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Foreword

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way."

Charles Dickens, the opening of 'A Tale of Two Cities'.

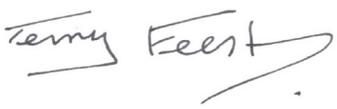
This may describe the feelings of those of us associated with the UK Renal Registry over the near twenty years of its existence – but now, certainly, is the best of times.

In the past there was excitement within the Registry. There was the thrill at producing the first report, followed in the last decade by achieving complete coverage of the United Kingdom. There was satisfaction when the statistics and audit produced by the Registry began to be recognised and used by clinicians, and more as the Registry came to work closely with patients and government to play significant roles in national planning and, importantly, in improving the quality of renal care. Today there are even more exciting opportunities.

Currently the Registry has a strong team delivering a service of increasing quality. There are now 22 employees. Some have given long loyal exceptional service, whilst newcomers have brought fresh ideas making important contributions. The data validation process has been radically revised and routine procedures automated, leaving the data managers more time to talk with renal units about the important things. The data completeness and quality have massively improved, the cycle of data collection and validation is much quicker and the Registry is on course to catch up and collect data in a timely fashion during 2013. In addition the Registry has moved into monitoring of vascular access data, is conducting a pilot on the audit of peritoneal access and will soon be fully integrated with the Paediatric Renal Registry. The Registry also acts as an umbrella organisation co-ordinating and supporting the growing number of Rare Disease Registries (RADAR) and liaises closely with Renal PatientView. Commissioners are engaged with the Registry, some are even considering making the provision of timely returns to the Registry part of the contract with dialysis units. Throughout, the Registry has remained independent of government and industry. All this provides the groundwork for the Registry of the future.

Looking to the future the Registry has many projects for patients, including facilitation of patient recorded data and production of patient decision aids. There are negotiations with the NHS Institute for qualitative research into dialysis decision making and the benefits of 'activated' patients. There are plans to begin to monitor Acute Kidney Injury and Chronic Kidney Disease. Research is growing: one most important project is the linkage with HES data. The Registry is exploring new technologies (the interactive data portal is one exciting current example) intending to radically change its techniques of data collection to improve speed and data quality, facilitate links with RADAR and other parts of Registry activities, and with their permission allow transfer of information as patients move unit to unit.

My association with the Registry is nearing its end. I will be leaving a great team at a Registry for which, I am convinced, this is the best of times with everything before it!



Terry Feest
UK Renal Registry Advisor and former Chairman

Chapters and appendices

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UK Renal Registry 14th Annual Report: Introduction

Ron Cullen, Damian Fogarty

UK Renal Registry, Bristol, UK

Introduction

The UK Renal Registry (UKRR) provides independent audit and analysis of renal replacement therapy (RRT) in the UK. The UKRR 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 relatively 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 UKRR receives quarterly electronic data extracts from information systems used for clinical and administrative purposes within each renal centre in England, Wales and Northern Ireland. Data from Scotland is received via the Scottish Renal Registry. Details of how the UKRR 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 UKRR 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 2010. 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 present 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 UKRR in 2011. Ron Cullen was appointed as Director of the Renal Registry. Ron's background is in quality improvement and policy development having worked extensively on both the clinical governance agenda and as Head of Healthcare, Quality and Standards within the Department of Health. Prof Terry Feest remains within the Registry as a Medical Advisor. Two data managers (Shaun Mannings and Jo Wilson), a statistician (David Pitcher), a programmer (George Swinnerton) whose main work has been to refine our validation steps and help with systems in general and secretary (Laura Woodward) have joined the Registry.

Data collection and validation

The UKRR has conducted a major review of the processes used for collection and validation of data and

of its communications with renal centres. This review demonstrated that the processes used had not kept abreast of developments in technology and were no longer fully fit for purpose. For some four months these have been examined in detail and new more automated processes developed which will reduce the time taken to collect and validate data. This will result in 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 led to some delay in starting to process the data files for 2010. This delay was necessary in order to produce a process which will enable faster data collection, validation and timely production of the Registry Reports in the future. It is expected the data for 2011 will be validated by November 2012 and the 2012 data by June 2013. It is the intention of the UKRR to publish data following an initial validation on a quarterly basis via the data portal (www.renalreg.com).

The UKRR 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 PatientView and RADAR to produce a single extraction routine. If successful this would facilitate the production of timely interim audit reports pending publication of the detailed annual analysis of the present.

Completeness of data returns from UK renal centres

Data completeness has generally improved this year, partly because of the improved feedback to centres and other improvements mentioned above. Table 1 shows the completeness of some key items over four years. In contrast to elsewhere in this Report, the first three rows of the table show the percentages as they were published in previous reports rather than as the data stands now. This is because the work on improving data collection and validation has also improved the 'historical' completeness, e.g. more information on date first seen for incident patients in 2009 is now available than when it was published in last year's report. Large improvements can be seen for ethnicity, date first seen and cause of death and these improvements will enable better and more comprehensive analyses. However, data are still incomplete, particularly for those data items that require clinical input, for example comorbidity at the start of RRT. These deficiencies limit the UKRR's ability to perform analyses that are fully adjusted for case-mix; it is of major importance that returns of these data items are improved.

Table 1. Percentage completeness of data returns for ethnicity, date first seen by a nephrologist and comorbidity (all for incident patients, E, W & NI) and cause of death (for deaths in 2010 amongst incident or existing patients, UK)

	2007	2008	2009	2010
Ethnicity	75.9	73.2	77.0	94.3
Date first seen	34.7	42.3	39.9	76.9
Comorbidity	40.0	40.0	44.4	49.1
Cause of death	35.7	38.4	42.2	60.1

Table 2 gives completeness of data returns on ethnic origin, primary renal diagnosis, date first seen by a nephrologist and comorbidity at the start of RRT in 2010, and also for cause of death for deaths in 2010, by centre. This shows that there are still some centres where improvements could be made.

Interpretation of centre-specific comparisons

The UKRR 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 (generally 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, Chi-squared tests have sometimes been used. Caution should be used when interpreting 'no overlap' of 95% confidence intervals between centres. 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

Table 2. 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 2010) and for cause of death (for deaths in 2010 amongst incident or existing patients)

Centre	Ethnicity	Primary diagnosis	Date first seen	Comorbidity	Cause of death	Average completeness	Country
Tyrone	100.0	100.0	100.0	100.0	100.0	100.0	N Ireland
Ulster	100.0	100.0	100.0	95.0	100.0	98.8	N Ireland
Nottm	100.0	100.0	97.3	96.5	98.8	98.1	England
Antrim	100.0	95.1	100.0	95.1	100.0	97.6	N Ireland
L Kings	93.2	100.0	93.9	99.3	96.1	97.3	England
Wolve	100.0	99.1	99.0	92.5	96.9	96.9	England
Wrexm	100.0	95.8	95.8	100.0	95.7	96.8	Wales
Kent	89.6	97.8	100.0	100.0	89.0	96.7	England
Newry	100.0	100.0	95.2	95.2	95.2	96.4	N Ireland
Leeds	98.5	99.2	100.0	89.2	95.9	96.1	England
Middlbr	100.0	100.0	96.9	95.9	88.2	95.2	England
Stevng	100.0	100.0	96.4	98.2	84.9	94.9	England
Bristol	100.0	99.4	97.6	92.3	89.4	94.7	England
Bradfd	93.8	98.4	100.0	92.2	87.9	94.6	England
York	94.4	100.0	94.4	91.7	88.9	93.7	England
Swanse	100.0	98.5	99.2	78.5	96.9	93.3	Wales
Derry	100.0	100.0	100.0	72.2	100.0	93.1	N Ireland
Oxford	99.4	94.6	95.8	94.6	84.6	92.4	England
Bangor	100.0	100.0	96.0	96.2	73.9	91.5	Wales
Derby	87.5	97.5	98.8	85.0	84.2	91.4	England
B Heart	100.0	99.0	95.8	73.7	96.6	91.3	England
Basldn	100.0	100.0	93.8	90.6	71.0	88.8	England
Sund	100.0	94.6	89.1	78.2	93.5	88.8	England
Truro	100.0	97.7	95.3	67.4	93.3	88.4	England
Donc	100.0	100.0	95.5	61.4	90.9	86.9	England
Shrew	100.0	100.0	100.0	100.0	46.0	86.5	England
Dorset	100.0	95.8	87.5	65.3	95.7	86.1	England
Sthend	96.7	90.0	90.0	70.0	92.3	85.6	England
Prestn	98.4	95.1	96.7	45.9	95.7	83.3	England
Hull	97.7	92.1	64.8	84.1	90.9	83.0	England
Glouc	98.3	100.0	91.4	43.1	97.3	82.9	England
Belfast	97.2	98.6	93.0	46.5	82.8	80.2	N Ireland
Leic	95.6	81.2	98.0	64.0	70.1	78.3	England
Chelms	88.1	95.2	97.6	28.6	86.7	77.0	England
Ports	98.7	96.7	98.0	45.3	67.0	76.7	England
Redng	100.0	95.5	97.8	0.0	97.3	72.7	England
Norwch	88.2	91.8	77.4	38.8	77.0	71.3	England
Dudley	100.0	97.6	90.0	0.0	94.3	70.5	England
L St.G	94.0	95.2	75.9	54.2	53.1	69.6	England
Sheff	99.3	91.7	98.6	78.5	3.0	67.9	England
Carlis	100.0	100.0	[b] 0.0	61.9	100.0	65.5	England
Newc	100.0	97.9	93.7	51.6	14.3	64.4	England
Exeter	86.8	96.3	61.8	4.4	89.5	63.0	England
Plymth	94.5	92.7	0.0	72.7	78.7	61.0	England
Carsh	85.5	81.0	86.8	67.9	6.7	60.6	England
Stoke	98.9	83.9	100.0	0.0	53.9	59.5	England
L Barts	97.6	89.9	[b] 0.0	72.0	73.9	58.9	England
Colchr	81.3	81.3	84.4	0.0	69.6	58.8	England
L Guys	95.1	77.1	86.7	2.1	67.3	58.3	England
Ipswi	100.0	[a] 44.1	93.9	8.8	70.0	54.2	England
Cardff	98.4	99.5	95.7	16.0	2.0	53.3	Wales
Wirral	96.2	69.2	82.4	0.0	54.1	51.4	England

Table 2. Continued

Centre	Ethnicity	Primary diagnosis	Date first seen	Comorbidity	Cause of death	Average completeness	Country
Clwyd	84.6	[a] 34.0	69.2	0.0	100.0	50.8	Wales
Covnt	99.2	97.5	95.7	0.9	0.0	48.5	England
M RI	96.9	82.2	62.3	40.5	4.7	47.4	England
B QEH	100.0	100.0	88.3	0.0	0.6	47.2	England
Liv RI	71.6	[a] 28.0	47.5	20.6	71.6	41.9	England
Camb	99.1	[a] 46.3	99.1	0.9	10.4	39.2	England
L Rfree	94.1	21.7	89.6	0.5	1.7	28.4	England
L West	98.9	98.9	0.0	0.8	0.5	25.0	England
Liv Ain	34.7	[a] 2.0	[b] 0.0	4.1	80.0	21.5	England
M Hope	100.0	48.6	1.4	0.0	0.0	12.5	England
Brightn	1.9	28.0	1.9	5.6	2.4	9.5	England
Abrdn		100.0			89.2		Scotland
Airdrie		100.0			96.8		Scotland
D & Gall		100.0			100.0		Scotland
Dundee		100.0			85.7		Scotland
Dunfn		100.0			72.4		Scotland
Edinb		100.0			98.3		Scotland
Glasgw		100.0			66.4		Scotland
Inverns		100.0			91.7		Scotland
Klmarnk		100.0			93.9		Scotland

[a]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'. For these centres the value given is the percentage with a specific diagnosis

[b]as in previous Reports, all 'first seen' dates have been set to 'missing' because at least 10% of the dates returned were identical to the date of start of RRT. Whilst it is possible to start RRT on the day of presentation, comparison with the data returned from other centres raises the possibility, requiring further investigation, of incorrect data entry or extraction from these centres

$p = 0.01$ 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 one 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. Furthermore the interpretation of survival in RRT patients needs to be seen in the context of the total population with advanced CKD (symptomatic stage 5 CKD) that may merit RRT. Since conservative care is used for many patients in whom there is a choice not to start dialysis the selection of sicker (and/or) older patients in one centre versus the practice in another centre may result in differences in survival due to this potential selection bias. For this important reason and the need to understand the quality of conservative care it is hoped to expand the Registry remit (technically and with appropriate information governance) to capture routine data on those patients with CKD stage 5.

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

The UKRR is part of the Renal Association. The Chair of the UKRR is appointed by the Renal Association and reports to the Renal 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' (below two standard deviations from the mean) for age-adjusted survival is informed 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 UKRR 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. This framework has been further strengthened this year with Dr Afzal Chaudhry (Chair of the Registry Committee) appointed as the Caldicott guardian and David Bull appointed as information governance lead. The UKRR has successfully completed the Connecting for Health information governance toolkit to a satisfactory standard.

The UKRR and the National Renal Dataset

The National Renal Dataset (NRD) was designed, with the support of the Department of Health, 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 Uses Service (SUS) through Connecting for Health. It was 'mandated' for use, which meant that the suppliers of clinical information systems are obliged to provide the capacity for these data to be recorded in those systems, and hospital Trusts to collect and submit the data.

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 never envisaged that it would be the responsibility of renal centres to assemble and enter all these data into their own systems, rather that they would be collected in these other systems as part of routine care.

Sadly the investment envisaged in hospital clinical information systems and the development of Connecting for Health has not taken place and the current information strategy is focused instead on sharing information between existing systems to improve access to information. 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 NHS Blood and 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 UKRR to collect these data and it

is certainly not the role of the UKRR to pass such data onto any other body. The UKRR can easily provide the capacity within its database to store the data items from the NRD for subsequent audit, but the UKRR has not been resourced for the significant workload of validating and cleaning such data; furthermore it can only collect data which are being stored on renal centre IT systems and most of these data items are not yet available on these systems. More fundamentally there has been a realisation that the whole of the NHS needs to reduce the scale of the burden of data-collection. Only key information with direct evidence of improvement of outcomes is likely to be a priority for centralised collection in the future. Nationally agreed data standards such as the NRD, reflecting the opinions of the wider renal community (including the UKRR and NHSBT) help direct where that collection effort should be focused. Encouragingly in many cases prioritising data item collection can effectively be done with little or no effect on the proven benefits of reflecting variation in performance to clinicians. Whilst centres that have systems and processes to effectively submit complete datasets should be congratulated, it is likely that there will be increasing focus on collecting a smaller number of items well. In this regard the goals of both the UKRR and the NRD remain the same.

Nevertheless going forward, the NRD is still a valuable potential tool for good audit and the UKRR 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. The UKRR will also continue to work to refine and influence the continued development of the NRD and provide data where it is available.

Vascular access

Over the last few years the Vascular Access Audit was funded by the Healthcare Quality Improvement Partnership (HQIP) and run by the NHS Information Centre. The funding for this project came to an end with the expectation that centres would have established systems and processes that record the access for all incident dialysis patients. The Renal Association and the UKRR always considered that this project should fall to its systems and electronic renal patient records. Therefore earlier this year and with support from renal centres, NHS Kidney Care and the Department of Health the UKRR refined which items are both important and available for collection for audit of vascular access. Since some systems were not ready to submit electronically the UKRR agreed that undertaking a spreadsheet exercise again this year was prudent and at the same time are assessing site readiness to collect future data electronically. This year the exercise was combined with an audit of peritoneal dialysis to provide richer information.

Linkage with Hospital Episode Statistics (HES) database

To date, the UKRR'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 has worked successfully with academic colleagues in Sheffield on a three 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 (see Chapter 13 The Linkage of Incident Renal Replacement Therapy Patients in England (2002–2006) to Hospital Episodes and National Mortality Data) for further information. This project, funded by Kidney Research UK and the Department of Health Research Capability Programme has been highly successful and has paved the way for regular linkage with hospital episode data. Furthermore, the recent amalgamation of the General Practice Research Database with the HES data (now called Clinical Practice Research Datalink, www.CPRD.com) means that the potential to assess many aspects of care for RRT patients for that proportion of the population covered by the CPRD is possible.

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 UK Renal Registry appears in peer-reviewed journals [2–10] in addition to articles

published in collaboration with the EDTA-ERA Registry [11–12].

Conclusion

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

References

1 Ansell D, Tomson CRV. UK Renal Registry 11th Annual Report (December 2008): Chapter 15. The UK Renal Registry, UKRR database, validation, and methodology. Nephron Clinical Practice 2009;111(suppl 1):c277–c285

2 Thomas H, Banner N, Murphy C, Steenkamp R, Birch R, Fogarty D, et al. Incidence, Determinants, and Outcome of Chronic Kidney Disease After Adult Heart Transplantation in the United Kingdom. Transplantation. 2012 15 Jun 2012;93(11):1151–1157

3 Sinha M, Gilg J, Kerecuk L, Reid C. Progression to hypertension in non-hypertensive children following renal transplantation. Nephrol Dial Transplant. 2012

4 Judge A, Caskey FJ, Welton NJ, Ansell D, Tomson CRV, Roderick PJ, et al. Inequalities in rates of renal replacement therapy in England: does it matter who you are or where you live? Nephrology Dialysis Transplantation. 2012 Apr;27(4):1598–1607

5 McCarthy H, Ansell D, Braddon F, Taylor M, Saleem M. The UK Registry of Rare Renal Disease (RaDaR) Enables Research Studies on a National Scale. Pediatric Nephrology. 2010 Sep;25(9):1872–1873

6 Sinha M, Kerecuk L, Gilg J, Reid CobotBAfPN. Systemic arterial hypertension in children following renal transplantation: prevalence and risk factors. Nephrol Dial Transplant. 2012

7 Tangri N, Ansell D, Naimark D. Determining Factors That Predict Technique Survival on Peritoneal Dialysis: Application of Regression and Artificial Neural Network Methods. Nephron Clinical Practice 2011;118(2):C93–C100

8 Udayaraj U, Ben-Shlomo Y, Roderick P, Casula A, Dudley C, Collett D, et al. Social Deprivation, Ethnicity, and Uptake of Living Kidney Donor Transplantation in the United Kingdom. Transplantation. 2012 Mar 27; 93(6):610–616

9 van der Veer SN, Jager KJ, Nache AM, Richardson D, Hegarty J, Couchoud C, et al. Translating knowledge on best practice into improving quality of RRT care: a systematic review of implementation strategies. Kidney International. 2011 Nov;80(10):1021–1034

10 Castledine CI, Gilg JA, Rogers C, Ben-Shlomo Y, Caskey FJ. How much of the regional variation in RRT incidence rates within the UK is explained by the health needs of the general population? Nephrology Dialysis Transplantation 2012;doi: 10.1093/ndt/gfs294

11 Koopman JJE, Rozing MP, Kramer A, de Jager DJ, Ansell D, De Meester JMJ, et al. Senescence rates in patients with end-stage renal disease: a critical appraisal of the Gompertz model. Aging Cell. 2011 Apr;10(2): 233–238

12 Kramer A, Stel V, Zoccali C, Heaf J, Ansell D, Gronhagen-Riska C, et al. An update on renal replacement therapy in Europe: ERA-EDTA Registry data from 1997 to 2006. Nephrology Dialysis Transplantation. 2009 Dec;24(12):3557–3566

UK Renal Registry 14th Annual Report: Chapter 1 UK RRT Incidence in 2010: 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 · Treatment modality

Summary

- In 2010 the incidence rate in the UK was stable at 107 per million population (pmp).
- The incidence rate pmp was stable for England from 2006 to 2010 but had increased from 95 pmp in 2001.
- The median age of all incident patients was 64.9 years and for non-Whites 57.1 years.
- Diabetic renal disease remained the single most common cause of renal failure (24%).
- By 90 days, 68.3% of patients were on haemodialysis, 18.1% on peritoneal dialysis, 7.7% had had a transplant and 5.9% had died or stopped treatment.
- The mean eGFR at the start of RRT was 8.7 ml/min/1.73 m^2 similar to the previous four years.
- There was no relationship between social deprivation and presentation pattern.
- Late presentation (<90 days) fell from 28.2% in 2005 to 20.6% in 2010.

Introduction

This chapter contains analyses of adult patients starting renal replacement therapy (RRT) in the UK in 2010. It describes regional and national variations in incidence rates of RRT, the demographics and clinical characteristics of all patients starting RRT and those presenting late. The methodology and 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/report 2011/appendix-B.pdf). In brief, it is all patients over 18 who commenced RRT in the UK in 2010 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).

Differences may be seen in the 2005 to 2009 numbers 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 2010.

1 Geographical variation in incidence rates

Over the years, there have been wide variations in incidence rates between renal centres. Equity of access to RRT is an important aim but is hard to assess as the need for RRT depends on many variables including medical, social and demographic factors such as underlying conditions, age, gender, social deprivation and ethnicity. Thus, comparison of crude incidence 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 incidence rates. More detailed investigations into variation in incidence rates are continuing at the UKRR.

Methods

Crude incidence rates were calculated per million population (pmp) and age/gender standardised incidence ratios were calculated as detailed in appendix D: Methodology used for Analyses (www.renalreg.com/report-area/report 2011/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 incidence 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) were obtained from the Office for National Statistics (ONS) [1]. These are referred to by the umbrella term 'PCT/HB' in this report. The population breakdown was extrapolated by the ONS from the 2001 census data to mid-2010 estimates. For Northern Ireland the population data were aggregated from district council to HSC level. The population breakdown and the overall incidence rates were used to calculate the expected age and gender specific incident numbers for each PCT/HB. The age and gender standardised incidence ratio was the observed incident numbers divided by the expected incident 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 especially 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.

Results

In 2010 the number of adult patients starting RRT in the UK was 6,648 equating to an incidence rate of 107 pmp (table 1.1), slightly lower than in 2009. Wales remained the country with the highest incidence rate (figure 1.1). For England, incidence rates have been stable for the last 5 years. There continued to be very

Table 1.1. Number of new adult patients starting RRT in the UK in 2010

	England	N Ireland	Scotland	Wales	**UK**
Number starting RRT	5,587	181	494	386	**6,648**
[a]Total estimated population mid-2010 (millions)	52.2	1.8	5.2	3.0	**62.3**
Incidence rate (pmp)	107	101	95	128	**107**
(95% CI)	(104–110)	(86–115)	(86–103)	(116–141)	**(104–109)**

[a]Data extrapolated by the Office for National Statistics–based on the 2001 census

marked gender differences in incidence rates which were 136 pmp (95% CI 132–140) in males and 79 pmp (95% CI 75–82) in females. Including incident patients aged under 18 the UK rate was 108 pmp.

Table 1.2 shows incidence rates and standardised incidence ratios for PCT/HBs. The ratios, calculated using combined data from up to six years, have been used to determine areas with significantly high or low incidence rates. Significantly high areas have been shaded with bold text and significantly low areas shaded a lighter grey with italicised text. There were wide variations between areas, with 52 being significantly high and 54 being significantly low out of a total of 177 areas. As would be expected, urban areas with high percentages of non-White residents tended to have high incidence rates. Figure 1.2 shows the positive correlation ($r = 0.81$, $p < 0.001$) between the standardised incidence ratio and the percentage of the PCT/HB that is non-White.

Confidence intervals are not presented for the crude rates per million population but figures D1 and D2 in appendix D can be used to determine if a PCT/HB falls within the 95% confidence interval around the national average rate.

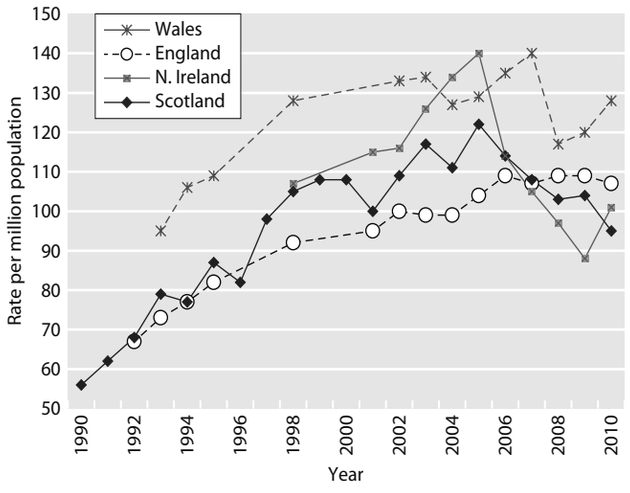

Fig. 1.1. RRT incidence rates in the countries of the UK 1990–2010

The number of new patients starting RRT at each renal centre from 2005 to 2010 is shown in table 1.3 along with the percentage change in these numbers 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, changes in catchment populations or in completeness of reporting. Variation may also be due to changing incidence of established renal failure (increases in underlying disease prevalence, survival from co-morbid conditions and recognition of ERF), changes to treatment thresholds or the introduction of conservative care programmes. Incidence rates per million population by centre were presented for the first time in last year's report after a detailed piece of work was done to estimate the centre's catchment populations. These rates are again reported this year. For a full description of the methodology used to estimate the catchment populations see appendix E: Methodology for Estimating Catchment Populations Analyses (www.renalreg.com/report-area/report 2011/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. 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 which gained catchment population); in addition the analysis used dialysis patients only and transplant patients may come from a different catchment population. Estimation of centre's catchment populations

Table 1.2. Crude adult incidence rates (pmp) and age/gender standardised incidence ratios 2005–2010

PCT/HB = PCT in England, Health and Social Care Trust Areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland
O/E = standardised incidence ratio
LCL = lower 95% confidence limit
UCL = upper 95% confidence limit
pmp = per million population
pmp[a] = per million population per year
Blank cells = no data returned to the UKRR for that year
Areas with significantly low incidence ratios over six years are italicised in greyed areas, those with significantly high incidence ratios over six years 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)
For those areas not covered by the Registry for the entire period 2005–2010, the combined years standardised incidence ratios and incidence rates are averages for the years covered by the Registry

UK Area	PCT/HB	Tot pop (2010)	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 pmp	2005–2010 O/E	2005–2010 LCL	2005–2010 UCL	2005–2010 pmp[a]	% non-White
North East	*County Durham*	*510,800*	*0.89*	*0.86*	*0.67*	*0.67*	*0.76*	*0.78*	*88*	*0.77*	*0.68*	*0.87*	*88*	*2.5*
	Darlington	100,600	0.55	0.61	1.15	0.97	0.96	0.99	109	0.87	0.68	1.13	98	3.3
	Gateshead	*192,000*	*0.80*	*0.90*	*0.78*	*0.55*	*0.90*	*0.79*	*89*	*0.79*	*0.65*	*0.95*	*89*	*3.8*
	Hartlepool	91,400	0.83	1.37	0.50	1.29	0.78	0.61	66	0.90	0.69	1.17	98	2.6
	Middlesbrough	142,100	1.02	1.38	1.18	1.18	0.62	1.49	148	1.14	0.94	1.40	115	8.6
	Newcastle	292,200	1.08	0.82	1.18	1.00	0.89	0.73	68	0.95	0.81	1.11	90	9.7
	North Tyneside	*198,400*	*0.88*	*0.79*	*0.75*	*0.49*	*0.88*	*0.95*	*106*	*0.79*	*0.65*	*0.95*	*89*	*3.6*
	Northumberland	*312,100*	*0.64*	*0.71*	*0.74*	*0.67*	*0.61*	*0.60*	*74*	*0.66*	*0.57*	*0.78*	*82*	*2.2*
	Redcar and Cleveland	137,300	0.96	0.91	0.98	0.74	0.85	0.69	80	0.85	0.69	1.06	101	3.0
	South Tyneside	154,100	0.95	1.07	1.14	0.57	1.24	0.76	84	0.96	0.79	1.17	108	4.8
	Stockton-on-Tees Teaching	*192,600*	*0.81*	*0.87*	*0.63*	*0.83*	*0.68*	*0.89*	*93*	*0.78*	*0.64*	*0.96*	*83*	*4.7*
	Sunderland Teaching	283,400	0.80	0.73	1.05	0.86	0.92	1.04	113	0.90	0.77	1.05	99	3.3
North West	*Ashton, Leigh and Wigan*	*307,200*	*0.89*	*0.67*	*0.86*	*0.86*	*0.59*	*0.69*	*75*	*0.76*	*0.65*	*0.89*	*83*	*2.9*
	Blackburn with Darwen Teaching	140,000	1.43	1.28	1.30	0.46	0.91	1.09	100	1.08	0.87	1.33	100	22.7
	Blackpool	*140,200*	*0.82*	*0.54*	*0.91*	*0.91*	*0.96*	*0.62*	*71*	*0.79*	*0.64*	*0.99*	*93*	*3.7*
	Bolton Teaching	266,500	0.71	0.88	0.89	0.96	0.88	1.42	146	0.96	0.82	1.12	100	12.3
	Bury	*183,500*	*0.74*	*0.55*	*0.71*	*0.77*	*0.71*	*0.73*	*76*	*0.70*	*0.57*	*0.87*	*74*	*8.5*
	Central and Eastern Cheshire	*457,200*			*0.61*	*0.65*	*0.72*	*0.76*	*87*	*0.68*	*0.58*	*0.80*	*80*	*3.4*
	Central Lancashire	*459,200*	*0.74*	*0.58*	*0.81*	*0.87*	*0.92*	*0.64*	*70*	*0.76*	*0.67*	*0.87*	*83*	*6.7*
	Cumbria Teaching	*494,400*	*0.84*	*0.61*	*0.62*	*0.71*	*0.58*	*0.67*	*83*	*0.67*	*0.59*	*0.76*	*83*	*2.0*
	East Lancashire Teaching	*381,200*	*0.68*	*0.90*	*0.72*	*0.65*	*0.81*	*0.69*	*73*	*0.74*	*0.64*	*0.86*	*80*	*9.4*
	Halton and St Helens	296,700	1.21	1.21	1.01	0.55	0.88	0.91	98	0.96	0.83	1.11	105	2.1
	Heywood, Middleton and Rochdale	205,000			0.90	1.00	1.13	0.82	83	0.96	0.78	1.20	99	12.6
	Knowsley	*149,200*	*0.67*	*0.89*	*1.03*	*0.51*	*0.76*	*0.91*	*94*	*0.80*	*0.63*	*1.00*	*83*	*2.8*
	Liverpool	**445,300**	**1.34**	**1.21**	**1.11**	**1.15**	**1.21**	**0.90**	**88**	**1.15**	**1.03**	**1.29**	**114**	**8.3**
	Manchester Teaching	**498,800**			**1.25**	**1.32**	**1.38**	**1.29**	**100**	**1.31**	**1.14**	**1.50**	**104**	**23.4**
	North Lancashire Teaching	*329,100*	*0.38*	*0.51*	*0.59*	*0.52*	*0.70*	*0.62*	*76*	*0.56*	*0.47*	*0.66*	*68*	*4.2*
	Oldham	219,600	0.51	0.84	0.90	1.08	0.85	0.92	91	0.85	0.71	1.02	86	12.2
	Salford	229,100	0.36	0.96	0.53	1.05	0.96	1.39	135	0.88	0.73	1.05	87	7.7
	Sefton	*272,800*	*0.91*	*0.83*	*0.57*	*0.90*	*0.77*	*0.98*	*117*	*0.83*	*0.71*	*0.96*	*100*	*2.6*
	Stockport	*284,700*			*0.80*	*0.77*	*0.61*	*0.88*	*98*	*0.77*	*0.63*	*0.93*	*87*	*6.4*
	Tameside and Glossop	250,700			1.36	0.71	0.93	0.96	100	0.99	0.82	1.20	105	5.9
	Trafford	217,100			1.12	0.60	1.06	1.36	143	1.03	0.85	1.26	111	11.2
	Warrington	*199,100*	*0.82*	*0.73*	*0.74*	*0.60*	*1.00*	*0.56*	*60*	*0.74*	*0.61*	*0.91*	*80*	*3.5*
	Western Cheshire	*234,300*	*0.56*	*0.88*	*0.90*	*0.54*	*0.88*	*1.16*	*137*	*0.82*	*0.70*	*0.97*	*97*	*3.1*
	Wirral	*308,800*	*1.25*	*0.80*	*0.75*	*0.75*	*0.83*	*0.74*	*84*	*0.85*	*0.73*	*0.98*	*98*	*2.8*

Table 1.2. Continued

UK Area	PCT/HB	Tot pop (2010)	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 pmp	2005–2010 O/E	2005–2010 LCL	2005–2010 UCL	2005–2010 pmp[a]	% non-White
Yorkshire and the Humber	Barnsley	227,500	0.74	1.01	0.87	1.11	0.94	1.25	136	0.99	0.84	1.16	109	2.7
	Bradford and Airedale Teaching	**512,700**	**1.38**	**0.88**	**1.47**	**1.11**	**0.98**	**1.29**	**119**	**1.18**	**1.06**	**1.32**	**111**	**25.0**
	Calderdale	202,800	1.01	0.91	0.92	0.83	1.05	0.52	54	0.87	0.73	1.05	93	9.8
	Doncaster	*290,900*	*0.67*	*0.79*	*0.64*	*0.80*	*1.06*	*0.93*	*103*	*0.82*	*0.70*	*0.95*	*91*	*4.3*
	East Riding of Yorkshire	*338,500*	*1.07*	*0.67*	*0.63*	*0.96*	*0.90*	*0.69*	*86*	*0.82*	*0.71*	*0.94*	*103*	*3.0*
	Hull Teaching	263,800	1.24	0.76	1.04	1.00	1.03	0.94	91	1.00	0.85	1.17	98	5.8
	Kirklees	409,900	0.77	1.18	0.72	0.79	1.09	0.93	93	0.92	0.80	1.04	93	16.0
	Leeds	*798,700*	*1.14*	*0.92*	*0.82*	*0.97*	*0.81*	*0.67*	*64*	*0.89*	*0.81*	*0.98*	*85*	*11.8*
	North East Lincolnshire	158,800	1.17	1.11	1.07	1.12	0.83	0.68	76	1.00	0.82	1.20	111	3.1
	North Lincolnshire	157,500	1.07	1.01	0.65	0.81	0.75	0.71	83	0.83	0.68	1.02	97	3.2
	North Yorkshire and York	*802,100*	*0.91*	*0.87*	*0.81*	*0.73*	*0.81*	*0.63*	*74*	*0.79*	*0.72*	*0.87*	*94*	*3.7*
	Rotherham	254,300	1.14	0.91	1.03	1.31	0.95	1.16	126	1.08	0.93	1.25	119	5.2
	Sheffield	**555,700**	**1.05**	**1.10**	**1.14**	**1.12**	**1.25**	**1.07**	**106**	**1.12**	**1.01**	**1.24**	**113**	**12.2**
	Wakefield District	*325,500*	*0.69*	*1.04*	*0.50*	*0.75*	*0.63*	*0.88*	*95*	*0.75*	*0.64*	*0.87*	*82*	*4.3*
East Midlands	Bassetlaw	112,100	1.02	0.59	1.73	0.60	0.74	0.84	98	0.92	0.73	1.16	109	3.1
	Derby City	**247,100**	**1.19**	**1.21**	**1.03**	**1.62**	**1.37**	**1.05**	**105**	**1.25**	**1.08**	**1.44**	**127**	**15.0**
	Derbyshire County	*729,900*	*0.69*	*0.66*	*0.82*	*1.03*	*0.77*	*0.74*	*86*	*0.79*	*0.71*	*0.87*	*92*	*3.2*
	Leicester City	**306,800**	**1.55**	**1.47**	**1.75**	**1.63**	**1.40**	**1.82**	**156**	**1.60**	**1.42**	**1.81**	**140**	**38.2**
	Leicestershire County and Rutland	*687,200*	*0.75*	*0.86*	*0.85*	*0.72*	*0.78*	*0.96*	*108*	*0.82*	*0.74*	*0.91*	*94*	*7.7*
	Lincolnshire Teaching	*705,000*	*1.03*	*0.76*	*0.79*	*0.71*	*0.73*	*0.89*	*109*	*0.82*	*0.74*	*0.90*	*101*	*3.3*
	Northamptonshire Teaching	687,600	0.81	0.88	0.97	1.20	0.83	0.82	86	0.92	0.83	1.01	97	7.4
	Nottingham City	**306,300**	**1.40**	**1.38**	**0.96**	**1.31**	**1.42**	**1.50**	**124**	**1.33**	**1.16**	**1.52**	**112**	**18.7**
	Nottinghamshire County Teaching	668,000	1.19	1.16	1.04	0.89	1.03	0.91	103	1.04	0.95	1.13	119	5.1
West Midlands	**Birmingham East and North**	**409,300**	**1.93**	**1.84**	**1.45**	**1.70**	**1.48**	**1.43**	**134**	**1.64**	**1.48**	**1.81**	**156**	**23.8**
	Coventry Teaching	**315,700**	**1.05**	**1.06**	**1.36**	**1.59**	**1.67**	**1.29**	**124**	**1.34**	**1.18**	**1.52**	**130**	**19.6**
	Dudley	307,500	1.02	0.91	0.95	0.87	1.41	0.80	91	1.00	0.87	1.14	115	8.5
	Heart of Birmingham Teaching	**285,100**	**2.04**	**2.38**	**2.67**	**2.86**	**2.90**	**2.32**	**168**	**2.53**	**2.27**	**2.83**	**188**	**61.8**
	Herefordshire	*179,400*	*0.81*	*0.72*	*0.86*	*0.82*	*1.06*	*0.70*	*89*	*0.83*	*0.69*	*0.99*	*107*	*2.4*
	North Staffordshire	211,900			0.59	0.83	1.25	0.72	85	0.85	0.69	1.05	101	3.5
	Sandwell	**292,900**	**1.52**	**1.34**	**1.53**	**2.13**	**1.74**	**1.80**	**181**	**1.68**	**1.50**	**1.88**	**171**	**21.8**
	Shropshire County	293,400	0.90	0.96	0.79	1.11	0.72	0.91	112	0.90	0.78	1.03	112	3.0
	Solihull	206,300	1.22	1.32	0.80	0.97	1.32	0.98	111	1.10	0.94	1.29	127	9.0
	South Birmingham	**342,200**	**1.28**	**1.09**	**1.29**	**1.64**	**1.39**	**1.10**	**105**	**1.30**	**1.15**	**1.47**	**126**	**17.9**
	South Staffordshire	611,300			0.95	0.90	0.80	1.03	118	0.92	0.81	1.04	107	4.7
	Stoke on Trent	**248,000**			**1.27**	**1.01**	**1.34**	**1.26**	**133**	**1.22**	**1.03**	**1.45**	**131**	**7.1**
	Telford and Wrekin	**162,400**	**0.74**	**1.34**	**1.59**	**1.00**	**1.17**	**1.45**	**148**	**1.22**	**1.02**	**1.45**	**126**	**6.6**
	Walsall Teaching	**256,800**	**1.18**	**1.44**	**1.21**	**1.35**	**1.02**	**1.88**	**202**	**1.35**	**1.18**	**1.54**	**147**	**14.7**
	Warwickshire	536,200	0.95	1.05	1.03	0.97	0.99	1.20	136	1.03	0.93	1.14	119	6.7
	Wolverhampton City	**239,300**	**1.67**	**1.27**	**1.02**	**1.45**	**1.12**	**1.51**	**159**	**1.34**	**1.16**	**1.53**	**142**	**23.8**
	Worcestershire	*557,300*	*0.80*	*0.62*	*0.83*	*0.95*	*1.07*	*0.79*	*93*	*0.84*	*0.76*	*0.94*	*100*	*4.4*
East of England	*Bedfordshire*	*416,300*	*0.66*	*1.02*	*0.56*	*0.74*	*0.82*	*0.89*	*94*	*0.78*	*0.68*	*0.90*	*83*	*9.3*
	Cambridgeshire	616,400	0.94	1.09	0.83	0.81	1.00	0.80	84	0.91	0.82	1.01	98	7.4
	Hertfordshire	*1,107,500*	*0.74*	*0.93*	*0.77*	*0.94*	*0.83*	*0.89*	*92*	*0.85*	*0.79*	*0.92*	*89*	*9.9*
	Great Yarmouth and Waveney	214,700	1.29	1.29	1.13	1.21	0.86	1.11	140	1.15	0.99	1.32	146	3.5
	Luton	198,900	1.32	1.15	1.49	1.05	0.99	1.07	96	1.17	0.99	1.40	106	31.5
	Mid Essex	*374,500*	*0.85*	*0.95*	*0.93*	*0.81*	*0.88*	*0.78*	*85*	*0.87*	*0.76*	*0.99*	*96*	*5.1*
	Norfolk	764,800	1.16	1.01	1.06	0.90	0.71	0.82	102	0.94	0.86	1.02	117	3.9

