	0
Belfast*	4	82	0	2	12	0
Bradfd	0	65	18	5	13	0
Brightn	8	38	32	11	11	0
Bristol	7	15	63	10	6	0
Camb	2	37	51	0	0	10
Cardff	7	18	55	19	0	0
Carlis	0	59	21	7	13	0
Carsh	1	32	51	5	11	0
Chelms	1	73	0	18	8	0
Clwyd	2	88	0	7	4	0
Covnt	1	79	0	20	0	0
D & Gall**	0	80	0	10	10	0
Derby	5	70	0	21	4	0
Derry*	2	93	0	0	5	0
Donc	0	63	18	2	16	0
Dorset	1	24	54	10	12	0
Dudley	1	50	24	25	0	0
Dundee**	0	85	0	2	14	0
Dunfn**	0	83	0	2	15	0
Edinb**	3	79	0	8	11	0
Exeter	1	37	46	11	5	0

Table F.2.6. Continued

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Glasgw**	5	69	17	7	2	0
Glouc	0	80	0	5	14	0
Hull	4	39	38	6	13	0
Inverns**	4	70	0	12	15	0
Ipswi	2	63	9	13	13	1
Kent	3	24	57	17	0	0
Klmarnk**	4	75	0	6	15	0
L Barts	1	28	49	9	13	0
L Guys	7	21	64	3	6	0
L Kings	0	28	52	7	13	0
L Rfree	4	36	52	2	6	0
L St.G	3	44	31	10	12	0
L West	1	29	67	2	2	0
Leeds	3	14	65	6	12	0
Leic	3	18	60	7	12	0
Liv Ain	3	8	85	1	3	0
Liv RI	3	42	37	8	10	0
M Hope	0	37	39	19	5	0
M RI	14	26	36	5	18	0
Middlbr	2	32	59	6	0	0
Newc	4	79	0	2	15	0
Newry*	4	83	0	0	13	0
Norwch	4	49	31	12	3	0
Nottm	3	47	29	6	15	0
Oxford	5	74	0	9	11	0
Plymth	2	72	0	17	8	0
Ports	0	23	60	17	0	0
Prestn	5	19	62	4	9	0
Redng	0	64	14	22	0	0
Sheff	8	35	48	10	0	0
Shrew	2	47	39	13	0	0
Stevng	0	38	54	8	0	0
Sthend	0	84	0	16	0	0
Stoke	2	51	29	5	13	0
Sund	1	64	21	6	9	0
Swanse	3	52	30	11	4	0
Truro	1	47	37	6	8	0
Tyrone*	1	90	0	0	9	0
Ulster*	3	96	0	0	1	0
Wolve	1	23	60	15	0	0
Wrexm	4	68	0	27	1	0
York	1	64	28	6	1	0
England	**3**	**39**	**42**	**9**	**7**	**0**
N Ireland*	**3**	**87**	**0**	**1**	**9**	**0**
Scotland**	**3**	**78**	**5**	**6**	**8**	**0**
Wales	**5**	**42**	**34**	**16**	**3**	**0**
UK	**3**	**44**	**37**	**8**	**7**	**0**

Excluded centres with $\geqslant$40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with $\geqslant$50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code
* There are no satellite centres in Northern Ireland
** All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

Table F.2.7. Number of non-diabetic patients by treatment modality

	HD	PD	Transplant
England	13,458	2,584	17,037
N Ireland	563	65	582
Scotland	1,474	246	1,850
Wales	819	192	1,066
UK	**16,314**	**3,087**	**20,535**

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code

Table F.2.8. Dialysis modalities for non-diabetic patients aged under 65

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Abrdn**	6	75	0	5	14	0
Airdrie**	0	91	0	3	6	0
Antrim*	7	82	0	0	11	0
B Heart	5	79	6	8	1	0
B QEH	4	18	58	8	12	0
Bangor	7	70	0	7	16	0
Basldn	0	86	0	3	10	0
Belfast*	3	82	0	3	11	1
Bradfd	0	69	10	8	13	0
Brightn	14	34	25	12	15	0
Bristol	10	18	51	12	10	0
Camb	5	37	42	0	0	16
Cardff	11	20	45	24	0	0
Carlis	0	52	24	9	15	0
Carsh	1	35	44	6	13	0
Chelms	0	69	0	20	12	0
Clwyd	3	82	0	9	6	0
Covnt	3	76	0	21	0	0
D & Gall**	0	63	0	16	21	0
Derby	5	64	0	24	7	0
Derry*	4	85	4	0	7	0
Donc	0	64	12	3	21	0
Dorset	0	25	55	8	12	0
Dudley	2	51	22	26	0	0
Dundee**	0	72	0	4	24	0
Dunfn**	0	85	0	2	13	0
Edinb**	4	77	0	7	12	0
Exeter	2	33	39	16	10	0
Glasgw**	7	65	15	10	3	0
Glouc	0	65	0	6	27	1
Hull	6	38	34	10	12	0