Table 1.2. Continued

UK Area	PCT/HB	Tot pop (2010)	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 pmp	2005–2010 O/E	2005–2010 LCL	2005–2010 UCL	2005–2010 pmp[a]	% non-White
East of	North East Essex	329,500				1.47	0.65	0.93	109	1.02	0.85	1.21	121	6.4
England	Peterborough	173,600	1.21	1.27	1.11	1.05	1.27	0.71	69	1.10	0.92	1.33	108	13.0
	South East Essex	338,200	0.89	1.22	1.06	0.98	0.62	0.84	98	0.94	0.82	1.07	109	5.7
	South West Essex	410,000	0.96	1.03	0.94	1.11	0.68	0.87	88	0.93	0.82	1.06	96	7.6
	Suffolk	*601,900*	*0.92*	*0.78*	*0.94*	*0.79*	*0.86*	*0.76*	*88*	*0.84*	*0.76*	*0.93*	*99*	*5.7*
	West Essex	*286,400*	*0.80*	*0.72*	*0.73*	*0.45*	*0.82*	*0.65*	*70*	*0.69*	*0.58*	*0.82*	*76*	*7.9*
London	Barking and Dagenham	179,700	0.83	0.79	1.13	1.53	1.45	1.43	117	1.20	0.99	1.45	99	23.7
	Barnet	**348,000**	**0.77**	**1.34**	**1.83**	**1.44**	**1.34**	**1.81**	**172**	**1.43**	**1.27**	**1.60**	**138**	**29.4**
	Bexley	**228,300**	**0.99**	**1.11**	**1.12**	**1.20**	**1.31**	**1.35**	**140**	**1.18**	**1.02**	**1.37**	**124**	**13.0**
	Brent Teaching	**256,300**		**1.88**	**2.14**	**2.18**	**2.37**	**3.04**	**281**	**2.32**	**2.06**	**2.60**	**219**	**53.5**
	Bromley	312,400	1.05	0.88	0.71	1.25	0.99	1.12	118	1.00	0.87	1.15	107	11.9
	Camden	235,500	0.75	1.19	1.08	1.03	1.34	1.66	132	1.18	0.99	1.39	96	24.9
	City and Hackney Teaching	**231,000**		**1.31**	**1.43**	**1.26**	**1.87**	**1.71**	**130**	**1.51**	**1.28**	**1.79**	**119**	**35.7**
	Croydon	**345,400**	**1.69**	**1.04**	**1.74**	**1.44**	**1.66**	**1.44**	**136**	**1.50**	**1.34**	**1.68**	**144**	**34.5**
	Ealing	**318,300**	**1.63**	**1.79**	**2.05**	**1.59**	**2.28**	**2.18**	**192**	**1.92**	**1.72**	**2.14**	**172**	**40.7**
	Enfield	**295,000**	**1.11**	**1.40**	**1.17**	**1.38**	**1.26**	**1.34**	**125**	**1.28**	**1.12**	**1.46**	**121**	**28.0**
	Greenwich Teaching	**228,100**	**2.11**	**1.10**	**1.51**	**1.61**	**1.40**	**2.39**	**202**	**1.68**	**1.46**	**1.93**	**145**	**26.1**
	Hammersmith and Fulham	**169,800**	**1.21**	**1.03**	**1.44**	**0.62**	**1.43**	**1.56**	**130**	**1.21**	**1.00**	**1.47**	**103**	**21.0**
	Haringey Teaching	**225,100**	**1.31**	**1.40**	**1.31**	**1.73**	**1.15**	**1.63**	**133**	**1.42**	**1.22**	**1.66**	**119**	**33.1**
	Harrow	**230,300**		**1.38**	**0.48**	**1.65**	**1.98**	**2.32**	**226**	**1.56**	**1.35**	**1.80**	**155**	**44.7**
	Havering	*236,100*		*1.02*	*0.76*	*0.76*	*0.60*	*0.43*	*47*	*0.72*	*0.58*	*0.88*	*80*	*8.8*
	Hillingdon	**266,200**	**1.16**	**1.57**	**0.95**	**1.51**	**1.30**	**1.50**	**139**	**1.33**	**1.16**	**1.53**	**125**	**25.9**
	Hounslow	**236,700**	**1.49**	**1.66**	**1.48**	**1.24**	**1.71**	**1.97**	**169**	**1.59**	**1.38**	**1.83**	**139**	**37.8**
	Islington	**193,900**	**1.60**	**1.73**	**1.28**	**0.96**	**1.54**	**1.66**	**129**	**1.46**	**1.23**	**1.73**	**116**	**22.9**
	Kensington and Chelsea	169,500		0.81	0.53	1.11	0.70	0.96	94	0.82	0.65	1.04	83	22.6
	Kingston	169,000			0.96	1.34	0.70	0.85	77	0.96	0.75	1.24	89	19.9
	Lambeth	**284,400**	**1.93**	**1.45**	**1.98**	**1.58**	**2.07**	**1.51**	**116**	**1.75**	**1.54**	**1.99**	**138**	**32.0**
	Lewisham	**266,400**	**1.73**	**1.69**	**1.84**	**1.61**	**2.37**	**1.53**	**124**	**1.80**	**1.58**	**2.04**	**149**	**34.4**
	Newham	**240,200**	**2.30**	**2.24**	**1.76**	**2.14**	**2.42**	**2.90**	**212**	**2.29**	**2.02**	**2.60**	**171**	**57.0**
	Redbridge	**270,300**	**1.00**	**1.03**	**1.24**	**1.52**	**1.78**	**1.59**	**144**	**1.36**	**1.19**	**1.56**	**125**	**40.9**
	Richmond and Twickenham	190,800			0.86	0.75	0.80	0.88	84	0.82	0.64	1.06	80	11.7
	Southwark	**287,100**	**1.75**	**1.45**	**2.19**	**2.01**	**1.41**	**1.91**	**150**	**1.79**	**1.58**	**2.02**	**143**	**34.1**
	Sutton and Merton	**403,000**			**1.17**	**1.43**	**1.16**	**1.31**	**122**	**1.27**	**1.10**	**1.46**	**120**	**20.8**
	Tower Hamlets	**238,100**	**1.47**	**1.30**	**1.77**	**2.00**	**1.89**	**1.47**	**101**	**1.65**	**1.42**	**1.92**	**116**	**22.8**
	Waltham Forest	**227,400**		**1.84**	**2.63**	**1.44**	**1.69**	**1.38**	**114**	**1.80**	**1.55**	**2.09**	**153**	**36.6**
	Wandsworth	**289,200**			**1.75**	**1.62**	**1.95**	**1.60**	**124**	**1.73**	**1.48**	**2.02**	**139**	**19.7**
	Westminster	**253,400**		**1.40**	**0.62**	**1.31**	**1.53**	**1.23**	**107**	**1.22**	**1.03**	**1.44**	**109**	**27.8**
South	Brighton and Hove City	258,400	1.00	0.91	0.88	1.12	1.15	0.86	81	0.99	0.84	1.16	95	8.7
East	*East Sussex Downs and Weald*	*336,100*	*0.69*	*0.97*	*0.85*	*0.65*	*0.63*	*0.60*	*77*	*0.73*	*0.64*	*0.85*	*95*	*4.9*
Coast	**Eastern and Coastal Kent**	**742,200**			**1.33**	**1.18**	**1.08**	**1.05**	**120**	**1.16**	**1.05**	**1.28**	**134**	**5.3**
	Hastings and Rother	*179,700*	*0.81*	*1.02*	*0.56*	*0.90*	*0.68*	*0.78*	*100*	*0.79*	*0.66*	*0.95*	*102*	*5.2*
	Medway	256,600			1.46	0.69	0.96	0.75	74	0.97	0.79	1.18	97	7.5
	Surrey	*1,114,400*	*0.61*	*0.76*	*0.80*	*0.97*	*0.99*	*1.02*	*110*	*0.86*	*0.80*	*0.93*	*94*	*8.3*
	West Kent	685,100			0.99	1.01	0.95	0.74	80	0.92	0.82	1.04	102	6.8
	West Sussex	*800,000*	*0.77*	*0.85*	*0.89*	*0.90*	*0.77*	*0.74*	*89*	*0.82*	*0.75*	*0.90*	*99*	*5.8*

Table 1.2. Continued

UK Area	PCT/HB	Tot pop (2010)	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 pmp	2005–2010 O/E	2005–2010 LCL	2005–2010 UCL	2005–2010 pmp[a]	% non-White
South Central	**Berkshire East**	**406,500**	**1.12**	**1.06**	**1.38**	**1.30**	**1.27**	**1.31**	**123**	**1.24**	**1.10**	**1.39**	**118**	**18.9**
	Berkshire West	471,500	1.22	1.05	0.94	1.13	0.91	0.74	72	1.00	0.89	1.12	99	10.1
	Buckinghamshire	*512,100*	*0.61*	*0.70*	*0.77*	*0.77*	*0.97*	*0.80*	*86*	*0.77*	*0.68*	*0.87*	*84*	*10.4*
	Hampshire	*1,297,200*	*0.66*	*0.91*	*0.77*	*0.79*	*0.81*	*0.79*	*90*	*0.79*	*0.73*	*0.85*	*91*	*4.2*
	Isle of Wight National Health Service	*140,200*	*0.33*	*0.42*	*0.22*	*0.32*	*0.16*	*0.65*	*86*	*0.35*	*0.26*	*0.48*	*46*	*3.6*
	Milton Keynes	247,000	0.72	0.73	1.12	0.95	0.94	1.02	93	0.91	0.77	1.09	85	12.7
	Oxfordshire	*624,200*	*0.89*	*0.74*	*0.72*	*0.71*	*1.05*	*0.91*	*93*	*0.84*	*0.75*	*0.93*	*87*	*8.1*
	Portsmouth City Teaching	*207,200*	*0.59*	*0.77*	*0.78*	*0.88*	*0.72*	*0.58*	*53*	*0.72*	*0.58*	*0.90*	*67*	*8.0*
	Southampton City	239,800	0.76	0.68	0.82	1.18	0.68	1.21	108	0.89	0.74	1.07	81	11.4
South West	Bath and North East Somerset	179,800	1.06	0.86	0.97	0.71	1.31	0.62	67	0.92	0.76	1.11	100	5.8
	Bournemouth and Poole Teaching	*310,800*	*0.70*	*0.63*	*0.73*	*0.89*	*0.57*	*0.56*	*64*	*0.68*	*0.58*	*0.80*	*78*	*5.0*
	Bristol	**441,100**	**1.16**	**1.38**	**1.04**	**1.49**	**1.21**	**1.40**	**125**	**1.28**	**1.15**	**1.43**	**116**	**11.6**
	Cornwall and Isles of Scilly	*537,900*	*0.67*	*1.07*	*0.93*	*0.88*	*1.01*	*0.79*	*99*	*0.90*	*0.81*	*0.99*	*113*	*2.8*
	Devon	749,700	1.04	0.92	1.08	1.13	1.02	0.90	113	1.01	0.93	1.10	129	3.3
	Dorset	*404,900*	*0.63*	*0.53*	*0.77*	*0.90*	*0.70*	*0.65*	*89*	*0.70*	*0.61*	*0.79*	*96*	*3.5*
	Gloucestershire	*593,600*	*0.85*	*1.01*	*0.87*	*0.65*	*1.11*	*0.88*	*101*	*0.90*	*0.81*	*0.99*	*104*	*4.7*
	North Somerset	212,100	1.05	0.84	0.74	1.12	0.84	0.87	104	0.91	0.77	1.07	110	3.6
	Plymouth Teaching	**258,900**	**1.09**	**1.79**	**1.73**	**1.05**	**1.15**	**1.22**	**124**	**1.34**	**1.17**	**1.54**	**137**	**4.4**
	Somerset	*525,500*	*0.63*	*0.75*	*0.67*	*0.76*	*1.10*	*1.10*	*135*	*0.84*	*0.75*	*0.93*	*104*	*3.2*
	South Gloucestershire	264,900	1.08	0.99	0.90	0.97	0.72	1.13	121	0.96	0.83	1.12	104	5.0
	Swindon	206,900	0.74	0.75	0.52	1.14	1.08	1.07	106	0.88	0.73	1.07	89	7.1
	Torbay	134,400	1.01	0.79	0.92	1.55	0.68	1.45	186	1.06	0.88	1.28	138	3.1
	Wiltshire	*459,800*	*0.82*	*0.70*	*0.60*	*0.85*	*0.74*	*0.82*	*94*	*0.76*	*0.67*	*0.86*	*87*	*3.4*
Wales	Betsi Cadwaladr University	678,500	1.32	1.09	1.11	0.94	0.87	0.92	109	1.04	0.95	1.14	125	1.0
	Powys Teaching	131,100	1.19	0.68	0.98	0.86	1.02	0.76	99	0.91	0.75	1.12	121	0.9
	Hywel Dda	374,800	1.04	0.91	1.13	1.20	0.80	1.13	139	1.03	0.92	1.16	129	1.0
	Abertawe Bro Morgannwg Univ.	**504,800**	**1.03**	**1.39**	**1.49**	**1.23**	**1.54**	**1.53**	**172**	**1.37**	**1.25**	**1.50**	**156**	**1.6**
	Cwm Taf	**290,600**	**1.50**	**1.73**	**1.60**	**1.10**	**1.30**	**0.99**	**107**	**1.37**	**1.21**	**1.55**	**150**	**1.1**
	Aneurin Bevan	**561,300**	**1.17**	**1.11**	**1.36**	**0.96**	**0.94**	**1.33**	**148**	**1.14**	**1.04**	**1.26**	**128**	**1.9**
	Cardiff and Vale University	**466,100**	**1.18**	**1.36**	**1.44**	**0.98**	**1.15**	**1.36**	**131**	**1.25**	**1.12**	**1.39**	**122**	**6.7**
Scotland	Ayrshire & Arran	366,900	1.19	1.35	0.85	0.85	0.88	1.12	131	1.04	0.92	1.17	123	0.7
	Borders	113,000	0.59	0.83	1.20	1.06	0.98	1.08	133	0.96	0.77	1.19	119	0.6
	Dumfries and Galloway	148,100	1.29	1.12	0.83	1.09	1.02	0.52	68	0.98	0.81	1.17	127	0.7
	Fife	**364,800**	**1.47**	**1.01**	**1.02**	**0.97**	**1.18**	**1.16**	**129**	**1.13**	**1.01**	**1.27**	**127**	**1.3**
	Forth Valley	293,100	0.97	1.01	1.31	0.78	1.02	1.02	109	1.02	0.88	1.17	111	1.1
	Grampian	*550,500*	*1.01*	*0.81*	*0.89*	*0.89*	*0.88*	*0.76*	*82*	*0.87*	*0.78*	*0.97*	*96*	*1.6*
	Greater Glasgow & Clyde	1,204,100	1.18	1.11	1.06	0.94	0.98	0.87	89	1.02	0.95	1.10	106	3.4
	Highland	310,700	1.45	0.85	0.86	0.79	0.73	0.64	77	0.88	0.77	1.01	108	0.8
	Lanarkshire	*562,700*	*0.77*	*0.91*	*0.84*	*0.76*	*0.86*	*0.99*	*105*	*0.85*	*0.76*	*0.96*	*92*	*1.2*
	Lthian	*837,000*	*1.02*	*1.04*	*0.86*	*0.96*	*0.84*	*0.61*	*61*	*0.89*	*0.81*	*0.97*	*91*	*2.8*
	Orkney	19,800	1.29	0.81	0.41	1.65	1.23	0.42	51	0.97	0.57	1.63	118	0.4
	Shetland	*22,500*	*0.41*	*0.00*	*1.57*	*0.00*	*0.39*	*0.40*	*44*	*0.46*	*0.22*	*0.96*	*52*	*1.1*
	Tayside	**402,400**	**1.37**	**1.05**	**1.23**	**1.17**	**1.28**	**1.01**	**117**	**1.18**	**1.06**	**1.32**	**138**	**1.9**
	Western Isles	26,500	0.00	0.87	1.77	0.29	0.87	1.20	151	0.84	0.52	1.35	107	0.6
N Ireland	**Belfast**	**335,700**	**1.61**	**1.60**	**1.26**	**1.01**	**0.80**	**1.34**	**131**	**1.27**	**1.12**	**1.43**	**126**	**1.1**
	Northern	**458,600**	**1.57**	**1.26**	**1.38**	**1.13**	**0.80**	**1.15**	**116**	**1.21**	**1.09**	**1.35**	**124**	**0.6**
	Southern	357,700	1.28	0.65	0.60	0.99	0.80	1.04	95	0.89	0.77	1.03	82	0.4
	South Eastern	347,100	1.24	0.99	0.86	0.83	0.69	0.71	72	0.88	0.77	1.02	91	0.7
	Western	299,900	0.95	1.25	1.02	0.85	1.23	0.90	83	1.04	0.89	1.20	97	0.5

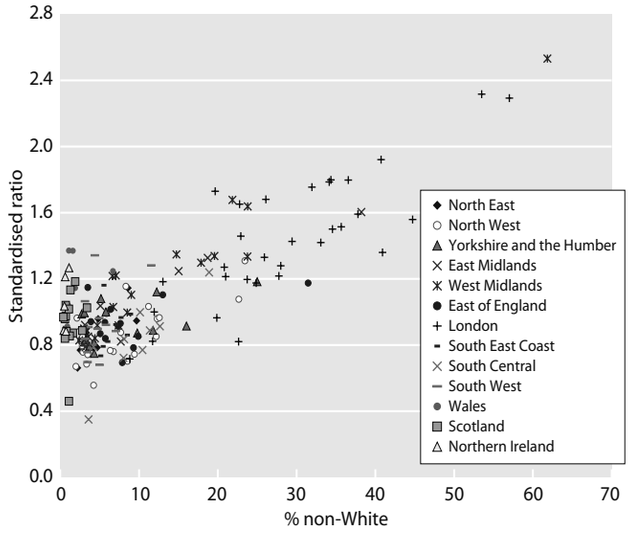

Fig. 1.2. Age/gender standardised incidence ratio (2005–2010) by percentage non-White

therefore remains an inexact science and these figures should be regarded as indicative only. 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.

There was a fall of over 20% in the number of new patients for Scotland and Northern Ireland from 2005 to 2010. There was a small fall for Wales over the same period. After omitting the four English centres which did not contribute data for 2005 there was an increase of almost 5% in new patients for England from 2005 to 2010. However, this change occurred from 2005 to 2006 after which the number of patients was relatively stable. Across all four countries the change averages out at an increase of 0.5%.

Table 1.3. Number of new patients accepted by individual renal centres reporting to the UK Renal Registry 2005–2010

		Year						Catchment population (millions)	2010 rate pmp	(95% CI)
Country	Centre	2005	2006	2007	2008	2009	2010			
England	B Heart	119	116	101	105	99	95	0.72	131	(105–157)
	B QEH	199	186	225	268	255	197	1.62	121	(104–138)
	Basldn	32	45	39	40	26	32	0.41	78	(51–106)
	Bradfd	67	50	88	63	61	64	0.58	111	(83–138)
	Brightn	112	131	120	121	120	107	1.20	90	(73–106)
	Bristol	175	176	156	176	158	169	1.57	108	(91–124)
	Camb[a]	111	156	128	109	136	108	1.27[a]	85[a]	(69–101)
	Carlis	31	27	26	30	24	21	0.31	67	(38–95)
	Carsh	183	186	194	216	208	221	1.92	115	(100–131)
	Chelms[a]	40	50	52	36	52	42	0.47[a]	90[a]	(63–117)
	Colchr[b]	n/a	n/a	n/a	58	17	32	[b]	[b]	[b]
	Covnt	84	104	113	116	118	118	0.87	136	(111–160)
	Derby	71	70	63	96	78	80	0.65	124	(97–151)
	Donc[b]	n/a	n/a	20	26	40	44	[b]	[b]	[b]
	Dorset	49	53	65	85	76	72	0.73	99	(76–122)
	Dudley	38	45	40	46	69	41	0.42	99	(69–129)
	Exeter	111	105	126	135	145	136	1.03	132	(110–155)
	Glouc	61	74	58	47	79	58	0.58	101	(75–127)
	Hull	125	105	99	113	101	88	0.99	89	(71–108)
	Ipswi[a]	59	42	40	38	38	34	0.56[a]	61[a]	(40–81)
	Kent			172	140	131	134	1.16	115	(96–135)
	L Barts	187	190	214	206	239	207	1.68	123	(106–140)
	L Guys	148	152	168	164	176	144	1.15	125	(104–145)
	L Kings	131	110	121	151	128	148	0.97	153	(128–177)
	L Rfree	132	194	185	173	170	203	1.50	135	(116–154)
	L St.G			93	100	109	83	0.59	142	(111–172)
	L West	302	313	278	318	357	367	2.23	165	(148–182)
	Leeds	172	178	127	159	154	130	1.65	79	(65–93)
	Leic	226	241	244	243	228	250	2.32	108	(94–121)
	Liv Ain	29	35	36	42	38	49	0.29	169	(122–216)
	Liv RI	139	141	112	102	110	102	1.20	85	(69–102)
	M Hope	110	132	121	142	125	146	1.42	103	(86–119)

Table 1.3. Continued

Country	Centre	Year						Catchment population (millions)	2010 rate pmp	(95% CI)
		2005	2006	2007	2008	2009	2010			
England	M RI			160	133	147	163	1.47	111	(94–128)
	Middlbr	84	108	99	93	95	98	1.01	97	(78–116)
	Newc	112	106	106	97	100	95	1.11	86	(69–103)
	Norwch	119	113	110	90	73	85	0.79	107	(84–130)
	Nottm	145	137	130	115	134	113	1.14	99	(81–118)
	Oxford	153	157	144	150	177	167	1.68	99	(84–114)
	Plymth	60	92	76	69	56	55	0.48	116	(85–146)
	Ports	149	175	157	170	149	150	2.00	75	(63–87)
	Prestn	121	121	132	112	147	122	1.51	81	(66–95)
	Redng	90	88	94	105	99	89	0.80	111	(88–134)
	Sheff[a]	158	168	165	180	150	144	1.49[a]	97[a]	(81–113)
	Shrew	41	55	58	61	47	58	0.39	148	(110–186)
	Stevng	89	122	89	103	98	110	1.09	101	(82–120)
	Sthend	34	48	34	36	23	30	0.32	95	(61–129)
	Stoke			87	81	110	93	0.90	104	(83–125)
	Sund	60	57	62	45	64	55	0.59	93	(69–118)
	Truro	32	52	45	41	58	43	0.41	104	(73–136)
	Wirral	60	52	53	39	63	52	0.52	100	(73–127)
	Wolve	95	85	68	88	65	107	0.61	176	(143–210)
	York	46	48	38	38	47	36	0.51	71	(48–95)
N Ireland	Antrim	42	33	37	41	21	41	0.30	137	(95–179)
	Belfast	130	121	90	70	61	71	0.55	128	(99–158)
	Derry		4	8	6	17	18	0.18	102	(55–149)
	Newry	28	13	15	21	20	21	0.28	74	(42–106)
	Tyrone	24	29	21	25	19	10	0.18	57	(22–92)
	Ulster	9	8	16	14	13	20	0.30	67	(37–96)
Scotland	Abrdn	62	53	56	56	55	46			
	Airdrie	39	55	49	39	48	56			
	D & Gall	22	20	17	19	17	10			
	Dundee	73	51	62	64	69	50			
	Dunfn	44	37	37	30	33	44			
	Edinb	99	106	95	103	98	67			
	Glasgw	199	186	187	159	175	151			
	Inverns	44	26	26	25	21	27			
	Klmarnk	44	57	36	33	39	43			
Wales	Bangor	40	42	36	41	30	26	0.25	104	(64–144)
	Cardff	184	206	221	150	179	188	1.45	130	(111–148)
	Clwyd	26	18	22	15	17	13	0.20	65	(30–100)
	Swanse	101	116	127	124	116	135	0.80	169	(140–197)
	Wrexm	42	26	27	21	20	24	0.30	80	(48–112)
								% change since 2005		
England		**4,891**	**5,191**	**5,531**	**5,710**	**5,767**	**5,587**	[c]		
N Ireland		**233**	**208**	**187**	**177**	**151**	**181**	**−22.3**		
Scotland		**626**	**591**	**565**	**528**	**555**	**494**	**−21.1**		
Wales		**393**	**408**	**433**	**351**	**362**	**386**	**−1.8**		
UK		**6,143**	**6,398**	**6,716**	**6,766**	**6,835**	**6,648**	[c]		
Omitting Kent, L St.G, M RI and Stoke to look at change over time as they were not reporting for 2005										
England		**4,891**	**5,191**	**5,019**	**5,256**	**5,270**	**5,114**	**4.6**		
UK		**6,143**	**6,398**	**6,204**	**6,312**	**6,338**	**6,175**	**0.5**		

Blank cells = no data returned to the registry for that year
n/a – renal centre not yet operational
[a]Some reduction required to the population and increase to the rate after the opening of Colchester renal centre and the expansion of Doncaster renal centre
[b]Colchester renal centre was opened in 2007, Doncaster was still expanding and so catchment populations could not be calculated
[c]Percentage change not given as not all centres contributing for 2005

2 Demographics and clinical characteristics of patients starting RRT

Methods

Age, gender, primary renal disease, ethnic origin and treatment 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/report 2011/appendix-H.pdf). Chi-squared, Fisher's exact, ANOVA and Kruskal Wallis tests were used as appropriate to test for significant differences.

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 overall in the last four years and declined slightly in the under 65 age groups (figure 1.3).

Figure 1.4 shows RRT incidence rates for 2010 by age group. For men, the peak was in the 80-84 age group, for women 75–79 and overall 75–79 (the higher male peak at 80–84 does not shift the overall figure as there are relatively few people in this age group).

In 2010, the median age of patients starting renal replacement therapy was 64.9 years (table 1.4) and this had changed little over the previous six years (data not shown). The median age of 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. The median age of patients starting RRT in England was lower than that for N Ireland, Scotland and Wales possibly reflecting the larger percentage of the population being non-White in England.

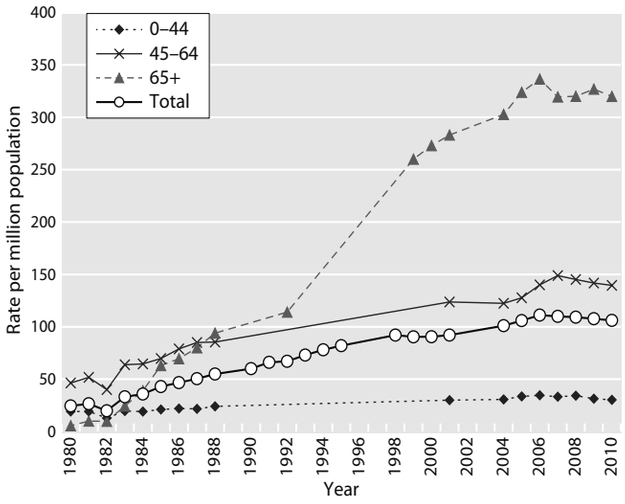

Fig. 1.3. UK incident RRT rates between 1980 and 2010

Figure 1.5 shows that the 45–54, 55–64 and 65–74 age groups contained the most patients starting on peritoneal dialysis whereas the 65–74 age group contained the most patients starting on haemodialysis closely followed by the 75–84 age group.

There were large differences between centres in the median age of incident patients (figure 1.6). This reflects differences in the age and ethnic structure of the catchment populations and also chance fluctuations, particularly in small centres. The median age of patients treated at transplant centres was 63.1 years (IQR 49.7, 74.2) and at non-transplanting centres 66.5 years (IQR 52.9, 76.0) ($p < 0.0001$).

Whilst the median age of patients has risen only slightly over the last 10 years the percentage of patients aged over 75 years has risen from 22.3% to 25.6%.

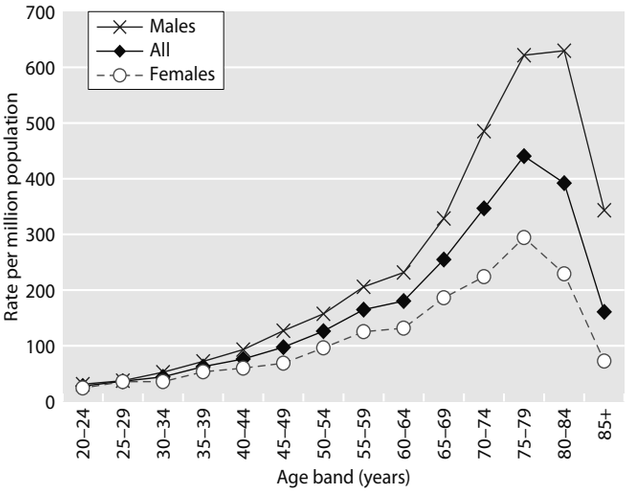

Fig. 1.4. Incidence rates by age and gender in 2010

Table 1.4. Median and inter-quartile range of the age of patients starting renal replacement therapy in 2010 by country

Country	Median	IQR
England	64.4	(50.6–75.1)
N Ireland	67.6	(57.1–77.8)
Scotland	65.3	(51.9–75.0)
Wales	68.5	(56.4–77.2)
UK	**64.9**	**(51.0–75.2)**

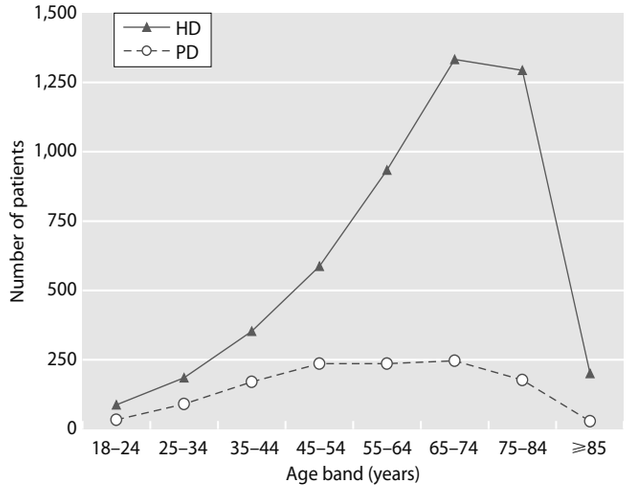

Fig. 1.5. Number of incident patients in 2010, by age group and initial dialysis modality

There is 6-fold variation in crude incidence rates in the over 75 year age group between PCT/HBs (excluding outlying areas) using a combined 6 year cohort. The absolute range in rates was from 0 per million age related population (pmarp) (Shetland) to 1,003 pmarp (Heart of Birmingham). Incidence rates in older patients were able

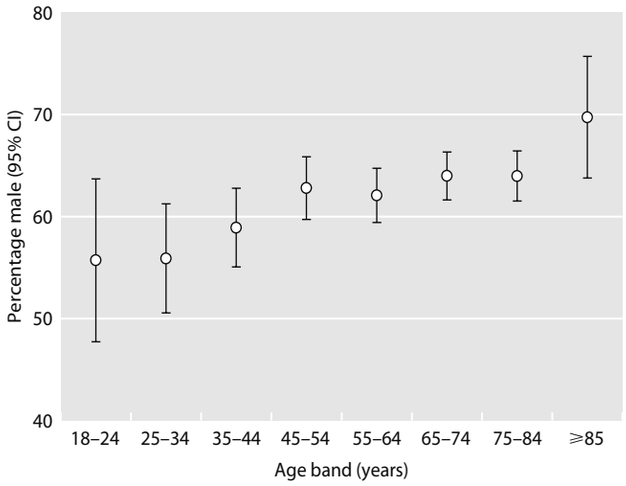

Fig. 1.7. Percentage of patients starting RRT in 2010 who were male, by age group

to explain 55% of the variation in overall RRT incidence rate suggesting that this is one of the explanatory factors for the variation in RRT incidence seen in the UK. The wide range of treatment rates suggests there is geographical variation in the prevalence of co-morbid and predisposing renal conditions within the UK as well as uncertainty within the renal community about the suitability of older patients for dialysis. The median age of new patients with diabetes was slightly younger than the overall median at 63.9 years and this has not changed over the last 5 years.

Gender

As in previous years, more men than women started RRT (62.6% male). The percentage male was above 50 for all age groups and increased with increasing age group (figure 1.7).

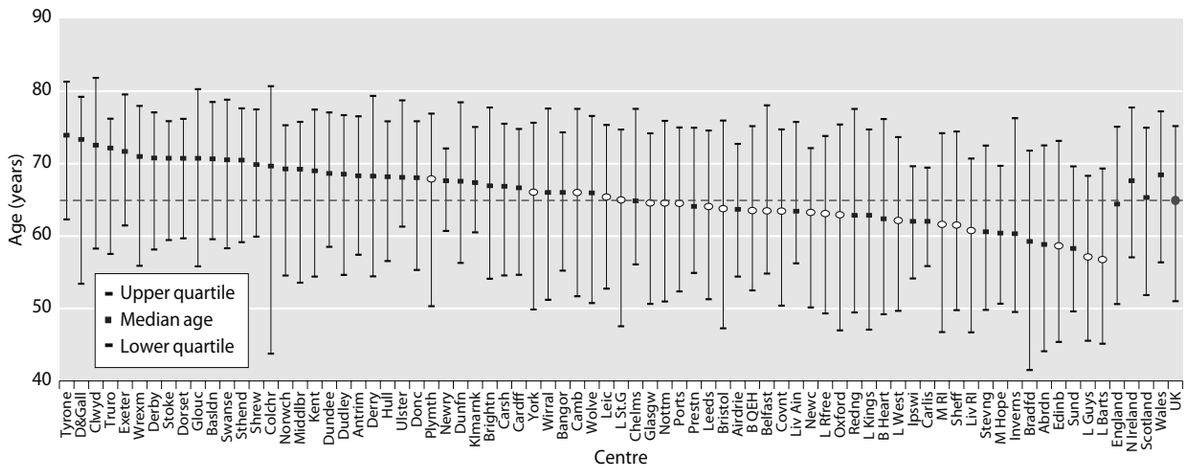

Fig. 1.6. Median age of incident patients in each centre in 2010
White points indicate transplant centres

Table 1.5. Percentage of incident patients (2010) in different ethnic groups by centre

Country	Centre	% data not available	N with data	Percentage in each ethnic group				
				White	Black	South Asian	Chinese	Other
England	B Heart	0.0	95	67.4	2.1	28.4	1.1	1.1
	B QEH	0.0	197	67.5	6.6	21.8	1.5	2.5
	Basldn	0.0	32	87.5	12.5			
	Bradfd	6.3	60	46.7	3.3	50.0		
	Brightn	98.1	2					
	Bristol	0.0	169	88.8	3.6	5.3	1.2	1.2
	Camb	0.9	107	98.1	0.9	0.9		
	Carlis	0.0	21	100.0				
	Carsh	14.5	189	77.2	7.4	11.6		3.7
	Chelms	11.9	37	91.9	2.7	2.7		2.7
	Colchr	18.8	26	96.2	3.8			
	Covnt	0.8	117	82.1	5.1	12.8		
	Derby	12.5	70	90.0		8.6		1.4
	Donc	0.0	44	95.5	2.3	2.3		
	Dorset	0.0	72	98.6				1.4
	Dudley	0.0	41	85.4	2.4	9.8		2.4
	Exeter	13.2	118	99.2		0.8		
	Glouc	1.7	57	96.5				3.5
	Hull	2.3	86	100.0				
	Ipswi	0.0	34	97.1		2.9		
	Kent	10.4	120	96.7		2.5		0.8
	L Barts	2.4	202	32.2	35.1	31.7		1.0
	L Guys	4.9	137	56.2	33.6	4.4	1.5	4.4
	L Kings	6.8	138	55.8	31.2	11.6	1.4	
	L Rfree	5.9	191	49.7	17.3	20.4	0.5	12.0
	L St.G	6.0	78	61.5	17.9	17.9		2.6
	L West	1.1	363	44.4	16.0	35.3	0.6	3.9
	Leeds	1.5	128	80.5	2.3	15.6		1.6
	Leic	4.4	239	81.6	2.1	14.6	0.4	1.3
	Liv Ain	65.3	17					
	Liv RI	28.4	73	94.5	4.1		1.4	
	M Hope	0.0	146	89.0		8.2	0.7	2.1
	M RI	3.1	158	73.4	12.0	12.7	1.9	
	Middlbr	0.0	98	93.9	1.0	5.1		
	Newc	0.0	95	94.7		4.2		1.1
	Norwch	11.8	75	98.7		1.3		
	Nottm	0.0	113	88.5	5.3	4.4		1.8
	Oxford	0.6	166	87.3	3.0	9.0		0.6
	Plymth	5.5	52	96.2		1.9		1.9
	Ports	1.3	148	90.5	2.7	5.4	0.7	0.7
	Prestn	1.6	120	83.3	0.8	15.8		
	Redng	0.0	89	70.8	5.6	23.6		
	Sheff	0.7	143	90.9	1.4	2.8	0.7	4.2
	Shrew	0.0	58	94.8	1.7	1.7		1.7
	Stevng	0.0	110	78.2	2.7	18.2		0.9
	Sthend	3.3	29	93.1	3.4		3.4	
	Stoke	1.1	92	98.9	1.1			
	Sund	0.0	55	96.4	1.8	1.8		
	Truro	0.0	43	100.0				
	Wirral	3.8	50	94.0		2.0	2.0	2.0
	Wolve	0.0	107	71.0	9.3	17.8	0.9	0.9
	York	5.6	34	97.1	2.9			
N Ireland	Antrim	0.0	41	97.6		2.4		
	Belfast	2.8	69	98.6		1.4		
	Derry	0.0	18	94.4		5.6		

Table 1.5. Continued

Country	Centre	% data not available	N with data	Percentage in each ethnic group				
				White	Black	South Asian	Chinese	Other
N Ireland	Newry	0.0	21	100.0				
	Tyrone	0.0	10	100.0				
	Ulster	0.0	20	95.0		5.0		
Wales	Bangor	0.0	26	100.0				
	Cardff	1.6	185	93.0	1.6	4.3		1.1
	Clwyd	15.4	11	100.0				
	Swanse	0.0	135	98.5		1.5		
	Wrexm	0.0	24	100.0				
England		**6.2**	**5,241**	**78.1**	**7.4**	**12.3**	**0.5**	**1.8**
N Ireland		**1.1**	**179**	**97.8**		**2.2**		
Wales		**1.3**	**381**	**96.1**	**0.8**	**2.6**		**0.5**
E, W & NI		**5.7**	**5,801**	**79.8**	**6.8**	**11.3**	**0.4**	**1.7**

The percentage breakdown is not shown for centres with less than 50% data completeness, but these centres are included in national averages

Ethnicity

In 2010, there was an improvement in the completeness of ethnicity data. Sixty-one centres returned ethnicity data that were 50% or more complete (table 1.5) compared with 51 centres last year. Fifty-two of these 61 centres provided ethnicity data for 90% or more of their incident patients compared with 27 centres last year. Ethnicity completeness is low in the Scottish Renal Registry and Scotland has not been included in the table. The low completeness for some centres means results should still be interpreted with some caution. There was great variation between centres in the ethnic mix of incident patients ranging from 0% ethnic minorities in Carlisle, Hull, Truro, Newry, Tyrone, Bangor, Clywd and Wrexham to over 50% in Bradford, London Barts, London Royal Free and London West.

Primary renal diagnosis

The distribution of primary renal disease (PRD) by centre is shown in table 1.6. Data for PRD were missing in 9.8% of patients and there remained marked differences between centres in completeness of data returns. Sixty centres provided data on over 90% of incident patients and 28 of these had 100% completeness. Four centres had missing PRD data for more than 25% of new patients and for these centres the percentages in the diagnostic categories have not been shown in table 1.6.