Table F.2.8. Continued

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Inverns**	9	63	0	9	19	0
Ipswi	2	58	12	10	18	0
Kent	4	21	53	21	0	0
Klmarnk**	6	71	0	4	19	0
L Barts	1	30	46	8	15	0
L Guys	10	22	58	3	6	0
L Kings	0	34	42	7	17	0
L Rfree	7	39	45	2	8	0
L St.G	6	40	28	9	16	0
L West	2	30	63	1	3	0
Leeds	6	17	55	8	15	0
Leic	5	19	56	6	13	0
Liv Ain	5	7	83	0	5	0
Liv RI	5	40	36	5	14	0
M Hope	0	37	33	23	7	0
M RI	20	25	30	5	20	0
Middlbr	3	37	53	6	1	0
Newc	6	74	0	2	18	0
Newry*	4	76	0	0	20	0
Norwch	7	47	24	15	6	1
Nottm	4	46	23	6	21	0
Oxford	7	69	0	8	16	0
Plymth	6	59	0	20	16	0
Ports	0	28	53	19	0	0
Prestn	8	21	55	6	11	0
Redng	0	59	11	29	0	0
Sheff	12	33	44	10	0	0
Shrew	3	41	39	17	0	0
Stevng	0	40	48	12	0	0
Sthend	0	71	0	29	0	0
Stoke	4	51	27	3	16	0
Sund	1	66	16	3	14	0
Swanse	8	53	24	10	5	0
Truro	3	55	26	10	6	0
Tyrone*	2	85	0	0	12	0
Ulster*	11	84	0	0	5	0
Wolve	3	29	49	19	0	0
Wrexm	6	75	0	19	0	0
York	2	71	19	7	0	0
England	**5**	**38**	**38**	**9**	**10**	**0**
N Ireland*	**4**	**82**	**0**	**1**	**12**	**0**
Scotland**	**5**	**73**	**5**	**7**	**11**	**0**
Wales	**9**	**43**	**29**	**17**	**3**	**0**
UK	**5**	**43**	**33**	**9**	**9**	**0**

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code
* There are no satellite centres in Northern Ireland
** All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

Table F.2.9. Number of non-diabetic patients aged under 65 by treatment modality

	HD	PD	Transplant
England	6,539	1,555	14,146
N Ireland	247	39	484
Scotland	727	155	1,573
Wales	364	92	883
UK	**7,877**	**1,841**	**17,086**

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code

Table F.2.10. Dialysis modalities for non-diabetic patients aged over 65

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Abrdn**	1	90	0	7	1	0
Airdrie**	0	97	0	1	1	0
Antrim*	0	91	0	0	9	0
B Heart	2	82	9	7	0	0
B QEH	1	19	70	5	6	0
Bangor	2	65	0	17	17	0
Basldn	0	82	0	8	10	0
Belfast*	4	83	0	1	12	0
Bradfd	0	59	28	1	12	0
Brightn	5	41	37	10	8	0
Bristol	4	12	73	9	2	0
Camb	0	37	57	0	0	6
Cardff	4	16	65	15	0	0
Carlis	0	65	19	5	11	0
Carsh	1	29	57	5	8	0
Chelms	1	76	0	17	6	0
Clwyd	0	96	0	4	0	0
Covnt	0	81	0	19	0	0
D & Gall**	0	90	0	6	3	0
Derby	6	75	0	17	2	0
Derry*	0	97	0	0	3	0
Donc	0	63	24	1	12	0
Dorset	1	24	53	10	12	0
Dudley	0	49	26	25	0	0
Dundee**	0	93	0	0	7	0
Dunfn**	0	81	0	2	17	0
Edinb**	1	81	0	8	10	0
Exeter	0	39	52	7	2	0
Glasgw**	2	75	19	5	1	0
Glouc	0	90	0	4	6	0

Table F.2.10. Continued

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Hull	2	39	43	3	13	0
Inverns**	0	74	0	14	12	0
Ipswi	3	67	6	15	8	2
Kent	2	25	60	13	0	0
Klmarnk**	3	79	0	8	11	0
L Barts	0	23	55	11	11	0
L Guys	1	18	72	3	6	0
L Kings	0	18	68	7	7	0
L Rfree	1	33	61	2	4	0
L St.G	0	48	34	10	7	0
L West	0	28	70	2	0	0
Leeds	0	12	75	4	10	0
Leic	0	18	65	7	11	0
Liv Ain	0	9	88	2	2	0
Liv RI	1	44	39	11	4	1
M Hope	0	37	47	13	2	0
M RI	4	28	47	6	16	0
Middlbr	1	28	64	6	0	0
Newc	0	86	0	2	11	0
Newry*	4	89	0	0	7	0
Norwch	2	51	36	10	2	0
Nottm	2	47	36	6	9	0
Oxford	3	80	0	11	6	0
Plymth	0	81	0	16	4	0
Ports	0	18	66	16	0	0
Prestn	3	17	70	3	8	0
Redng	0	67	17	16	0	0
Sheff	3	37	51	9	0	0
Shrew	0	53	38	9	0	0
Stevng	0	35	60	4	0	0
Sthend	0	94	0	6	0	0
Stoke	0	51	32	7	10	0
Sund	0	61	28	10	1	0
Swanse	0	52	33	12	3	0
Truro	0	44	43	4	9	0
Tyrone*	0	93	0	0	7	0
Ulster*	0	100	0	0	0	0
Wolve	0	19	69	12	0	0
Wrexm	2	63	0	33	2	0
York	0	56	39	4	1	0
England	**1**	**40**	**46**	**8**	**5**	**0**
N Ireland*	**2**	**91**	**0**	**0**	**7**	**0**
Scotland**	**1**	**82**	**6**	**5**	**6**	**0**
Wales	**2**	**41**	**39**	**15**	**3**	**0**
UK	**1**	**45**	**41**	**8**	**5**	**0**

Excluded centres with $\geqslant$40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with $\geqslant$50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code
* There are no satellite centres in Northern Ireland
** All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

Table F.2.11. Number of non-diabetic patients aged over 65 by treatment modality

	HD	PD	Transplant
England	6,919	1,029	2,891
N Ireland	316	26	98
Scotland	747	91	277
Wales	455	100	183
UK	**8,437**	**1,246**	**3,449**

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code

Table F.2.12. Dialysis modalities for diabetic patients

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Abrdn**	0	89	0	11	0	0
Airdrie**	0	88	0	12	0	0
Antrim*	0	89	0	11	0	0
B Heart	2	88	6	5	0	0
B QEH	0	16	69	15	0	0
Bangor	6	67	0	28	0	0
Basldn	0	79	0	17	3	0
Belfast*	7	86	0	7	0	0
Bradfd	0	86	9	5	0	0
Brightn	7	42	35	17	0	0
Bristol	3	20	66	10	0	0
Camb	5	35	45	0	15	0
Cardff	3	16	68	13	0	0
Carlis	0	64	27	9	0	0
Carsh	0	26	62	13	0	0
Chelms	0	83	0	17	0	0
Clwyd	0	96	0	4	0	0
Covnt	0	84	0	16	0	0
D & Gall**	0	85	0	15	0	0
Derby	1	70	0	29	0	0
Derry*	0	100	0	0	0	0
Donc	0	48	17	34	0	0
Dorset	2	21	62	15	0	0
Dudley	0	57	13	30	0	0
Dundee**	0	95	0	5	0	0
Dunfn**	0	83	0	17	0	0
Edinb**	2	81	0	18	0	0
Exeter	0	43	50	8	0	0
Glasgw**	2	73	18	7	0	0

Table F.2.12. Continued

Centre	% home HD	% hospital HD	% satellite HD	% CAPD	% APD	% unknown type of PD
Glouc	0	88	0	12	0	0
Hull	0	38	44	18	0	0
Inverns**	0	100	0	0	0	0
Ipswi	0	58	4	38	0	0
Kent	0	25	56	19	0	0
Klmarnk**	0	81	0	19	0	0
L Barts	0	32	49	19	0	0
L Guys	1	36	59	3	1	0
L Kings	0	32	56	12	0	0
L Rfree	0	45	50	5	0	0
L St.G	0	42	43	13	1	0
L West	0	32	66	2	0	0
Leeds	1	17	65	16	0	0
Leic	1	24	60	15	0	0
Liv Ain	0	7	87	7	0	0
Liv RI	0	53	27	20	0	0
M Hope	0	28	44	28	0	0
M RI	4	39	40	15	1	0
Middlbr	2	33	65	0	0	0
Newc	0	86	0	14	0	0
Newry*	0	100	0	0	0	0
Norwch	2	42	42	15	0	0
Nottm	4	56	20	21	0	0
Oxford	2	72	0	26	0	0
Plymth	0	75	0	25	0	0
Ports	0	28	60	13	0	0
Prestn	2	29	57	12	0	0
Redng	0	59	12	29	0	0
Sheff	3	39	41	17	0	0
Shrew	0	48	38	15	0	0
Stevng	0	29	67	4	0	0
Sthend	0	97	0	3	0	0
Stoke	0	49	26	25	0	0
Sund	0	76	14	10	0	0
Swanse	4	59	26	10	0	0
Truro	0	37	59	4	0	0
Tyrone*	0	79	0	21	0	0
Ulster*	0	95	0	5	0	0
Wolve	0	30	57	13	0	0
Wrexm	0	81	0	19	0	0
York	0	52	34	14	0	0
England	**1**	**41**	**44**	**14**	**0**	**0**
N Ireland*	**2**	**90**	**0**	**8**	**0**	**0**
Scotland**	**1**	**83**	**6**	**10**	**0**	**0**
Wales	**3**	**42**	**42**	**13**	**0**	**0**
UK	**1**	**46**	**40**	**13**	**0**	**0**

Excluded centres with $\geqslant 40\%$ primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with $\geqslant 50\%$ primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code
* There are no satellite centres in Northern Ireland
** All haemodialysis patients in centres in Scotland are shown as receiving treatment at home or in centre as no data is available regarding satellite dialysis (except Glasgow)

Table F.2.13. Number of diabetic patients by treatment modality

	HD	PD	Transplant
England	3,681	603	1,716
N Ireland	157	13	47
Scotland	355	41	179
Wales	230	34	128
UK	4,423	691	2,070