Table 1.6. Percentage distribution of primary renal diagnosis by centre in the 2010 incident cohort

Country	Centre	% data not available	N with data	Percentage							
				Uncertain aetiology[a]	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
England	B Heart	1.1	94	28.7	26.6	12.8	3.2	10.6	2.1	8.5	7.5
	B QEH	0.0	197	12.7	25.9	12.7	7.1	17.3	8.1	7.1	9.1
	Basldn	0.0	32	25.0	18.8	12.5	3.1	9.4	12.5	6.3	12.5
	Bradfd	1.6	63	23.8	36.5	9.5	9.5	7.9	3.2	4.8	4.8
	Brightn	72.0	30								
	Bristol	0.6	168	21.4	17.3	12.5	6.0	20.2	7.1	7.1	8.3
	Camb	0.0	108	53.7							
	Carlis	0.0	21	4.8	23.8	14.3	19.1	19.1	4.8	14.3	0.0
	Carsh	19.0	179	34.1	17.9	6.2	6.7	20.1	3.4	5.0	6.7
	Chelms	4.8	40	30.0	25.0	10.0	5.0	15.0	0.0	7.5	7.5
	Colchr	18.8	26	11.5	11.5	15.4	11.5	15.4	3.9	19.2	11.5
	Covnt	2.5	115	18.3	13.9	12.2	10.4	15.7	11.3	7.0	11.3
	Derby	2.5	78	24.4	24.4	15.4	1.3	16.7	1.3	9.0	7.7
	Donc	0.0	44	43.2	25.0	2.3	6.8	11.4	4.6	4.6	2.3

Table 1.6. Continued

Country	Centre	% data not available	N with data	Percentage							
				Uncertain aetiology[a]	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
England	Dorset	4.2	69	14.5	13.0	5.8	7.3	21.7	14.5	13.0	10.1
	Dudley	2.4	40	7.5	30.0	12.5	27.5	12.5	5.0	5.0	0.0
	Exeter	3.7	131	14.5	22.9	4.6	7.6	19.1	6.1	8.4	16.8
	Glouc	0.0	58	25.9	19.0	10.3	0.0	15.5	12.1	3.5	13.8
	Hull	8.0	81	24.7	21.0	9.9	4.9	17.3	6.2	13.6	2.5
	Ipswi	0.0	34	55.9							
	Kent	2.2	131	28.2	16.8	12.2	2.3	18.3	9.2	6.1	6.9
	L Barts	10.1	186	12.4	36.6	12.4	9.1	15.6	5.4	4.8	3.8
	L Guys	22.9	111	12.6	25.2	14.4	10.8	15.3	6.3	11.7	3.6
	L Kings	0.0	148	19.6	27.0	14.2	14.2	10.8	6.8	5.4	2.0
	L Rfree	78.3	44								
	L St.G	4.8	79	15.2	26.6	13.9	5.1	19.0	8.9	8.9	2.5
	L West	1.1	363	16.5	33.1	11.6	3.6	19.8	4.7	5.8	5.0
	Leeds	0.8	129	20.2	24.8	8.5	9.3	17.8	4.7	7.8	7.0
	Leic	18.8	203	18.2	22.2	13.3	3.5	15.8	8.4	10.8	7.9
	Liv Ain	0.0	49	98.0							
	Liv RI	2.0	100	70.0							
	M Hope	51.4	71								
	M RI	17.8	134	14.9	26.1	14.9	13.4	13.4	7.5	7.5	2.2
	Middlbr	0.0	98	22.5	17.4	16.3	2.0	17.4	11.2	8.2	5.1
	Newc	2.1	93	22.6	22.6	14.0	6.5	11.8	10.8	4.3	7.5
	Norwch	8.2	78	24.4	19.2	10.3	1.3	16.7	11.5	5.1	11.5
	Nottm	0.0	113	19.5	22.1	10.6	4.4	15.9	9.7	11.5	6.2
	Oxford	5.4	158	18.4	27.2	14.6	2.5	15.2	6.3	12.0	3.8
	Plymth	7.3	51	7.8	23.5	23.5	5.9	15.7	9.8	7.8	5.9
	Ports	3.3	145	10.3	25.5	8.3	11.0	18.6	5.5	12.4	8.3
	Prestn	4.9	116	15.5	18.1	13.8	12.1	14.7	9.5	6.0	10.3
	Redng	4.5	85	16.5	24.7	18.8	2.4	14.1	4.7	10.6	8.2
	Sheff	8.3	132	27.3	22.0	11.4	2.3	15.9	3.8	9.9	7.6
	Shrew	0.0	58	27.6	22.4	8.6	10.3	17.2	3.5	3.5	6.9
	Stevng	0.0	110	16.4	29.1	12.7	6.4	15.5	7.3	6.4	6.4
	Sthend	10.0	27	37.0	14.8	11.1	3.7	11.1	14.8	3.7	3.7
	Stoke	16.1	78	15.4	18.0	10.3	5.1	16.7	7.7	9.0	18.0
	Sund	5.5	52	11.5	23.1	13.5	21.2	15.4	3.9	7.7	3.9
	Truro	2.3	42	19.1	23.8	11.9	0.0	21.4	0.0	4.8	19.1
	Wirral	30.8	36								
	Wolve	0.9	106	30.2	22.6	13.2	2.8	14.2	5.7	3.8	7.6
	York	0.0	36	16.7	13.9	19.4	13.9	19.4	5.6	0.0	11.1
N Ireland	Antrim	4.9	39	15.4	38.5	15.4	0.0	10.3	7.7	7.7	5.1
	Belfast	1.4	70	17.1	21.4	10.0	7.1	20.0	7.1	10.0	7.1
	Derry	0.0	18	16.7	11.1	16.7	11.1	16.7	0.0	5.6	22.2
	Newry	0.0	21	28.6	28.6	9.5	4.8	9.5	0.0	4.8	14.3
	Tyrone	0.0	10	0.0	20.0	0.0	40.0	10.0	10.0	0.0	20.0
	Ulster	0.0	20	20.0	30.0	5.0	5.0	20.0	10.0	5.0	5.0
Scotland	Abrdn	0.0	46	17.4	23.9	8.7	6.5	17.4	8.7	8.7	8.7
	Airdrie	0.0	56	26.8	17.9	10.7	1.8	17.9	5.4	12.5	7.1
	D & Gall	0.0	10	40.0	30.0	10.0	10.0	10.0	0.0	0.0	0.0
	Dundee	0.0	50	12.0	28.0	16.0	10.0	14.0	2.0	2.0	16.0
	Dunfn	0.0	44	27.3	20.5	2.3	6.8	25.0	4.6	2.3	11.4
	Edinb	0.0	67	11.9	26.9	0.0	9.0	31.3	1.5	9.0	10.5
	Glasgw	0.0	151	18.5	23.8	11.9	4.0	15.2	9.9	7.3	9.3
	Inverns	0.0	27	25.9	18.5	18.5	3.7	11.1	11.1	7.4	3.7
	Klmarnk	0.0	43	9.3	30.2	11.6	23.3	7.0	9.3	7.0	2.3

Table 1.6. Continued

Country	Centre	% data not available	N with data	Percentage							
				Uncertain aetiology[a]	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
Wales	Bangor	0.0	26	34.6	23.1	11.5	7.7	7.7	3.9	7.7	3.9
	Clwyd	7.7	12	58.3							
	Cardff	0.5	187	27.3	27.8	12.3	5.4	9.6	7.5	7.0	3.2
	Swanse	1.5	133	16.5	24.1	10.5	3.8	12.0	6.0	5.3	21.8
	Wrexm	4.2	23	21.7	21.7	4.4	13.0	8.7	13.0	8.7	8.7
England		**11.6**	**4,970**	**19.7**	**24.0**	**11.9**	**6.7**	**16.6**	**6.6**	**7.5**	**7.0**
N Ireland		**1.7**	**178**	**17.4**	**25.8**	**10.7**	**7.3**	**15.7**	**6.2**	**7.3**	**9.6**
Scotland		**0.0**	**494**	**18.6**	**24.1**	**9.7**	**7.3**	**17.6**	**6.7**	**7.1**	**8.9**
Wales		**1.1**	**381**	**23.6**	**25.8**	**11.1**	**5.4**	**10.3**	**7.1**	**6.5**	**10.3**
UK		**9.8**	**6,023**	**19.8**	**24.2**	**11.6**	**6.7**	**16.2**	**6.6**	**7.4**	**7.5**

[a]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 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

The UKRR 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. This year data was not used from five 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 or used in the country and UK averages. These centres have also been excluded where PRD is used to stratify analyses.

For the non-excluded centres, the overall UK percentage with uncertain aetiology was slightly down on 2009 (19.8% from 20.7%) and again, there was great variation between centres. Some of this variation is likely to reflect the lack of a clear definition of certain diagnostic categories e.g. hypertensive renal disease and renal vascular disease; some may result from differences between centres in attitudes to the degree of certainty required to record other diagnoses.

There was only a small amount of missing data for Northern Ireland and Wales and none for Scotland, whilst England had 11.6% missing. The overall percentage missing was similar to last year (9.8% from 9.9%) and was similar in under and over 65 year olds (10.0% and 9.7% respectively).

The overall distribution of PRDs is shown in table 1.7. Diabetic nephropathy was the most common specific

Table 1.7. Percentage distribution of primary renal diagnosis by age, plus gender ratio, in the 2010 incident cohort

Diagnosis	Age <65	Age ⩾65	All patients	M:F
Diabetes	27.0	21.3	24.2	1.8
Glomerulonephritis	15.8	7.3	11.6	2.1
Pyelonephritis	7.8	7.1	7.4	2.1
Hypertension	5.7	7.8	6.7	2.2
Polycystic kidney	9.8	3.5	6.6	1.0
Renal vascular disease	1.9	13.1	7.5	2.2
Other	17.3	15.2	16.2	1.3
Uncertain aetiology[a]	14.8	24.8	19.8	1.5

[a]includes presumed glomerulonepritis not biopsy proven
Percentages calculated after excluding those patients with data not available

Table 1.8. Primary renal diagnosis incidence rates per million population (unadjusted) 2010

Diagnosis	England	N Ireland	Scotland	Wales	UK
Diabetes	22.9	25.6	22.8	33.8	23.5
Glomerulonephritis	11.3	10.6	9.2	14.6	11.3
Pyelonephritis	7.2	7.2	6.7	8.5	7.2
Hypertension	6.4	7.2	6.9	7.1	6.5
Polycystic kidney	6.3	6.1	6.3	9.3	6.5
Renal vascular disease	6.7	9.4	8.4	13.5	7.3
Other	15.8	15.6	16.7	13.5	15.8
Uncertain aetiology[a]	18.8	17.2	17.6	31.0	19.3
Data not available	12.6	1.7	0.0	1.4	10.6
All	**108**	**101**	**95**	**133**	**108**

[a]includes presumed glomerulonephritis not biopsy proven
The overall rates per country may be slightly different to those in table 1.1 as those centres whose PRD data has not been used have been excluded from both the numerator and the denominator here

renal diagnosis in both the under and over 65 year age groups, accounting for 24% 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. 4% respectively), whilst renal vascular disease was much more common in older incident patients (13% vs. 2%). It was perhaps not surprising that uncertainty about the underlying diagnosis was also more common in the older cohort (25% vs. 15%).

For all primary renal diagnoses except ADPKD, the male to female ratio was 1.3 or greater. This gender difference may relate to factors such as hypertension, atheroma and renal vascular disease and smoking which are more common in males and may influence the rate of progression of renal failure.

Table 1.8 shows the incidence rates for each PRD per million population in the 2010 cohort by country. As there were some missing data, the rates for at least some of the diagnoses will be underestimates.

First established treatment modality

The first treatment recorded, irrespective of any later change, was haemodialysis (HD) in 74.8% of patients, peritoneal dialysis (PD) in 18.3% and pre-emptive transplant in 6.9% in 2010. This is a small decrease for HD (76.3 to 74.8) and an increase for PD (17.9 to 18.3) and transplant (5.9 to 6.9) since 2009.

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, 5.6% of the 2010 incident patients had died and a further 0.3% had stopped treatment, leaving 94.1% of the original cohort still on RRT. Table 1.9 shows the percentages on each treatment modality at 90 days both as percentages of all of those starting RRT and then of those still on treatment at 90 days. For this analysis, the incident cohort from 1st October 2009 to 30th September 2010 was used so that follow up to 90 days was available for all patients. Expressed as percentages of the whole incident cohort, 68.3% were on HD at 90 days, 18.1% were on PD and 7.7% had received a transplant. Expressed as a percentage of those still receiving RRT at 90 days, 72.6% were on HD, 19.2% on PD and 8.1% had received a transplant. Figure 1.8 shows these percentages with the HD patients further subdivided. Of those still on RRT at 90 days, 46.1% were treated with main centre HD and 26.2% with satellite HD. The percentage of patients receiving peritoneal dialysis at 90 days increased from the previous year for the first time since the start of the Renal Registry.

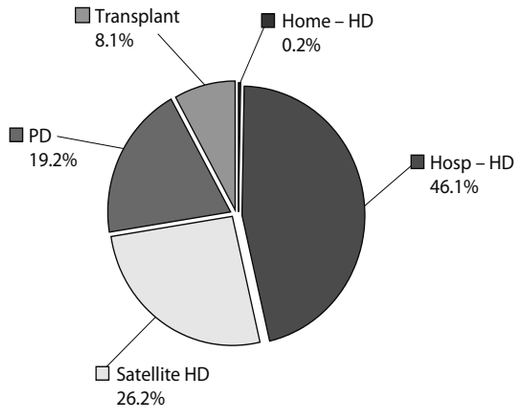

Fig. 1.8. RRT modality at day 90 (incident cohort 1/10/2009 to 30/09/2010)

Northern Ireland continued to have the lowest percentage of patients on PD at 90 days.

The percentage of incident patients who had died by 90 days varied considerably between centres (0% to 19%, table 1.9). Differences in the definition of whether patients have acute or chronic renal failure may be a factor in this apparent variation alongside possible differences in clinical practice.

The percentage with a functioning transplant at 90 days in different centres varied between 0% and 22%. The mean percentage of the incident cohort with a functioning transplant by 90 days was significantly greater in transplanting compared to non-transplanting centres (10.5% vs. 5.0%: $p < 0.0001$). 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) and this was particularly the case in Reading, Oxford, Carlisle and Newcastle.

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 twice as high in patients aged <65 years than in older patients (28.2% vs. 14.0%). The median age on HD was 67.4 years compared with 58.4 years for PD. There were however four centres where the percentage of patients treated with PD was higher in the over 65s than the under 65s (Cambridge, Dorset, Liverpool Aintree and Truro).

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% 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].

Table 1.9. RRT modality at 90 days by centre (incident cohort 1/10/2009 to 30/09/2010)

			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	97	77.3	15.5	5.2	0.0	2.1	79.0	15.8	5.3
	B QEH	214	73.4	15.9	8.4	0.0	2.3	75.1	16.3	8.6
	Basldn	32	68.8	12.5	0.0	0.0	18.8	84.6	15.4	0.0
	Bradfd	56	73.2	12.5	3.6	0.0	10.7	82.0	14.0	4.0
	Brightn	127	66.9	26.0	0.8	0.0	6.3	71.4	27.7	0.8
	Bristol	170	72.9	11.8	8.8	0.0	6.5	78.0	12.6	9.4
	Camb	99	61.6	12.1	22.2	0.0	4.0	64.2	12.6	23.2
	Carlis	24	66.7	25.0	8.3	0.0	0.0	66.7	25.0	8.3
	Carsh	225	79.6	8.9	6.7	0.0	4.9	83.6	9.4	7.0
	Chelms	47	51.1	40.4	4.3	2.1	2.1	53.3	42.2	4.4
	Colchr	25	88.0	0.0	4.0	0.0	8.0	95.7	0.0	4.4
	Covnt	110	65.5	19.1	7.3	0.0	8.2	71.3	20.8	7.9
	Derby	73	46.6	41.1	1.4	1.4	9.6	52.3	46.2	1.5
	Donc	45	68.9	20.0	0.0	0.0	11.1	77.5	22.5	0.0
	Dorset	65	64.6	20.0	10.8	1.5	3.1	67.7	21.0	11.3
	Dudley	46	65.2	28.3	0.0	0.0	6.5	69.8	30.2	0.0
	Exeter	134	71.6	17.9	2.2	0.8	7.5	78.1	19.5	2.4
	Glouc	55	76.4	14.6	3.6	0.0	5.5	80.8	15.4	3.9
	Hull	102	71.6	18.6	1.0	0.0	8.8	78.5	20.4	1.1
	Ipswi	33	63.6	24.2	12.1	0.0	0.0	63.6	24.2	12.1
	Kent	135	62.2	15.6	11.1	0.7	10.4	70.0	17.5	12.5
	L Barts	226	60.6	27.4	7.1	0.0	4.9	63.7	28.8	7.4
	L Guys	165	64.9	10.9	21.2	0.0	3.0	66.9	11.3	21.9
	L Kings	135	63.7	31.1	1.5	0.0	3.7	66.2	32.3	1.5
	L Rfree	202	71.3	10.4	16.3	0.0	2.0	72.7	10.6	16.7

Table 1.9. Continued

			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	L St.G	88	68.2	12.5	17.1	0.0	2.3	69.8	12.8	17.4
	L West	379	79.7	2.4	12.4	0.5	5.0	84.4	2.5	13.1
	Leeds	125	63.2	20.8	9.6	0.0	6.4	67.5	22.2	10.3
	Leic	219	62.6	17.4	12.8	0.0	7.3	67.5	18.7	13.8
	Liv Ain	36	80.6	11.1	0.0	0.0	8.3	87.9	12.1	0.0
	Liv RI	101	51.5	30.7	9.9	1.0	6.9	55.9	33.3	10.8
	M Hope	128	57.8	28.9	11.7	0.0	1.6	58.7	29.4	11.9
	M RI	155	60.7	20.0	19.4	0.0	0.0	60.7	20.0	19.4
	Middlbr	101	74.3	12.9	5.0	0.0	7.9	80.7	14.0	5.4
	Newc	95	60.0	15.8	14.7	0.0	9.5	66.3	17.4	16.3
	Norwch	73	71.2	19.2	2.7	0.0	6.9	76.5	20.6	2.9
	Nottm	119	64.7	25.2	6.7	0.0	3.4	67.0	26.1	7.0
	Oxford	187	52.9	24.1	11.8	0.0	11.2	59.6	27.1	13.3
	Plymth	61	62.3	26.2	6.6	0.0	4.9	65.5	27.6	6.9
	Ports	150	60.0	23.3	8.7	0.0	8.0	65.2	25.4	9.4
	Prestn	126	66.7	22.2	4.0	0.0	7.1	71.8	23.9	4.3
	Redng	94	50.0	37.2	9.6	0.0	3.2	51.7	38.5	9.9
	Sheff	135	71.1	15.6	8.9	0.7	3.7	74.4	16.3	9.3
	Shrew	52	78.9	9.6	1.9	1.9	7.7	87.2	10.6	2.1
	Stevng	110	75.5	14.6	7.3	0.0	2.7	77.6	15.0	7.5
	Sthend	27	77.8	11.1	11.1	0.0	0.0	77.8	11.1	11.1
	Stoke	99	76.8	19.2	3.0	0.0	1.0	77.6	19.4	3.1
	Sund	62	61.3	27.4	6.5	0.0	4.8	64.4	28.8	6.8
	Truro	53	66.0	20.8	5.7	0.0	7.6	71.4	22.5	6.1
	Wirral	59	59.3	30.5	0.0	0.0	10.2	66.0	34.0	0.0
	Wolve	89	55.1	34.8	2.3	0.0	7.9	59.8	37.8	2.4
	York	40	80.0	15.0	0.0	0.0	5.0	84.2	15.8	0.0
N Ireland	Antrim	37	67.6	5.4	0.0	13.5	13.5	92.6	7.4	0.0
	Belfast	67	77.6	4.5	6.0	1.5	10.5	88.1	5.1	6.8
	Derry	15	73.3	6.7	6.7	6.7	6.7	84.6	7.7	7.7
	Newry	20	95.0	5.0	0.0	0.0	0.0	95.0	5.0	0.0
	Tyrone	12	91.7	8.3	0.0	0.0	0.0	91.7	8.3	0.0
	Ulster	21	90.5	4.8	0.0	0.0	4.8	95.0	5.0	0.0
Scotland	Abrdn	50	68.0	22.0	2.0	2.0	6.0	73.9	23.9	2.2
	Airdrie	64	84.4	12.5	0.0	0.0	3.1	87.1	12.9	0.0
	D & Gall	12	83.3	16.7	0.0	0.0	0.0	83.3	16.7	0.0
	Dundee	53	88.7	7.6	0.0	0.0	3.8	92.2	7.8	0.0
	Dunfn	43	76.7	18.6	0.0	0.0	4.7	80.5	19.5	0.0
	Edinb	73	71.2	16.4	4.1	1.4	6.9	77.6	17.9	4.5
	Glasgw	154	83.1	8.4	2.0	0.0	6.5	88.9	9.0	2.1
	Inverns	26	53.9	42.3	0.0	0.0	3.9	56.0	44.0	0.0
	Klmarnk	48	58.3	35.4	0.0	0.0	6.3	62.2	37.8	0.0
Wales	Bangor	25	80.0	20.0	0.0	0.0	0.0	80.0	20.0	0.0
	Cardff	181	71.8	15.5	6.1	0.6	6.1	76.9	16.6	6.5
	Clwyd	12	83.3	8.3	0.0	0.0	8.3	90.9	9.1	0.0
	Swanse	134	73.1	17.2	2.2	0.0	7.5	79.0	18.6	2.4
	Wrexm	26	42.3	46.2	0.0	0.0	11.5	47.8	52.2	0.0
England		**5,605**	**67.0**	**18.6**	**8.7**	**0.2**	**5.5**	**71.1**	**19.8**	**9.2**
N Ireland		**172**	**79.7**	**5.2**	**2.9**	**4.1**	**8.1**	**90.7**	**6.0**	**3.3**
Scotland		**523**	**76.5**	**16.4**	**1.3**	**0.4**	**5.4**	**81.1**	**17.4**	**1.4**
Wales		**378**	**71.2**	**18.3**	**3.7**	**0.3**	**6.6**	**76.4**	**19.6**	**4.0**
UK		**6,678**	**68.3**	**18.1**	**7.7**	**0.3**	**5.6**	**72.6**	**19.2**	**8.1**

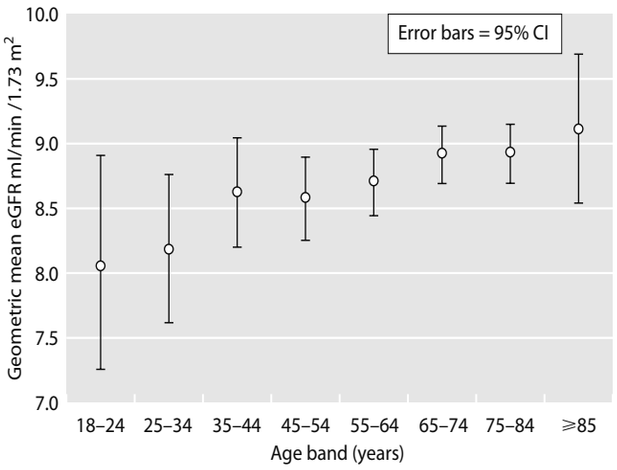

Fig. 1.9. Geometric mean eGFR at start of RRT (2010) by age group

The mean eGFR at initiation of RRT in 2010 was 8.7 ml/min/1.73 m^2. This was highest in patients who were aged 85 and over, at 9.1 ml/min/1.73 m^2 (figure 1.9). By contrast, in the United States 54% of patients starting RRT in 2009 had an eGFR greater than 10 ml/min/1.73 m^2 [6].

Figure 1.10 shows serial data from centres reporting annually to the UKRR since 1999. It demonstrates a continued pattern over the last six years of a higher mean eGFR at start of RRT for PD than HD patients. In patients starting HD, there may be some plateauing of this level around an eGFR of 8.5 ml/min/1.73 m^2.

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 nephrology 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 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 main analyses presented here do not differentiate between these groups and include any patient first seen by renal services within 90 days of starting RRT as 'late presentation' however this year we have also attempted to capture late referrals by

Table 1.10. Modality split of patients on dialysis at 90 days after starting RRT (1/10/2009 to 30/09/2010)

			Age <65 (%)		Age ⩾65 (%)		All patients (%)	
Country	Centre	N	HD	PD	HD	PD	HD	PD
England	B Heart	90	74.5	25.5	93.0	7.0	83.3	16.7
	B QEH	191	70.7	29.3	94.6	5.4	82.2	17.8
	Basldn	26	80.0	20.0	87.5	12.5	84.6	15.4
	Bradfd	48	70.8	29.2	100.0	0.0	85.4	14.6
	Brightn	118	65.3	34.7	76.8	23.2	72.0	28.0
	Bristol	144	79.5	20.5	93.0	7.0	86.1	13.9
	Camb	73	84.0	16.0	83.3	16.7	83.6	16.4
	Carlis	22	54.5	45.5	90.9	9.1	72.7	27.3
	Carsh	199	85.0	15.0	93.3	6.7	89.9	10.1
	Chelms	43	33.3	66.7	84.2	15.8	55.8	44.2
	Colchr	22	100.0	0.0	100.0	0.0	100.0	0.0
	Covnt	93	70.5	29.5	83.7	16.3	77.4	22.6
	Derby	64	34.5	65.5	68.6	31.4	53.1	46.9
	Donc	40	68.4	31.6	85.7	14.3	77.5	22.5
	Dorset	55	81.8	18.2	72.7	27.3	76.4	23.6
	Dudley	43	44.4	55.6	88.0	12.0	69.8	30.2
	Exeter	120	74.4	25.6	82.7	17.3	80.0	20.0
	Glouc	50	65.0	35.0	96.7	3.3	84.0	16.0
	Hull	92	76.9	23.1	81.1	18.9	79.3	20.7
	Ipswi	29	57.1	42.9	86.7	13.3	72.4	27.6
	Kent	105	66.7	33.3	90.0	10.0	80.0	20.0
	L Barts	199	64.8	35.2	78.9	21.1	68.8	31.2
	L Guys	125	84.8	15.2	87.0	13.0	85.6	14.4

Table 1.10. Continued

			Age <65 (%)		Age ⩾65 (%)		All patients (%)	
Country	Centre	N	HD	PD	HD	PD	HD	PD
England	L Kings	128	65.7	34.3	69.0	31.0	67.2	32.8
	L Rfree	165	83.5	16.5	90.7	9.3	87.3	12.7
	L St.G	71	78.6	21.4	88.4	11.6	84.5	15.5
	L West	311	96.4	3.6	97.9	2.1	97.1	2.9
	Leeds	105	64.0	36.0	85.5	14.5	75.2	24.8
	Leic	175	73.5	26.5	82.6	17.4	78.3	21.7
	Liv Ain	33	88.9	11.1	86.7	13.3	87.9	12.1
	Liv RI	83	51.1	48.9	77.8	22.2	62.7	37.3
	M Hope	111	64.6	35.4	69.6	30.4	66.7	33.3
	M RI	125	66.7	33.3	83.1	16.9	75.2	24.8
	Middlbr	88	71.4	28.6	94.3	5.7	85.2	14.8
	Newc	72	71.4	28.6	86.5	13.5	79.2	20.8
	Norwch	66	75.0	25.0	81.0	19.0	78.8	21.2
	Nottm	107	62.5	37.5	82.4	17.6	72.0	28.0
	Oxford	144	59.7	40.3	79.1	20.9	68.8	31.3
	Plymth	54	62.5	37.5	76.7	23.3	70.4	29.6
	Ports	125	66.2	33.8	78.3	21.7	72.0	28.0
	Prestn	112	70.3	29.7	81.3	18.8	75.0	25.0
	Redng	82	47.8	52.2	69.4	30.6	57.3	42.7
	Sheff	117	75.8	24.2	90.2	9.8	82.1	17.9
	Shrew	46	88.9	11.1	89.3	10.7	89.1	10.9
	Stevng	99	78.3	21.7	92.3	7.7	83.8	16.2
	Sthend	24	77.8	22.2	93.3	6.7	87.5	12.5
	Stoke	95	70.6	29.4	85.2	14.8	80.0	20.0
	Sund	55	57.6	42.4	86.4	13.6	69.1	30.9
	Truro	46	83.3	16.7	71.4	28.6	76.1	23.9
	Wirral	53	46.7	53.3	91.3	8.7	66.0	34.0
	Wolve	80	52.4	47.6	71.1	28.9	61.3	38.8
	York	38	81.8	18.2	87.5	12.5	84.2	15.8
N Ireland	Antrim	27	85.7	14.3	100.0	0.0	92.6	7.4
	Belfast	55	91.3	8.7	96.9	3.1	94.5	5.5
	Derry	12	83.3	16.7	100.0	0.0	91.7	8.3
	Newry	20	100.0	0.0	88.9	11.1	95.0	5.0
	Tyrone	12	75.0	25.0	100.0	0.0	91.7	8.3
	Ulster	20	80.0	20.0	100.0	0.0	95.0	5.0
Scotland	Abrdn	45	64.5	35.5	100.0	0.0	75.6	24.4
	Airdrie	62	82.9	17.1	92.6	7.4	87.1	12.9
	D & Gall	12	75.0	25.0	87.5	12.5	83.3	16.7
	Dundee	51	80.0	20.0	100.0	0.0	92.2	7.8
	Dunfn	41	73.3	26.7	84.6	15.4	80.5	19.5
	Edinb	64	79.4	20.6	83.3	16.7	81.3	18.8
	Glasgw	141	87.0	13.0	94.4	5.6	90.8	9.2
	Inverns	25	33.3	66.7	90.0	10.0	56.0	44.0
	Klmarnk	45	57.1	42.9	66.7	33.3	62.2	37.8
Wales	Bangor	25	80.0	20.0	80.0	20.0	80.0	20.0
	Cardff	158	74.2	25.8	88.0	12.0	82.3	17.7
	Clwyd	11	75.0	25.0	100.0	0.0	90.9	9.1
	Swanse	121	71.7	28.3	86.7	13.3	81.0	19.0
	Wrexm	23	12.5	87.5	66.7	33.3	47.8	52.2
England		**4,801**	**71.1**	**28.9**	**85.3**	**14.7**	**78.3**	**21.7**
N Ireland		**146**	**88.9**	**11.1**	**97.6**	**2.4**	**93.8**	**6.2**
Scotland		**486**	**75.0**	**25.0**	**89.7**	**10.3**	**82.3**	**17.7**
Wales		**338**	**70.1**	**29.9**	**85.8**	**14.2**	**79.6**	**20.4**
UK		**5,771**	**71.8**	**28.2**	**86.0**	**14.0**	**79.1**	**20.9**

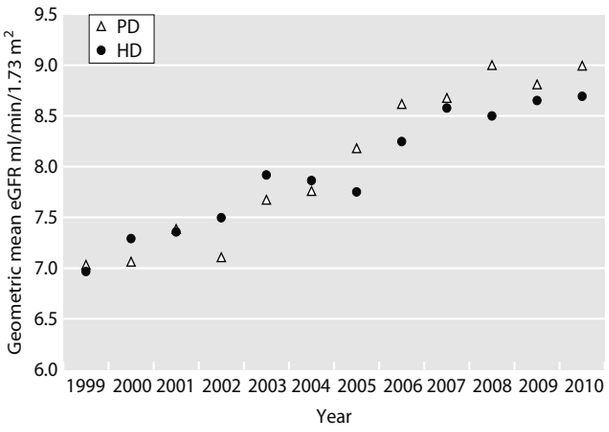

Fig. 1.10. eGFR on starting RRT 1999–2010; PD and HD (restricted to centres reporting since 1999)

excluding an acute renal disease group including all those conditions likely to present with rapidly deteriorating renal function: crescentic glomerulonephritis (type I, II, III), nephropathy (interstitial) due to cis-platinum, renal vascular disease due to malignant hypertension, renal vascular disease due to polyarteritis, Wegener's granulomatosis, cryoglobulinemic glomerulonephritis, myelomatosis/light chain deposit disease, Goodpasture's Syndrome, systemic sclerosis, haemolytic ureaemic syndrome (including Moschcowitz syndrome), multi-system disease – other, tubular necrosis (irreversible) or cortical necrosis, Balkan nephropathy, kidney tumour and traumatic or surgical loss of kidney.

Methods

Data were included from all incident patients in the years 2009 to 2010. The date first seen in a renal centre and the date of starting RRT were used to define the late presenting cohort. A small amount of data were excluded because of actual or potential inconsistencies. Only data from those centres/years 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 likely due to misunderstanding on the part of the renal centres resulting in incorrect recording of data. After these exclusions, data on 6,895 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 2009 to 2010 excluding centres/years with 10% or more start dates for RRT being on the same day as first presentation. There has been a big improvement in the reporting of presentation time data. Two years of data were combined in most of the following analyses in order to make the late presentation percentages more reliably estimated and to allow these to be shown for specific groups of patients. The improvement in completeness has allowed us to use only two years rather than the six years used in previous reports.

Late presentation by centre

Late presentation ranged by centre from 3.5–30.0% in patients commencing RRT in 2009 to 2010. The overall rate of late presentation was 20.0% and was 15.2% once diseases likely to present acutely were excluded.

Table 1.11. Percentage completeness of presentation time data (2009 to 2010) by centre

		N incident patients		Percentage completeness	
Country	Centre	2009	2010	2009	2010
England	B Heart	99	95	4.0	95.8
	B QEH	255	197	83.7	88.3
	Basldn	26	32	[a]	93.8
	Bradfd	61	64	91.7	100.0
	Brightn	120	107	0.8	1.9
	Bristol	158	169	72.2	97.6
	Camb	136	108	39.0	99.1
	Carlis	24	21	83.3	[a]
	Carsh	208	221	0.0	86.8
	Chelms	52	42	98.1	97.6
	Colchr	17	32	0.0	84.4
	Covnt	118	118	0.0	95.7
	Derby	78	80	97.4	98.8

Table 1.11. Continued

		N incident patients		Percentage completeness	
Country	Centre	2009	2010	2009	2010
England	Donc	40	44	95.0	95.5
	Dorset	76	72	88.0	87.5
	Dudley	69	41	7.4	90.0
	Exeter	145	136	21.5	61.8
	Glouc	79	58	100.0	91.4
	Hull	101	88	0.0	64.8
	Ipswi	38	34	92.1	93.9
	Kent	131	134	98.5	100.0
	L Barts	239	207	0.4	[a]
	L Guys	176	144	4.0	86.7
	L Kings	128	148	98.4	93.9
	L Rfree	170	203	47.6	89.6
	L St.G	109	83	6.4	75.9
	L West	357	367	0.6	0.0
	Leeds	154	130	94.1	100.0
	Leic	228	250	70.9	98.0
	Liv Ain	38	49	0.0	[a]
	Liv RI	110	102	0.0	47.5
	M Hope	125	146	0.0	1.4
	M RI	147	163	42.1	62.3
	Middlbr	95	98	96.8	96.9
	Newc	100	95	99.0	93.7
	Norwch	73	85	76.7	77.4
	Nottm	134	113	97.7	97.3
	Oxford	177	167	89.0	95.8
	Plymth	56	55	5.4	0.0
	Ports	149	150	98.0	98.0
	Prestn	147	122	0.0	96.7
	Redng	99	89	[a]	97.8
	Sheff	150	144	98.0	98.6
	Shrew	47	58	100.0	100.0
	Stevng	98	110	94.9	96.4
	Sthend	23	30	8.7	90.0
	Stoke	110	93	40.0	100.0
	Sund	64	55	0.0	89.1
	Truro	58	43	55.2	95.3
	Wirral	63	52	73.8	82.4
	Wolve	65	107	96.9	99.0
	York	47	36	85.1	94.4
N Ireland	Antrim	21	41	100.0	100.0
	Belfast	61	71	83.6	93.0
	Derry	17	18	100.0	100.0
	Newry	20	21	100.0	95.2
	Tyrone	19	10	100.0	100.0
	Ulster	13	20	100.0	100.0
Wales	Bangor	30	26	93.1	96.0
	Cardff	179	188	76.8	95.7
	Clwyd	17	13	0.0	69.2
	Swanse	116	135	81.1	99.2
	Wrexm	20	24	90.0	95.8
E, W & NI		**6,280**	**6,154**	**50.7**	**76.9**

[a]data not shown as >10% of patients reported as starting RRT on the same date as first presentation
Date first seen by a nephrologist has not been collected from the Scottish Renal Registry and so Scottish centres were excluded from these analyses

Table 1.12 shows the overall percentage presenting late for the combined 2009–2010 incident cohort, the percentages presenting late amongst those patients defined as not having an acute diagnosis and the percentages amongst non-diabetics (as PRD).

Late presentation in 2010 and trend over time

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.

In 2010, 65.8% of incident patients presented over a year before they needed to start RRT. There were 8.7%

Table 1.12 Percentage of patients presenting to a nephrologist less than 90 days before RRT initiation (2009–2010 incident patients)

			Percentage presenting late			
Country	Centre	N with data	Overall	(95% CI)	Non-acute[a]	Non-diab PRD
England	B Heart	91	9.9	(5.2–17.9)	9.6	13.6
	B QEH	383	16.5	(13.1–20.5)	13.7	17.0
	Basldn	30	30.0	(16.4–48.3)	30.0	33.3
	Bradfd	118	17.0	(11.2–24.8)	13.5	18.8
	Bristol	161	22.4	(16.6–29.4)	17.9	24.8
	Camb	107	22.4	(15.5–31.3)		
	Carlis	20	25.0	(10.8–47.8)	21.1	33.3
	Carsh	190	30.0	(23.9–36.9)	23.2	33.5
	Chelms	92	21.7	(14.5–31.3)	17.1	25.0
	Colchr	27	25.9	(12.9–45.3)	26.1	29.2
	Covnt	112	17.9	(11.8–26.1)	13.0	18.6
	Derby	155	23.9	(17.8–31.2)	16.2	27.8
	Donc	80	18.8	(11.6–28.8)	13.3	24.6
	Dorset	129	21.7	(15.4–29.6)	15.5	25.0
	Dudley	36	13.9	(5.9–29.3)	13.9	16.0
	Glouc	129	18.6	(12.8–26.3)	12.7	20.5
	Ipswi	66	30.3	(20.5–42.4)	24.2	25.9
	Kent	263	28.9	(23.7–34.7)	22.2	31.8
	L Guys	124	14.5	(9.3–21.9)	13.5	16.2
	L Kings	265	24.2	(19.4–29.7)	18.9	29.5
	L Rfree	181	26.5	(20.6–33.4)	22.5	26.9
	L St.G	63	25.4	(16.2–37.5)	17.9	29.2
	Leeds	272	18.0	(13.9–23.0)	13.8	21.3
	Leic	239	14.2	(10.3–19.3)	8.6	16.3
	Middlbr	187	23.0	(17.5–29.6)	16.8	21.9
	Newc	187	19.3	(14.2–25.5)	14.0	23.3
	Norwch	121	19.8	(13.7–27.9)	13.3	22.7
	Nottm	234	18.0	(13.5–23.4)	14.6	21.3
	Oxford	313	16.6	(12.9–21.2)	13.0	20.0
	Ports	289	15.6	(11.8–20.2)	12.7	18.4
	Prestn	117	21.4	(14.9–29.7)	15.8	24.0
	Redng	87	12.6	(7.1–21.4)	9.5	14.9
	Sheff	288	17.0	(13.1–21.8)	11.4	20.7
	Shrew	105	22.9	(15.8–31.9)	15.6	27.2
	Stevng	199	15.1	(10.8–20.7)	11.8	20.1
	Sthend	27	11.1	(3.6–29.3)	9.1	13.0
	Stoke	93	28.0	(19.8–37.9)	24.3	30.4
	Sund	49	28.6	(17.7–42.6)	23.8	32.4
	Truro	41	24.4	(13.7–39.7)	21.1	32.3
	Wirral	42	26.2	(15.1–41.4)	21.4	30.6
	Wolve	166	23.5	(17.7–30.5)	19.5	28.2
	York	74	20.3	(12.6–30.9)	10.7	25.9

Table 1.12 Continued

Country	Centre	N with data	Percentage presenting late			
			Overall	(95% CI)	Non-acute[a]	Non-diab PRD
N Ireland	Antrim	62	27.4	(17.8–39.8)	22.2	30.2
	Belfast	117	16.2	(10.6–24.1)	10.3	18.0
	Derry	35	17.1	(7.9–33.3)	15.6	16.1
	Newry	40	15.0	(6.9–29.6)	10.8	14.3
	Tyrone	29	3.5	(0.5–20.8)	0.0	5.0
	Ulster	33	27.3	(14.8–44.7)	14.3	34.8
Wales	Bangor	51	23.5	(13.9–37.0)	22.0	29.0
	Cardff	314	13.7	(10.3–18.0)	11.3	16.9
	Swanse	221	26.7	(21.3–32.9)	20.1	27.3
	Wrexm	41	14.6	(6.7–29.0)	11.4	19.4
E, W & NI		**6,895**	**20.0**	**(19.1–21.0)**	**15.2**	**22.9**

Blank cells = data for PRD not used

[a]Non-acute group excludes crescentic (extracapillary) glomerulonephritis (type I, II, III), nephropathy (interstitial) due to cis-platinum, renal vascular disease due to malignant hypertension, renal vascular disease due to polyarteritis, Wegener's granulomatosis, cryoglobulinemic glomerulonephritis, myelomatosis/light chain deposit disease, Goodpasture's Syndrome, systemic sclerosis (scleroderma), haemolytic ureaemic syndrome (including Moschcowitz syndrome), multi-system disease – other, tubular necrosis (irreversible) or cortical necrosis, Balkan nephropathy, kidney tumour, and traumatic or surgical loss of kidney

of patients presenting within 6–12 months, 4.9% within 3–6 months and 20.6% within 3 months. Figure 1.11 shows this breakdown by year for those 13 centres supplying data for each of the last 6 years with >75% completeness (Bradford, Dorset, Gloucester, Leeds, Middlesbrough, Nottingham, Oxford, Portsmouth, Sheffield, Stevenage, Swansea, Tyrone and Wolverhampton). The proportion of patients presenting late in these centres has steadily fallen since 2005 and there has been an increase in those presenting 12 months or more before starting RRT. These trends appear to have levelled off at the end of the six years.

Age and late presentation

In contrast to the results shown in last year's report, patients who presented late were not significantly older than patients who presented earlier (>90 days before RRT initiation) (median age 65.6 vs. 65.4 years: p = 0.5). The cohort used here was 2009 to 2010 whereas in last year's report it was 2004 to 2009 and so this change may have happened over the longer term than just 2009 to 2010. Also in contrast to the pattern shown in last year's report, the median duration of pre-RRT care did not diminish with increasing age beyond the 55–64 age group (figure 1.12).

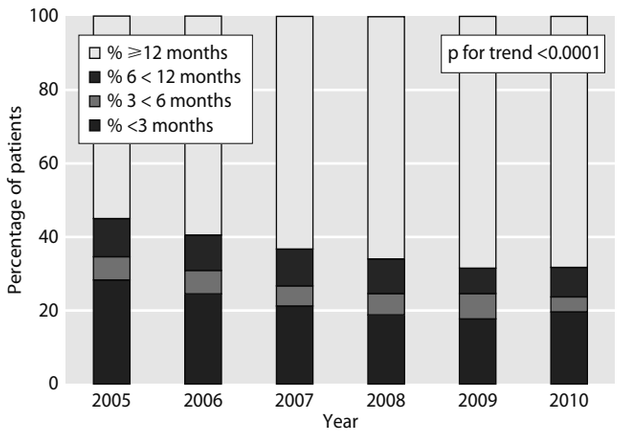

Fig. 1.11. Late presentation rate by year 2005–2010
Restricted to centres reporting continuous data 2005–2010

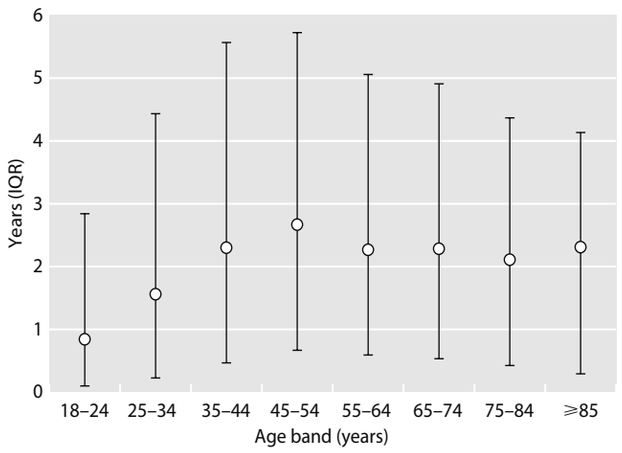

Fig. 1.12. Median duration of pre-RRT care by age group (2009–2010 incident patients)

Table 1.13. Late presentation by primary renal diagnosis (2009–2010 incident patients)

		Late presentation	
Diagnosis	N	N	%
Uncertain aetiology[a]	1,290	278	21.6
Diabetes	1,501	144	9.6
Glomerulonephritis	691	104	15.1
Other identified category	517	123	23.8
Polycystic kidney or pyelonephritis	931	93	10.0
Renal vascular disease	826	131	15.9
Acute group	608	353	58.1
Data not available	393	120	30.5

[a]includes presumed glomerulonephritis not biopsy proven
Unlike elsewhere in the report the RVD group includes hypertension. Also, polycystic and pyelonephritis are grouped together
Acute group includes crescentic (extracapillary) glomerulonephritis (type I, II, III), nephropathy (interstitial) due to cis-platinum, renal vascular disease due to malignant hypertension, renal vascular disease due to polyarteritis, Wegener's granulomatosis, cryoglobulinemic glomerulonephritis, myelomatosis/light chain deposit disease, Goodpasture's Syndrome, systemic sclerosis (scleroderma), haemolytic ureaemic syndrome (including Moschcowitz syndrome), multisystem disease–other, tubular necrosis (irreversible) or cortical necrosis, Balkan nephropathy, kidney tumour, and traumatic or surgical loss of kidney

Gender and late presentation

There was no significant difference in the proportion of males to females by time of presentation (male:female ratio 1.66 in early presentation, 1.84 in late presentation, $p = 0.12$).