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code

Table F.2.14. Diabetics

Centre	M:F ratio	Median age on 31/12/2008	Median age at start of treatment	Median time on RRT in days	Median time on RRT in years
Abrdn	1.6	60	55	1,398	3.8
Airdrie	1.5	53	47	1,095	3.0
Antrim	1.1	66	61	1,322	3.6
B Heart	1.7	65	61	933	2.6
B QEH	1.3	63	59	1,068	2.9
Bangor	1.6	70	68	467	1.3
Basldn	3.3	62	59	1,319	3.6
Belfast	1.6	59	53	1,380	3.8
Bradfd	1.7	61	56	1,025	2.8
Brightn	2.0	62	60		
Bristol	1.3	61	57	1,256	3.4
Camb	2.0	47	41	1,826	5.0
Cardff	1.7	61	54	1,059	2.9
Carlis	3.5	60	57	1,359	3.7
Carsh	1.9	63	59	1,098	3.0
Chelms	2.3	60	58	783	2.1
Clwyd	1.0	63	53	1,290	3.5
Covnt	1.7	65	61	963	2.6
D & Gall	2.5	59	53	1,104	3.0
Derby	1.4	65	62	961	2.6
Derry	0.3	57	53	1,877	5.1
Donc	2.6	59	57	812	2.2
Dorset	2.3	59	52	905	2.5
Dudley	3.6	60	58	978	2.7
Dundee	1.1	59	56	1,130	3.1
Dunfn	0.7	57	55	986	2.7
Edinb	1.9	55	48	1,269	3.5
Exeter	1.2	56	52	926	2.5
Glasgw	1.3	59	55	1,147	3.1
Glouc	1.3	58	51	1,196	3.3
Hull	1.6	62	54	1,369	3.7
Inverns	2.2	52	48	1,464	4.0
Ipswi	1.8	59	54	1,004	2.7
Kent	1.6	61	58	1,030	2.8
Klmarnk	1.3	56	49	1,039	2.8

Table F.2.14. Continued

Centre	M:F ratio	Median age on 31/12/2008	Median age at start of treatment	Median time on RRT in days	Median time on RRT in years
L Barts	1.8	62	58	1,034	2.8
L Guys	1.2	57	51	1,381	3.8
L Kings	1.1	63	59	844	2.3
L Rfree	1.2	65	59	1,304	3.6
L St.G	1.2	67	62	1,151	3.2
L West	1.7	62	57	1,267	3.5
Leeds	1.4	61	57	1,439	3.9
Leic	1.6	61	56	1,054	2.9
Liv Ain	0.9	59	57	711	1.9
Liv RI	1.5	55	50	1,652	4.5
M Hope	1.2	64	61	790	2.2
M RI	1.5	56	52	1,207	3.3
Middlbr	1.3	53	48	1,067	2.9
Newc	1.3	54	49	1,052	2.9
Newry	1.9	66	62	866	2.4
Norwch	1.1	63	56	982	2.7
Nottm	1.3	59	53	1,203	3.3
Oxford	1.9	56	49	1,410	3.9
Plymth	2.2	57	54	906	2.5
Ports	1.9	56	52	966	2.6
Prestn	1.9	61	58	1,110	3.0
Redng	1.5	63	60	949	2.6
Sheff	1.8	61	56	1,174	3.2
Shrew	1.5	64	62	876	2.4
Stevng	2.0	63	60	835	2.3
Sthend	1.2	62	55	1,310	3.6
Stoke	1.0	62	57	1,165	3.2
Sund	1.6	58	55	804	2.2
Swanse	2.2	63	58	908	2.5
Truro	2.4	62	62	1,191	3.3
Tyrone	1.5	66	63	570	1.6
Ulster	1.4	67	65	1,190	3.3
Wolve	1.8	59	56	1,052	2.9
Wrexm	3.0	51	41	1,966	5.4
York	1.3	56	54	979	2.7
England	**1.5**	**61**	**56**	**1,125**	**3.1**
N Ireland	**1.3**	**64**	**60**	**1,274**	**3.5**
Scotland	**1.4**	**57**	**52**	**1,196**	**3.3**
Wales	**1.8**	**61**	**55**	**1,071**	**2.9**
UK	**1.5**	**60**	**56**	**1,140**	**3.1**

Excluded centres with $\geqslant$40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral) as well as centres with $\geqslant$50% primary renal diagnosis not sent (Colchester)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding patients with diabetes and patients with a missing primary renal disease code

Table F.2.15. Transplant gender ratios

	% males	% females	N males	N females	M:F ratio
England	60.5	39.5	11,742	7,676	1.5
N Ireland	63.2	36.8	398	232	1.7
Scotland	59.5	40.5	1,213	825	1.5
Wales	63.2	36.8	757	441	1.7
UK	**60.6**	**39.4**	**14,110**	**9,174**	**1.5**

Appendix G
UK Renal Registry Dataset Specification

This appendix is available on the UK Renal Registry website only. The current version of this document can be found under the downloads menu at www.renalreg.org.

Appendix H
Coding: Ethnicity, EDTA Primary Renal Diagnoses, EDTA Causes of Death

H1: Ethnicity coding

Ethnicity data is recorded in the clinical information systems in the individual renal centres in the format of 9S... read codes.