Ethnicity, social deprivation and late presentation

This analysis of the 2009 to 2010 cohort was limited to patients from centres/years 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 lower than in Whites but not significantly so (17.4% vs. 20.0%: $p = 0.06$). The high incidence of diabetes in non-Whites (as discussed below, patients with diabetes tended to present earlier) may explain this difference. There was no relationship between social deprivation and presentation pattern.

Primary renal disease and late presentation

In the 2009 to 2010 cohort, late presentation differed significantly between primary renal diagnoses (Chi-squared test $p < 0.0001$) (table 1.13). Patients in the acute group or with data 'not available' had high rates of late presentation. Those with diabetes and pyelonephritis or adult polycystic kidney disease had low rates. Since 2005 there has been a significant decline in the proportion of diabetics presenting late (Mantel-Haenszel Chi-squared test $p = 0.002$) although this has levelled off in recent years. The decline seen likely reflects national initiatives to screen patients with diabetes for proteinuria and falling GFR.

Table 1.14. Percentage prevalence of specific comorbidities amongst patients presenting late (<3 months) compared with those presenting early (⩾3 months) (2009–2010 incident patients)

Comorbidity	<3 months	⩾3 months	p-value
Cerebrovascular disease	6.3	11.5	<0.0001
COPD	7.5	8.1	0.6
Diabetes (not a cause of ERF)	7.0	9.4	0.03
Ischaemic heart disease	16.9	23.0	0.0002
Liver disease	3.6	2.6	0.12
Malignancy	19.9	11.9	<0.0001
Peripheral vascular disease	10.0	12.4	0.07
Smoking	15.2	12.7	0.07

Modality and late presentation

In the 2009 to 2010 cohort, late presentation was associated with initial modality. The percentage of patients whose first modality was PD was significantly lower in the late presentation group compared to those presenting earlier (9.6% vs. 21.8%: $p < 0.0001$). By 90 days after RRT initiation this difference was reduced, although still highly significant (12.9% vs. 22.2%: $p < 0.0001$).

Comorbidity and late presentation

In the 2009 to 2010 cohort, the percentage of patients who were assessed as having no comorbidity was roughly the same in those who presented late and those presenting earlier (45.7% vs. 44.2%: $p = 0.4$). This is in contrast to the 2004–2009 analysis published last year which showed the percentage with no comorbidity to be slightly, but significantly, lower in patients who presented late. Cerebrovascular disease, ischaemic heart disease and diabetes were significantly less common in the group presenting late (table 1.14). Malignancy was significantly more common in those presenting late, perhaps because of the potential for rapid decline in renal function in this group.

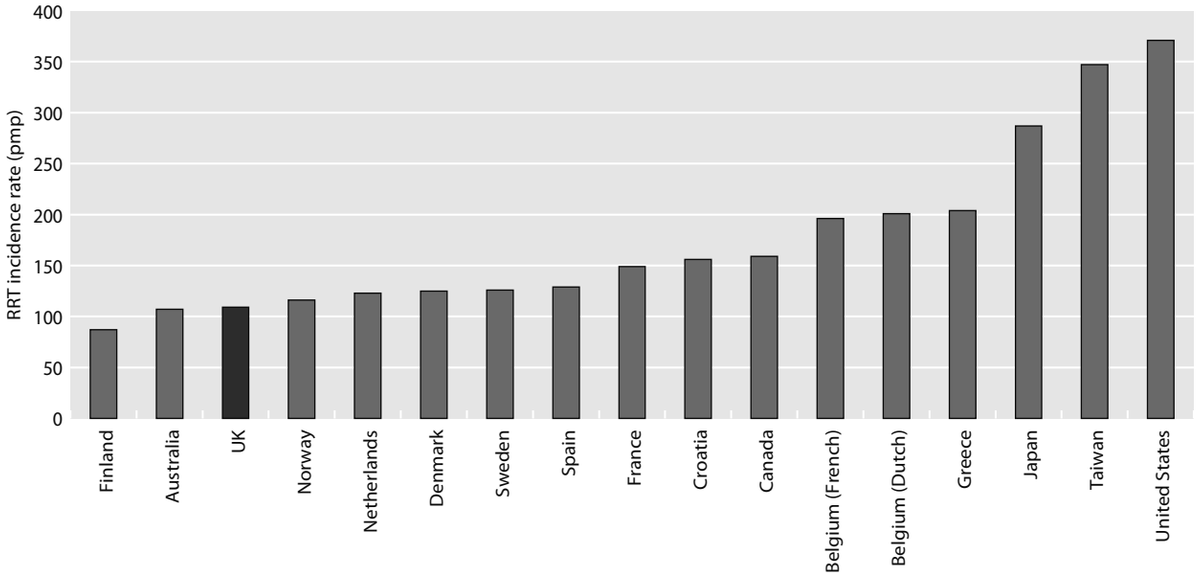

Fig. 1.13. International comparison of RRT incidence rates in 2009
Data from USRDS

Haemoglobin and late presentation

In the 2009 to 2010 cohort, patients presenting late had a significantly lower haemoglobin concentration at RRT initiation than patients presenting earlier (9.3 vs. 10.4 g/dl: $p < 0.0001$). This may reflect inadequate predialysis 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 2009 to 2010 cohort, eGFR at start of RRT was lower in patients presenting late (7.8 vs. 8.8 ml/min/1.73 m^2: $p < 0.0001$).

Survival of incident patients

This analysis is to be found in chapter 6: Survival and Causes of Death of UK Adult Patients on Renal Replacement Therapy in 2010.

International comparisons

Figure 1.13 shows the crude RRT incidence rates for 2009 for several countries. The UK incidence rate is similar to many other Northern European countries and Australia, but remains lower than Belgium, Greece, US, Japan and Taiwan. These differences are 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.

Summary

RRT incidence rates for 2010 were similar to 2009 for England and for the UK as a whole. At least partly because of the smaller numbers involved they have been more variable over the last few years for Northern Ireland, Scotland and Wales. Wales continues to have the highest incidence rate. There remain large centre variations in incidence rates for RRT. Significant numbers of patients continue to present late to renal centres.

Conflicts of interest: none

Acknowledgements

The Registry would like to acknowledge the significant contribution made by Andy Judge, Dan Ford, David Ansell, Charlie Tomson, Paul Roderick and Yoav Ben-Shlomo who developed the methodology for estimating catchment populations for England.

References

1 Office for National Statistics. www.ons.gov.uk
2 Office for National Statistics. The classification of ethnic groups. http://www.ons.gov.uk/ons/guide-method/classifications/archived-standard-classifications/ethnic-group-interim-classification-for-2001/index.html
3 Levey AS, Bosch JP, Lewis JB, Greene T, Rogers N, Roth D. A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Modification of Diet in Renal Disease Study Group. Ann Intern Med 1999;**130**:461–70
4 http://www.ons.gov.uk/ons/rel/ethnicity/focus-on-ethnicity-and-identity/focus-on-ethnicity-and-identity-summary-report/focus-on—ethnicity-and-identity-summary-report.pdf
5 Ford DJ, Fogarty DG, Steenkamp R, Tomson CRV, Ben-Shlomo Y, Ansell D. Chapter 13: The UK Renal Registry Advanced CKD Study: frequency of incorrect reporting of date of start of RRT. Nephron Clinical Practice; **115**(Suppl. 1):c271–c78
6 U.S. Renal Data System, USRDS 2011 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2011. Publications based upon USRDS data reported here or supplied upon request must include this citation and the following notice: The data reported here have been supplied by the United States Renal Data System (USRDS)
7 http://www.renal.org/CKDguide/full/UKCKDfull.pdf

UK Renal Registry 14th Annual Report: Chapter 2 UK RRT Prevalence in 2010: 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 50,965 adult patients receiving RRT in the UK on 31st December 2010. The UK prevalence of RRT was 832 pmp, an increase of 3% from 2009. The reported prevalence in 2000 was 523 pmp.
- Growth rate from 2009 to 2010 for prevalent patients was an increase of 1.5% for haemodialysis (HD), a fall of 3.2% for peritoneal dialysis (PD) and an increase of 5.4% with a functioning transplant.
- The number of patients receiving home HD increased by 23%, from 636 patients to 780 patients since 2009.
- The median age of prevalent patients was 57.9 years (HD 66.3 years, PD 61.7 years and transplant 51.2 years). In 2000 the median age was 55 years.
- Prevalence rates in males exceeded those in females: the peak prevalence rate for males was in the 75–79 years age-group at 2,765 pmp almost double that of the peak for females. Peak prevalence rate in females was in the 70–74 age-group at 1,406 pmp.
- The most common identifiable renal diagnosis was biopsy-proven glomerulonephritis (16.0%), followed by diabetes (14.9%).
- Transplantation continued as the most common treatment modality (48%), HD was used in 44% and PD 8% of RRT patients.
- Prevalence rates in patients aged >85 years have doubled between 2005 and 2010 (420 pmp age related to 856 pmp). There was 30 fold variation in prevalence rates in patients aged >80 years suggesting there is uncertainty regarding the risks and benefits of RRT in the elderly.
- 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. Assessment of conservatively managed stage 5 CKD patients might explain more of this variation.

Introduction

This chapter presents data on all adult patients on RRT in the UK at the end of 2010. The UK Renal Registry (UKRR) received data returns for 2010 from all five renal centres in Wales, all six in Northern Ireland and all 52 in England. Data from all nine centres in Scotland were obtained from the Scottish Renal Registry. Data on children and young adults can be found in chapter 5.

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. 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 2010. The cohort was defined as all adult patients receiving RRT on the UKRR database on 31st December 2010. 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 (www.renalreg.com/report-area/report 2011/appendix-D.pdf) for Primary Care Trusts (PCT) in England, Health & 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–2010 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 number 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 2010 were examined by time on RRT, age group, gender, ethnic origin, primary renal disease, presence of diabetes and treatment modality. (2009 Report appendix H: Coding (www.renalreg.com/report-area/report 2011/appendix-H.pdf). 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 to those centres not linked to PAS [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 (www.renalreg.com/report-area/report/2011/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 for each country (table 2.1) was calculated by adding the patient numbers in each renal centre and these differ marginally from those quoted elsewhere when patients are allocated to geographical areas by their individual postcodes, as some centres treat patients across national boundaries.

There were 50, 965 adult patients and 870 paediatric patients receiving RRT in the UK at the end of 2010, giving a UK population prevalence of 832 pmp (table 2.1) compared with 794 pmp in 2009 [3]. Prevalence rates increased in all four of the UK countries in 2010. For the first time there were no significant differences in prevalence rates between the four countries. PD prevalence remained similar to last year in England and Scotland, a change from the pattern of falling prevalence

Table 2.1. Prevalence of RRT in the UK on 31/12/2010 (including children <18 years)

	England	N Ireland	Scotland	Wales	UK
All UK centres	43,412	1,478	4,330	2,615	51,835
Total estimated population, mid–2010 (millions)*	52.2	1.8	5.2	3.0	62.3
Prevalence rate HD (pmp)	359	402	361	363	360
Prevalence rate PD (pmp)	65	37	54	73	64
Prevalence rate dialysis (pmp)	424	440	415	436	424
Prevalence rate transplant (pmp)	407	382	414	433	408
Prevalence rate total (pmp)	831	822	829	870	832
95% confidence intervals total (pmp)	823–839	780–863	804–854	836–903	825–840

* estimates from ONS web site
pmp = per million population

each year since 1997, and it decreased again in Northern Ireland and Wales. The prevalence of transplanted patients 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 and that Wales has a higher prevalence rate for patients aged >80 than the other countries. These higher rates were not due to higher numbers of older people in those countries. The prevalence rate in patients aged 80–84 has risen over time from 1,105 per million age related population (pmarp) in 2005 to 1,658 pmarp in 2010 and in patients aged >85 years from 420 pmarp in 2005 to 856 pmarp in 2010. This ageing of the prevalent population is more likely to be due to increasing numbers of older patients starting RRT although there is some effect of improving patient survival as well.

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, prevalence of diseases predisposing to kidney disease and the social deprivation index of that population may contribute to this.

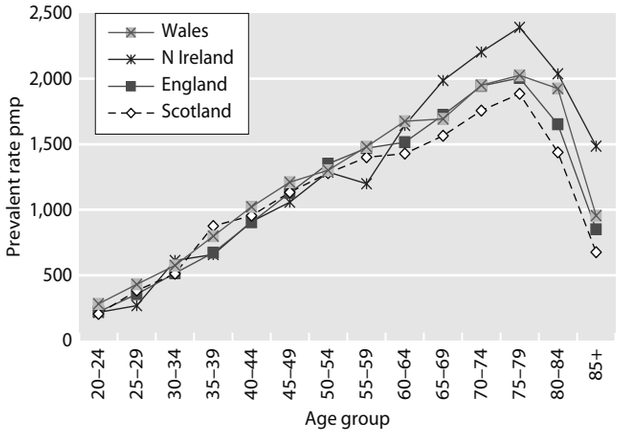

Fig. 2.1. Prevalence rates per million population by age group and UK country on 31/12/2010

Throughout this chapter, haemodialysis refers to all modes of HD treatment, including haemodiafiltration (HDF). Several centres reported significant numbers of patients on HDF, but other centres did not differentiate this treatment type in their UKRR returns.

Where joint care of renal transplant recipients between the referring centre and the transplant centre occurred, the patient was allocated to the centre which last saw the patient, usually the referring centre. Thus the number of patients allocated to a transplant centre is often lower than that recorded by the centre itself and as a converse pre-emptively transplanted patients are sometimes allocated to the transplanting centre rather than the referring centre if no transfer out code has been sent through. Queries and updated information is welcomed by the UKRR at any point during the year if this has occurred.

Changes in prevalence

Overall growth in the prevalent UK RRT population from 2009 to 2010 was 4% (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 Scotland, with slower growth in the prevalent RRT populations in Wales and Northern Ireland.

The prevalent growth per million population (pmp) disguises the differential growth in RRT modalities (HD, PD and transplant) and is shown in table 2.4. From 2009 to 2010, there was a 1.5% growth of prevalent HD patients, a 5.4% growth in those with a functioning

Table 2.2. Number of prevalent RRT patients by treatment modality and centre on 31/12/2010

Centre	HD	PD	Dialysis	Transplant	RRT	Catchment population (millions)	Rate RRT pmp	*(95% CI)*
England								
Birmingham Heartlands	426	43	469	163	632	0.72	872	*(804–940)*
Birmingham QEH*	858	153	1,011	833	1,844	1.62	1,136	*(1084–1188)*
Basildon	138	25	163	51	214	0.41	524	*(454–595)*
Bradford	185	37	222	233	455	0.58	786	*(714–858)*
Brighton	344	87	431	339	770	1.20	644	*(599–690)*
Bristol*	460	62	522	728	1,250	1.57	796	*(752–840)*
Cambridge*	349	35	384	604	988	1.27	780	*(731–828)*
Carlisle	60	13	73	130	203	0.31	646	*(557–735)*
Carshalton	726	103	829	548	1,377	1.92	719	*(681–757)*
Chelmsford	123	35	158	80	238	0.47	510	*(446–575)*
Colchester	120		120		120	**	**	**
Coventry*	358	84	442	402	844	0.87	970	*(905–1036)*
Derby	220	101	321	138	459	0.65	709	*(644–774)*
Doncaster	147	24	171	51	222	**	**	**
Dorset	244	55	299	286	585	0.73	806	*(741–872)*
Dudley	158	62	220	83	303	0.42	730	*(648–812)*
Exeter	361	77	438	347	785	1.03	764	*(710–817)*
Gloucester	191	41	232	145	377	0.58	656	*(589–722)*
Hull	326	67	393	332	725	0.99	735	*(681–788)*
Ipswich	116	35	151	165	316	0.56	563	*(501–625)*
Kent	360	71	431	362	793	1.16	682	*(635–730)*
London Barts*	791	190	981	797	1,778	1.68	1,059	*(1009–1108)*
London Guys*	565	47	612	1,006	1,618	1.15	1,402	*(1334–1470)*
London Kings	427	94	521	316	837	0.97	863	*(804–921)*
London RFree*	677	71	748	891	1,639	1.50	1,090	*(1037–1142)*
London St. George's*	283	56	339	339	678	0.59	1,158	*(1071–1245)*
London West*	1,329	37	1,366	1,496	2,862	2.23	1,285	*(1238–1332)*
Leeds*	496	98	594	789	1,383	1.65	840	*(796–884)*
Leicester*	795	169	964	844	1,808	2.32	780	*(744–816)*
Liverpool Aintree	152	7	159		159	0.29	548	*(463–633)*
Liverpool RI*	386	85	471	767	1,238	1.20	1,033	*(975–1090)*
Manchester Hope	364	124	488	349	837	1.42	589	*(549–629)*
Manchester RI*	481	88	569	983	1,552	1.47	1,057	*(1004–1109)*
Middlesbrough	286	22	308	403	711	1.01	703	*(651–754)*
Newcastle*	270	54	324	564	888	1.11	803	*(750–856)*
Norwich	319	54	373	242	615	0.79	775	*(714–837)*
Nottingham*	416	88	504	468	972	1.14	854	*(801–908)*
Oxford*	381	110	491	872	1,363	1.68	811	*(768–854)*
Plymouth*	134	46	180	279	459	0.48	965	*(877–1053)*
Portsmouth*	481	102	583	750	1,333	2.00	665	*(630–701)*
Preston	504	63	567	401	968	1.51	640	*(600–681)*
Reading	260	86	346	290	636	0.80	790	*(729–852)*
Sheffield*	611	66	677	577	1,254	1.49	842	*(796–889)*
Shrewsbury	201	22	223	114	337	0.39	861	*(769–953)*
Stevenage	385	36	421	185	606	1.09	557	*(513–601)*
Southend	126	18	144	68	212	0.32	671	*(581–761)*
Stoke	295	73	368	267	635	0.90	708	*(653–763)*
Sunderland	176	33	209	160	369	0.59	626	*(562–690)*
Truro	153	29	182	153	335	0.41	813	*(726–901)*
Wirral	186	37	223		223	0.52	428	*(372–484)*
Wolverhampton	315	72	387	131	518	0.61	854	*(781–928)*
York	152	24	176	161	337	0.51	667	*(596–738)*

Table 2.2. Continued

Centre	HD	PD	Dialysis	Transplant	RRT	Catchment population (millions)	Rate RRT pmp	*(95% CI)*
Northern Ireland								
Antrim	129	11	140	77	217	0.30	723	*(627–820)*
Belfast*	234	30	264	418	682	0.55	1,233	*(1141–1326)*
Derry	61	2	63	48	111	0.18	629	*(512–746)*
Newry	109	9	118	59	177	0.28	625	*(533–718)*
Tyrone	95	9	104	41	145	0.18	822	*(688–955)*
Ulster	93	2	95	17	112	0.30	373	*(304–442)*
Scotland								
Aberdeen	201	30	231	231	462	**		
Airdrie	183	11	194	132	326	**		
Dumfries & Galloway	53	8	61	57	118	**		
Dundee	173	26	199	186	385	**		
Dunfermline	135	26	161	102	263	**		
Edinburgh*	274	51	325	388	713	**		
Glasgow*	627	53	680	810	1,490	**		
Inverness	87	23	110	120	230	**		
Kilmarnock	152	42	194	90	284	**		
Wales								
Bangor	87	26	113		113	0.25	452	*(369–535)*
Cardiff*	496	103	599	918	1,517	1.45	1046	*(994–1099)*
Clwyd***	70	16	86	56	142	0.20	710	*(593–827)*
Swansea	361	51	412	183	595	0.80	744	*(684–804)*
Wrexham	77	22	99	124	223	0.30	743	*(646–841)*
England	**18,667**	**3,311**	**21,978**	**20,682**	**42,660**			
N Ireland	**721**	**63**	**784**	**660**	**1,444**			
Scotland	**1,885**	**270**	**2,155**	**2,116**	**4,271**			
Wales	**1,091**	**218**	**1,309**	**1,281**	**2,590**			
UK	**22,364**	**3,862**	**26,226**	**24,739**	**50,965**			

Centres prefixed 'L' are London centres

Transplant patients are often followed up by two centres but are assigned throughout his report to the centre which last saw the patient. This may result in some discrepancy in transplant numbers particularly in Oxford/Reading and Clywd/Liverpool RI

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 postcodes, as some centres treat patients from across national boundaries

* Transplant centres

** Doncaster and Colchester were not established main renal centres when the catchment population work was undertaken and this work also did not include Scotland

Blank cells indicate no patients on that treatment modality

***There was a large decrease in prevalent patient numbers in 1 centre (Clwyd) from 2009–2010 which was a data extraction issue. These missing patients have been inserted into tables 2.1–2.3 but do not feature in any of the other analyses

transplant and a decline in patients on PD of 3.2%. During the period 2005 to 2010 there was a 4.1% pmp growth in HD, 5.9% pmp fall in PD, and 4.6% pmp growth in prevalent transplant patients in the UK (table 2.4).

There were large variations between centres as well as countries. From 2009 to 2010 growth increased by more than 16.3% in Colchester and 16.8% in Doncaster largely due to relocation of patients from Cambridge to Colchester and from Sheffield to Doncaster (table 2.3). 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. The decline in prevalent patients on PD was evident at 38 of the 72 renal centres (data not shown) in the UK and PD numbers declined slightly across all the 4 UK countries. The prevalence rate per million population for each centre was calculated using a derived catchment population. This was calculated from the postcode of each prevalent patient in 2007 and the population within that postcode assigned to the renal

Table 2.3. Number of prevalent patients on RRT by centre 2006–2010

Centre	Date					% change 2009–2010	% annual change 2006–2010
	2006	2007	2008	2009	2010		
Abrdn	434	452	456	444	462	4.1	1.6
Airdrie	233	230	245	310	326	5.2	8.8
Antrim	200	200	220	213	217	1.9	2.1
B Heart	578	578	597	623	632	1.4	2.3
B QEH	1,557	1,626	1,714	1,820	1,844	1.3	4.3
Bangor	103	98	112	110	113	2.7	2.3
Basldn	187	209	218	211	214	1.4	3.4
Belfast	751	748	726	675	682	1.0	−2.4
Bradfd	365	395	414	422	455	7.8	5.7
Brightn	659	686	722	720	770	6.9	4.0
Bristol	1,203	1,234	1,247	1,231	1,250	1.5	1.0
Camb	906	935	927	939	988	5.2	2.2
Cardff	1,333	1,438	1,372	1,429	1,517	6.2	3.3
Carlis	188	202	205	202	203	0.5	1.9
Carsh	1,102	1,165	1,249	1,301	1,377	5.8	5.7
Chelms	159	194	207	224	238	6.3	10.6
Clwyd	89	155	146	143	142	−0.7	12.4
Colchr	84	100	118	104	120	15.4	9.3
Covnt	675	717	745	791	844	6.7	5.7
D & Gall	77	77	113	116	118	1.7	11.3
Derby	301	301	389	404	459	13.6	11.1
Derry	40	69	101	114	111	–2.6	29.1
Donc[a]		109	154	190	222	16.8	26.8
Dorset	406	452	515	553	585	5.8	9.6
Dudley	263	259	275	290	303	4.5	3.6
Dundee	365	376	370	389	385	−1.0	1.3
Dunfn	156	220	220	237	263	11.0	13.9
Edinb	701	720	695	697	713	2.3	0.4
Exeter	630	664	708	725	785	8.3	5.7
Glasgw	1,553	1,605	1,568	1,442	1,490	3.3	−1.0
Glouc	319	326	325	358	377	5.3	4.3
Hull	610	672	696	723	725	0.3	4.4
Inverns	200	207	212	222	230	3.6	3.6
Ipswi	284	285	294	311	316	1.6	2.7
Kent	546	627	714	731	793	8.5	9.8
Klmarnk	215	214	263	271	284	4.8	7.2
L Barts	1,416	1,473	1,526	1,635	1,778	8.7	5.9
L Guys	1,324	1,395	1,447	1,611	1,618	0.4	5.1
L Kings	669	712	784	774	837	8.1	5.8
L Rfree	1,383	1,437	1,510	1,542	1,639	6.3	4.3
L St.G	595	575	624	658	678	3.0	3.3
L West[b]	2,156	2,162	2,570	2,721	2,862	5.2	7.3
Leeds	1,380	1,379	1,342	1,327	1,383	4.2	0.1
Leic c	1,500	1,594	1,660	1,735	1,808	4.2	4.8
Liv Ain	99	115	130	145	159	9.7	12.6
Liv RI	1,338	1,274	1,200	1,223	1,238	1.2	−1.9
M Hope	718	759	758	782	837	7.0	3.9
M RI	1,504	1,402	1,424	1,451	1,552	7.0	0.8
Middlbr	640	687	682	705	711	0.9	2.7
Newc	905	902	901	884	888	0.5	−0.5
Newry	148	148	164	173	177	2.3	4.6
Norwch	437	495	567	587	615	4.8	8.9
Nottm	923	971	954	971	972	0.1	1.3
Oxford[c]	1,266	1,328	1,318	1,337	1,363	1.9	1.9

Table 2.3. Continued

Centre	Date					% change 2009–2010	% annual change 2006–2010
	2006	2007	2008	2009	2010		
Plymth	412	421	443	457	459	0.4	2.7
Ports	1,143	1,182	1,268	1,298	1,333	2.7	3.9
Prestn	832	857	875	941	968	2.9	3.9
Redng	530	552	578	620	636	2.6	4.7
Sheff[a]	1,232	1,175	1,217	1,216	1,254	3.1	0.4
Shrew	259	285	325	331	337	1.8	6.8
Stevng	606	548	580	581	606	4.3	0.0
Sthend	187	195	204	205	212	3.4	3.2
Stoke	588	590	603	639	635	−0.6	1.9
Sund	271	344	343	368	369	0.3	8.0
Swanse	503	545	602	605	595	−1.7	4.3
Truro	291	288	297	316	335	6.0	3.6
Tyrone	160	149	136	141	145	2.8	–2.4
Ulster	61	89	97	113	112	−0.9	16.4
Wirral	206	219	216	224	223	−0.4	2.0
Wolve	451	449	491	491	518	5.5	3.5
Wrexm[d]	210	213	223	218	223	2.3	1.5
York	223	231	276	305	337	10.5	10.9
England	**36,506**	**37,732**	**39,546**	**40,953**	**42,660**	**4.2**	**4.0**
N Ireland	**1,360**	**1,403**	**1,444**	**1,429**	**1,444**	**1.0**	**1.5**
Scotland	**3,934**	**4,101**	**4,142**	**4,128**	**4,271**	**3.5**	**2.1**
Wales	**2,238**	**2,449**	**2,455**	**2,505**	**2,590**	**2.9**	**3.6**
UK	**44,038**	**45,685**	**47,587**	**49,015**	**50,965**	**4.0**	**3.7**

[a] Doncaster previously a satellite of Sheffield
[b] Hammersmith and Charing Cross amalgamated with St Mary's
[c] Oxford transferred Northamptonshire local authority to Leicester
Transplant patients are often followed up by two centres but are assigned throughout his report to the centre which last saw the patient. This may result in some differences in transplant figures particularly in Oxford/Reading and Clywd/Liverpool RI

centre where that patient was treated. Centre prevalence rates showed marked variation; from 373 pmp in Tyrone to 1,402 pmp at London Guy's. The long-term (1997–2010) 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 associated with a slow contraction in home-based therapies, particularly PD in more recent years.

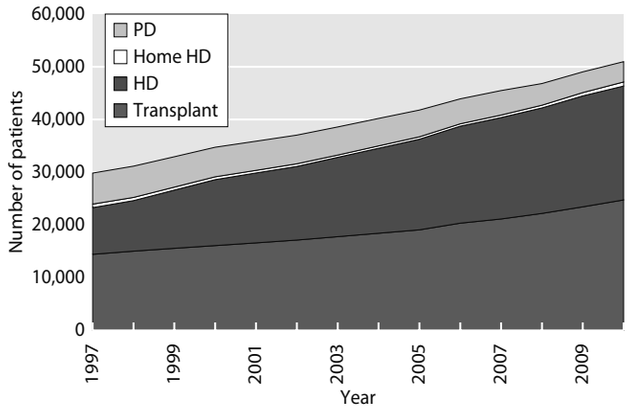

Fig. 2.2. Growth in prevalent patients by treatment modality at the end of each year 1997–2010

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 such as predisposing conditions but also 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].

Table 2.4. Change in RRT prevalence rates pmp 2005–2010 by modality

	Prevalence					% growth in prevalence pmp				
Year	HD pmp	PD pmp	Dialysis pmp	Transplant pmp	RRT pmp	HD	PD	Dialysis	Tx	RRT
2005	293	84	377	317	694					
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
2010	359	62	421	397	818	1.5	−3.2	0.8	5.4	3.0
Average annual growth 2005–2010						**4.1**	**−5.9**	**2.2**	**4.6**	**3.3**

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

There were substantial variations in the crude PCT/HB prevalence rate pmp, from 489 pmp (Shetland, population 22,500) to 1,810 pmp (Brent, population 256,500). There were similar variations in standardised prevalence ratios (ratio of observed: expected prevalence rate given the age/gender breakdown of the PCT/HB) from 0.54 (Isle of Wight, population 140,200) to 2.45 (Brent) (table 2.5). Confidence intervals are not presented for the rates per million population for 2010 but figures D3 and D4 in appendix D (www.renalreg.com/report-area/report 2011/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 (chapter 1).

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 2010, there were 56 PCT/HBs with a significantly low SPR, 72 with a 'normal' SPR and 48 with a significantly high SPR. 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. Mean SPRs were significantly higher in the 58 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 $r = 0.82$ $p < 0.001$) was positively correlated with ethnicity. In 2010 for each 10% increase in ethnic minority population, the age standardised prevalence ratio increased by 0.20 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, Aneurin Bevan, Belfast, Cwm Taf, Plymouth and Rotherham. Forty-two of the 58 PCT/HBs with ethnic minority populations greater than 10% had high SPRs (72%), whereas only 2 had low SPRs (Medway and Surrey). Medway and Surrey have lower socio-economic deprivation than many areas with higher than average ethnic minority populations which might explain their unexpectedly lower rates. Not all PCT/HBs with high (>15%) ethnic minority populations also had higher than expected RRT prevalence rates; Westminster and Kensington had rates similar to average (1.03 and 0.93 respectively 2005–2010) possibly due to lower levels of social deprivation in these areas. The standardised prevalence ratios in each region of England and in Wales, Northern Ireland and Scotland are presented in table 2.6. North East England, North West England, East of England, South East England, South Central and South West England have lower than expected prevalence rates of RRT given the age and gender of their populations and this pattern has been similar for the last 5 years. West Midlands, London and Wales have higher than expected prevalence rates of RRT given the age and gender of their populations and again this pattern has remained similar for the last 5 years. Scotland and Northern Ireland previously had higher than expected prevalence rates but in more recent years are similar to their expected

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. Ratio of observed : expected rate of RRT given the age and gender breakdown of the area
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 2010 are italicised in greyed areas, those with significantly high prevalence ratios in 2010 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)

								2010					
UK area	**Name**	**Total population**	**2005 O/E**	**2006 O/E**	**2007 O/E**	**2008 O/E**	**2009 O/E**	**O/E**	**95% LCL**	**95% UCL**	**Crude rate pmp**	**O/E**	**% non-White**
North East	*County Durham*	*510,800*	*0.94*	*0.91*	*0.89*	*0.86*	*0.85*	*0.85*	*0.77*	*0.94*	*726*	*0.88*	*2.5*
	Darlington	100,600	0.94	0.78	0.85	0.89	0.91	0.85	0.67	1.07	716	0.87	3.3
	Gateshead	*192,000*	*0.97*	*0.93*	*0.86*	*0.83*	*0.85*	*0.85*	*0.72*	*1.00*	*719*	*0.88*	*3.8*
	Hartlepool	91,400	0.96	0.98	0.88	0.92	0.91	0.85	0.66	1.08	700	0.91	2.6
	Middlesbrough	142,100	1.02	1.06	1.04	1.06	1.06	1.07	0.89	1.28	816	1.05	8.6
	Newcastle	*292,200*	*0.91*	*0.89*	*0.93*	*0.96*	*0.92*	*0.86*	*0.74*	*1.00*	*626*	*0.91*	*9.7*
	North Tyneside	198,400	1.09	1.07	1.00	0.95	0.96	0.97	0.84	1.13	832	1.00	3.6
	Northumberland	*312,100*	*0.88*	*0.82*	*0.81*	*0.78*	*0.76*	*0.72*	*0.62*	*0.82*	*660*	*0.79*	*2.2*
	Redcar and Cleveland	137,300	0.98	1.01	1.00	0.98	0.97	0.92	0.77	1.11	808	0.98	3.0
	South Tyneside	154,100	0.97	0.99	0.99	0.94	1.00	0.93	0.78	1.11	785	0.97	4.8
	Stockton-on-Tees Teaching	*192,600*	*0.78*	*0.88*	*0.82*	*0.81*	*0.80*	*0.79*	*0.66*	*0.94*	*644*	*0.81*	*4.7*
	Sunderland Teaching	283,400	1.03	0.97	0.94	0.96	0.95	0.94	0.83	1.07	783	0.96	3.3
North West	*Ashton, Leigh and Wigan*	*307,200*	*0.60*	*0.67*	*0.86*	*0.79*	*0.81*	*0.82*	*0.72*	*0.94*	*690*	*0.77*	*2.9*
	Blackburn with Darwen Teaching	**140,000**	**1.16**	**1.20**	**1.40**	**1.30**	**1.31**	**1.27**	**1.07**	**1.51**	**921**	**1.28**	**22.7**
	Blackpool	*140,200*	*0.71*	*0.60*	*0.76*	*0.79*	*0.85*	*0.80*	*0.65*	*0.97*	*692*	*0.76*	*3.7*
	Bolton Teaching	266,500	0.80	0.82	1.08	1.05	0.96	1.06	0.93	1.21	844	0.97	12.3
	Bury	183,500	0.43	0.46	0.88	0.83	0.91	0.88	0.74	1.04	714	0.75	8.5
	Central and Eastern Cheshire	*457,200*			*0.82*	*0.78*	*0.79*	*0.75*	*0.67*	*0.84*	*661*	*0.79*	*3.4*
	Central Lancashire	*459,200*	*0.77*	*0.73*	*0.80*	*0.82*	*0.85*	*0.84*	*0.75*	*0.93*	*697*	*0.80*	*6.7*
	Cumbria Teaching	*494,400*	*0.77*	*0.76*	*0.75*	*0.74*	*0.71*	*0.71*	*0.63*	*0.79*	*649*	*0.74*	*2.0*
	East Lancashire Teaching	381,200	0.90	0.93	1.07	1.02	0.98	0.96	0.85	1.07	787	0.98	9.4
	Halton and St Helens	296,700	0.88	0.94	0.97	0.90	0.92	0.94	0.82	1.07	779	0.92	2.1
	Heywood, Middleton and Rochdale	205,000			1.01	1.03	1.06	1.01	0.87	1.18	795	1.03	12.6
	Knowsley	149,200	1.24	1.19	1.14	1.08	1.03	0.95	0.79	1.14	751	1.09	2.8
	Liverpool	445,300	1.16	1.15	1.10	1.11	1.11	1.08	0.97	1.19	813	1.12	8.3
	Manchester Teaching	**498,800**			**1.06**	**1.13**	**1.16**	**1.20**	**1.09**	**1.33**	**762**	**1.14**	**23.4**
	North Lancashire Teaching	*329,100*	*0.71*	*0.69*	*0.77*	*0.73*	*0.74*	*0.71*	*0.62*	*0.82*	*638*	*0.73*	*4.2*
	Oldham	219,600	0.51	0.62	0.94	0.94	0.93	0.92	0.79	1.08	715	0.82	12.2
	Salford	229,100	0.59	0.62	0.78	0.83	0.82	0.87	0.74	1.02	659	0.76	7.7
	Sefton	*272,800*	*0.94*	*0.92*	*0.88*	*0.85*	*0.84*	*0.87*	*0.76*	*1.00*	*773*	*0.88*	*2.6*
	Stockport	*284,700*			*0.86*	*0.87*	*0.82*	*0.85*	*0.74*	*0.97*	*724*	*0.85*	*6.4*
	Tameside and Glossop	250,700			1.03	0.99	0.97	1.00	0.87	1.14	810	1.00	5.9
	Trafford	217,100			0.77	0.74	0.76	0.88	0.75	1.03	719	0.79	11.2
	Warrington	199,100	0.81	0.82	0.90	0.88	0.94	0.86	0.73	1.01	713	0.87	3.5
	Western Cheshire	234,300	0.95	0.94	0.93	0.93	0.95	0.98	0.86	1.13	862	0.95	3.1
	Wirral	*308,800*	*1.09*	*1.05*	*0.97*	*0.90*	*0.85*	*0.82*	*0.72*	*0.94*	*703*	*0.94*	*2.8*
Yorkshire and the Humber	Barnsley	227,500	1.14	1.12	1.06	1.06	1.10	1.14	1.00	1.30	958	1.10	2.7
	Bradford and Airedale Teaching	**512,700**	**1.23**	**1.14**	**1.16**	**1.15**	**1.12**	**1.19**	**1.08**	**1.30**	**862**	**1.16**	**25.0**
	Calderdale	202,800	1.06	1.09	1.11	1.07	1.06	1.08	0.93	1.25	883	1.08	9.8
	Doncaster	290,900	1.05	1.06	0.97	0.97	0.98	0.96	0.84	1.09	804	1.00	4.3
	East Riding of Yorkshire	*338,500*	*0.80*	*0.81*	*0.79*	*0.81*	*0.83*	*0.79*	*0.70*	*0.90*	*736*	*0.81*	*3.0*
	Hull Teaching	263,800	1.00	0.99	1.03	0.96	1.00	0.99	0.86	1.13	747	1.00	5.8
	Kirklees	409,900	1.15	1.18	1.11	1.04	1.04	1.06	0.95	1.18	827	1.09	16.0

Table 2.5. Continued

UK area	Name	Total population	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 95% LCL	2010 95% UCL	2010 Crude rate pmp	% non-White O/E	% non-White
Yorkshire and the Humber	*Leeds*	*798,700*	*0.98*	*0.99*	*0.93*	*0.88*	*0.86*	*0.88*	*0.80*	*0.96*	*647*	*0.92*	*11.8*
	North East Lincolnshire	158,800	0.98	1.02	1.01	1.01	0.99	0.99	0.84	1.18	831	1.00	3.1
	North Lincolnshire	*157,500*	*0.90*	*0.95*	*0.91*	*0.88*	*0.76*	*0.73*	*0.60*	*0.89*	*641*	*0.85*	*3.2*
	North Yorkshire and York	*802,100*	*0.80*	*0.79*	*0.79*	*0.78*	*0.80*	*0.79*	*0.73*	*0.86*	*696*	*0.79*	*3.7*
	Rotherham	**254,300**	**1.21**	**1.11**	**1.11**	**1.14**	**1.11**	**1.15**	**1.01**	**1.30**	**963**	**1.14**	**5.2**
	Sheffield	**555,700**	**1.06**	**1.08**	**1.08**	**1.07**	**1.07**	**1.10**	**1.00**	**1.20**	**842**	**1.08**	**12.2**
	Wakefield District	*325,500*	*0.87*	*0.90*	*0.85*	*0.82*	*0.82*	*0.84*	*0.73*	*0.95*	*704*	*0.85*	*4.3*
East Midlands	*Bassetlaw*	*112,100*	*0.83*	*0.81*	*0.96*	*0.89*	*0.81*	*0.80*	*0.64*	*0.99*	*705*	*0.85*	*3.1*
	Derby City	**247,100**	**1.08**	**1.07**	**1.02**	**1.09**	**1.17**	**1.15**	**1.01**	**1.31**	**886**	**1.10**	**15.0**
	Derbyshire County	*729,900*	*0.84*	*0.84*	*0.88*	*0.88*	*0.86*	*0.84*	*0.77*	*0.91*	*741*	*0.86*	*3.2*
	Leicester City	**306,800**	**1.80**	**1.74**	**1.74**	**1.77**	**1.78**	**1.81**	**1.64**	**2.00**	**1,245**	**1.77**	**38.2**
	Leicestershire County and Rutland	*687,200*	*0.92*	*0.91*	*0.90*	*0.89*	*0.87*	*0.88*	*0.81*	*0.96*	*755*	*0.90*	*7.7*
	Lincolnshire Teaching	*705,000*	*0.83*	*0.79*	*0.78*	*0.78*	*0.77*	*0.79*	*0.72*	*0.86*	*712*	*0.79*	*3.3*
	Northamptonshire Teaching	*687,600*	*0.92*	*0.89*	*0.90*	*0.91*	*0.90*	*0.89*	*0.81*	*0.97*	*727*	*0.90*	*7.4*
	Nottingham City	**306,300**	**1.23**	**1.22**	**1.16**	**1.17**	**1.20**	**1.28**	**1.13**	**1.45**	**846**	**1.21**	**18.7**
	Nottinghamshire County Teaching	668,000	1.06	1.03	1.01	0.98	0.95	0.94	0.86	1.02	808	0.99	5.1
West Midlands	**Birmingham East and North**	**409,300**	**1.62**	**1.63**	**1.54**	**1.58**	**1.55**	**1.49**	**1.36**	**1.64**	**1,087**	**1.57**	**23.8**
	Coventry Teaching	**315,700**	**1.24**	**1.20**	**1.19**	**1.20**	**1.24**	**1.29**	**1.15**	**1.44**	**953**	**1.23**	**19.6**
	Dudley	307,500	0.97	0.92	0.93	0.90	0.96	0.94	0.83	1.07	810	0.94	8.5
	Heart of Birmingham Teaching	**285,100**	**2.40**	**2.40**	**2.37**	**2.39**	**2.41**	**2.38**	**2.16**	**2.63**	**1,414**	**2.39**	**61.8**
	Herefordshire	*179,400*	*0.91*	*0.87*	*0.86*	*0.77*	*0.81*	*0.76*	*0.64*	*0.90*	*713*	*0.83*	*2.4*
	North Staffordshire	211,900			0.88	0.88	0.92	0.87	0.75	1.02	774	0.89	3.5
	Sandwell	**292,900**	**1.50**	**1.51**	**1.48**	**1.55**	**1.60**	**1.57**	**1.42**	**1.75**	**1,222**	**1.54**	**21.8**
	Shropshire County	*293,400*	*0.92*	*0.90*	*0.90*	*0.95*	*0.92*	*0.86*	*0.76*	*0.98*	*791*	*0.91*	*3.0*
	Solihull	206,300	1.03	1.08	0.97	0.92	0.98	0.93	0.80	1.08	795	0.98	9.0
	South Birmingham	**342,200**	**1.49**	**1.41**	**1.34**	**1.37**	**1.38**	**1.33**	**1.20**	**1.48**	**991**	**1.38**	**17.9**
	South Staffordshire	*611,300*			*0.92*	*0.92*	*0.88*	*0.88*	*0.80*	*0.96*	*769*	*0.90*	*4.7*
	Stoke on Trent	248,000			1.12	1.08	1.11	1.11	0.97	1.27	899	1.11	7.1
	Telford and Wrekin	162,400	0.79	0.87	1.03	1.02	1.07	1.05	0.89	1.24	844	0.98	6.6
	Walsall Teaching	**256,800**	**1.34**	**1.30**	**1.27**	**1.32**	**1.29**	**1.36**	**1.21**	**1.53**	**1,102**	**1.32**	**14.7**
	Warwickshire	536,200	1.08	1.03	1.03	0.99	1.01	1.02	0.93	1.12	884	1.03	6.7
	Wolverhampton City	**239,300**	**1.32**	**1.26**	**1.20**	**1.23**	**1.24**	**1.18**	**1.04**	**1.35**	**944**	**1.24**	**23.8**
	Worcestershire	*557,300*	*0.88*	*0.84*	*0.83*	*0.83*	*0.85*	*0.85*	*0.77*	*0.93*	*754*	*0.85*	*4.4*
East of England	*Bedfordshire*	*416,300*	*0.83*	*0.86*	*0.81*	*0.82*	*0.82*	*0.84*	*0.74*	*0.94*	*687*	*0.83*	*9.3*
	Cambridgeshire	*616,400*	*0.91*	*0.91*	*0.87*	*0.83*	*0.85*	*0.87*	*0.80*	*0.96*	*714*	*0.87*	*7.4*
	Hertfordshire	*1,107,500*	*0.73*	*0.80*	*0.81*	*0.90*	*0.90*	*0.90*	*0.84*	*0.97*	*727*	*0.85*	*9.9*
	Great Yarmouth and Waveney	214,700	0.42	0.43	0.51	0.78	0.85	0.90	0.78	1.05	829	0.67	3.5
	Luton	**198,900**	**1.19**	**1.18**	**1.22**	**1.27**	**1.25**	**1.25**	**1.07**	**1.44**	**880**	**1.23**	**31.5**
	Mid Essex	*374,500*	*0.79*	*0.83*	*0.87*	*0.84*	*0.85*	*0.82*	*0.72*	*0.92*	*692*	*0.83*	*5.1*
	Norfolk	*764,800*	*0.93*	*0.94*	*0.93*	*0.90*	*0.87*	*0.83*	*0.77*	*0.90*	*754*	*0.90*	*3.9*
	North East Essex	*329,500*				*0.78*	*0.78*	*0.80*	*0.71*	*0.92*	*698*	*0.79*	*6.4*
	Peterborough	173,600	0.99	1.04	1.05	0.98	1.05	1.03	0.88	1.22	789	1.03	13.0
	South East Essex	*338,200*	*0.93*	*0.95*	*0.93*	*0.93*	*0.92*	*0.87*	*0.77*	*0.98*	*751*	*0.92*	*5.7*
	South West Essex	410,000	0.92	0.93	0.94	0.96	0.95	0.96	0.86	1.07	759	0.95	7.6
	Suffolk	*601,900*	*0.84*	*0.84*	*0.85*	*0.82*	*0.83*	*0.83*	*0.76*	*0.91*	*726*	*0.83*	*5.7*
	West Essex	*286,400*	*0.84*	*0.80*	*0.75*	*0.69*	*0.71*	*0.74*	*0.64*	*0.86*	*615*	*0.75*	*7.9*
London	**Barking and Dagenham**	**179,700**	**1.10**	**1.11**	**1.15**	**1.13**	**1.21**	**1.30**	**1.11**	**1.52**	**863**	**1.17**	**23.7**
	Barnet	**348,000**	**1.11**	**1.22**	**1.41**	**1.45**	**1.43**	**1.51**	**1.37**	**1.66**	**1,141**	**1.37**	**29.4**
	Bexley	**228,300**	**1.12**	**1.18**	**1.19**	**1.20**	**1.23**	**1.26**	**1.11**	**1.43**	**1,007**	**1.20**	**13.0**
	Brent Teaching	**256,300**		**1.36**	**2.04**	**2.25**	**2.33**	**2.45**	**2.24**	**2.68**	**1,810**	**2.11**	**53.5**

Table 2.5. Continued

UK area	Name	Total population	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 95% LCL	2010 95% UCL	2010 Crude rate pmp	% non-White O/E	% non-White
London	Bromley	312,400	1.00	0.99	0.96	1.00	0.98	1.01	0.89	1.14	826	0.99	11.9
	Camden	**235,500**	**0.94**	**1.02**	**1.10**	**1.16**	**1.19**	**1.23**	**1.07**	**1.42**	**832**	**1.12**	**24.9**
	City and Hackney Teaching	**231,000**		**1.38**	**1.43**	**1.35**	**1.43**	**1.51**	**1.33**	**1.72**	**983**	**1.43**	**35.7**
	Croydon	**345,400**	**1.16**	**1.14**	**1.32**	**1.32**	**1.38**	**1.38**	**1.25**	**1.53**	**1,051**	**1.29**	**34.5**
	Ealing	**318,300**	**1.41**	**1.47**	**1.61**	**1.92**	**1.92**	**1.96**	**1.79**	**2.15**	**1,426**	**1.74**	**40.7**
	Enfield	**295,000**	**1.48**	**1.47**	**1.43**	**1.43**	**1.40**	**1.42**	**1.27**	**1.59**	**1,064**	**1.44**	**28.0**
	Greenwich Teaching	**228,100**	**1.14**	**1.16**	**1.18**	**1.26**	**1.30**	**1.44**	**1.26**	**1.64**	**1,000**	**1.26**	**26.1**
	Hammersmith and Fulham	**169,800**	**1.23**	**1.24**	**1.22**	**1.25**	**1.33**	**1.32**	**1.13**	**1.55**	**919**	**1.27**	**21.0**
	Haringey Teaching	**225,100**	**1.50**	**1.53**	**1.56**	**1.61**	**1.61**	**1.63**	**1.45**	**1.85**	**1,137**	**1.58**	**33.1**
	Harrow	**230,300**			**1.53**	**1.70**	**1.79**	**1.86**	**1.67**	**2.07**	**1,442**	**1.73**	**44.7**
	Havering	*236,100*			*0.80*	*0.81*	*0.81*	*0.79*	*0.68*	*0.93*	*661*	*0.80*	*8.8*
	Hillingdon	**266,200**	**0.96**	**1.04**	**0.94**	**1.31**	**1.31**	**1.34**	**1.19**	**1.51**	**988**	**1.16**	**25.9**
	Hounslow	**236,700**	**1.33**	**1.25**	**1.26**	**1.48**	**1.50**	**1.57**	**1.39**	**1.77**	**1,120**	**1.41**	**37.8**
	Islington	**193,900**	**1.33**	**1.45**	**1.35**	**1.28**	**1.27**	**1.36**	**1.18**	**1.58**	**908**	**1.34**	**22.9**
	Kensington and Chelsea	169,500			0.79	0.96	0.96	1.00	0.85	1.19	791	0.93	22.6
	Kingston	169,000			1.05	1.16	1.13	1.11	0.94	1.31	817	1.12	19.9
	Lambeth	**284,400**	**1.35**	**1.36**	**1.66**	**1.65**	**1.72**	**1.68**	**1.50**	**1.87**	**1,122**	**1.58**	**32.0**
	Lewisham	**266,400**	**1.63**	**1.66**	**1.69**	**1.65**	**1.74**	**1.70**	**1.52**	**1.90**	**1,179**	**1.68**	**34.4**
	Newham	**240,200**	**1.68**	**1.78**	**1.81**	**1.84**	**1.91**	**2.16**	**1.93**	**2.41**	**1,341**	**1.88**	**57.0**
	Redbridge	**270,300**	**1.23**	**1.22**	**1.19**	**1.32**	**1.37**	**1.45**	**1.29**	**1.63**	**1,058**	**1.31**	**40.9**
	Richmond and Twickenham	*190,800*			*0.63*	*0.70*	*0.76*	*0.77*	*0.64*	*0.92*	*597*	*0.72*	*11.7*
	Southwark	**287,100**	**1.52**	**1.53**	**1.63**	**1.67**	**1.69**	**1.74**	**1.56**	**1.94**	**1,174**	**1.64**	**34.1**
	Sutton and Merton	**403,000**			**1.12**	**1.15**	**1.19**	**1.21**	**1.09**	**1.34**	**908**	**1.17**	**20.8**
	Tower Hamlets	**238,100**	**1.12**	**1.16**	**1.24**	**1.29**	**1.42**	**1.48**	**1.29**	**1.70**	**882**	**1.30**	**22.8**
	Waltham Forest	**227,400**		**1.38**	**1.57**	**1.55**	**1.50**	**1.59**	**1.40**	**1.80**	**1,095**	**1.52**	**36.6**
	Wandsworth	**289,200**			**1.37**	**1.38**	**1.44**	**1.43**	**1.27**	**1.61**	**954**	**1.41**	**19.7**
	Westminster	253,400			0.92	1.00	1.07	1.09	0.95	1.25	789	1.03	27.8
South East Coast	Brighton and Hove City	258,400	0.86	0.87	0.87	0.88	0.87	0.86	0.74	1.00	646	0.87	8.7
	East Sussex Downs and Weald	*336,100*	*0.82*	*0.78*	*0.80*	*0.74*	*0.71*	*0.70*	*0.62*	*0.80*	*652*	*0.76*	*4.9*
	Eastern and Coastal Kent	742,200			0.86	0.92	0.93	0.96	0.89	1.04	818	0.92	5.3
	Hastings and Rother	*179,700*	*0.82*	*0.79*	*0.75*	*0.78*	*0.73*	*0.79*	*0.67*	*0.94*	*735*	*0.78*	*5.2*
	Medway	256,600			0.84	0.88	0.88	0.87	0.75	1.01	686	0.87	7.5
	Surrey	*1,114,400*	*0.76*	*0.77*	*0.86*	*0.87*	*0.89*	*0.88*	*0.83*	*0.95*	*738*	*0.84*	*8.3*
	West Kent	*685,100*			*0.86*	*0.89*	*0.89*	*0.86*	*0.79*	*0.94*	*720*	*0.88*	*6.8*
	West Sussex	*800,000*	*0.76*	*0.76*	*0.80*	*0.82*	*0.82*	*0.83*	*0.76*	*0.90*	*733*	*0.80*	*5.8*
South Central	**Berkshire East**	**406,500**	**1.01**	**1.07**	**1.19**	**1.19**	**1.20**	**1.19**	**1.08**	**1.32**	**903**	**1.15**	**18.9**
	Berkshire West	471,500	0.96	1.03	1.12	1.12	1.13	1.04	0.94	1.15	808	1.07	10.1
	Buckinghamshire	512,100	0.97	0.97	0.95	0.93	0.92	0.91	0.82	1.00	756	0.94	10.4
	Hampshire	*1,297,200*	*0.76*	*0.79*	*0.78*	*0.80*	*0.81*	*0.80*	*0.75*	*0.86*	*692*	*0.79*	*4.2*
	Isle of Wight National Health Service	*140,200*	*0.64*	*0.62*	*0.57*	*0.57*	*0.53*	*0.54*	*0.43*	*0.68*	*514*	*0.57*	*3.6*
	Milton Keynes	247,000	0.90	0.85	0.90	0.92	0.89	0.91	0.78	1.05	684	0.90	12.7
	Oxfordshire	*624,200*	*1.05*	*1.04*	*0.96*	*0.92*	*0.89*	*0.89*	*0.81*	*0.98*	*710*	*0.96*	*8.1*
	Portsmouth City Teaching	207,200	1.05	0.99	0.97	0.97	0.93	0.91	0.77	1.08	652	0.97	8.0
	Southampton City	239,800	0.93	0.89	0.89	0.93	0.92	0.98	0.84	1.14	688	0.93	11.4
South West	Bath and North East Somerset	179,800	0.94	0.92	0.91	0.84	0.85	0.84	0.71	1.01	684	0.88	5.8
	Bournemouth and Poole Teaching	*310,800*	*0.88*	*0.86*	*0.89*	*0.88*	*0.85*	*0.83*	*0.73*	*0.95*	*701*	*0.87*	*5.0*
	Bristol	**441,100**	**1.29**	**1.30**	**1.22**	**1.26**	**1.22**	**1.20**	**1.08**	**1.32**	**850**	**1.25**	**11.6**
	Cornwall and Isles of Scilly	537,900	1.02	1.04	0.99	0.97	0.97	0.94	0.86	1.03	861	0.99	2.8
	Devon	*749,700*	*0.81*	*0.83*	*0.84*	*0.86*	*0.88*	*0.87*	*0.80*	*0.94*	*800*	*0.85*	*3.3*
	Dorset	*404,900*	*0.86*	*0.82*	*0.83*	*0.85*	*0.85*	*0.83*	*0.75*	*0.93*	*810*	*0.84*	*3.5*

Table 2.5. Continued

UK area	Name	Total population	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2009 O/E	2010 O/E	2010 95% LCL	2010 95% UCL	2010 Crude rate pmp	% non-White O/E	% non-White
	Gloucestershire	*593,600*	*0.91*	*0.92*	*0.88*	*0.82*	*0.85*	*0.83*	*0.75*	*0.91*	*716*	*0.86*	*4.7*
	North Somerset	*212,100*	*1.04*	*0.99*	*0.91*	*0.92*	*0.86*	*0.83*	*0.71*	*0.97*	*745*	*0.92*	*3.6*
	Plymouth Teaching	**258,900**	**1.08**	**1.18**	**1.14**	**1.12**	**1.12**	**1.16**	**1.02**	**1.32**	**896**	**1.14**	**4.4**
	Somerset	*525,500*	*0.89*	*0.88*	*0.83*	*0.81*	*0.82*	*0.85*	*0.77*	*0.94*	*773*	*0.85*	*3.2*
	South Gloucestershire	264,900	1.05	1.04	0.99	0.97	0.91	0.97	0.85	1.11	800	0.99	5.0
	Swindon	206,900	0.91	0.93	0.87	0.86	0.87	0.91	0.78	1.07	720	0.89	7.1
	Torbay	134,400	0.89	0.86	0.79	0.92	0.88	0.94	0.78	1.13	871	0.88	3.1
	Wiltshire	*459,800*	*0.70*	*0.71*	*0.73*	*0.75*	*0.73*	*0.73*	*0.65*	*0.82*	*626*	*0.73*	*3.4*
Wales	*Betsi Cadwaladr University*	*678,500*	*1.04*	*0.99*	*0.95*	*0.94*	*0.91*	*0.88*	*0.81*	*0.96*	*778*	*0.95*	*1.0*
	Powys Teaching	131,100	1.01	0.95	0.90	0.89	0.95	0.88	0.73	1.06	839	0.93	0.9
	Hywel Dda	374,800	1.04	1.02	0.97	1.02	0.96	0.90	0.81	1.01	816	0.98	1.0
	Abertawe Bro Morgannwg University	**504,800**	**1.26**	**1.25**	**1.27**	**1.21**	**1.23**	**1.27**	**1.17**	**1.38**	**1,076**	**1.25**	**1.6**
	Cwm Taf	**290,600**	**1.42**	**1.47**	**1.52**	**1.44**	**1.40**	**1.32**	**1.18**	**1.48**	**1,087**	**1.43**	**1.1**
	Aneurin Bevan	**561,300**	**1.20**	**1.16**	**1.18**	**1.11**	**1.09**	**1.12**	**1.03**	**1.22**	**942**	**1.14**	**1.9**
	Cardiff and Vale University	466,100	1.17	1.18	1.17	1.07	1.08	1.07	0.97	1.18	800	1.12	6.7
Scotland	Ayrshire & Arran	366,900	1.13	1.19	1.12	1.14	1.08	1.08	0.98	1.20	959	1.12	0.7
	Borders	113,000	0.82	0.82	0.93	0.96	1.00	1.06	0.88	1.28	982	0.94	0.6
	Dumfries and Galloway	148,100	1.06	0.99	0.89	0.92	0.92	0.90	0.75	1.07	851	0.94	0.7
	Fife	364,800	0.98	0.94	0.93	0.93	0.95	0.96	0.86	1.08	814	0.95	1.3
	Forth Valley	293,100	0.96	0.92	0.97	0.94	0.92	0.94	0.82	1.07	781	0.94	1.1
	Grampian	550,500	0.97	0.93	0.91	0.90	0.93	0.95	0.86	1.04	796	0.93	1.6
	Greater Glasgow & Clyde	1,204,100	1.28	1.22	1.18	1.13	1.09	1.06	1.00	1.13	850	1.15	3.4
	Highland	310,700	1.05	1.01	1.00	0.98	1.00	0.98	0.87	1.10	895	1.00	0.8
	Lanarkshire	562,700	1.05	1.01	0.96	0.96	0.93	0.96	0.88	1.05	794	0.98	1.2
	Lothian	*837,000*	*0.95*	*0.93*	*0.92*	*0.89*	*0.87*	*0.85*	*0.78*	*0.92*	*671*	*0.90*	*2.8*
	Orkney	19,800	1.16	1.16	0.95	1.14	1.09	0.99	0.63	1.58	909	1.08	0.4
	Shetland	22,500	0.54	0.44	0.65	0.45	0.54	0.57	0.31	1.02	489	0.53	1.1
	Tayside	402,400	1.16	1.14	1.09	1.02	1.07	1.05	0.94	1.16	905	1.09	1.9
	Western Isles	26,500	0.53	0.50	0.84	0.75	0.71	0.76	0.49	1.20	717	0.69	0.6
Northern Ireland	**Belfast**	**335,700**	**1.38**	**1.38**	**1.37**	**1.31**	**1.21**	**1.21**	**1.09**	**1.36**	**915**	**1.30**	**1.1**
	Northern	458,600	1.22	1.23	1.17	1.12	1.07	1.02	0.92	1.13	796	1.13	0.6
	Southern	357,700	1.15	1.07	1.01	1.02	1.00	1.01	0.89	1.14	732	1.04	0.4
	South Eastern	347,100	1.12	1.08	1.02	1.01	0.97	0.90	0.79	1.02	714	1.01	0.7
	Western	299,900	1.12	1.17	1.15	1.12	1.15	1.11	0.98	1.26	824	0.93	0.5

rates. Yorkshire and East Midlands previously met expected prevalence rates but these have fallen to lower than expected in the last 2 years. There was marked variation (30-fold) in prevalence rates in over 80 year olds between PCT/HBs.

Case mix in prevalent RRT patients

Time on RRT

Table 2.7 shows the median time, in years, since starting RRT of prevalent RRT patients on 31/12/2010. Median time on RRT for all prevalent patients was 5.6 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 (3.2 and 2.0 years respectively $p < 0.001$). The median time on RRT increased for both transplant and haemodialysis patients over the past 6 years (additional 0.7 and 0.5 years respectively) but not for peritoneal dialysis patients.

Age

The median age of prevalent UK patients on RRT at 31st December 2010 was slightly higher (57.9 years)

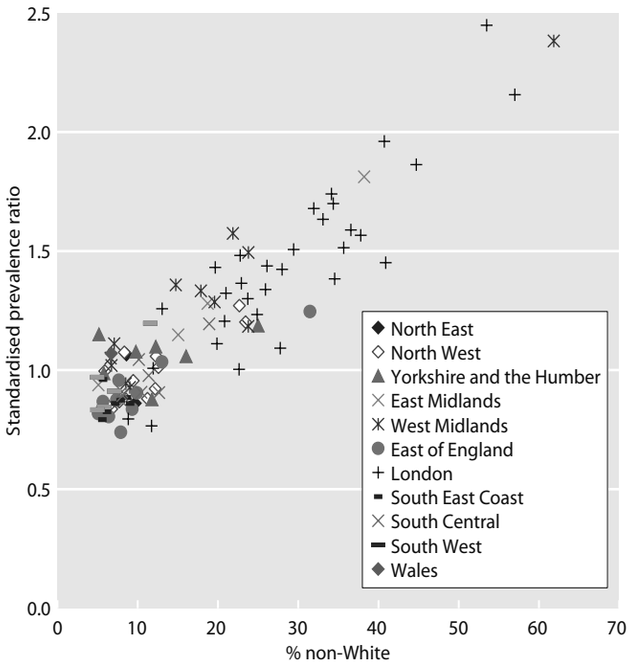

Fig. 2.3. Ethnicity and standardised prevalence ratios for all PCT/HB areas by percentage non-White on 31/12/2010 (excluding areas with <5% ethnic minorities)
PCT/HB = Primary Care Trusts in England, Health and Social Care areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland
SPR = standardised prevalence ratio

compared with 2009 (57.7 years) (table 2.8) and significantly higher than in 2005 when it was 55 years. There were marked differences between modalities; the median age of HD patients (66.3 years) was greater than those on PD (61.7 years) and substantially higher than those of transplanted patients (51.2 years). 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 (16.8% and 16.7% respectively) of patients older than 75+ years compared with England (15.2%) and Scotland (13.5%) (table 2.9). Furthermore there existed a wide range between centres in the proportion of patients aged over 75 (range 9% in Manchester Royal Infirmary to 35% in Ulster) and over 85 (0.5% in Carlisle and 6.4% in Gloucester).

There were wide inter-centre variations in the median age of patients on RRT. Ulster had the highest median age (69.4 years), whilst London Guys and Manchester Royal Infirmary had the lowest median ages (53.2 years each) (table 2.8). The median age of the non-White dialysis population was lower than the White dialysis

Table 2.7. Median time on RRT of prevalent patients on 31/12/2010

Modality	N	Median time treated (years)
Haemodialysis	21,939	3.2
Peritoneal dialysis	3,788	2.0
Transplant	23,836	10.3
All RRT	**49,563**	**5.6**

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 2.6. Standardised rate ratio of RRT for each Strategic Health Authority in England and for Wales, Scotland and Northern Ireland in 2010

UK Area	Total population	O/E	95% LCL	95% UCL	Crude rate pmp
North East England	*2,607,000*	*0.87*	*0.83*	*0.91*	*726.1*
North West England	*6,969,700*	*0.90*	*0.88*	*0.92*	*737.5*
Yorkshire and the Humber	*5,298,700*	*0.96*	*0.93*	*0.99*	*775.3*
East Midlands	*4,450,000*	*0.95*	*0.92*	*0.99*	*795.7*
West Midlands	**5,455,000**	**1.12**	**1.09**	**1.15**	**919.5**
East of England	*5,832,700*	*0.87*	*0.85*	*0.90*	*731.2*
London	**7,824,900**	**1.45**	**1.42**	**1.48**	**1,042.2**
South East Coast	*4,372,500*	*0.86*	*0.83*	*0.89*	*732.3*
South Central England	*4,145,700*	*0.90*	*0.87*	*0.93*	*727.7*
South West England	*5,280,300*	*0.89*	*0.87*	*0.92*	*775.3*
Wales	**3,007,200**	**1.06**	**1.02**	**1.10**	**899.5**
Scotland	5,222,100	0.98	0.95	1.01	818.6
Northern Ireland	1,799,000	1.04	0.99	1.10	794.3

O/E = observed/expected prevalence rate ratio given the age/gender breakdown of each region

Table 2.8. Median age of prevalent RRT patients by treatment modality in renal centres on 31/12/2010

	Median age			
Centre	HD	PD	Transplant	RRT
Abrdn	65.8	54.1	51.8	56.2
Airdrie	61.7	55.5	49.6	56.0
Antrim	68.7	71.2	50.1	64.3
B Heart	66.6	58.3	52.9	62.3
B QEH	65.1	57.7	50.4	56.6
Bangor	65.7	63.6		65.7
Basldn	66.2	69.5	48.1	63.4
Belfast	63.7	54.5	50.2	53.9
Bradfd	62.1	44.0	49.9	53.4
Brightn	70.6	65.9	52.6	61.5
Bristol	67.4	59.0	52.3	57.5
Camb	71.5	65.0	51.5	57.7
Cardff	67.9	62.8	50.6	56.8
Carlis	68.3	60.3	52.5	57.5
Carsh	68.9	63.8	50.6	61.1
Chelms	70.1	64.5	57.1	63.4
Clwyd	63.9	58.8	55.5	61.4
Colchr	68.1			68.1
Covnt	66.4	64.5	50.1	57.6
D & Gall	68.7	66.9	49.1	60.0
Derby	69.6	64.1	53.7	63.0
Derry	64.8	52.7	52.0	59.5
Donc	66.9	61.0	55.3	63.4
Dorset	70.4	70.4	56.1	63.5
Dudley	66.5	57.6	58.2	61.2
Dundee	70.3	61.3	51.9	62.1
Dunfn	66.3	65.9	50.5	59.6
Edinb	62.0	59.8	50.2	55.2
Exeter	72.7	64.2	51.1	62.2
Glasgw	63.1	57.9	51.3	55.6
Glouc	73.0	61.4	53.7	64.2
Hull	65.6	62.5	50.5	57.4
Inverns	71.7	63.3	47.1	55.1
Ipswi	66.3	63.7	52.3	58.9
Kent	70.2	66.3	52.2	61.4
Klmarnk	65.9	62.2	49.3	60.0
L Barts	60.5	58.8	48.9	54.2
L Guys	61.0	61.3	49.7	53.2
L Kings	63.4	60.2	51.1	56.8
L Rfree	64.3	64.3	50.4	56.1
L St.G	68.3	63.6	52.3	59.7
L West	66.4	63.1	52.5	58.0
Leeds	67.8	60.1	50.7	56.7
Leic	66.5	65.4	51.4	59.2
Liv Ain	63.7	63.8		63.8
Liv RI	62.2	54.3	50.6	54.0
M Hope	61.4	57.9	49.5	56.0
M RI	61.7	55.2	49.3	53.2
Middlbr	68.4	57.3	51.4	57.6
Newc	63.6	61.5	52.9	56.8
Newry	66.1	64.3	52.4	61.3
Norwch	70.9	66.2	51.8	63.3
Nottm	66.6	60.5	49.0	57.1
Oxford	66.9	63.3	50.3	55.7
Plymth	69.1	67.0	53.7	58.8
Ports	65.8	63.8	51.7	57.2
Prestn	64.4	60.2	52.0	58.7
Redng	69.7	60.4	54.5	59.9
Sheff	64.7	62.0	51.5	58.5
Shrew	67.9	61.5	52.9	62.2
Stevng	65.1	56.2	49.9	59.1
Sthend	69.8	60.8	53.6	63.6
Stoke	66.9	65.5	49.1	59.1
Sund	63.1	50.6	52.0	56.7
Swanse	70.4	63.1	54.6	64.5
Truro	72.4	71.5	55.0	63.7
Tyrone	68.6	58.0	45.2	62.7
Ulster	72.2	48.8	54.4	69.4
Wirral	65.0	55.1		63.9
Wolve	66.8	61.4	50.1	60.9
Wrexm	67.2	67.6	51.5	57.0
York	64.2	61.4	50.9	57.4
England	**66.3**	**61.7**	**51.2**	**57.9**
N Ireland	**67.1**	**57.9**	**50.2**	**58.9**
Scotland	**64.5**	**59.6**	**50.6**	**56.7**
Wales	**68.4**	**63.6**	**51.7**	**59.7**
UK	**66.3**	**61.7**	**51.2**	**57.9**

Blank cells – no patients for that treatment modality

population (60 vs. 66 years). The differing age distributions of the transplant and dialysis populations are illustrated in figure 2.4, demonstrating that the age peak for prevalent dialysis patients is around 27 years later than for prevalent transplant patients.

In the UK on 31st December 2010, 62% of patients aged under 65 years on RRT had a functioning transplant (table 2.14) compared with only 24% 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-2010 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 at 2,007 pmp (a slight increase from 1,912 pmp in 2009) in the age-group 70–74 years before showing a reducing

Table 2.9. Percentage of prevalent RRT patients in each age group by centre on 31/12/2010

		Percentage of patients			
Centre	N	18–39 years	40–64 years	65–74 years	75+ years
Abrdn	462	18.8	51.5	18.0	11.7
Airdrie	326	18.7	51.5	17.2	12.6
Antrim	217	12.4	38.7	28.1	20.7
B Heart	632	11.4	43.8	24.1	20.7
B QEH	1,844	16.3	50.8	18.0	15.0
Bangor	113	7.1	40.7	26.5	25.7
Basldn	214	14.5	39.7	21.5	24.3
Belfast	682	17.4	54.7	15.4	12.5
Bradfd	455	22.2	48.4	18.0	11.4
Brightn	770	13.0	45.1	21.4	20.5
Bristol	1,250	16.1	51.0	19.1	13.8
Camb	987	16.6	50.4	17.3	15.7
Cardff	1,517	16.3	53.0	17.9	12.8
Carlis	203	13.3	54.2	23.6	8.9
Carsh	1,377	12.6	46.4	22.4	18.7
Chelms	238	9.7	45.8	20.2	24.4
Clwyd[a]	130	7.7	55.4	19.2	17.7
Colchr	121	8.3	33.9	23.1	34.7
Covnt	844	13.6	51.4	20.0	14.9
D & Gall	118	13.6	52.5	16.1	17.8
Derby	459	11.5	43.4	24.6	20.5
Derry	111	12.6	52.3	19.8	15.3
Donc	222	12.2	42.3	24.3	21.2
Dorset	585	11.1	42.1	25.6	21.2
Dudley	303	8.9	49.8	23.8	17.5
Dundee	385	13.8	44.9	22.1	19.2
Dunfn	263	14.4	44.9	22.8	17.9
Edinb	713	17.5	54.8	17.8	9.8
Exeter	785	11.5	44.8	18.9	24.8
Glasgw	1,490	16.4	54.2	17.6	11.8
Glouc	377	9.8	42.7	22.5	24.9
Hull	725	15.3	51.7	19.6	13.4
Inverns	230	16.1	50.9	15.7	17.4
Ipswi	316	13.0	53.8	21.2	12.0
Kent	793	12.6	45.8	22.7	18.9
Klmarnk	284	10.6	51.8	18.7	19.0
L Barts	1,778	17.8	56.4	16.3	9.6
L Guys	1,618	20.5	54.4	14.9	10.3
L Kings	837	14.0	52.3	18.5	15.2
L Rfree	1,639	19.0	49.7	17.1	14.2
L St.G	678	13.7	50.9	18.9	16.5
L West	2,862	12.9	53.1	20.6	13.3
Leeds	1,383	17.8	50.7	18.5	13.0
Leic	1,808	13.2	51.2	20.1	15.5
Liv Ain	159	11.9	41.5	22.0	24.5
Liv RI	1,238	17.6	56.9	15.6	9.9
M Hope	837	16.7	53.4	19.2	10.6
M RI	1,552	19.3	57.1	14.8	8.8
Middlbr	711	13.8	51.3	19.7	15.2
Newc	888	16.2	54.6	18.6	10.6
Newry	177	16.4	42.9	26.6	14.1
Norwch	615	12.4	41.8	23.6	22.3
Nottm	972	18.6	48.9	18.5	14.0
Oxford	1,363	16.9	53.2	17.2	12.6
Plymth	459	13.5	49.9	22.2	14.4

Table 2.9. Continued

Centre	N	Percentage of patients			
		18–39 years	40–64 years	65–74 years	75+ years
Ports	1,333	14.8	53.4	18.2	13.7
Prestn	968	13.6	51.3	19.8	15.2
Redng	636	13.4	47.3	20.0	19.3
Sheff	1,254	13.2	52.2	18.9	15.8
Shrew	337	11.3	45.1	23.7	19.9
Stevng	606	13.9	47.4	21.5	17.3
Sthend	212	10.8	43.9	22.6	22.6
Stoke	635	15.7	46.8	20.0	17.5
Sund	369	13.3	56.9	19.0	10.8
Swanse	595	9.6	41.7	24.2	24.5
Truro	335	11.6	41.8	21.5	25.1
Tyrone	145	17.9	37.2	23.4	21.4
Ulster	112	8.9	28.6	27.7	34.8
Wirral	223	9.9	43.5	23.3	23.3
Wolve	518	11.0	46.7	21.6	20.7
Wrexm	223	16.1	47.5	19.3	17.0
York	337	20.5	45.4	16.6	17.5
England	**42,660**	**15.0**	**50.5**	**19.3**	**15.2**
N Ireland	**1,444**	**15.6**	**46.9**	**20.8**	**16.8**
Scotland	**4,271**	**16.2**	**52.0**	**18.3**	**13.5**
Wales	**2,578**	**13.9**	**49.5**	**19.9**	**16.7**
UK	**50,953**	**15.1**	**50.5**	**19.3**	**15.1**

[a] 10 PD and 2 HD patients from Clwyd are not included in this table

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 2,765 pmp and for females in age-group 70–74 years at 1,406 pmp. Survival of males and females on RRT has been described in chapter 6.

Ethnicity

Forty-nine of the 72 centres (68%) provided ethnicity data that were at least 90% complete (table 2.10) and this was an improvement compared with 2009. Ethnicity completeness for prevalent RRT patients improved in the UK from 83.3% in 2009 to 87.4% in 2010 with

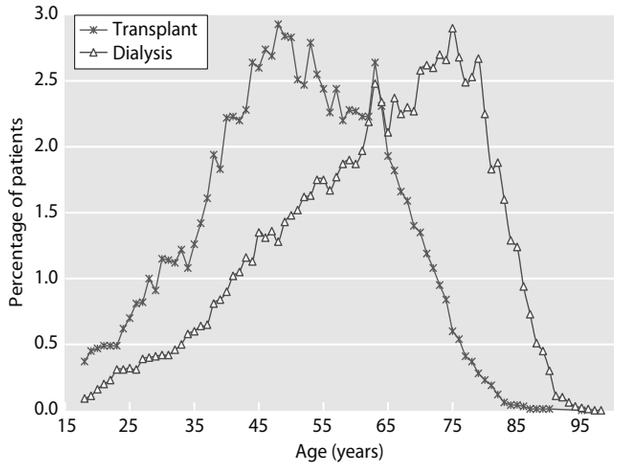

Fig. 2.4. Age profile of prevalent RRT patients by modality on 31/12/2010

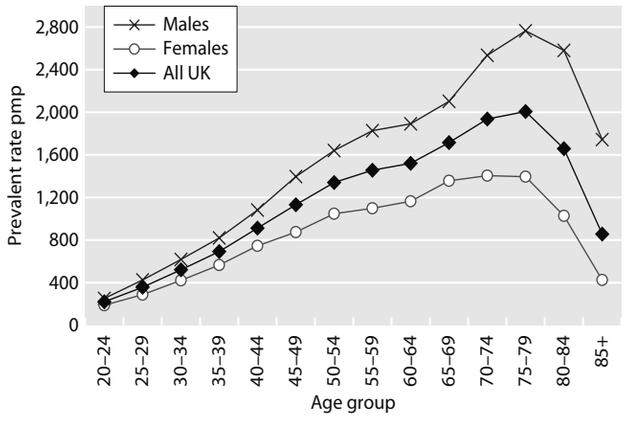

Fig. 2.5. Prevalence rate of RRT patients per million population by age and gender on 31/12/2010

Table 2.10. Ethnicity of prevalent RRT patients by centre on 31/12/2010

		Percentage of patients					
Centre	N	White	Black	Asian	Chinese	Other	Missing
Abrdn	462	45.7	0.0	0.4	0.4	0.2	53.2
Airdrie	326	31.3	0.0	0.9	0.3	0.0	67.5
Antrim	217	99.1	0.0	0.9	0.0	0.0	0.0
B Heart	632	61.9	6.3	29.9	0.6	1.3	0.0
B QEH	1,844	65.0	9.3	22.1	1.1	2.4	0.1
Bangor	113	62.8	1.8	0.0	0.0	0.0	35.4
Basldn	214	89.7	7.0	2.3	0.0	0.9	0.0
Belfast	682	96.2	0.1	0.6	0.1	0.0	2.9
Bradfd	455	54.1	3.1	36.9	0.0	1.1	4.8
Brightn	770	49.0	1.3	0.6	0.1	0.5	48.4
Bristol	1,250	89.2	4.3	3.6	0.5	1.4	1.0
Camb	988	91.6	1.5	3.6	0.2	0.8	2.2
Cardff	1,517	70.7	0.9	2.5	0.4	0.5	24.9
Carlis	203	98.0	0.0	0.5	0.0	0.0	1.5
Carsh	1,377	69.6	8.3	11.0	1.7	2.7	6.7
Chelms	238	89.1	2.1	2.5	1.3	2.1	2.9
Clwyd	130	68.5	0.0	0.0	0.8	0.0	30.8
Colchr	120	52.5	1.7	1.7	0.8	0.8	42.5
Covnt	844	80.2	3.2	12.9	0.5	0.1	3.1
D & Gall	118	11.9	0.0	0.0	0.0	0.0	88.1
Derby	459	80.0	3.3	9.4	0.2	1.1	6.1
Derry	111	99.1	0.0	0.0	0.9	0.0	0.0
Donc	222	97.7	0.5	1.4	0.5	0.0	0.0
Dorset	585	97.1	0.3	0.9	0.5	1.2	0.0
Dudley	303	86.1	2.6	8.9	0.7	1.7	0.0
Dundee	385	49.1	0.0	0.8	0.0	0.3	49.9
Dunfn	263	21.3	0.0	0.0	0.0	0.4	78.3
Edinb	713	7.4	0.0	0.3	0.1	0.0	92.1
Exeter	785	94.1	0.5	0.1	0.3	0.3	4.7
Glasgw	1,490	7.4	0.1	1.1	0.1	0.0	91.2
Glouc	377	95.5	2.4	1.6	0.3	0.3	0.0
Hull	725	48.7	0.4	0.3	0.0	0.4	50.2
Inverns	230	41.7	0.0	0.4	0.0	0.0	57.8
Ipswi	316	91.5	2.5	2.5	0.3	0.3	2.8
Kent	793	88.3	0.8	2.0	0.1	0.5	8.3
Klmarnk	284	6.3	0.0	0.0	0.4	0.0	93.3
L Barts	1,778	41.0	30.6	26.1	1.7	0.3	0.3
L Guys	1,618	53.3	22.4	2.7	1.2	0.7	19.7
L Kings	837	50.7	33.0	10.5	1.7	0.6	3.6
L Rfree	1,639	50.0	20.6	18.5	1.6	7.5	1.7
L St.G	678	51.2	20.9	8.6	1.8	6.0	11.5
L West	2,862	45.4	18.1	31.4	1.0	3.8	0.2
Leeds	1,383	75.1	3.5	12.7	0.0	1.6	7.2
Leic	1,808	74.6	3.3	16.6	0.3	1.0	4.1
Liv Ain	159	56.6	0.6	0.6	0.6	1.3	40.3
Liv RI	1,238	80.1	2.1	1.0	1.1	0.7	15.0
M Hope	837	82.8	1.3	13.9	0.4	1.3	0.4
M RI	1,552	77.4	7.7	11.0	1.0	0.1	2.7
Middlbr	711	95.1	0.4	3.4	0.1	0.1	0.8
Newc	888	95.4	0.2	3.0	0.5	0.9	0.0
Newry	177	99.4	0.0	0.0	0.6	0.0	0.0
Norwch	615	83.3	0.3	1.0	0.7	0.2	14.6
Nottm	972	87.4	5.3	5.9	0.0	1.3	0.0
Oxford	1,363	81.1	3.2	7.3	0.7	2.2	5.4
Plymth	459	96.1	0.4	0.2	0.4	0.9	2.0

Table 2.10. Continued

Centre	N	Percentage of patients					
		White	Black	Asian	Chinese	Other	Missing
Ports	1,333	92.7	1.2	3.0	0.7	1.1	1.3
Prestn	968	85.4	0.7	13.0	0.0	0.6	0.2
Redng	636	72.6	6.3	18.4	0.6	1.9	0.2
Sheff	1,254	92.6	1.4	3.7	0.4	1.6	0.2
Shrew	337	96.1	1.2	2.1	0.0	0.6	0.0
Stevng	606	72.1	8.4	17.3	0.5	1.7	0.0
Sthend	212	84.4	1.9	0.9	2.4	0.5	9.9
Stoke	635	71.8	0.3	2.8	0.2	1.3	23.6
Sund	369	95.9	1.4	1.4	0.3	0.3	0.8
Swanse	595	98.0	0.3	1.2	0.0	0.2	0.3
Truro	335	76.1	1.8	0.0	0.3	0.0	21.8
Tyrone	145	98.6	0.7	0.7	0.0	0.0	0.0
Ulster	112	98.2	0.0	0.9	0.9	0.0	0.0
Wirral	223	92.8	0.4	1.8	1.8	1.8	1.3
Wolve	518	72.4	8.7	17.4	0.4	0.0	1.2
Wrexm	223	98.7	0.0	0.4	0.0	0.0	0.9
York	337	87.5	0.6	0.6	0.0	0.3	11.0
England	**42,660**	**73.2**	**7.7**	**10.9**	**0.7**	**1.5**	**6.0**
N Ireland	**1,444**	**97.6**	**0.1**	**0.6**	**0.3**	**0.0**	**1.4**
Scotland	**4,271**	**19.9**	**0.0**	**0.7**	**0.2**	**0.1**	**79.2**
Wales	**2,578**	**79.0**	**0.7**	**1.8**	**0.3**	**0.3**	**17.9**
UK	**50,953**	**69.7**	**6.5**	**9.3**	**0.6**	**1.3**	**12.6**

Appendix H ethnicity coding

94% ethnicity completeness in England in 2010. 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 2010, 17.7% of the prevalent UK RRT population (with assigned ethnicity) were from ethnic minorities (20.8% in England). The proportions in Wales, Scotland and Northern Ireland were very small, although there was a high level of missing ethnicity data in Scotland. 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 improvements in coding of ethnicity as well as increasing incidence of ERF and increased referral rates in these populations.