Ethnic category	Read code	Old PAS	Renal Assoc	New PAS
White	9S1..	0	W	A1
Black Caribbean	9S2..	1		M1
Black African	9S3..	2		N1
Black other/non-mixed origin	9S4..	3		P1
Indian	9S6..	4		H1
Pakistani	9S7..	5		J1
Bangladeshi	9S8..	6		K1
Chinese	9S9..	7	C	R1
Black British	9S41.			PD
Black Caribbean	9S42.			
Black North African	9S43.			
Black other African country	9S44.			
Black East African Asian	9S45.			
Black Indian sub-continent	9S46.			
Black other Asian	9S47.			
Black Black other	9S48.		B	PE
Black other/mixed	9S5..			
Other Black Black/White origin	9S51.			GC
Other Black Black/Asian origin	9S52.			GA
Other ethnic non-mixed (NMO)	9SA..			
Brit. ethnic minor. spec. (NMO)	9SA1.			
Brit. ethnic minor. unsp. (NMO)	9SA2.			
Caribbean Island (NMO)	9SA3.			
North African Arab (NMO)	9SA4.			
Other African countries (NMO)	9SA5.			
East African Asian (NMO)	9SA6.			
Indian sub-continent (NMO)	9SA7.			
Other Asian (NMO)	9SA8.		A	L1

Ethnic category	Read code	Old PAS	Renal Assoc	New PAS
Irish (NMO)	9SA9.			B1
Greek Cypriot (NMO)	9SAA.			CG
Turkish Cypriot (NMO)	9SAB.			CJ
Other European (NMO)	9SAC.			C1
Other ethnic NEC (NMO)	9SAD.			S1
Other ethnic mixed origin	9SB..	8		
Other ethnic Black/White origin	9SB1.			E1
Other ethnic Asian/White origin	9SB2.			F1
Other ethnic mixed white origin	9SB3.			
Other ethnic other mixed origin	9SB4.			G1

H2: EDTA primary renal diagnoses

Code	Title	Group
0	Chronic renal failure; aetiology uncertain unknown/unavailable	Uncertain
10	Glomerulonephritis; histologically NOT examined	Uncertain
11	Focal segmental glomerulosclerosis with nephrotic syndrome in children	Glomerulonephritis
12	IgA nephropathy (proven by immunofluorescence, not code 76 and not 85)	Glomerulonephritis
13	Dense deposit disease; membrano-proliferative GN; type II (proven by immunofluorescence and/or electron microscopy)	Glomerulonephritis
14	Membranous nephropathy	Glomerulonephritis
15	Membrano-proliferative GN; type I (proven by immunofluorescence and/or electron microscopy – not code 84 or 89)	Glomerulonephritis
16	Crescentic (extracapillary) glomerulonephritis (type I, II, III)	Glomerulonephritis
17	Focal segmental glomerulosclerosis with nephrotic syndrome in adults	Glomerulonephritis
19	Glomerulonephritis; histologically examined, not given above	Glomerulonephritis
20	Pyelonephritis – cause not specified	Pyelonephritis
21	Pyelonephritis associated with neurogenic bladder	Pyelonephritis
22	Pyelonephritis due to congenital obstructive uropathy with/without vesico-ureteric reflux	Pyelonephritis
23	Pyelonephritis due to acquired obstructive uropathy	Pyelonephritis
24	Pyelonephritis due to vesico-ureteric reflux without obstruction	Pyelonephritis
25	Pyelonephritis due to urolithiasis	Pyelonephritis
29	Pyelonephritis due to other cause	Pyelonephritis
30	Interstitial nephritis (not pyelonephritis) due to other cause, or unspecified (not mentioned above)	Interstitial
31	Nephropathy (interstitial) due to analgesic drugs	Interstitial
32	Nephropathy (interstitial) due to cis-platinum	Interstitial
33	Nephropathy (interstitial) due to cyclosporin A	Interstitial
34	Lead induced nephropathy (interstitial)	Interstitial
39	Drug induced nephropathy (interstitial) not mentioned above	Interstitial
40	Cystic kidney disease – type unspecified	Cystic/poly
41	Polycystic kidneys; adult type (dominant)	Cystic/poly
42	Polycystic kidneys; infantile (recessive)	Cystic/poly
43	Medullary cystic disease; including nephronophtisis	Other
49	Cystic kidney disease – other specified type	Other
50	Hereditary/Familial nephropathy – type unspecified	Other
51	Hereditary nephritis with nerve deafness (Alport's Syndrome)	Other
52	Cystinosis	Other
53	Primary oxalosis	Other
54	Fabry's disease	Other
59	Hereditary nephropathy – other specified type	Other
60	Renal hypoplasia (congenital) – type unspecified	Other
61	Oligomeganephronic hypoplasia	Other