Amongst 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 0.5% in one centre (Carlisle) to over 50% in London Barts (58.7%) and London West (54.4%). Three centres have over 40% of prevalent patients from ethnic minorities, Bradford (41.1%), London Kings (45.8%), London Royal Free (48.3%). Centres with an ethnic minority population greater than 10% had higher numbers of prevalent patients on RRT, both on dialysis and with functioning transplants. Fifty-seven percent of transplanting centres had an ethnic minority population greater than 10% compared with 25% of non-transplanting centres.

As would be expected, ethnicity also impacted 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. 59 years).

Primary renal diagnosis

Data for primary renal diagnosis (PRD) were not sent in 2.5% of patients (3.3% in 2009) and there remained a marked inter-centre difference in completeness of data returns. Where centres had $\geqslant 50\%$ 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

Table 2.11. Primary renal diagnosis in prevalent RRT patients by age and gender on 31/12/2010

Primary diagnosis[a]	N	% all patients	Inter-centre range %	age <65		age ⩾65		M:F ratio
				N	%	N	%	
Aetiology uncertain/GN (not biopsy proven)[b]	10,044	20.5	6.2–38.1	5,820	18.1	4,224	25.1	1.6
GN (biopsy proven)[b]	7,834	16.0	1.1–22.8	6,008	18.7	1,826	10.8	2.2
Pyelonephritis	5,733	11.7	6.3–18.8	4,329	13.5	1,404	8.3	1.2
Diabetes	7,282	14.9	8.2–25.4	4,451	13.9	2,831	16.8	1.6
Polycystic kidney	4,720	9.7	1.7–16.8	3,242	10.1	1,478	8.8	1.1
Hypertension	2,802	5.7	0.5–14.9	1,576	4.9	1,226	7.3	2.4
Renal vascular disease	1,697	3.5	0.3–12.9	338	1.1	1,359	8.1	2.0
Other	7,576	15.5	5.0–39.4	5,525	17.2	2,051	12.2	1.3
Not sent	1,244	2.5	0.1–48.8	795	2.5	449	2.7	1.6

[a] Appendix H: ERA-EDTA coding
[b] GN–glomerulonephritis
Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral and Liv RI) as well as centres with ⩾50% primary renal diagnosis not sent (L RFree)

of renal vascular 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, two centres with ⩾40% 'uncertain' diagnosis (Wirral, Liverpool RI) have been excluded from the inter-centre analysis and the UK and national totals have been adjusted. The three 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. There was wide inter-centre variation in the proportion of primary renal diagnoses not sent in the RRT prevalent population but this is improving in most centres. There were 4 centres with >15% not sent (Brighton 16.6%, Colchester 48.8%, Truro 16.4%, London Royal Free 50.2%). Uncertain primary renal diagnosis also ranged widely between centres and 6 centres had >30% uncertain diagnosis (Bangor 31%, Cambridge 31%, Doncaster 34%, Ipswich 32%, Liverpool RI 38%, Manchester Hope 33%).

Biopsy-proven glomerulonephritis remained the most common specific primary renal diagnosis in the 2010 prevalent cohort at 16.0% (table 2.11), although 20.5% of patients had an uncertain diagnostic code. Diabetes accounted for 14.9% of renal disease in the prevalent patients on RRT, although it was more common in the ⩾65-year age-group compared to the younger group (16.8% vs. 13.9%). This contrasted with the pattern seen in incident patients where diabetes is the predominant specific diagnostic code in 24% 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.

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 renal vascular disease, which are more common in males, 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 and this was similar in the incident cohort.

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 7,282 in 2010,

Table 2.12. Median age, gender ratio and treatment modality in diabetic and non-diabetic prevalent RRT patients on 31/12/2010

	Diabetic patients	Other PRD
N	7,282	40,406
M:F ratio	1.57	1.54
Median age on 31/12/10	61	57
Median age at start of RRT	56	47
Median years on RRT	3.4	6.5
% HD	61	40
% PD	10	7
% transplant	30	52

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

Table 2.13. Age relationships in diabetic and non-diabetic patients and modality in prevalent RRT patients on 31/12/2010

	<65		⩾65	
	Diabetic patients	Other PRD	Diabetic patients	Other PRD
N	4,451	26,838	2,831	13,568
% HD	47.2	28.7	81.8	63.6
% PD	9.7	6.3	9.6	9.0
% transplant	43.1	65.0	8.7	27.3

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Wirral, Liv RI) as well as centres with ⩾50% primary renal diagnosis not sent (L RFree)
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

representing 14.9% of all prevalent patients (compared to 12.0% in 2004) (tables 2.12 and 2.13). 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 2010 for diabetic patients was only 3.5 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 (3.4 years vs. 6.5 years) and this difference in survival between diabetics and non-diabetics has not changed over the last 5 years. Patients with diabetes starting RRT in Scotland were 4 years younger and in Northern Ireland 3 years older compared with the UK average age of diabetic patients starting RRT.

Diabetes as the primary renal diagnosis also influenced the modality distribution. The predominant mode of treatment for patients with diabetes was HD (61%). The percentage of patients with a functioning transplant was much lower in prevalent patients with diabetes than in prevalent patients without diabetes (30% vs. 52%). However this has increased since 2004 when only 26% of patients with diabetes had a functioning transplant. As would be expected, this difference was even more pronounced for older patients with diabetes (age ⩾65 years) (table 2.13), with only 8.7% of older prevalent patients with diabetes having a functioning transplant compared with 27.3% of their non-diabetic peers. In Northern Ireland, only 21% of prevalent patients with diabetes had a functioning transplant compared with the UK average of 30% although Northern Ireland diabetic patients were older. More prevalent patients without diabetes were on home dialysis therapies (home HD and PD 18.5%) compared with prevalent patients with diabetes (15.1%).

Modalities of treatment

Transplantation was the most common treatment modality (48%) for prevalent RRT patients in 2010, followed closely by centre-based HD (44%) in either

Table 2.14. Treatment modalities by age in UK countries on 31/12/2010

	<65 years				⩾65 years			
Country	N	% HD	% PD	% transplant	N	% HD	% PD	% transplant
England	27,965	31.6	6.9	61.4	14,695	66.8	9.4	23.8
N Ireland	902	35.1	3.9	61.0	542	74.5	5.2	20.3
Scotland	2,913	32.9	5.7	61.4	1,358	68.2	7.7	24.2
Wales	1,634	27.7	6.9	65.4	944	67.4	10.2	22.5
UK	**33,414**	**31.6**	**6.7**	**61.6**	**17,539**	**67.2**	**9.1**	**23.7**

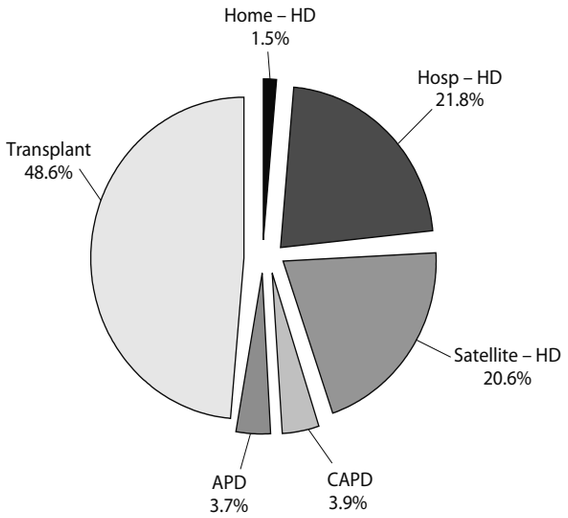

Fig. 2.6. Treatment modality in prevalent RRT patients on 31/12/2010

hospital centre (22%) or satellite unit (21%) (figure 2.6). Home therapies made up the remaining 9% of treatment therapies, largely PD in its different formats (8%) which was similar to 2009. Home therapies are now being used by 17.6% of prevalent dialysis patients (2.9% home HD and 14.7% PD). The proportion on continuous ambulatory peritoneal dialysis (CAPD) and automated PD (APD) was 3.9% and 3.7% respectively, though the proportion on APD may be an under-estimate 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, rising 23% since 2009 (636 to 780 patients).

As mentioned earlier, treatment modality was related to patient age. Younger patients (age <65 years), were more likely to have a functioning transplant (61.6%) when compared with patients aged over 65 years (23.7%) (table 2.14). HD was the principal modality in the older patients (67.2%).

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 68.5% in Derby to 100% in Colchester (table 2.15).

The number of centres with no prevalent HD patients reported as being treated at satellite units decreased in 2010, 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 40% this year compared to 36% in 2009 and 35% 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. In 2010, the number of centres that had more than 50% of their HD activity taking place in satellite units increased to 27 (table 2.15 and figure 2.8). There was also wide variation between centres in the proportion of PD patients on APD treatment, ranging from 0 to

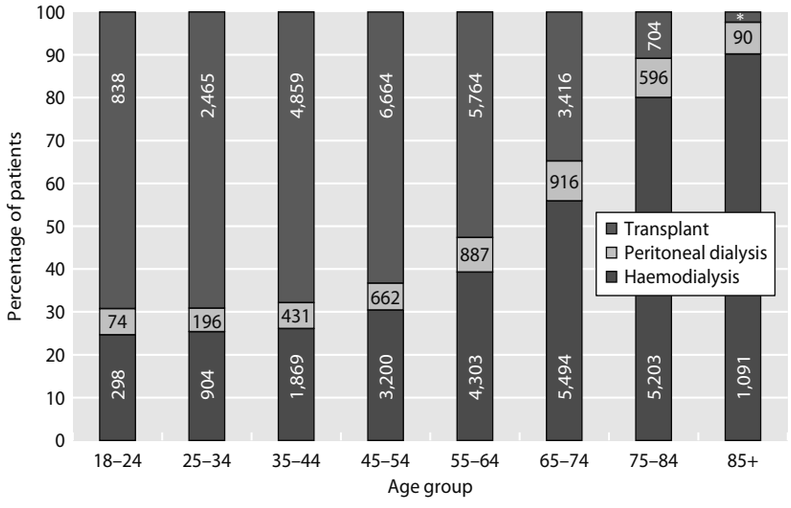

Fig. 2.7. Treatment modality distribution by age in prevalent RRT patients on 31/12/2010
* Transplant in age group 85+, N = 29

Table 2.15. Percentage of prevalent dialysis patients by dialysis modality by centre on 31/12/2010

		Haemodialysis				Peritoneal dialysis	
Centre	N	Total	Home	Hospital	Satellite	CAPD	APD
Abrdn[a]	231	87.0	2.6	84.4	0.0	6.9	6.1
Airdrie[a]	194	94.3	0.0	94.3	0.0	2.1	3.6
Antrim[b]	140	92.1	2.1	90.0	0.0	0.7	6.4
B Heart	469	90.8	3.6	80.2	7.0	7.7	1.5
B QEH	1,011	84.9	2.9	15.8	66.2	6.5	8.6
Bangor	113	77.0	9.7	52.2	15.0	6.2	16.8
Basldn	163	84.7	0.0	84.1	0.6	7.4	8.0
Belfast[b]	264	88.6	4.9	83.7	0.0	1.1	9.9
Bradfd	222	83.3	0.0	70.7	12.6	2.3	14.4
Brightn	431	79.8	6.0	40.1	33.6	9.1	11.1
Bristol	522	88.1	5.6	14.9	67.6	6.7	5.2
Camb	384	90.9	2.6	41.7	46.6	0.0	0.0
Cardff	599	82.8	5.5	17.9	59.4	13.5	3.7
Carlis	73	82.2	0.0	61.6	20.6	9.6	8.2
Carsh	829	87.6	1.2	36.4	49.9	3.7	8.7
Chelms	158	77.9	0.0	77.9	0.0	13.9	8.2
Clwyd [c]	74	91.9	1.4	90.5	0.0	6.8	1.4
Colchr	120	100.0	0.0	100.0	0.0	0.0	0.0
Covnt	442	81.0	0.5	80.5	0.0	19.0	0.0
D & Gall[a]	61	86.9	0.0	86.9	0.0	6.6	6.6
Derby	321	68.5	14.3	54.2	0.0	25.6	5.9
Derry[b]	63	96.8	1.6	95.2	0.0	0.0	3.2
Donc	171	86.0	0.0	50.9	35.1	1.8	12.3
Dorset	299	81.6	1.0	21.7	58.9	8.4	10.0
Dudley	220	71.8	0.9	47.7	23.2	17.3	10.9
Dundee[a]	199	86.9	0.0	86.9	0.0	1.5	11.6
Dunfn[a]	161	83.9	0.0	83.9	0.0	2.5	13.7
Edinb[a]	325	84.3	2.2	82.2	0.0	4.9	10.8
Exeter	438	82.4	0.7	16.0	65.8	8.9	8.7
Glasgw[a]	680	92.2	4.1	88.1	0.0	3.2	4.6
Glouc	232	82.3	0.0	82.3	0.0	4.3	13.4
Hull	393	83.0	2.3	37.9	42.8	6.1	10.9
Inverns[a]	110	79.1	3.6	75.5	0.0	16.4	4.6
Ipswi	151	76.8	2.7	62.9	11.3	11.3	11.9
Kent	431	83.5	2.8	26.2	54.5	16.5	0.0
Klmarnk[a]	194	78.4	3.6	74.7	0.0	3.6	18.0
L Barts	981	80.6	0.8	27.7	52.1	8.0	11.4
L Guys[d]	612	92.3	5.9	27.6	58.8	3.1	4.6
L Kings	521	82.0	0.0	31.5	50.5	6.1	11.9
L Rfree	748	90.5	1.3	15.9	73.3	1.6	7.9
L St.G	339	83.5	2.1	44.3	37.2	3.8	12.4
L West	1,366	97.3	0.8	23.6	72.9	1.1	1.6
Leeds	594	83.5	2.5	17.9	63.1	4.9	11.6
Leic	964	82.5	2.3	18.2	62.0	5.8	11.7
Liv Ain	159	95.6	4.4	10.1	81.1	1.3	3.1
Liv RI	471	82.0	3.8	39.1	39.1	6.6	11.5
M Hope	488	74.6	3.3	36.7	34.6	20.1	5.3
M RI	569	84.5	12.1	29.9	42.5	3.7	11.8
Middlbr	308	92.9	2.9	28.6	61.4	6.8	0.3
Newc	324	83.3	4.6	78.7	0.0	2.2	14.2
Newry[b]	118	92.4	4.2	88.1	0.0	0.0	6.8
Norwch	373	85.5	4.0	48.8	32.7	10.7	3.5
Nottm	504	82.5	4.2	44.4	33.9	7.9	9.5
Oxford	491	77.6	3.7	36.0	37.9	7.7	14.7
Plymth	180	74.4	2.2	72.2	0.0	18.9	6.7

Table 2.15. Continued

		Haemodialysis				Peritoneal dialysis	
Centre	N	Total	Home	Hospital	Satellite	CAPD	APD
Ports	583	82.5	0.5	20.1	61.9	17.5	0.0
Prestn	567	88.9	4.8	20.3	63.8	2.7	8.5
Redng	346	75.1	0.3	64.2	10.7	24.9	0.0
Sheff	677	90.3	7.1	35.9	47.3	9.8	0.0
Shrew	223	90.1	2.7	49.3	38.1	9.9	0.0
Stevng	421	91.5	2.4	40.4	48.7	8.6	0.0
Sthend	144	87.5	2.1	85.4	0.0	12.5	0.0
Stoke	368	80.2	4.4	50.3	25.5	5.2	14.7
Sund	209	84.2	0.5	67.0	16.8	6.7	9.1
Swanse	412	87.6	4.9	51.5	31.3	9.5	2.9
Truro	182	84.1	1.1	46.7	36.3	6.6	9.3
Tyrone[b]	104	91.3	2.9	88.5	0.0	1.0	7.7
Ulster[b]	95	97.9	4.2	93.7	0.0	0.0	2.1
Wirral	223	83.4	1.8	33.6	48.0	4.5	12.1
Wolve	387	81.4	1.3	23.0	57.1	18.6	0.0
Wrexm	99	77.8	3.0	74.8	0.0	21.2	1.0
York	176	86.4	1.1	57.4	27.8	13.6	0.0
England	**21,978**	**84.9**	**2.8**	**36.8**	**45.3**	**7.9**	**7.0**
N Ireland	**784**	**92.0**	**3.7**	**88.3**	**0.0**	**0.6**	**7.0**
Scotland	**2,155**	**87.5**	**2.4**	**85.1**	**0.0**	**4.4**	**8.2**
Wales	**1,297**	**84.0**	**5.2**	**40.0**	**38.7**	**11.8**	**4.2**
UK	**26,214**	**85.3**	**2.9**	**42.5**	**39.9**	**7.6**	**7.0**

[a] 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)
[b] There are no satellite centres in Northern Ireland
[c] 10 PD and 2 HD patients from Clwyd are not included in this table
[d] Data on all patients receiving treatment at one of L Guys satellite centres are not included n = 9

18% (table 2.15). Twelve of the 71 centres with a PD programme had no patients on APD, whilst in four Northern Ireland centres almost 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 2.15.

Home haemodialysis

The use of home HD as a RRT peaked in 1982 when almost 2,200 patients were estimated to be on this therapy, representing 61% of HD patients reported to the ERA-EDTA registry at that time. The fall in the use of this modality to just 445 patients (2.4% of HD patients) in 2006 was probably due to an increase in the use of renal transplantation and also the expansion of hospital HD provision with the introduction of satellite units. In the last seven years there has been renewed interest in home HD and a target of 15% of HD patients on this modality has been suggested [5]. Equipment changes and patient choice has helped drive this change. Since 2006 there has been a gradual increase in the proportion of prevalent patients receiving haemodialysis in their own homes so that in 2010 it reached 3.4% of HD patients (n = 780, figure 2.2 and table 2.15). These numbers may be an under-estimate as some centres have been unable to submit data for patients coded as home HD and work is on-going to address this.

In 2010, the percentage of dialysis patients receiving home HD varied from 0% in 13 centres, to greater than 5% in 8 centres, namely Bangor 9.7%, Brighton 6%, Bristol 5.6%, Cardiff 5.5%, Derby 14.3%, London Guys 5.9%, Manchester RI 12.1% and Sheffield 7.1% (table 2.15).

The increase in home HD patients was mainly due to an increase in Wales plus the Northern Ireland 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

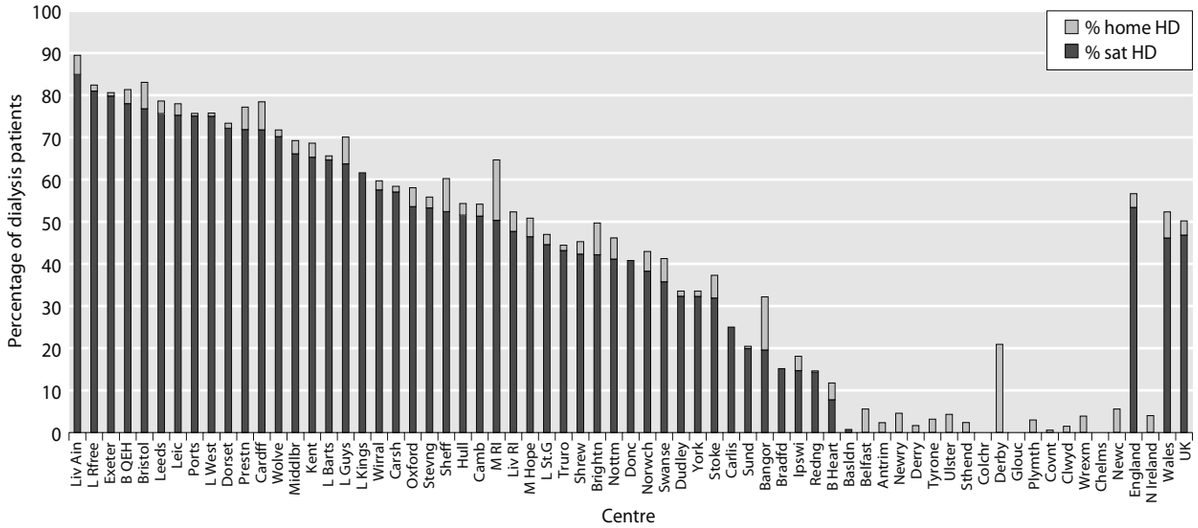

Fig. 2.8. Percentage of prevalent haemodialysis patients treated with satellite or home haemodialysis by centre on 31/12/2010
* Scottish centres excluded as information on satellite HD was not available (except Glasgow)

on this treatment modality. Of the 15 centres with no patients recorded to be on home haemodialysis in 2009, four centres (Manchester Hope 3.3%, Portsmouth 0.5%, Southend 2.1%, Stevenage 2.4%) subsequently reported patients on this modality in 2010. Notable increases in the proportion of prevalent dialysis patients on home HD in 2010 compared with 2009 [3], were seen at Bangor (9.7% vs. 4.6%) and Derby (14.3% vs. 4.2%). In 19 centres, the proportion of prevalent dialysis patients on home HD decreased slightly in 2010 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 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 2009 and 2010 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 proposed

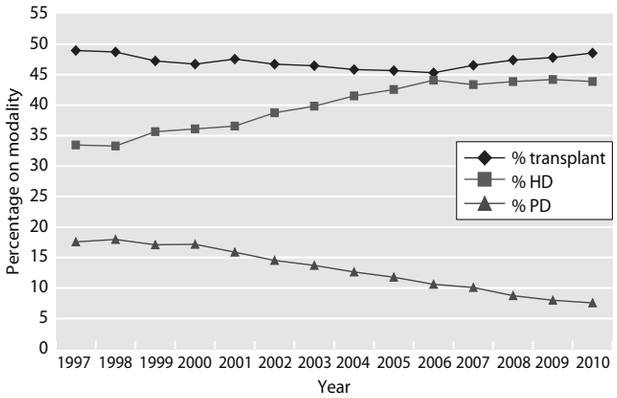

Fig. 2.9. Modality changes in prevalent RRT patients from 1997–2010

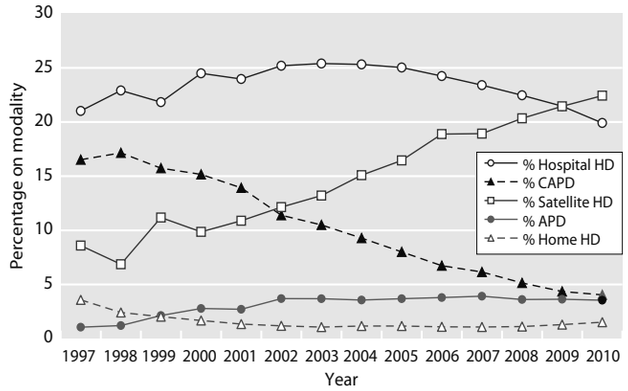

Fig. 2.10. Detailed dialysis modality changes in prevalent RRT patients from 1997–2010
* Scottish centres excluded as information on satellite HD was not available

introduction of dialysis tariffs in England may well result in further changes to the types of treatment patients receive in England.

The proportion of patients treated with 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].

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 Belgium and far lower than in the USA (figure 2.11).

Summary

There continued to be growth across the UK in prevalent patients on RRT with regional and centre level variation. For the first time this year there was no real difference in prevalence rates between the four nations of the UK. 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. The prevalence rate in the over 80 year olds has doubled since 2005. There have been substantial increases in home HD use in some areas although several centres are still unable to offer this modality.

Conflicts of interest: none

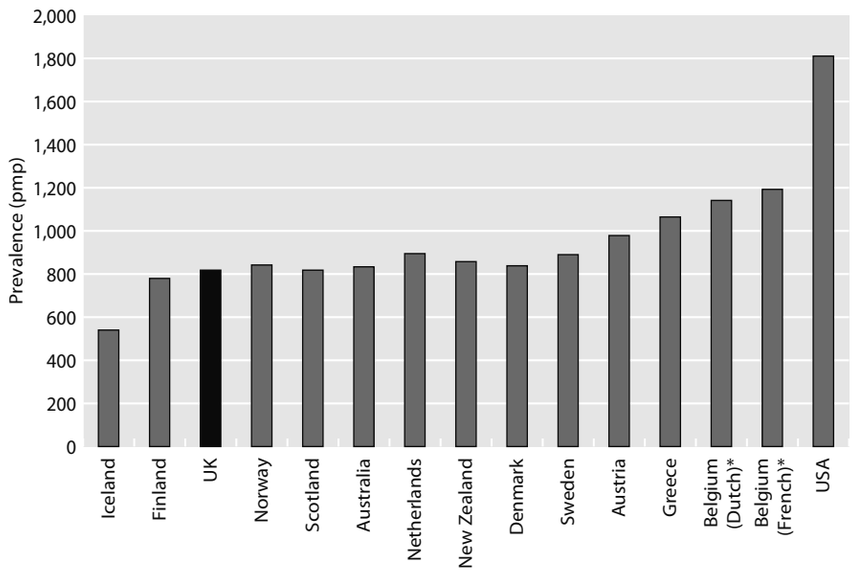

Fig. 2.11. RRT Prevalence rates (pmp) by country in 2010
* Data from USRDS, ERA-EDTA Registry and ANZDATA

References

1 Office for National Statistics. www.statistics.gov.uk
2 Office of the national statistics. The classification of ethnic groups. www.statistics.gov.uk
3 Byrne C, Steenkamp R, Castledine C, Ansell D, Feehally J. UK Renal Registry report 2008. UK Renal Registry Bristol; Chapter 4: p 41–67
4 Ansell D, Feest T. The sixth annual report. Chapter 17: Social deprivation on renal replacement therapy. Bristol, UK Renal Registry, 2003
5 NICE 2002. Technology appraisal No 48. National Institute Clinical Excellence. www.nice.org.uk
6 McDonald SP, Marshall MR, Johnson DW, Polkinghorne KR. Relationship between Dialysis Modality and Mortality. *J Am Soc Nephrol*. 2009; 20(1):155–63
7 Couchoud C, Stengel B, Landais P, Aldigier J-C, de Cornelissen F, Dabot C, et al. The renal epidemiology and information network (REIN): a new registry for end-stage renal disease in France. *Nephrol Dial Transplant*. 2006;21(2):411–8
8 NHS Blood and Transplant activity report 2009/2010. Transplant activity in the UK. http://www.organdonation.nhs.uk/ukt/statistics/transplant_activity_report/current_activity_reports/ukt/activity_report_2009_10.pdf

UK Renal Registry 14th Annual Report: Chapter 3 Demoraphic and Biochemistry Profile of Kidney Transplant Recipients in the UK in 2010: 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 · Outcomes · Renal transplantation · Survival

Summary

- There was an increase in renal transplantation from all sources of organs in 2010, with the biggest percentage increase seen in kidneys from donors after circulatory death (11%).
- In 2010, death-censored renal transplant failure rates in prevalent patients remained stable at 2.4% per annum. 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 49.7 and 51.2 years respectively.
- The median eGFR of prevalent renal transplant recipients was 51.3 ml/min/1.73 m^2.
- The median eGFR of patients one year post-live donor transplantation was 54.1 ml/min/1.73 m^2.
- The median eGFR of patients one year post-deceased donor transplant was 50.9 ml/min/1.73 m^2.
- 13.8% of prevalent transplant patients had eGFR <30 ml/min/1.73 m^2.
- The median decline in eGFR slope beyond the first year after transplantation was -0.6 ml/min/1.73 m^2/year.
- In 2010, the commonest causes of death with a functioning renal transplant were malignancy (23%), infection (22%) and cardiac disease (17%).

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 6 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; (5) eGFR slope analysis; and (6) causes of death in transplant recipients. Methodology, results and conclusions of these analyses are discussed in detail for all six 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 2010.

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.

Methods

There are 23 UK adult renal transplant centres, 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 circulatory death), living kidney donors, patient survival and graft survival is available on the NHSBT website (http://www.organdonation.nhs.uk/ukt/statistics/statistics.asp).

Results

During 2010, 2,724 kidney or kidney plus other organ transplants were performed. The absolute numbers of living kidney donor and donor after circulatory death transplants continued to increase and comprised 37.7% and 20.2% of all kidney transplants performed respectively. There was also an increase in numbers of transplants from donors after brainstem death between 2009 and 2010 that was not seen between 2008 and 2009 (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

Table 3.1. Kidney and kidney plus other organ transplant numbers in the UK, 1/1/2008–31/12/2010

Organ	2008	2009	2010	% change 2009–2010
Donor after brainstem death[a]	944	945	989	5
Donor after circulatory death[b]	439	496	549	11
Living donor kidney	924	983	1,026	4
Kidney and liver	17	15	9	−40
Kidney and heart	0	1	0	
Kidney and pancreas[c]	162	160	151	−7
Total kidney transplants	**2,486**	**2,600**	**2,724**	**5**

[a] Includes en bloc kidney transplants (3 in 2008, 3 in 2009, 7 in 2010) and double kidney transplants (1 in 2008, 6 in 2009, 6 in 2010)
[b] Includes en bloc kidney transplants (2 in 2008, 1 in 2009, 2 in 2010) and double kidney transplants (3 in 2008, 4 in 2009, 16 in 2010)
[c] Includes donor after circulatory death transplants (16 in 2008, 19 in 2009, 29 in 2010)

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	92	96	88	92	94	100	97	93
B QEH	88	96	82	89	95	98	85	97
Bristol	95	96	86	85	98	99	95	98
Camb	92	98	86	89	98	99	93	97
Cardff	94	98	86	88	94	98	86	97
Covnt	95	96	89	92	95	100	86	96
Edin	88	94	82	83	95	98	92	96
Glasgw	94	96	84	82	96	96	96	100
L Guy's	93	95	82	89	96	98	93	95
Leeds	94	96	85	89	96	100	91	97
Leic	91	89	84	83	95	97	92	93
Liv RI	91	97	80	94	95	100	88	92
M Hope	95	95	85	88	98	98	92	97
Newc	93	94	83	86	98	99	92	95
Nottm	91	94	78	85	95	97	92	96
Oxford	95	97	89	86	97	96	96	95
Plymth	90	96	86	90	95	99	90	93
Ports	95	94	80	88	94	98	84	91
L Rfree	95	96	87	93	98	100	93	93
L Barts	92	93	86	91	97	98	86	94
Sheff	90	99	81	92	100	100	88	100
L St.G	94	98	86	92	100	100	89	97
L West	95	98	89	92	96	99	88	96
All centres	**93**	**96**	**84**	**88**	**97**	**99**	**91**	**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
Cohorts for survival rate estimation: 1 year survival: 1/1/2006–31/12/2010; 5 year survival: 1/1/2002–31/12/2006; 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

rates include grafts with primary non-function (which are excluded from analyses by some countries).

Using data from the UKRR on prevalent renal-only transplant patients on 1st January 2010, the death rate during 2010 was 2.4/100 patient years (CI 2.2–2.6) when censored for return to dialysis and 2.5/100 patient years (CI 2.3–2.7) without censoring for dialysis. These death rates are similar to those observed over the last few years.

During 2010, 2.4% of prevalent transplant patients experienced graft failure (excluding death as a cause of graft failure). This is lower than in recent years but it is premature to assume that graft failure rates are falling.

Conclusions

In 2010 there was an increase in renal transplantation from all sources of organs with the biggest percentage increase in kidneys from donors after circulatory death. The graft failure rate of 2.4% per annum and patient death rate of 2.5 per 100 patient years are similar to recent 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 patient level data across the UK.

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. This process may result in some discrepancies in transplant numbers particularly in Oxford/Reading and Clywd/Liverpool RI.

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 only submit limited 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, a few centres 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 2010. 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 renal replacement therapy (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 ethnicity regrouping into the above categories are provided in appendix H: Coding http://www.renalreg.com/report-area/report 2011/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 (Health and Social Care Trust Areas), Scotland (Health Boards) and Wales (Local Health Boards) 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. There are a number of potential explanations for these inconsistencies, including geographical differences in access to renal transplantation in the UK. This has previously been analysed in detail by the UKRR [2] and is currently the focus of a large national study (Access to Transplant and Transplant Outcome Measures–ATTOM).

The proportion of prevalent RRT patients with a transplant relative to the number on dialysis has been fairly stable since at least 2000.

Age and gender

The gender ratio amongst incident and prevalent transplant patients has remained stable for at least the last ten years (table 3.6, figure 3.1). Note absolute patient numbers differ from those published in previous reports as a result of additional data validation and reallocation of patients. The average age of incident transplant patients has steadily increased during the same time period. 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 had increased to 24,739 patients at the end of 2010. The continued expansion of this patient group means there is a need for careful planning by renal centres for future service provision and resource allocation.

Table 3.3. The prevalence per million population (pmp) of renal transplants in adults in the UK on 31/12/2010 (including children <18 years)

	England	N Ireland	Scotland	Wales	UK
Number of prevalent transplants	21,254	687	2,163	1,303	25,407
Total population, mid-2010 estimates from ONS[a] (millions)	52.2	1.8	5.2	3.0	62.3
Prevalence pmp transplant	407	382	414	433	408

[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 2006–2010

[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 2010 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 2010		
			2006	2007	2008	2009	2010	O/E[c]	LCL	UCL
North East	County Durham	510,800	343	370	382	394	409	1.00	0.87	1.14
	Darlington	100,600	318	348	368	338	368	0.91	0.66	1.25
	Gateshead	192,000	375	365	370	385	396	0.98	0.78	1.22
	Hartlepool	91,400	383	394	361	350	394	0.99	0.71	1.37
	Middlesbrough	142,100	387	394	422	457	457	1.22	0.96	1.56
	Newcastle	292,200	311	335	346	359	363	1.01	0.84	1.22
	North Tyneside	**198,400**	**439**	**494**	**494**	**514**	**559**	**1.36**	**1.13**	**1.64**
	Northumberland	312,100	349	368	378	388	372	0.86	0.72	1.03
	Redcar and Cleveland	**137,300**	**466**	**481**	**517**	**532**	**539**	**1.31**	**1.04**	**1.65**
	South Tyneside	154,100	370	409	415	422	415	1.03	0.80	1.31
	Stockton-on-Tees Teaching	192,600	363	343	384	400	400	1.00	0.80	1.25
	Sunderland Teaching	283,400	381	399	406	395	406	1.01	0.84	1.21
North West	Ashton, Leigh and Wigan	307,200	192	348	358	342	378	0.92	0.76	1.10
	Blackburn with Darwen Teaching	140,000	186	321	329	336	336	0.92	0.69	1.22
	Blackpool	140,200	200	292	342	357	357	0.88	0.67	1.16
	Bolton Teaching	266,500	221	386	428	432	447	1.14	0.95	1.37
	Bury	183,500	114	354	343	403	398	1.00	0.79	1.25
	Central and Eastern Cheshire	*457,200*		*311*	*311*	*313*	*332*	*0.79*	*0.68*	*0.93*
	Central Lancashire	459,200	226	287	307	320	353	0.87	0.75	1.02
	Cumbria Teaching	494,400	285	309	328	368	392	0.92	0.80	1.06
	East Lancashire Teaching	381,200	283	393	407	404	401	1.00	0.86	1.17
	Halton and St Helens	296,700	249	283	310	324	357	0.88	0.73	1.07
	Heywood, Middleton and Rochdale	205,000		390	405	420	444	1.15	0.93	1.41
	Knowsley	149,200	302	315	322	349	362	0.93	0.72	1.22
	Liverpool	445,300	292	296	319	341	366	0.98	0.84	1.14
	Manchester Teaching	498,800		243	257	261	307	0.92	0.78	1.08
	North Lancashire Teaching	*329,100*	*267*	*328*	*322*	*319*	*313*	*0.77*	*0.63*	*0.93*
	Oldham	219,600	159	346	364	383	414	1.08	0.88	1.33
	Salford	229,100	148	262	288	319	345	0.92	0.73	1.14
	Sefton	272,800	297	319	301	319	348	0.85	0.69	1.04
	Stockport	284,700		327	348	369	390	0.95	0.79	1.15
	Tameside and Glossop	250,700		411	411	415	451	1.12	0.93	1.35
	Trafford	217,100		276	299	286	322	0.81	0.64	1.02
	Warrington	199,100	316	392	392	422	392	0.95	0.76	1.19
	Western Cheshire	234,300	299	324	316	350	388	0.94	0.77	1.16
	Wirral	308,800	311	301	327	343	347	0.86	0.71	1.04
Yorkshire and the Humber	Barnsley	227,500	343	347	374	382	404	0.99	0.80	1.21
	Bradford and Airedale Teaching	**512,700**	**335**	**365**	**396**	**423**	**451**	**1.24**	**1.09**	**1.41**
	Calderdale	202,800	390	409	444	454	483	1.20	0.98	1.46
	Doncaster	290,900	316	309	330	354	364	0.90	0.75	1.09
	East Riding of Yorkshire	338,500	254	292	325	349	360	0.84	0.70	1.00
	Hull Teaching	263,800	292	322	341	360	371	0.98	0.81	1.20

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	Kirklees	409,900	400	405	407	420	439	1.13	0.98	1.31
	Leeds	798,700	274	285	299	317	342	0.93	0.83	1.05
	North East Lincolnshire	158,800	258	277	302	334	365	0.92	0.71	1.19
	North Lincolnshire	*157,500*	*279*	*286*	*292*	*267*	*279*	*0.67*	*0.50*	*0.90*
	North Yorkshire and York	802,100	295	313	355	375	384	0.93	0.83	1.04
	Rotherham	254,300	299	330	366	385	433	1.07	0.88	1.28
	Sheffield	555,700	252	261	295	315	351	0.94	0.81	1.08
	Wakefield District	325,500	301	301	320	329	363	0.88	0.74	1.06
East Midlands	Bassetlaw	112,100	241	294	294	285	312	0.74	0.53	1.03
	Derby City	247,100	214	235	251	299	364	0.97	0.79	1.19
	Derbyshire County	*729,900*	*234*	*278*	*295*	*297*	*314*	*0.74*	*0.65*	*0.85*
	Leicester City	**306,800**	**443**	**466**	**495**	**567**	**570**	**1.62**	**1.39**	**1.88**
	Leicestershire County and Rutland	687,200	335	358	387	393	422	1.03	0.92	1.15
	Lincolnshire Teaching	*705,000*	*272*	*275*	*291*	*298*	*315*	*0.75*	*0.66*	*0.86*
	Northamptonshire Teaching	687,600	279	301	348	362	384	0.95	0.84	1.07
	Nottingham City	306,300	225	232	235	248	323	0.95	0.78	1.16
	Nottinghamshire County Teaching	668,000	305	314	325	338	380	0.92	0.81	1.04
West Midlands	Birmingham East and North	409,300	310	320	342	357	374	1.05	0.90	1.23
	Coventry Teaching	315,700	304	326	345	367	386	1.06	0.89	1.27
	Dudley	307,500	250	276	280	293	302	0.74	0.61	0.91
	Heart of Birmingham Teaching	**285,100**	**361**	**379**	**403**	**403**	**417**	**1.33**	**1.11**	**1.59**
	Herefordshire	*179,400*	*284*	*284*	*273*	*295*	*295*	*0.69*	*0.53*	*0.90*
	North Staffordshire	211,900		316	335	363	373	0.89	0.71	1.11
	Sandwell	292,900	324	338	358	376	376	0.99	0.82	1.20
	Shropshire County	*293,400*	*228*	*283*	*300*	*341*	*334*	*0.79*	*0.65*	*0.96*
	Solihull	*206,300*	*286*	*291*	*296*	*305*	*301*	*0.74*	*0.58*	*0.95*
	South Birmingham	342,200	289	316	348	351	380	1.04	0.87	1.23
	South Staffordshire	*611,300*		*291*	*317*	*327*	*340*	*0.81*	*0.71*	*0.93*
	Stoke on Trent	248,000		310	355	379	407	1.04	0.86	1.26
	Telford and Wrekin	*162,400*	*172*	*216*	*246*	*289*	*296*	*0.74*	*0.56*	*0.98*
	Walsall Teaching	256,800	304	339	358	386	401	1.04	0.86	1.26
	Warwickshire	536,200	351	360	362	380	423	1.02	0.90	1.16
	Wolverhampton City	*239,300*	*217*	*259*	*280*	*297*	*288*	*0.76*	*0.60*	*0.96*
	Worcestershire	*557,300*	*264*	*282*	*294*	*319*	*343*	*0.81*	*0.71*	*0.94*
East of England	Bedfordshire	416,300	281	310	336	358	372	0.92	0.78	1.07
	Cambridgeshire	616,400	271	290	321	360	399	1.00	0.88	1.13
	Hertfordshire	1,107,500	210	265	326	344	382	0.96	0.88	1.06
	Great Yarmouth and Waveney	*214,700*	*144*	*154*	*214*	*279*	*279*	*0.68*	*0.52*	*0.87*
	Luton	198,900	312	347	362	372	397	1.11	0.89	1.38
	Mid Essex	374,500	270	294	315	358	374	0.91	0.77	1.07
	Norfolk	*764,800*	*272*	*305*	*307*	*326*	*332*	*0.80*	*0.71*	*0.91*
	North East Essex	*329,500*			*276*	*294*	*303*	*0.76*	*0.63*	*0.93*
	Peterborough	173,600	230	265	265	305	323	0.84	0.65	1.10
	South East Essex	*338,200*	*225*	*260*	*293*	*325*	*313*	*0.77*	*0.64*	*0.94*
	South West Essex	410,000	234	283	293	329	359	0.91	0.78	1.07
	Suffolk	*601,900*	*271*	*287*	*299*	*332*	*356*	*0.87*	*0.76*	*0.99*
	West Essex	286,400	269	269	272	318	342	0.85	0.70	1.03
London	Barking and Dagenham	179,700	228	262	267	328	351	1.02	0.80	1.31
	Barnet	**348,000**	**316**	**417**	**428**	**497**	**532**	**1.39**	**1.21**	**1.61**
	Bexley	**228,300**	**381**	**434**	**460**	**477**	**526**	**1.35**	**1.13**	**1.61**
	Brent Teaching	**256,300**	**148**	**456**	**636**	**694**	**734**	**1.95**	**1.69**	**2.25**

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	312,400	352	400	423	439	467	1.17	1.00	1.38
	Camden	235,500	246	272	335	378	395	1.07	0.87	1.31
	City and Hackney Teaching	231,000	225	281	312	338	355	1.00	0.80	1.24
	Croydon	345,400	261	307	318	356	373	0.96	0.81	1.15
	Ealing	**318,300**	**298**	**377**	**566**	**594**	**635**	**1.65**	**1.44**	**1.90**
	Enfield	**295,000**	**369**	**417**	**468**	**471**	**508**	**1.34**	**1.14**	**1.57**
	Greenwich Teaching	228,100	281	320	329	386	438	1.20	0.99	1.46
	Hammersmith and Fulham	**169,800**	**212**	**212**	**330**	**424**	**465**	**1.25**	**1.00**	**1.56**
	Haringey Teaching	**225,100**	**338**	**378**	**431**	**493**	**538**	**1.42**	**1.19**	**1.70**
	Harrow	**230,300**		**447**	**599**	**673**	**734**	**1.89**	**1.62**	**2.19**
	Havering	*236,100*		*250*	*271*	*292*	*301*	*0.76*	*0.60*	*0.96*
	Hillingdon	**266,200**	**252**	**282**	**428**	**473**	**518**	**1.39**	**1.17**	**1.64**
	Hounslow	**236,700**	**249**	**262**	**444**	**511**	**562**	**1.48**	**1.24**	**1.75**
	Islington	**193,900**	**325**	**382**	**428**	**469**	**495**	**1.35**	**1.10**	**1.65**
	Kensington and Chelsea	169,500		254	319	348	413	1.03	0.82	1.31
	Kingston	169,000		355	373	391	396	1.04	0.82	1.32
	Lambeth	284,400	229	302	341	387	376	1.01	0.83	1.22
	Lewisham	**266,400**	**368**	**417**	**424**	**450**	**462**	**1.22**	**1.02**	**1.45**
	Newham	**240,200**	**258**	**283**	**316**	**387**	**454**	**1.34**	**1.11**	**1.62**
	Redbridge	**270,300**	**296**	**322**	**374**	**407**	**477**	**1.28**	**1.08**	**1.52**
	Richmond and Twickenham	190,800		189	262	299	314	0.78	0.60	1.00
	Southwark	**287,100**	**376**	**421**	**439**	**495**	**529**	**1.42**	**1.21**	**1.67**
	Sutton and Merton	403,000		357	367	402	422	1.08	0.93	1.26
	Tower Hamlets	238,100	231	244	235	273	328	0.98	0.78	1.22
	Waltham Forest	**227,400**	**325**	**365**	**391**	**418**	**466**	**1.27**	**1.05**	**1.54**
	Wandsworth	289,200		335	349	353	370	1.01	0.84	1.22
	Westminster	253,400		229	320	387	422	1.09	0.90	1.32
South East Coast	Brighton and Hove City	258,400	228	271	298	321	360	0.95	0.77	1.16
	East Sussex Downs and Weald	*336,100*	*211*	*259*	*292*	*309*	*318*	*0.77*	*0.64*	*0.93*
	Eastern and Coastal Kent	742,200		290	340	372	402	1.01	0.90	1.13
	Hastings and Rother	179,700	250	289	312	312	328	0.79	0.61	1.02
	Medway	256,600		308	359	398	417	1.06	0.87	1.28
	Surrey	1,114,400	272	323	349	368	380	0.94	0.86	1.04
	West Kent	685,100		350	377	394	401	0.99	0.88	1.12
	West Sussex	*800,000*	*271*	*316*	*336*	*345*	*363*	*0.89*	*0.79*	*1.00*
South Central	**Berkshire East**	**406,500**	**273**	**369**	**433**	**475**	**497**	**1.29**	**1.12**	**1.48**
	Berkshire West	471,500	282	384	426	456	443	1.13	0.99	1.30
	Buckinghamshire	512,100	379	404	410	416	441	1.09	0.96	1.24
	Hampshire	1,297,200	308	328	359	374	391	0.95	0.87	1.04
	Isle of Wight National Health Service	140,200	278	257	307	314	328	0.77	0.58	1.03
	Milton Keynes	247,000	279	312	328	348	385	0.97	0.79	1.19
	Oxfordshire	624,200	388	399	415	420	437	1.12	1.00	1.26
	Portsmouth City Teaching	207,200	314	328	357	357	401	1.11	0.90	1.38
	Southampton City	239,800	309	325	334	346	342	0.96	0.78	1.20
South West	Bath and North East Somerset	179,800	267	284	289	323	311	0.81	0.62	1.06
	Bournemouth and Poole Teaching	310,800	322	364	354	351	364	0.94	0.78	1.13
	Bristol	**441,100**	**372**	**388**	**422**	**433**	**462**	**1.27**	**1.11**	**1.46**
	Cornwall and Isles of Scilly	537,900	329	361	398	429	433	1.03	0.91	1.17
	Devon	749,700	292	329	352	385	399	0.95	0.85	1.07
	Dorset	404,900	348	400	420	432	449	1.06	0.92	1.23
	Gloucestershire	*593,600*	*315*	*320*	*332*	*330*	*323*	*0.79*	*0.68*	*0.91*

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	212,100	387	349	372	391	415	1.00	0.81	1.23
	Plymouth Teaching	**258,900**	**402**	**413**	**463**	**502**	**506**	**1.35**	**1.14**	**1.60**
	Somerset	525,500	337	352	354	375	386	0.93	0.81	1.07
	South Gloucestershire	264,900	385	423	430	434	461	1.14	0.96	1.37
	Swindon	206,900	304	314	338	353	416	1.05	0.85	1.29
	Torbay	134,400	298	327	387	439	461	1.12	0.87	1.43
	Wiltshire	*459,800*	*274*	*300*	*313*	*318*	*350*	*0.85*	*0.73*	*1.00*
Wales	*Betsi Cadwaladr University*	*678,500*	*292*	*305*	*327*	*338*	*342*	*0.83*	*0.73*	*0.95*
	Powys Teaching	131,100	313	351	374	389	420	0.97	0.74	1.26
	Hywel Dda	374,800	342	358	382	398	392	0.95	0.81	1.12
	Abertawe Bro Morgannwg University	**504,800**	**406**	**424**	**442**	**468**	**505**	**1.26**	**1.11**	**1.42**
	Cwm Taf	**290,600**	**485**	**513**	**540**	**575**	**643**	**1.63**	**1.41**	**1.88**
	Aneurin Bevan	**561,300**	**392**	**429**	**447**	**470**	**513**	**1.28**	**1.14**	**1.43**
	Cardiff and Vale University	**466,100**	**365**	**386**	**403**	**412**	**440**	**1.19**	**1.04**	**1.37**
Scotland	Ayrshire & Arran	366,900	362	376	406	398	398	0.95	0.81	1.12
	Borders	113,000	283	319	363	372	434	1.00	0.76	1.32
	Dumfries and Galloway	148,100	324	344	378	405	405	0.93	0.72	1.20
	Fife	364,800	291	299	321	332	348	0.85	0.72	1.01
	Forth Valley	*293,100*	*263*	*290*	*300*	*300*	*321*	*0.79*	*0.64*	*0.96*
	Grampian	550,500	331	343	352	381	396	0.96	0.84	1.09
	Greater Glasgow & Clyde	**1,204,100**	**389**	**410**	**424**	**432**	**444**	**1.12**	**1.03**	**1.22**
	Highland	**310,700**	**354**	**373**	**425**	**476**	**509**	**1.18**	**1.01**	**1.37**
	Lanarkshire	562,700	350	359	384	387	421	1.03	0.91	1.17
	Lothian	837,000	281	305	324	335	355	0.90	0.80	1.01
	Orkney	19,800	556	455	556	455	404	0.92	0.46	1.84
	Shetland	22,500	267	267	222	267	267	0.63	0.28	1.41
	Tayside	402,400	413	420	437	435	435	1.07	0.92	1.24
	Western Isles	26,500	226	302	264	264	264	0.61	0.29	1.27
Northern Ireland	Belfast	335,700	354	366	369	390	432	1.18	1.00	1.38
	Northern	458,600	329	331	353	366	375	0.97	0.83	1.12
	Southern	357,700	282	296	294	296	308	0.83	0.69	1.00
	South Eastern	347,100	326	343	354	363	369	0.94	0.79	1.12
	Western	299,900	293	300	307	323	333	0.88	0.73	1.07

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 ethnicity between 2005 and 2009 provided in this year's chapter are different from those in last year's chapter [3]; 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, 3.9b) 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

Table 3.5. Distribution of prevalent patients on RRT by centre and modality on 31/12/2010

Centre	N	% HD	% PD	% transplant
Transplant centres				
B QEH	1,844	47	8	45
Belfast	682	34	4	61
Bristol	1,250	37	5	58
Camb	988	35	4	61
Cardff	1,517	33	7	61
Covnt	844	42	10	48
Edinb	713	38	7	54
Glasgw	1,490	42	4	54
L Barts	1,778	44	11	45
L Guys	1,618	35	3	62
L Rfree	1,639	41	4	54
L St. G	678	42	8	50
L West	2,862	46	1	52
Leeds	1,383	36	7	57
Leic	1,808	44	9	47
Liv RI	1,238	31	7	62
Man RI	1,552	31	6	63
Newc	888	30	6	64
Nottm	972	43	9	48
Oxford	1,363	28	8	64
Plymth	459	29	10	61
Ports	1,333	36	8	56
Sheff	1,254	49	5	46
Dialysis centres				
Abrdn	462	44	6	50
Airdrie	326	56	3	40
Antrim	217	59	5	35
B Heart	632	67	7	26
Bangor	113	77	23	0
Basldn	214	64	12	24
Bradfd	455	41	8	51
Brightn	770	45	11	44
Carlis	203	30	6	64
Carsh	1,377	53	7	40
Chelms	238	52	15	34
Clwyd	142	49	11	40
Colchester	120	100	0	0
D & Gall	118	45	7	48
Derby	459	48	22	30
Derry	111	55	2	43
Donc	222	66	11	23
Dorset	585	42	9	49
Dudley	303	52	20	27
Dundee	385	45	7	48
Dunfn	263	51	10	39
Exeter	785	46	10	44
Glouc	377	51	11	38
Hull	725	45	9	46
Inverns	230	38	10	52
Ipswi	316	37	11	52
Kent	793	45	9	46
Klmarnk	284	54	15	32
L Kings	837	51	11	38
Liv Ain	159	96	4	0
M Hope	837	43	15	42

Table 3.5. Continued

Centre	N	% HD	% PD	% transplant
Middlbr	711	40	3	57
Newry	177	62	5	33
Norwch	615	52	9	39
Prestn	968	52	7	41
Redng	636	41	14	46
Shrew	337	60	7	34
Stevng	606	64	6	31
Sthend	212	59	8	32
Stoke	635	46	12	42
Sund	369	48	9	43
Swanse	595	61	9	31
Truro	335	46	9	46
Tyrone	145	66	6	28
Ulster	112	83	2	15
Wirral	223	83	17	0
Wolve	518	61	14	25
Wrexm	223	35	10	56
York	337	45	7	48
England	**42,660**	**44**	**8**	**48**
N Ireland	**1,444**	**50**	**4**	**46**
Scotland	**4,271**	**44**	**6**	**50**
Wales	**2,590**	**42**	**8**	**50**
UK	**50,965**	**44**	**8**	**49**

Table 3.6. Median age and gender ratio of incident and prevalent transplant patients 2005–2010

	Incident transplants			Prevalent transplants[a]		
Year	N	Median age	M:F ratio	N	Median age	M:F ratio
2005	1,754	45.4	1.4	16,646	49.7	1.6
2006	1,969	45.3	1.6	17,637	49.9	1.5
2007	2,128	45.6	1.6	20,603	50.1	1.5
2008	2,357	46.4	1.5	22,182	50.4	1.5
2009	2,499	48.4	1.6	23,433	50.7	1.5
2010	2,568	49.7	1.7	24,739	51.2	1.5

[a]As on 31st December for given year

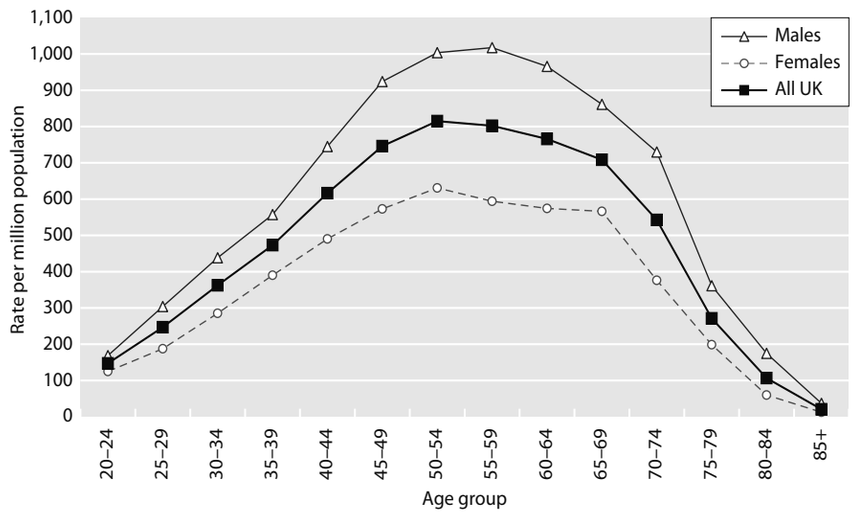

Fig. 3.1. Transplant prevalence rate per million population by age and gender on 31/12/2010

Table 3.7. Primary renal diagnosis in renal transplant recipients 2006–2010

	New transplants by year						Established transplants on 01/01/2010	
	2006	2007	2008	2009	2010			
Primary renal diagnosis	%	%	%	%	%	N	%	N
Aetiology uncertain/GN[a] not biopsy proven	16.6	16.1	15.3	15.3	15.4	360	19.6	4,584
Diabetes	13.4	14.5	12.9	12.5	11.6	272	8.9	2,086
Glomerulonephritis	19.6	20.5	19.4	20.8	17.3	406	19.4	4,549
Polycystic kidney disease	12.6	13.3	13.1	12.8	13.4	314	12.2	2,857
Pyelonephritis	12.4	11.9	12.1	11.5	9.6	225	14.5	3,400
Renovascular disease	6.0	5.5	6.8	6.1	6.8	159	5.7	1,333
Other	16.8	16.1	17.3	15.6	15.8	371	16.7	3,903
Not available	2.6	2.0	3.2	5.2	10.1	237	3.1	721

[a]GN = glomerulonephritis

Table 3.8. Ethnicity of patients who received a transplant in the years 2005–2010

Year	% White	% South Asian	% Black	% Other	% Unknown
2005	77.0	7.8	5.1	1.0	9.1
2006	74.9	8.1	6.6	2.0	8.4
2007	75.0	7.8	6.1	2.0	9.3
2008	71.9	8.4	6.4	1.9	11.5
2009	70.1	10.2	6.8	2.2	10.6
2010	71.2	9.9	6.4	2.2	10.2

the causes of between-centre differences in outcomes. For this reason, along with differences in repatriation policies of prevalent transplant patients between centres as highlighted previously, caution needs to be exercised when comparing performance between centres.

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

For the one year post-transplant analyses, in which patients were assigned to the centres that performed their transplant, the two Scottish transplant centres were excluded as they only submit limited biochemical data to the UKRR. After excluding these 2 transplant centres, one year outcomes are described for 21 transplant centres across the UK.

Methods

Data for key laboratory variables are reported for all prevalent patients with valid data returns for a given renal centre (both transplanting and non-transplanting centres) and for one year post-transplant results for patients transplanted 2003–2009, 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. It is presumed that patient selection policies and local clinical practices are more likely to be relevant in influencing outcomes 12 months post-transplant and therefore comparison of outcomes between centres are more robust. However, even the 12 months post-transplant comparisons could be biased by the fact that in some centres, repatriation of patients 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 the 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 2010. Patients were considered as having a functioning transplant if 'transplant' was listed as the last mode of RRT in the last quarter of 2010. Patients were assigned to the renal centre that sent the data to

Table 3.9a. Percentage completeness by centre for prevalent transplant patients on 31/12/2010[a]

Centre	N	Ethnicity	eGFR[b]	Blood pressure	Centre	N	Ethnicity	eGFR[b]	Blood pressure
Antrim	77	100	94	87	Leic	811	94	96	41
B Heart	157	100	93	0	Liv RI	745	92	91	61
B QEH	810	100	93	2	M Hope	344	99	88	0
Basldn	50	100	94	48	M RI	940	97	99	0
Belfast	412	98	98	64	Middlbr	394	99	96	52
Bradfd	226	99	84	77	Newc	551	100	99	1
Brightn	327	63	87	0	Newry	56	100	100	93
Bristol	710	99	98	71	Norwch	238	95	95	55
Camb	574	97	98	97	Nottm	446	100	98	92
Cardff	896	75	97	97	Oxford	846	91	99	12
Carlis	123	98	98	0	Plymth	275	99	95	0
Carsh	538	96	93	0	Ports	733	99	94	12
Chelms	80	99	93	81	Prestn	391	100	95	0
Clwyd	55	75	98	80	Redng	272	100	99	95
Covnt	386	98	86	77	Sheff	561	100	98	97
Derby	129	98	77	98	Shrew	114	100	64	0
Derry	46	100	93	89	Stevng	183	100	73	0
Donc	47	100	100	98	Sthend	67	93	96	55
Dorset	279	100	90	75	Stoke	262	54	99	0
Dudley	83	100	98	16	Sund	154	99	98	94
Exeter	341	96	96	81	Swanse	172	99	98	99
Glouc	133	100	98	100	Truro	148	89	99	98
Hull	329	63	93	0	Tyrone	40	100	95	88
Ipswi	158	99	99	87	Ulster	17	100	94	94
Kent	357	91	46	0	Wolve	130	100	96	95
L Barts	766	100	96	0	Wrexm	123	99	80	0
L Guys	973	81	95	0	York	159	81	99	48
L Kings	306	98	95	0	**England**	**20,058**	**95**	**94**	**32**
L RFree	873	99	98	0	**N Ireland**	**648**	**99**	**97**	**73**
L St.G	333	88	94	0	**Wales**	**1,246**	**81**	**96**	**87**
L West	1,445	100	98	0	**E, W & NI**	**21,952**	**94**	**95**	**36**
Leeds	761	90	97	94					

[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

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, phosphate and blood pressure (BP), the latest value in quarter 3 or quarter 4 of 2010 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 (unless otherwise stated). 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 2010. 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 2003 and 31st December 2009 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 2003–2009, they were included as separate episodes provided each of the transplants functioned for a year.

Table 3.9b. Percentage completeness by centre for prevalent transplant patients on 31/12/2010[a]

Centre	N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[b]	Serum phosphate	Serum PTH
Antrim	77	92	92	86	94	81
B Heart	157	93	38	90	89	12
B QEH	810	93	73	93	91	67
Basldn	50	94	56	94	86	24
Belfast	412	98	97	97	97	23
Bradfd	226	80	56	81	81	19
Brightn	327	88	26	83	82	27
Bristol	710	98	67	98	98	97
Camb	574	98	73	98	98	91
Cardff	896	98	52	98	98	9
Carlis	123	96	72	94	92	7
Carsh	538	74	55	92	92	3
Chelms	80	91	48	93	93	18
Clwyd	55	98	80	100	100	64
Covnt	386	85	0	84	44	28
Derby	129	73	55	66	65	51
Derry	46	93	91	91	91	85
Donc	47	100	85	100	100	28
Dorset	279	88	60	52	58	19
Dudley	83	95	67	55	96	53
Exeter	341	96	72	95	90	23
Glouc	133	97	47	98	95	35
Hull	329	93	18	91	91	14
Ipswi	158	99	49	99	98	75
Kent	357	95	55	93	93	13
L Barts	766	96	95	96	96	63
L Guys	973	95	46	90	90	33
L Kings	306	95	41	95	95	13
L RFree	873	96	96	98	98	82
L St.G	333	94	42	94	94	46
L West	1,445	98	82	98	98	7
Leeds	761	94	89	96	96	46
Leic	811	96	84	95	95	61
Liv RI	745	90	5	86	90	71
M Hope	344	88	82	88	88	74
M RI	940	99	47	99	99	61
Middlbr	394	95	45	95	94	17
Newc	551	98	70	98	98	15
Newry	56	96	96	98	96	57
Norwch	238	93	90	92	92	18
Nottm	446	98	54	95	94	87
Oxford	846	99	50	98	98	28
Plymth	275	89	45	92	92	20
Ports	733	94	35	91	88	11
Prestn	391	93	79	93	93	63
Redng	272	98	93	98	93	85
Sheff	561	98	42	98	98	19
Shrew	114	88	78	80	80	4
Stevng	183	94	69	93	90	39
Sthend	67	94	28	93	93	4
Stoke	262	99	98	99	98	31
Sund	154	97	81	98	98	91
Swanse	172	98	71	98	98	38
Truro	148	99	66	98	98	72
Tyrone	40	90	90	93	93	63

Table 3.9b. Continued

Centre	N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[b]	Serum phosphate	Serum PTH
Ulster	17	94	88	94	94	71
Wolve	130	96	58	96	89	49
Wrexm	123	96	94	98	98	95
York	159	86	62	87	92	15
England	**20,058**	**94**	**61**	**93**	**92**	**43**
N Ireland	**648**	**96**	**96**	**95**	**96**	**41**
Wales	**1,246**	**98**	**60**	**98**	**98**	**24**
E, W & NI	**21,952**	**95**	**62**	**94**	**93**	**42**

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

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 a transplant centre
B QEH	718	Dudley	1
		Shrew	2
		Stoke	4
Belfast	209	Antrim	2
		Derry	4
		Newry	14
		Tyrone	1
Bristol	685	Dorset	3
		Glouc	3
Camb	866	Norwch	1
		Stevng	3
Cardff	624		n/a
Covnt	286		n/a
L Barts	531		n/a
L Guys	1,021	Kent	13
		L Kings	5
L Rfree	388		n/a
L St.G	270	Brightn	11
		Carsh	7
L West	1,015		n/a
Leeds	901	Hull	16
Leic	427		n/a
Liv RI	530	Prestn	2
		Wrexm	1
M RI	457	M Hope	2
Newc	673	Carlis	6
		Middlbr	19
		Sund	6
Nottm	258		n/a
Oxford	857		n/a
Plymth	379		n/a
Ports	399		n/a
Sheff	341		n/a
Total	**11,835**		**126**

Only transplant centres in England, N Ireland and Wales included

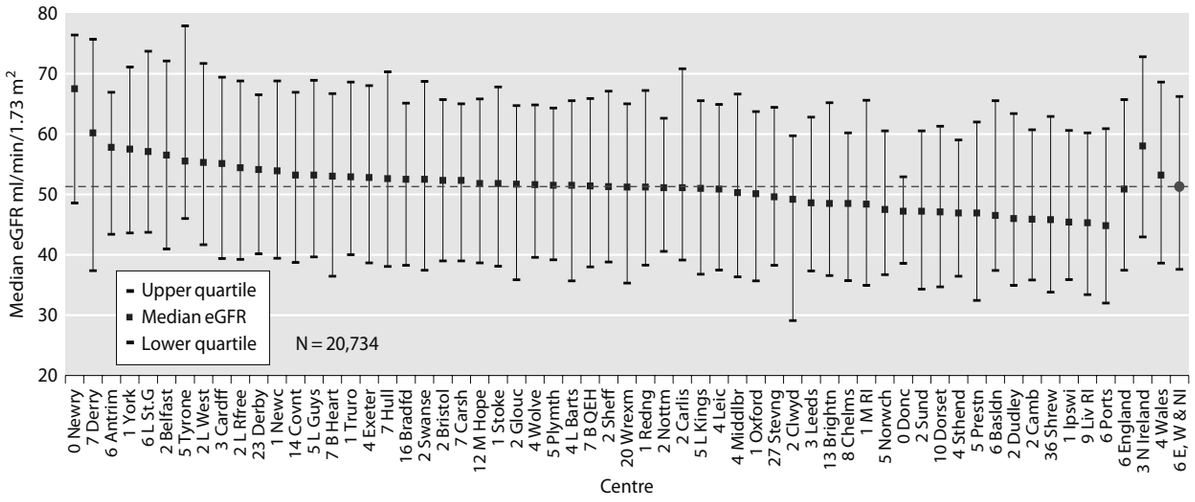

Fig. 3.2. Median eGFR in prevalent transplant patients by centre on 31/12/2010

For each patient, the most recent laboratory or blood pressure for the relevant 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 [4]. 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 51.3 ml/min/1.73 m^2, with 13.8% 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 and non-transplant centres feature at both ends of the scale. The accuracy of the 4-variable MDRD equation in estimating GFR ⩾60 ml/min/1.73 m^2 is questionable [5], therefore a figure describing this is not included in this chapter.

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

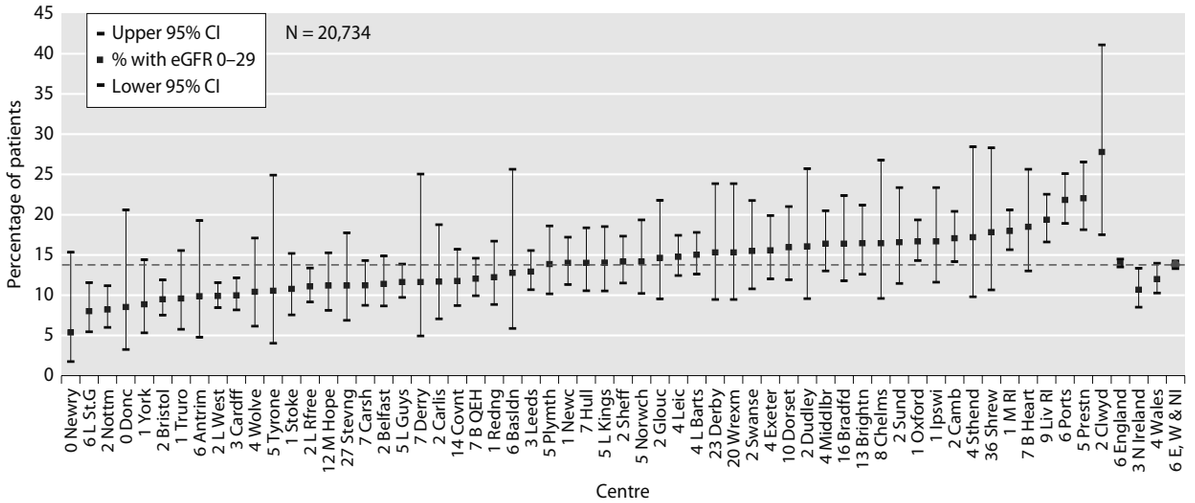

Fig. 3.3. Percentage of prevalent transplant patients by centre on 31/12/2010 with eGFR <30 ml/min/1.73 m^2

Table 3.11. Proportion of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 on 31/12/2010

Centre	Patients with eGFR data N	eGFR <30 %	Centre	Patients with eGFR data N	eGFR <30 %
Tyrone	38	10.5	Redng	270	12.2
Derry	43	11.6	Brightn	286	16.4
Basldn	47	12.8	L Kings	292	14.0
Donc	47	8.5	M Hope	304	11.2
Clwyd	54	27.8	Hull	307	14.0
Newry	56	5.4	L St.G	313	8.0
Sthend	64	17.2	Exeter	328	15.5
Antrim	71	9.9	Covnt	332	11.7
Shrew	73	17.8	Prestn	372	22.0
Chelms	73	16.4	Middlbr	378	16.4
Dudley	81	16	Belfast	404	11.4
Derby	98	15.3	Nottm	439	8.2
Wrexm	98	15.3	Carsh	500	11.2
Carlis	120	11.7	Newc	543	14.0
Wolve	125	10.4	Sheff	551	14.2
Glouc	130	14.6	Camb	563	17.1
Stevng	134	11.2	Liv RI	681	19.4
Truro	146	9.6	Ports	687	21.8
B Heart	146	18.5	Bristol	696	9.5
Sund	151	16.6	L Barts	732	15.0
Ipswi	156	16.7	Leeds	736	12.9
York	158	8.9	B QEH	755	12.1
Kent	163	15.3	Leic	779	14.8
Swanse	168	15.5	Oxford	840	16.7
Bradfd	189	16.4	L Rfree	858	11.1
Norwch	226	14.2	Cardff	873	10.0
Dorset	251	15.9	L Guys	929	11.6
Stoke	260	10.8	M RI	929	18.0
Plymth	260	13.8	L West	1415	9.9

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.

There continued to be variation between centres; these data show over-dispersion with 15 centres falling outside the 95% CI of which 8 centres were outside the 99.9% CI. Five centres (Bristol, Cardiff, London St George's, London West, Nottingham) 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, Portsmouth and Preston fall outside the upper 99.9% CI suggesting a higher than expected proportion of patients with eGFR <30 ml/min/1.73 m^2.

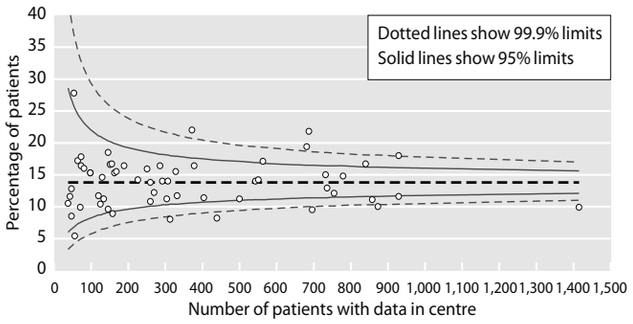

Fig. 3.4. Funnel plot of percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 by centre size on 31/12/2010

eGFR in patients one year after transplantation

Graft function at one year post-transplantation may predict subsequent long-term graft outcome [6]. The median eGFR of patients one year post-live donor transplantation was 54.1 ml/min/1.73 m^2. The median eGRF of patients one year post-deceased donor transplant was 50.9 ml/min/1.73 m^2. Figures 3.5a and 3.5b show the median one year post-transplant eGFR for patients transplanted 2003–2009, by transplant type.

Figures 3.6a and 3.6b show one year post-transplant eGFR by donor type and year of transplantation. An

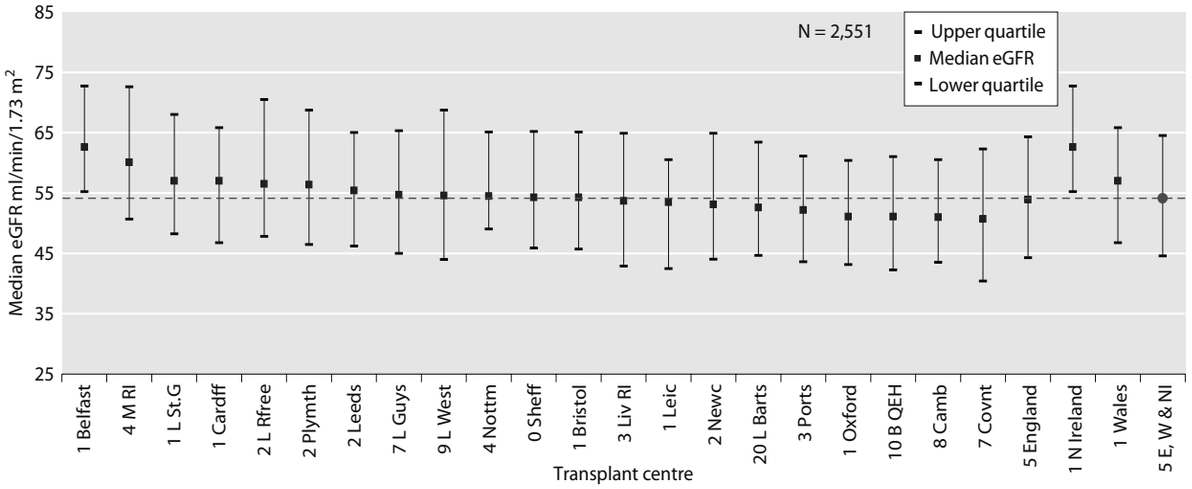

Fig. 3.5a. Median eGFR one year post-live donor transplant by transplant centre 2003–2009

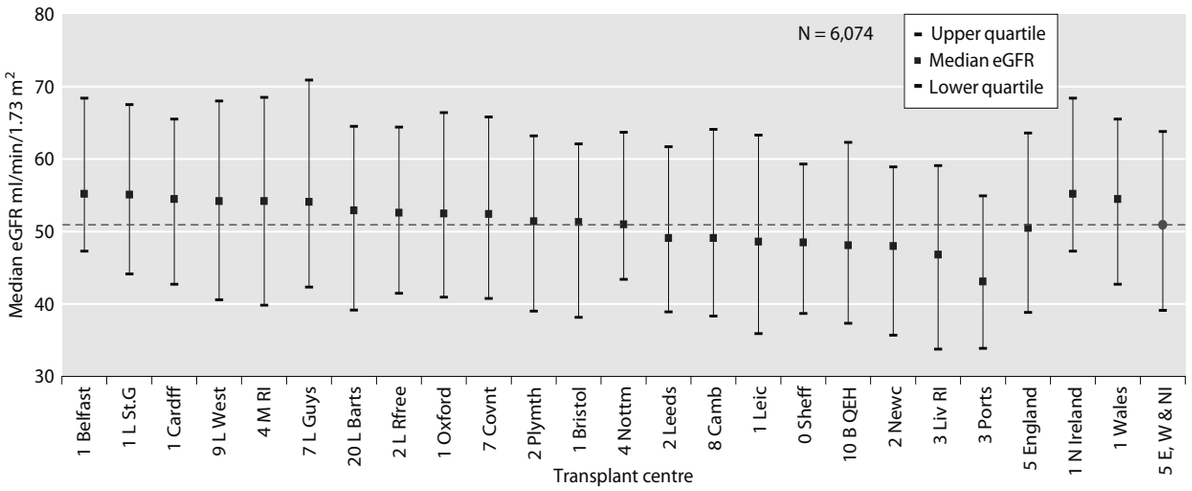

Fig. 3.5b. Median eGFR one year post-deceased donor transplant by transplant centre 2003–2009

upward trend in eGFR ($p < 0.001$) over the time period is noticed with both live and deceased donor transplants. 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 November 2010 [7]. However, most of 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. Most of these data are not collected by the UKRR and therefore caution must be used when interpreting analyses of haemoglobin attainment. Figures 3.7a and 3.7b report centre results stratified according to graft function as estimated by eGFR. The percentage of

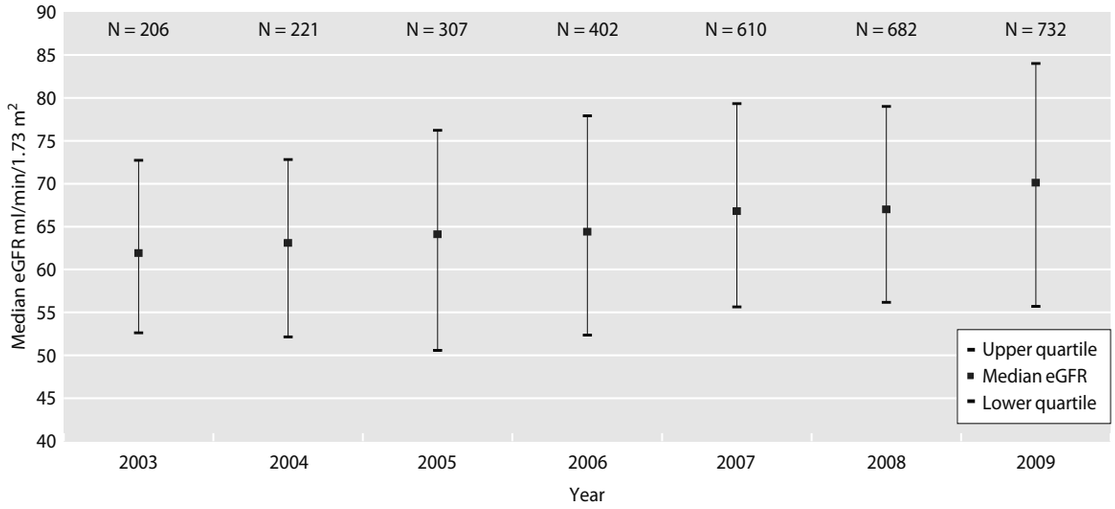

Fig. 3.6a. Median eGFR one year post-live donor transplant by year of transplantation 2003–2009

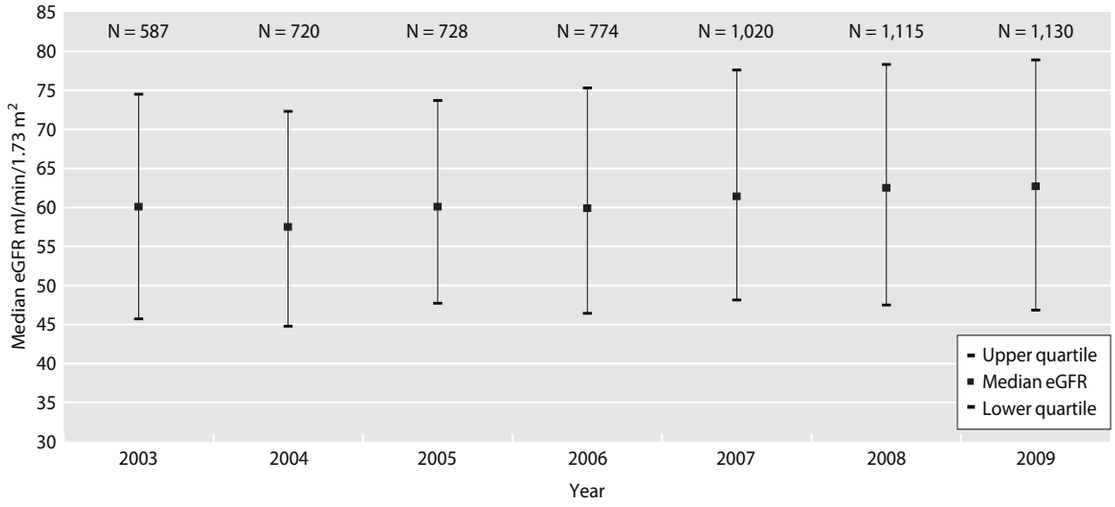

Fig. 3.6b. Median eGFR one year post-deceased donor transplant by year of transplantation 2003–2009

prevalent transplant patients achieving Hb >10.5g/dl in each centre, stratified by eGFR, is displayed in figures 3.8a and 3.8b. In previous reports a cut-off of 45ml/min/1.73 m^2 was used to stratify analysis for patients with poor graft function. For this report a cut-off of 30 ml/min/1.73 m^2 was used as a more appropriate category for transplants with poor function.

Figure 3.9 describes the percentage of prevalent patients by centre with haemoglobin <10.5g/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 (London Barts, London Royal Free) fall outside the upper 99.9% CI and four further centres (Leicester, Liverpool RI, London Kings, London West) fall outside the upper 95% CI indicating a higher than predicted proportion of transplant patients not achieving the haemoglobin target. Eleven centres fall outside the lower 99.9% CI, indicating they perform better than expected with fewer than predicted patients having a haemoglobin <10.5g/dl.

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***

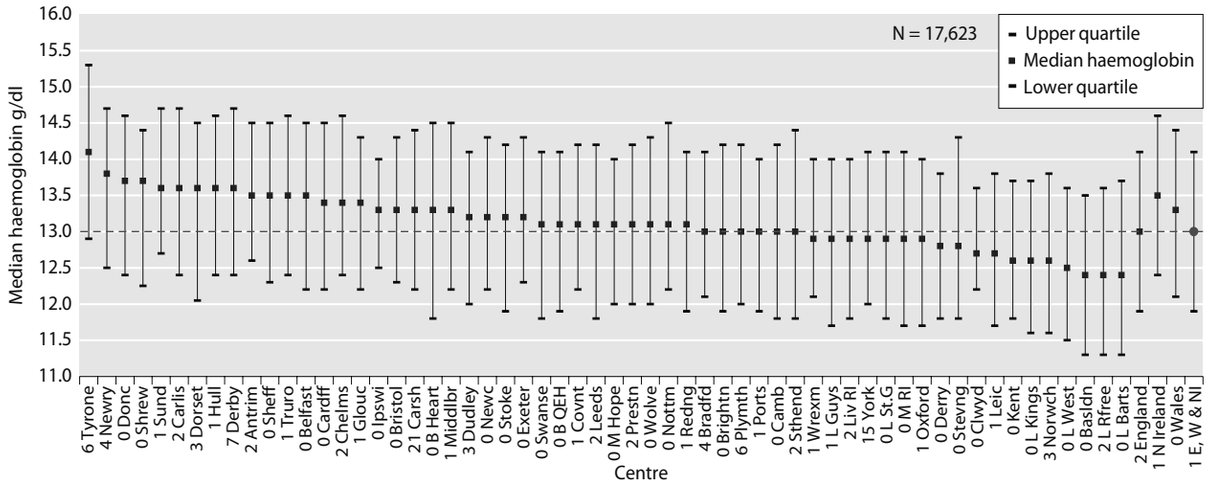

Fig. 3.7a. Median haemoglobin for prevalent transplant patients with eGFR $\geqslant$30 ml/min/1.73 m^2 by centre on 31/12/2010

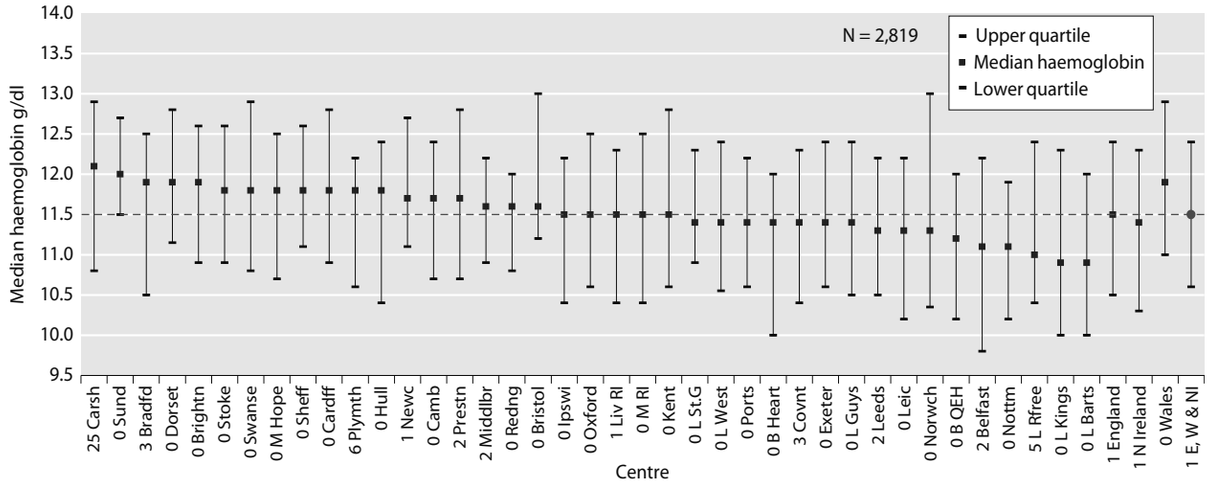

Fig. 3.7b. Median haemoglobin for prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 by centre on 31/12/2010

should be <130/80mmHg (or <125/75mmHg 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). Figures 3.10a and 3.10b show the percentage of patients with a blood pressure of <130/80mmHg, by eGFR. The percentage of patients with BP <130/80 (systolic BP <130 **and** diastolic BP <80 mmHg) was higher (28.6% vs. 23.3%) in those with better renal function (eGFR $\geqslant$ 30 ml/min/1.73 m^2). To avoid repetition, further analyses of the attainment of the RA standards for blood pressure are reported in chapter 10.