Code	Title	Group
63	Congenital renal dysplasia with or without urinary tract malformation	Other
66	Syndrome of agenesis of abdominal muscles (Prune Belly)	Other
70	Renal vascular disease – type unspecified	Renal vascular disease
71	Renal vascular disease due to malignant hypertension	Renal vascular disease
72	Renal vascular disease due to hypertension	Renal vascular disease
73	Renal vascular disease due to polyarteritis	Renal vascular disease
74	Wegener's granulomatosis	Other
75	Ischaemic renal disease/cholesterol embolism	Renal vascular disease
76	Glomerulonephritis related to liver cirrhosis	Other
78	Cryoglobulinemic glomerulonephritis	Other
79	Renal vascular disease – due to other cause (not given above and not code 84–88)	Renal vascular disease
80	Type 1 diabetes with diabetic nephropathy	Diabetes
81	Type 2 diabetes with diabetic nephropathy	Diabetes
82	Myelomatosis/light chain deposit disease	Other
83	Amyloid	Other
84	Lupus erythematosus	Other
85	Henoch-Schoenlein purpura	Other
86	Goodpasture's Syndrome	Other
87	Systemic sclerosis (scleroderma)	Other
88	Haemolytic Ureaemic Syndrome (including Moschcowitz Syndrome)	Other
89	Multi-system disease – other (not mentioned above)	Other
90	Tubular necrosis (irreversible) or cortical necrosis (different from 88)	Other
91	Tuberculosis	Other
92	Gout nephropathy (urate)	Other
93	Nephrocalcinosis and hypercalcaemic nephropathy	Other
94	Balkan nephropathy	Other
95	Kidney tumour	Other
96	Traumatic or surgical loss of kidney	Other
98	Not known	Missing
99	Other identified renal disorders	Other
199	Code not sent	Missing

H3: EDTA cause of death

EDTA code	Cause
0	Cause of death uncertain/not determined
11	Myocardial ischaemia and infarction
12	Hyperkalaemia
13	Haemorrhagic pericarditis
14	Other causes of cardiac failure
15	Cardiac arrest/sudden death; other cause or unknown
16	Hypertensive cardiac failure
17	Hypokalaemia
18	Fluid overload/pulmonary oedema
21	Pulmonary embolus
22	Cerebro-vascular accident, other cause or unspecified
23	Gastro-intestinal haemorrhage (digestive)
24	Haemorrhage from graft site
25	Haemorrhage from vascular access or dialysis circuit
26	Haemorrhage from ruptured vascular aneurysm (not code 22 or 23)
27	Haemorrhage from surgery (not codes 23, 24, 26)
28	Other haemorrhage (not codes 23–27)
29	Mesenteric infarction
31	Pulmonary infection bacterial (not code 73)
32	Pulmonary infection (viral)
33	Pulmonary infection (fungal or protozoal; parasitic)
34	Infections elsewhere except viral hepatitis
35	Septicaemia
36	Tuberculosis (lung)
37	Tuberculosis (elsewhere)
38	Generalized viral infection
39	Peritonitis (all causes except for peritoneal dialysis)
41	Liver disease due to hepatitis B virus
42	Liver disease due to other viral hepatitis
43	Liver disease due to drug toxicity
44	Cirrhosis – not viral (alcoholic or other cause)
45	Cystic liver disease
46	Liver failure – cause unknown
51	Patient refused further treatment for end stage renal failure (ESRF)
52	Suicide
53	ESRF treatment ceased for any other reason
54	ESRF treatment withdrawn for medical reasons
61	Uraemia caused by graft failure
62	Pancreatitis
63	Bone marrow depression (Aplasia)
64	Cachexia
66	Malignant disease in patient treated by immunosuppressive therapy
67	Malignant disease: solid tumours except those of 66
68	Malignant disease: lymphoproliferative disorders (except 66)
69	Dementia
70	Peritonitis (sclerosing, with peritoneal dialysis)
71	Perforation of peptic ulcer
72	Perforation of colon
73	Chronic obstructive pulmonary disease
81	Accident related to ESRF treatment (not 25)
82	Accident unrelated to ESRF treatment
99	Other identified cause of death
100	Peritonitis (bacterial, with peritoneal dialysis)
101	Peritonitis (fungal, with peritoneal dialysis)
102	Peritonitis (due to other cause, with peritoneal dialysis)

Appendix I
Acronyms and Abbreviations used in the Report

ACE (inhibitor)	Angiotensin converting enzyme (inhibitor)
ANZDATA	Australia and New Zealand Dialysis and Transplant Registry
APD	Automated peritoneal dialysis
ADPKD	Autosomal dominant polycystic kidney disease
APKD	Adult polycystic kidney disease
AVF	Arteriovenous fistula
AVG	Arteriovenous graft
BAPN	British Association of Paediatric Nephrology
BCG	Bromocresol green
BCP	Bromocresol purple
BMI	Body mass index
BP	Blood pressure
BTS	British Transplant Society
CAB	Clinical Affairs Board (Renal Association)
CABG	Coronary artery bypass grafting
CAPD	Continuous ambulatory peritoneal dialysis
CCL	Clinical Computing Limited
CCPD	Cycling peritoneal dialysis
CHr	Target reticulocyte Hb content
CI	Confidence interval
CK	Creatine kinase
CKD	Chronic kidney disease
CK-MB	Creatine kinase isoenzyme MB
COPD	Chronic obstructive pulmonary disease
CRF	Chronic renal failure
CRP	C-reactive protein
CVVH	Continuous veno-venous haemofiltration
CXR	Chest x-ray
DBP	Diastolic blood pressure
DCCT	Diabetes Control and Complications Trial
DH	Department of Health
DM	Diabetes mellitus
DOPPS	Dialysis Outcomes and Practice Patterns Study
E&W	England and Wales
E, W & NI	England, Wales and Northern Ireland
EBPG	European Best Practice Guidelines
ECG	Electrocardiogram
EDTA	European Dialysis and Transplant Association
EF	Error factor
eGFR	Estimated glomerular filtration rate
E_i	Expected cases in area i

EPO	Erythropoietin
ERA	European Renal Association
ERA-EDTA	European Renal Association – European Dialysis and Transplant Association
ERF	Established renal failure
ESA	Erythropoiesis stimulating agent
ESRD	End stage renal disease
ESRF	End stage renal failure
EWNI	England, Wales and Northern Ireland
FEV1	Forced expiratory volume in 1 second
FVC	Forced vital capacity
GFR	Glomerular filtration rate
GN	Glomerulonephritis
HA	Health Authority
Hb	Haemoglobin
HbA1c	Glycated Haemoglobin
HBeAg	Hepatitis B e antigen
HCAI-DCS	Healthcare-associated infection data collection system
HD	Haemodialysis
HDL	High-density lipoprotein
HLA	Human leucocyte antigen
HPA	Health Protection Agency
HR	Hazard ratio
HRC	Hypochromic red blood cells
ICU	Intensive care unit
IDMS	Isotope dilution mass spectrometry
IDOPPS	International Dialysis Outcomes and Practice Patterns Study
IFCC	International Federation of Clinical Chemistry & Laboratory Medicine
IHD	Ischaemic heart disease
IPD	Intermittent peritoneal dialysis
IQR	Inter-quartile range
IT	Information technology
IU	International units
KDIGO	Kidney Disease: Improving Global Outcomes
KDOQI	Kidney Disease Outcomes Quality Initiative
KM	Kaplan Meier
LA	Local Authority
LCL	Lower confidence limit
LDL	Low-density lipoprotein
M:F	Male:Female
MAP	Mean arterial blood pressure
MDRD	Modification of diet in renal disease
MI	Myocardial infarction
MRSA	Methicillin resistant Staphylococcal aureus
N Ireland	Northern Ireland
NE	North East
NEQAS	UK National External Quality Assessment Scheme
NHS	National Health Service
NHS BT	National Health Service Blood and Transplant
NI	Northern Ireland
NICE	National Institute for Health and Clinical Excellence
NSF	National service framework
NTC	Non-tunnelled dialysis catheter
NW	North West
O/E	Observed/expected
ODT	Organ Donation and Transplantation (a Directorate of NHS Blood and Transplant)
O_i	Observed cases in area i
ONS	Office of National Statistics
PAS	Patient Administration System
PCT	Primary Care Trust
PD	Peritoneal dialysis

PIAG	Patient Information Advisory Group
PKD	Polycystic kidney disease
PMARP	Per million age related population
PMCP	Per million child population
PMP	Per million population
PP	Pulse pressure
PRD	Primary renal disease
PTH	Parathyroid hormone
PUV	Posterior urethral valves
PVD	Peripheral vascular disease
QOF	Quality and Outcomes Framework
QUEST	Quality European Studies
RA	Renal Association
RI	Royal Infirmary
RNSF	Renal National Service Framework (or NSF)
RR	Relative risk
RRDSS	Renal Registry data set specification
RRT	Renal replacement therapy
SAR	Standardised acceptance ratio (= O/E)
SAS	Statistical Analysis System
SBP	Systolic blood pressure
SD	Standard deviation
SES	Socio-economic status
SHA	Strategic health authority
SHARP	Study of Heart and Renal Protection
SI	System International (units)
SMR	Standardised mortality ratios
SPR	Standardised prevalence ratio (= O/E)
SR	Standardised ratio (used to cover either SAR or SPR)
SUS	Secondary uses service
SW	South West
TC	Tunnelled dialysis catheter
TSAT	Transferrin saturation
TWL	Transplant waiting list
Tx	Transplant
UCL	Upper confidence limit
UK	United Kingdom
UKRR	UK Renal Registry
UKT	UK Transplant (now ODT)
URR	Urea reduction ratio
USRDS	United States Renal Data System

Appendix J
Laboratory Conversion Factors

	Conversion factors from SI units
Albumin	$g/dl = g/L \times 0.1$
Aluminium	$\mu g/L = \mu mol/L \times 27.3$
Bicarbonate	$mg/dl = mmol/L \times 6.1$
Calcium	$mg/dl = mmol/L \times 4$
Calcium × phosphate	$mg^2/dl^2 = mmol^2/L^2 \times 12.4$
Cholesterol	$mg/dl = mmol/L \times 38.6$
Creatinine	$mg/dl = \mu mol/L \times 0.011$
Glucose	$mg/dl = mmol/L \times 18$
Haemoglobin	$Hct = g/dl \times 3.11$ (*NB this factor is variable)*
Phosphate	$mg/dl = mmol/L \times 3.1$
PTH	$ng/L = pmol/L \times 9.5$
Urea	$mg/dl = mmol/L \times 2.8$

Appendix K
Renal Centre Names and Abbreviations used in the Figures and Data Tables

Adult Centres

City	Hospital	Abbreviation	Country
Basildon	Basildon Hospital	Basldn	England
Birmingham	Heartlands Hospital	B Heart	England
Birmingham	Queen Elizabeth Hospital	B QEH	England
Bradford	St Luke's Hospital	Bradfd	England
Brighton	Royal Sussex County Hospital	Brightn	England
Bristol	Southmead Hospital	Bristol	England
Cambridge	Addenbrookes Hospital	Camb	England
Carlisle	Cumberland Infirmary	Carlis	England
Carshalton	St Helier Hospital	Carsh	England
Chelmsford	Broomfield Hospital	Chelms	England
Colchester	Colchester General Hospital	Colchr	England
Coventry	Walsgrave Hospital	Covnt	England
Derby	Royal Derby Hospital	Derby	England
Doncaster	Doncaster Royal Infirmary	Donc	England
Dorset	Dorset Country Hospital	Dorset	England
Dudley	Russells Hall Hospital	Dudley	England
Exeter	Royal Devon and Exeter Hospital	Exeter	England
Gloucester	Gloucester Royal Hospital	Glouc	England
Hull	Hull Royal Infirmary	Hull	England
Ipswich	Ipswich Hospital	Ipswi	England
Kent	Kent and Canterbury Hospital	Kent	England
Leeds	St James's University Hospital and Leeds General Infirmary	Leeds	England
Leicester	Leicester General Hospital	Leic	England
Liverpool	University Hospital Aintree	Liv Ain	England
Liverpool	Royal Liverpool University Hospital	Liv RI	England
London	St Barts and The London Hospital	L Barts	England
London	St George's Hospital	L St. G	England
London	Guy's & St Thomas' Hospital	L Guys	England
London	Hammersmith, Charing Cross, St Marys' and Paddington Hospitals	L West	England
London	King's College Hospital	L Kings	England
London	Royal Free, Middlesex and UCL Hospitals	L Rfree	England
Manchester	Hope Hospital	M Hope	England
Manchester	Manchester Royal Infirmary	M RI	England
Middlesbrough	James Cook University Hospital	Middlbr	England
Newcastle	Freeman Hospital and Royal Victoria Informary	Newc	England

City	Hospital	Abbreviation	Country
Norwich	Norfolk and Norwich University Hospital	Norwch	England
Nottingham	Nottingham City Hospital	Nottm	England
Oxford	Oxford Radcliffe Hospital (previously reported as Churchill Hospital)	Oxford	England
Plymouth	Derriford Hospital	Plymth	England
Portsmouth	Queen Alexandra Hospital	Ports	England
Preston	Royal Preston Hospital	Prestn	England
Reading	Royal Berkshire Hospital	Redng	England
Sheffield	Northern General Hospital	Sheff	England
Shrewsbury	Royal Shrewsbury Hospital	Shrew	England
Southend	Southend Hospital	Sthend	England
Stevenage	Lister Hospital	Stevng	England
Stoke	University Hospital of North Staffordshire	Stoke	England
Sunderland	Sunderland Royal Hospital	Sund	England
Truro	Royal Cornwall Hospital	Truro	England
Wirral	Arrowe Park Hospital	Wirral	England
Wolverhampton	New Cross Hospital	Wolve	England
York	York District General Hospital	York	England
Bangor	Ysbyty Gwynedd	Bangor	Wales
Cardiff	University Hospital of Wales	Cardff	Wales
Clwyd	Ysbyty Glan Clwyd	Clwyd	Wales
Swansea	Morriston Hospital	Swanse	Wales
Wrexham	Wrexham Maelor Hospital	Wrexm	Wales
Aberdeen	Aberdeen Royal Infirmary	Abrdn	Scotland
Airdrie	Monklands Hospital	Airdrie	Scotland
Dumfries	Dumfries & Galloway Royal Infirmary	D&Gall	Scotland
Dundee	Ninewells Hospital	Dundee	Scotland
Dunfermline	Queen Margaret Hospital	Dunfn	Scotland
Edinburgh	Edinburgh Royal Infirmary	Edinb	Scotland
Glasgow	Glasgow Western Infirmary, Royal Infirmary and Stobhill Hospital	Glasgw	Scotland
Inverness	Raigmore Hospital	Inverns	Scotland
Kilmarnock	Crosshouse Hospital	Klmarnk	Scotland
Antrim	Antrim Hospital	Antrim	Northern Ireland
Belfast	Belfast City Hospital	Belfast	Northern Ireland
Derry	Altnagelvin Hospital	Derry	Northern Ireland
Newry	Daisy Hill Hospital	Newry	Northern Ireland
Tyrone	Tyrone County Hospital	Tyrone	Northern Ireland
Ulster	Ulster Hospital	Ulster	Northern Ireland

Paediatric Centres

City	Hospital	Abbreviation	Country
Belfast	Royal Belfast Hospital for Children	Blfst_P	Northern Ireland
Birmingham	Birmingham Children's Hospital	Bham_P	England
Bristol	Bristol Royal Hospital for Children	Brstl_P	England
Cardiff	Kruf Children's Kidney Centre	Cardf_P	Wales
Glasgow	Royal Hospital for Sick Children	Glasg_P	Scotland
Leeds	St James's University Hospital &en; Paediatric	Leeds_P	England
Liverpool	Royal Liverpool Children's Hospital	Livpl_P	England
London	Guy's Hospital – Paediatric	L Eve_P	England
London	Great Ormond Street Hospital for Children	LGOSH_P	England
Manchester	Royal Manchester Children's Hospital	Manch_P	England
Newcastle	Royal Victoria Infirmary – Paediatric	Newc_P	England
Nottingham	Nottingham City Hospital – Paediatric	Nottm_P	England
Southampton	Southampton General Hospital – Paediatric	Soton_P	England