Analysis of prevalent patients by CKD stage

Introduction

Approximately 2.4% of prevalent transplant patients returned to dialysis in 2010, 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

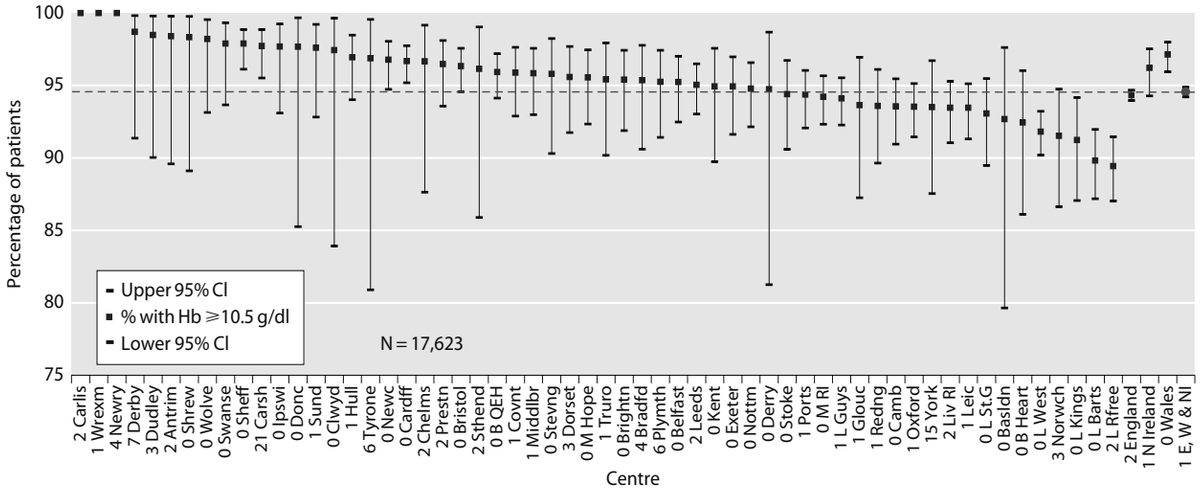

Fig. 3.8a. Percentage of prevalent transplant patients with eGFR ⩾30 ml/min/1.73 m^2 achieving haemoglobin ⩾10.5g/dl by centre on 31/12/2010

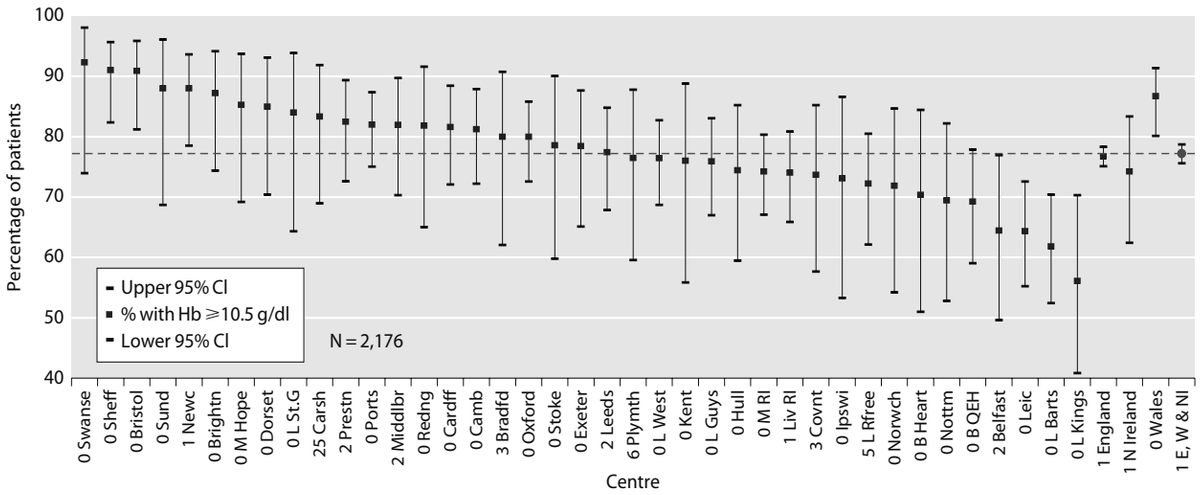

Fig. 3.8b. Percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 achieving haemoglobin ⩾10.5g/dl by centre on 31/12/2010

transplant or renal clinics and it would be reasonable to expect patients with failing grafts to receive appropriate care and therefore have many of their modifiable risk factors addressed before complete graft failure and return to dialysis.

Methods

The transplant cohort consisted of prevalent transplant recipients as on 31st December 2010 (N = 20,744) 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 2010, comprised the comparison dialysis cohort (N = 18,751) including 2,411 peritoneal dialysis patients. Only

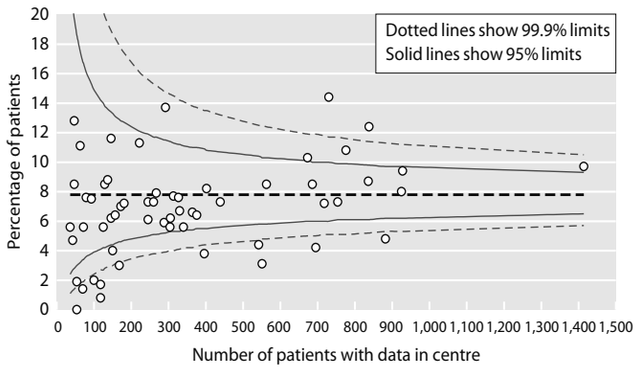

Fig. 3.9. Funnel plot of percentage of prevalent transplant patients with haemoglobin <10.5g/dl by centre size on 31/12/2010

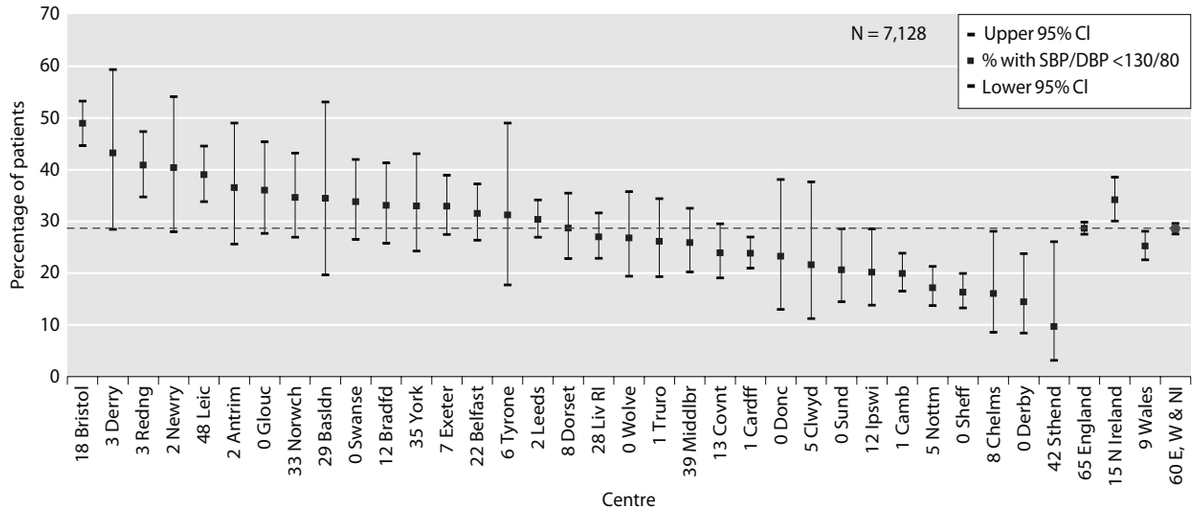

Fig. 3.10a. Percentage of prevalent transplant patients with eGFR $\geqslant$30 ml/min/1.73 m^2 achieving blood pressure of <130/80mmHg by centre on 31/12/2010

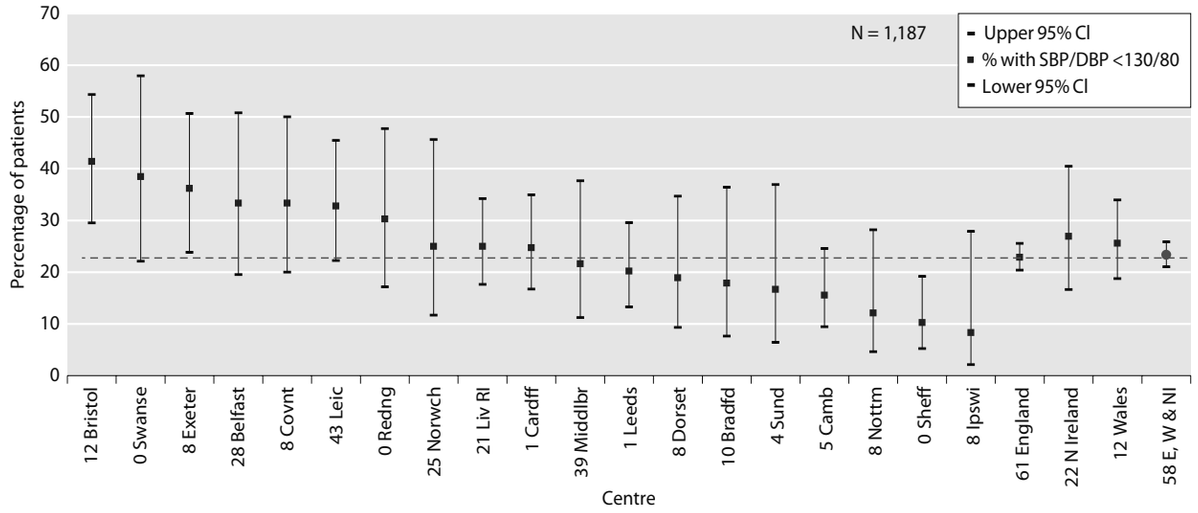

Fig. 3.10b. Percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 achieving blood pressure of <130/80mmHg by centre on 31/12/2010

patients on peritoneal dialysis were considered when examining differences in serum phosphate between transplant recipients and dialysis patients. For both the transplant and dialysis cohorts, the analysis used the most recent available value from the last two quarters of the 2010 laboratory data.

Results and discussion

Table 3.12 shows that 13.7% of the prevalent transplant population (2,855 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 achieved UK Renal Association standards for some key biochemical and clinical outcome variables less often than dialysis patients. This substantial group of patients represents a considerable challenge, as resources need to be channelled to improve key outcome variables and achieve a safe and timely modality switch to another form of renal replacement therapy.

eGFR slope analysis

Introduction

The gradient of deterioration in eGFR (slope) may predict patients likely to have early graft failure. For the first time the UKRR have analysed eGFR slope and its relationship to specific patient characteristics, and the results are presented here.

Table 3.12. Analysis by CKD stage for prevalent transplant patients compared with prevalent dialysis patients on 31/12/2010

	Stage 1–2T (⩾60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
Number of patients	7,135	10,754	2,538	317	18,751
% of patients	34.4	51.8	12.2	1.5	
eGFR ml/min/1.73 m^2[a]					
mean ± SD	76.5 ± 14.9	45.6 ± 8.3	23.8 ± 4.1	11.7 ± 2.5	
median	72.4	45.7	24.4	12.0	
Systolic BP mmHg					
mean ± SD	133.0 ± 16.3	135.9 ± 17.7	139.2 ± 19.7	142.6 ± 22.2	130.3 ± 24.7
% ⩾130	57.4	63.1	68.9	73.3	48.5
Diastolic BP mmHg					
mean ± SD	78.1 ± 10.4	78.5 ± 10.7	79.4 ± 12.2	81.2 ± 12.8	69.1 ± 14.5
% ⩾80	47.6	49.2	52.0	57.8	22.9
Cholesterol mmol/L					
mean ± SD	4.5 ± 1.0	4.6 ± 1.1	4.6 ± 1.2	4.6 ± 1.2	4.0 ± 1.1
% ⩾5	27.4	31.7	35.7	31.3	17.5
Haemoglobin g/dl					
mean ± SD	13.5 ± 1.6	12.7 ± 1.6	11.6 ± 1.5	10.9 ± 1.6	11.4 ± 1.4
% <10.5	3.2	6.9	21.1	36.1	22.6
Phosphate mmol/L[b]					
mean ± SD	0.9 ± 0.2	1.0 ± 0.2	1.2 ± 0.3	1.6 ± 0.4	1.6 ± 0.4
% ⩾1.8	0.1	0.2	2.0	22.9	27.0
Corrected calcium mmol/L					
mean ± SD	2.4 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.3 ± 0.2	2.3 ± 0.2
% >2.6	7.3	7.6	5.0	6.2	6.5
% <2.2	11.1	10.0	16.7	23.3	19.9
Phosphate mmol/L[b]					
median	8.3	9.7	16.0	27.6	28.5
% ⩾32	4.0	5.2	20.2	43.5	45.0

[a]Prevalent transplant patients with no ethnicity data were classed as White
[b]Only PD patients included in stage 5D, N = 2,411

Methods

Patients from England, Wales or Northern Ireland aged ⩾18 years receiving a renal transplant between 1st January 2000 and 31st December 2008, were considered for inclusion. A minimum duration of 18 months graft function was required and 3 or more creatinine measurements from the second year of graft function onwards were used to plot eGFR slope. If a transplant failed but there were at least three creatinine measurements between 18 months post-transplant and graft failure, the patient was included but no creatinine measurements after the quarter preceding the recorded date of transplant failure were analysed.

Slopes were calculated using linear regression, assuming linearity, and the effect of age, ethnicity, gender, diabetes, donor type, year of transplant and current transplant status were analysed. P values were calculated using the Kruskal–Wallis test. eGFR was calculated using the CKD–EPI equation and results expressed as ml/min/1.73 m^2/year. The CKD–EPI equation was used in preference to the MDRD formula as it is thought to have a greater degree of accuracy at higher levels of eGFR [11].

Results and discussion

The study cohort consisted of 9,734 patients. The median GFR slope was −0.6 ml/min/1.73 m^2/year (table 3.13). The gradient was steeper for Asian (−1.15 ml/min/1.73 m^2/year) and Black (−1.18 ml/min/1.73 m^2/year) recipients, in keeping with previously published data suggesting poorer outcomes for Black patients [12, 13]. eGFR slope was steeper in recipients of deceased donor kidneys (−0.68 ml/min/1.73 m^2/year) compared to patients who received organs from live donors (−0.24 ml/min/1.73 m^2/year). Female patients had a steeper slope

Table 3.13. Differences in median eGFR slope between prevalent transplant patients

Patient characteristic		N	Median slope	Lower quartile	Upper quartile	p-value
Age at transplant	<40	3,352	−1.22	−5.67	2.84	<0.0001
	40–55	3,786	−0.46	−4.05	3.08	
	>55	2,596	−0.08	−3.49	3.03	
Ethnicity	Asian	745	−1.15	−5.50	3.47	0.02
	Black	516	−1.18	−5.55	2.85	
	Other	152	−0.34	−4.14	3.70	
	White	7,803	−0.56	−4.24	2.89	
Gender	Male	5,961	−0.37	−3.92	3.09	<0.0001
	Female	3,773	−1.02	−5.08	2.79	
Diabetes	Non-diabetic	8,356	−0.49	−4.18	3.03	<0.0001
	Diabetic	1,182	−1.37	−5.84	2.69	
Donor type	Deceased	6,496	−0.68	−4.25	2.80	0.02
	Live	2,006	−0.24	−4.26	3.56	
Year of transplant	2000	600	−0.76	−3.94	2.40	0.01
	2001	725	−0.69	−4.37	2.74	
	2002	693	−0.87	−4.66	2.34	
	2003	837	−1.10	−4.54	2.18	
	2004	1,015	−1.13	−4.22	2.55	
	2005	1,076	−0.38	−3.74	2.88	
	2006	1,450	−0.36	−4.01	3.27	
	2007	1,594	−0.56	−4.49	3.03	
	2008	1,744	−0.23	−5.21	4.29	
Current status of transplant	Died	556	−1.11	−4.60	2.68	<0.0001
	Re-transplanted	58	−3.16	−6.48	0.01	
	Functioning	8,452	−0.31	−3.91	3.26	
	Failed	668	−4.50	−11.62	−0.52	
All		**9,734**	**−0.60**	**−4.37**	**2.99**	

−1.02 ml/min/1.73 m^2/year) than males −0.37 ml/min/1.73 m^2/year), as did diabetic patients −1.37 ml/min/1.73 m^2/year) compared to non-diabetic patients −0.49 ml/min/1.73 m^2/year). The slope was steeper in younger recipients, possibly reflecting increased risk of immunological damage. As might be expected, the steepest slope was in patients where the transplant subsequently failed. This analysis has assumed linearity of progression of fall in GFR and further work is underway to characterise the patterns of progression more precisely.

Table 3.14. Cause of death by modality in prevalent RRT patients on 1/1/2010

	All modalities		Dialysis		Transplant	
Cause of death	N	%	N	%	N	%
Cardiac disease	572	22	510	23	62	17
Cerebrovascular disease	122	5	101	5	21	6
Infection	498	19	419	19	79	22
Malignancy	279	11	196	9	83	23
Treatment withdrawal	351	14	337	15	14	4
Other	233	9	196	9	37	10
Uncertain	535	21	466	21	69	19
Total	**2,590**		**2,225**		**365**	
No cause of death data	1,666	39	1,393	39	273	43

Table 3.15. Cause of death in prevalent transplant patients on 1/1/2010 by age

	All age groups		<65 years		⩾65 years	
Cause of death	N	%	N	%	N	%
Cardiac disease	62	17	37	18	25	16
Cerebrovascular disease	21	6	12	6	9	6
Infection	79	22	38	18	41	26
Malignancy	83	23	54	26	29	19
Treatment withdrawal	14	4	6	3	8	5
Other	37	10	24	11	13	8
Uncertain	69	19	38	18	31	20
Total	**365**		**209**		**156**	
No cause of death data	273	43	157	57	116	43

The findings in this study differ slightly from previous UKRR work exploring eGFR changes in transplant recipients [14]. This identified male donor to female recipient transplantation, younger recipients, diabetes, white ethnicity, and human leukocyte antigen (HLA) mismatch were associated with faster decline in eGFR. These differences may be explained by patients with eGFR >60 ml/min/1.73 m^2 at one year post-transplantation being excluded and the more complex multivariable model used in the previous work. Udayaraj and colleagues [14] also adjusted for factors such as HLA mismatch and donor age, which were not available for the patients studied in this chapter.

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.

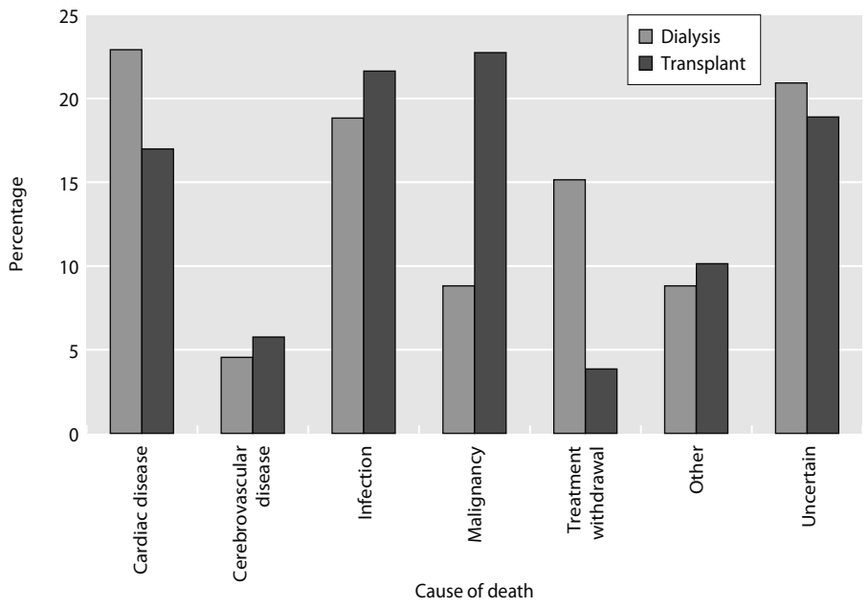

Fig. 3.11. Cause of death by modality for prevalent patients on 1/1/2010

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 31st December 2010.

Results and discussion

Tables 3.14, 3.15 and figure 3.11 show the differences in the causes of death between prevalent dialysis and transplant patients. Death due to cardiovascular disease is less common in transplanted patients than in dialysis patients, perhaps reflecting the cardiovascular screening undertaken during transplant work-up; transplant recipients are a pre-selected lower risk group of patients. Malignancy is the commonest reported cause of death in transplant recipients (23%), in keeping with current literature regarding post-transplantation malignancy [15]. There has been a reduction over time in the proportion of deaths in transplant patients attributed to cardiovascular or stroke disease (43% in 2003 compared to 23% in 2010) with an increase in the proportion ascribed to infection or malignancy (30% in 2003 compared to 45% in 2010). This change has also been reported in other registries, eg ANZDATA (http://www.anzdata.org.au) and may reflect better management of cardiovascular risk (although table 3.12 shows BP and phosphate management remained suboptimal). Explanations for the rising death rate secondary to malignancy may include the increasing age of transplant recipients and the increased intensity of immunosuppressive regimens leading to complications of over-immunosuppression.

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References

1 Ansell D, Tomson CRV: UK Renal Registry 11th Annual Report (December 2008) Chapter 15 The UK Renal Registry, UKRR database, validation and methodology. Nephron Clin Pract 2009;111(Suppl. 1): c277–c285

2 Ravanan R, O'Neill J, Webb L, Casula A, Johnson R, Feest T: UK Renal Registry 13th Annual Report (December 2010): Chapter 13 Centre Variation in Access to Renal Transplantation in the Uk (2004–2006). Nephron Clin Pract 2011; 119(Suppl.2)c239–c248

3 Webb L, Casula A, Ravanan R, Caskey F: UK Renal Registry 13th Annual Report (December 2010): Chapter 3 Demographic and biochemistry profile of kidney transplant recipients in the UK in 2009: national and centre-specific analyses. Nephron Clin Pract 2011;119 (Suppl. 2):c53–c84

4 Bosma RJ, Doorenbos CRC, Stegeman CA, Homan van der Heide JJ, Navis G: Predictive Performance of Renal Function Equations in Renal Transplant Recipients: An analysis of Patient Factors in Bias. Am J Transplant 2005;5:2183–2203

5 Froissart M, Rossert J, Jacquot C, Paillard M, Houillier P: Predictive Performance of the Modification of Diet in Renal Disease and Cockcroft-Gault Equations for Estimating Renal Function. J Am Soc Nephrol. 2005;16:763–773

6 Hariharan, S, McBride MA, Cherikh WS, Tolleris CB, Bresnahan BA, Johnson CP: Post- transplant renal function in the first year predicts long-term kidney transplant survival. Kidney Int 2002;62:1:311–318

7 UK Renal Association Clinical Practice Guidelines Committee: Anaemia of CKD, 5th Edition. 2010. http://www.renal.org/clinical/GuidelinesSection/AnaemiaInCKD.aspx

8 UK Renal Association Clinical Practice Guidelines Committee: Guideline 3.7: Target haemoglobin. 2007 RA Guidelines–Complications of CKD, 4th Edition. 2007. http://www.renal.org/Clinical/GuidelinesSection/ComplicationsofCKD.aspx

9 UK Renal Association Clinical Practice Guidelines Committee: Guideline: Post-operative Care of the Kidney Transplant Recipient, 5th Edition. 2011. http://www.renal.org/Clinical/GuidelinesSection/Post-operative-Care-Kidney-Transplant-Recipient.aspx

10 UK Renal Association Clinical Practice Guidelines Committee: Guideline 2.1: Treatment of patients with CKD. 2007 RA Guidelines – CKD, 4th Edition. 2007. http://www.renal.org/Clinical/GuidelinesSection/CKD.aspx

11 White CA, Akbari A, Doucette S, Fergusson D, Knoll GA: Estimating Glomerular Filtration Rate in Kidney Transplantation: Is the New Chronic Kidney Disease Epidemiology Collaboration Equation Any Better? Clin Chem 2010;56:3:474–477

12 Ng FL, Holt DW, Chang RWS, MacPhee IAM: Black renal transplant recipients have poorer long-term graft survival than CYP3A5 expressers from other ethnic groups. Nephrol Dial Transplant 2010;25:628–634

13 Isaacs RB, Nock SL, Spencer CE, Connors AF Jr, Wang XQ, Sawyer R, Lobo PI: Racial disparities in renal transplant outcomes. Am J Kidney Dis 1999;34:4:706–712

14 Udayaraj U, Casula A, Ansell D, Dudley CRK, Ravanan R: Chronic Kidney Disease in Transplant Recipients – Is It Different From Chronic Native Kidney Disease? Transplantation 2010;90:7:765–770

15 Kasiske BL, Snyder JJ, Gilbertson DT, Wang C: Cancer after Kidney Transplantation in the United States. Am J Transplant 2004;4:6:905–913

UK Renal Registry 14th Annual Report: Chapter 4 Comorbidities and Current Smoking Status amongst Patients starting Renal Replacement Therapy in England, Wales and Northern Ireland from 2009 to 2010

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

Summary

- Data on comorbidity at the time of start of RRT were submitted for only 6,130 (49.3%) of the incident adult ($\geqslant$18 years) RRT patients reported to the UKRR between 2009 and 2010. In 2010, four centres provided data on 100% of new patients and 15 centres provided data for less than 5% of new patients.
- In patients with comorbidity data, more than half had one or more comorbidities (55.4%). In the subgroup of patients aged $\geqslant$65 years, 67.6% had one or more comorbidities.
- Diabetes mellitus and ischaemic heart disease were the most common conditions, observed in 33.3% and 21.1% of patients respectively. Ischaemic heart disease, cerebrovascular disease, COPD, claudication and malignancy were more prevalent in patients aged >65 years.
- In 2009–2010, 13.2% of incident RRT patients were recorded as being smokers at the initiation of dialysis.
- There was a higher prevalence of ischaemic heart disease ($p < 0.01$) and cerebrovascular disease ($p < 0.0001$) in patients referred early to a nephrologist than amongst those referred late. Malignancy ($p < 0.0001$) was more common in patients who were 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 in individuals who survived more than 90 days from the start of RRT in patients <65 years.

Introduction

The importance of adjusting for comorbidity when undertaking centre [1–3] and international survival comparisons [4] is well recognised. As with all observational data, registry analyses exploring epidemiological issues, including access to treatments or survival analyses, are subject to a number of potential selection biases and confounding factors. Such registry analyses can be significantly strengthened by adjustment for case-mix as differences in patient populations that exist across centres may influence both process and outcome measures. However an important consideration in applying case-mix adjustment to analyses is data completeness. If individuals with comorbidity data differ systematically from those without data, entering variables into statistical models can further bias outcome measures and provide invalid associations [5, 6].

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

Methods

Study population

Incident adult ($\geqslant$18 years) RRT patients during 2009 and 2010 in the centres submitting data to the UKRR were considered. Of these, patients who had data recorded on comorbid conditions were included in statistical analyses. 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 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 on their renal information technology (IT) system. Definitions of each of these conditions are given in appendix B (www.renalreg.com/report-area/report 2011/appendix-B.pdf).

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

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'.

Specific consideration needs to be made regarding diabetes coding. The UKRR also collect data on Primary Renal Diagnosis (PRD), and have used these data alongside the comorbidity data to determine which people had diabetes mellitus. The comorbidity screen is intended to capture those patients who have diabetes only when it is not the PRD, however some clinicians do enter 'yes' in the comorbidity field in such cases. Prior to statistical analyses, we examine these fields together to identify these cases and ensure diabetes is only counted as either the PRD or a comorbid condition for a certain individual.

Ethnicity data reporting

Some centres electronically upload ethnicity coding to their renal IT system from the hospital Patient Administration Systems (PAS) [7]. Ethnicity coding in PAS is based on self-reported

ethnicity and uses a different system [8] to the remaining centres where coding of ethnicity 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.

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 statistically significant differences between groups.

2) Late presentation (referral) and 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. 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 Established Renal Failure (ERF). Patients presenting acutely and initially classified as acute renal failure requiring dialysis who continue to require long-term dialysis, can subsequently be re-classified by clinicians as having had ERF from the date of their first RRT. The death rate is high in the first 90 days of commencing RRT with variability observed between centres. This between centre variation may in part be due to clinician variation in the classification of patients who present acutely requiring RRT and who may be deemed from the start to be unlikely to recover renal function. As mortality rate varies with time on RRT and to remove the influence of between centre variation in the classification of patients, the survival analysis was stratified into two time frames. This also enables comparison with results from other national registries. The association of comorbid conditions and survival within the first 90 days was analysed and subsequently the association of comorbid conditions and 1 year survival in the cohort who survived after 90 days from the start of RRT was also analysed.

For each of the follow up periods, the association of baseline comorbidity with survival was analysed using univariable and multivariable Cox regression models. For analyses of survival within the first 90 days, the cohort included patients starting RRT between 1st January 2005 and 30th September 2010 to allow a minimum of three months follow-up from the start of RRT. For the 1 year survival analyses in individuals who survived at least 90 days after the start of RRT, the cohort data on individuals who started RRT between 1st January 2005 and 30th September 2009.

For each variable, the models were used to estimate the hazard ratio of death, comparing the survival experience of patients with a particular comorbidity with those who did not have the comorbidity (reference group). For both the univariable and multivariable Cox models, patients were first stratified by age group (<65 years and $\geqslant$65 years) to account for the increasing incidence of certain comorbidities with age, which may otherwise confound the analyses. The multivariable 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 table 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 more robust analysis would make a considered judgement of which variables should be included (rather than an automatic one) and may require additional interaction terms.

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.

All statistical analyses were performed using SAS version 9.2.

Results

Completeness of comorbidity returns from each participating centre

The number of patients with data on comorbidity and other variables included in the analyses are summarised in figure 4.1.

Of 12,434 incident RRT patients in 2009 and 2010, 6,130 individuals (49.3%) had data on comorbidity reported. In 2010, 6,154 patients commenced RRT in centres in England, Wales and Northern Ireland. Comorbidity data were provided for 3,024 (49.1%) of those patients (tables 4.2, 4.3). Table 4.2 highlights the continued wide variation in the completeness of data returns with 4 centres providing data on 100% of

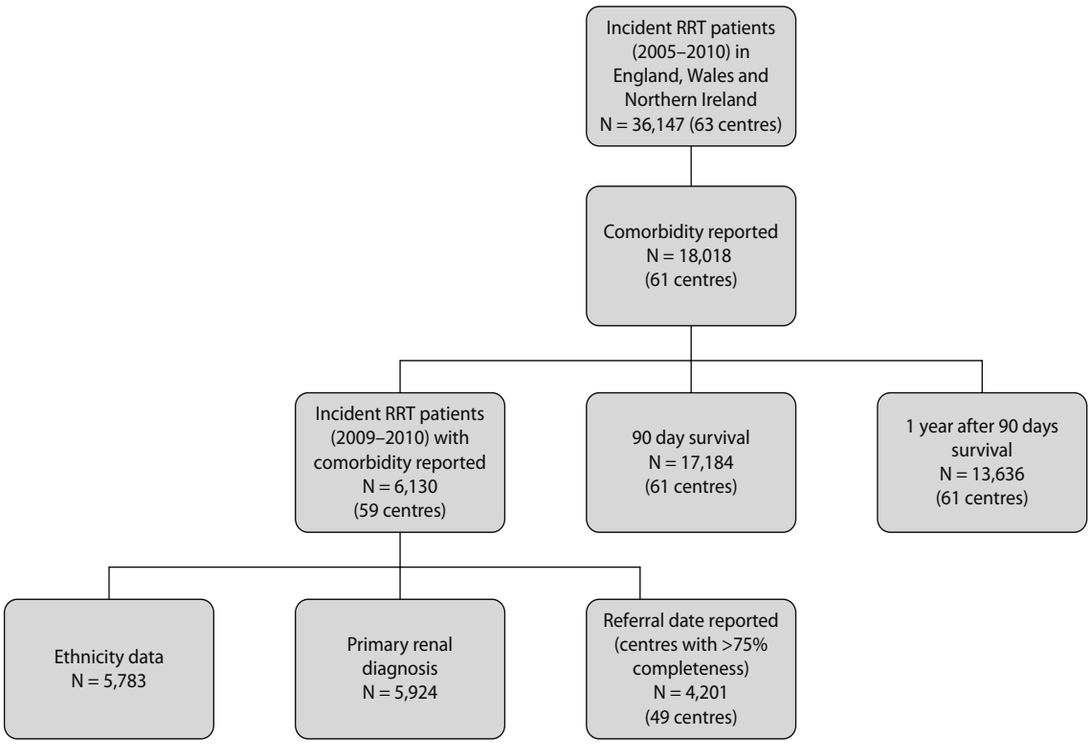

Fig. 4.1. Flow chart showing number of patients included in the various analyses

patients, but 15 centres providing data for less than 5% of new patients in 2010.

Limiting the comparison to the centres that reported in 2005, data completeness for comorbidity has remained roughly the same. Completeness was 48.9% in 2005 and 49.1% in 2010 (table 4.3). When centres with 0% completeness for comorbidity were excluded, the median percentage of comorbidity returns in 2010 was 72.0%. For centres returning comorbidity data there has been an annual improvement since 2005 (table 4.3). This could suggest that once renal information systems are set up to return comorbidity information, it is possible to improve data completeness.

Prevalence of multiple comorbidity

Including all incident patients from the years 2009–2010 (n = 12,434), comorbidity data were available for 6,130 (49.3%). More than half of these patients had one or more comorbidities (55.4%) (table 4.4), but in the subgroup of patients aged ⩾65 years, 67.6% 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 the cause of PRD or as a comorbidity) was present in 32.7% of all patients. This is different to the sum of diabetes (not listed as PRD) and diabetes listed as PRD in Table 4.5 and reflects some patients having both an entry in the comorbidity field for diabetes and having it recorded as their PRD as described in the methods section.

Prevalence of comorbidity by age band

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. With age categorised in 10 year age groups, prevalence of most comorbidities is seen to increase markedly from 18–65 years and appeared to plateau beyond this (figures 4.2, 4.3). 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

Table 4.2. Completeness of comorbidity data returns on incident patients from individual renal centres 2005–2010

	2005		2006		2007		2008		2009		2010	
Centre	N	% return	N	% return	N	% return	N	% return	N	% return	N	% return
Antrim	42	12	33	9	37	14	41	32	21	38	41	95
B Heart	119	5	116	3	101	6	105	10	99	49	95	74
B QEH	199	1	186	1	225	2	268	1	255	3	197	0
Bangor	40	50	42	60	36	69	41	68	30	83	26	96
Basldn	32	53	45	76	39	77	40	88	26	88	32	91
Belfast	130	25	121	26	90	33	70	33	61	44	71	46
Bradfd	67	96	50	98	88	100	63	90	61	90	64	92
Brightn	112	14	131	24	120	37	121	34	120	12	107	6
Bristol	175	81	176	98	156	83	176	77	158	85	169	92
Camb	111	3	156	3	128	2	109	0	136	3	108	1
Cardff	184	22	206	7	221	5	150	5	179	9	188	16
Carlis	31	94	27	93	26	92	30	97	24	88	21	62
Carsh	183	54	186	59	194	76	216	82	208	77	221	68
Chelms	40	48	50	84	52	54	36	36	52	37	42	29
Clwyd	26	19	18	22	22	36	15	40	17	53	13	0
Colchr							58	0	17	0	32	0
Covnt	84	0	104	2	113	0	116	0	118	0	118	1
Derby	71	76	70	71	63	86	96	92	78	94	80	85
Derry			4	75	8	63	6	50	17	71	18	72
Donc					20	90	26	27	40	43	44	61
Dorset	49	88	53	92	65	89	85	85	76	78	72	65
Dudley	38	0	45	2	40	0	46	0	69	0	41	0
Exeter	111	29	105	30	126	8	135	4	145	1	136	4
Glouc	61	97	74	89	58	97	47	87	79	67	58	43
Hull	125	98	105	91	99	98	113	91	101	76	88	84
Ipswi	59	29	42	62	40	50	38	34	38	8	34	9
Kent					172	75	140	79	131	89	134	100
L Barts	187	90	190	83	214	84	206	80	239	86	207	72
L Guys	148	11	152	12	168	8	164	2	176	3	144	2
L Kings	131	99	110	100	121	100	151	99	128	98	148	99
L Rfree	132	1	194	1	185	0	173	1	170	0	203	0
L St.G					93	69	100	70	109	60	83	54
L West	302	52	313	51	278	53	318	45	357	2	367	1
Leeds	172	74	178	78	127	83	159	79	154	90	130	89
Leic	226	66	241	68	244	77	243	77	228	69	250	64
Liv Ain	29	41	35	54	36	44	42	67	38	71	49	4
Liv RI	139	63	141	52	112	56	102	42	110	45	102	21
M Hope	110	33	132	12	121	12	142	1	125	0	146	0
M RI					160	33	133	41	147	64	163	40
Middlbr	84	90	108	77	99	79	93	92	95	92	98	96
Newc	112	17	106	16	106	22	97	21	100	23	95	52
Newry	28	14	13	23	15	27	21	90	20	100	21	95
Norwch	119	10	113	12	110	18	90	20	73	23	85	39
Nottm	145	99	137	97	130	93	115	89	134	97	113	96
Oxford	153	51	157	24	144	87	150	81	177	91	167	95
Plymth	60	45	92	66	76	79	69	70	56	82	55	73
Ports	149	64	175	64	157	69	170	58	149	62	150	45
Prestn	121	29	121	33	132	43	112	42	147	50	122	46
Redng	90	3	88	3	94	6	105	3	99	3	89	0
Sheff	158	43	168	58	165	57	180	52	150	53	144	78
Shrew	41	59	55	65	58	66	61	87	47	87	58	100
Stevng	89	48	122	53	89	73	103	77	98	95	110	98
Sthend	34	71	48	83	34	88	36	81	23	96	30	70
Stoke					87	0	81	0	110	0	93	0
Sund	60	93	57	93	62	100	45	98	64	98	55	78

Table 4.2. Continued

	2005		2006		2007		2008		2009		2010	
Centre	N	% return	N	% return	N	% return	N	% return	N	% return	N	% return
Swanse	101	97	116	97	127	97	124	96	116	97	135	79
Truro	32	84	52	77	45	91	41	37	58	64	43	67
Tyrone	24	42	29	59	21	81	25	72	19	89	10	100
Ulster	9	56	8	63	16	100	14	100	13	100	20	95
Wirral	60	7	52	0	53	0	39	3	63	2	52	0
Wolve	95	84	85	88	68	93	88	95	65	100	107	93
Wrexm	42	38	26	58	27	63	21	76	20	90	24	100
York	46	89	48	90	38	84	38	79	47	68	36	92
Totals	**5,517**		**5,807**		**6,151**		**6,238**		**6,280**		**6,154**	

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

Table 4.3. Summary of completeness of incident patient comorbidity returns (2005–2010)

	Years						Combined years
	2005	2006	2007	2008	2009	2010	
Number of renal centres included	56	57	62	63	63	63	
Total number of new patients	5,517	5,807	6,151	6,238	6,280	6,154	36,147
Number of patients with comorbidity data entries	2,699	2,838	3,195	3,156	3,106	3,024	18,018
Percentage of patients with comorbidity data entries	48.9	48.9	51.9	50.6	49.5	49.1	49.8
Percentage restricted to centres in since 2005	48.9	48.9	52.2	51.1	49.1	49.1	49.9
Median percentage amongst only centres returning >0% comorbidity	50.5	59.3	69.4	69.8	70.6	72.0	65.5

higher prevalence of having at least one comorbidity recorded amongst patients of White origin compared to incident patients from an ethnic minority. Figure 4.5 shows that this pattern is observed across all age groups. However, diabetes mellitus specifically is much more frequently reported in South Asian patients (48.1%) than in White individuals (30.0%) (table 4.6). The reported prevalence of smoking was highest in individuals of White ethnicity (14.8%).

Prevalence of comorbidity amongst patients with diabetes mellitus

Table 4.7 describes comorbidity amongst patients with and without diabetes (as either primary renal disease or comorbidity). As would be expected, patients with diabetes mellitus had higher prevalence of peripheral vascular disease (20.3% compared to 7.5% in non-diabetics). Similarly, ischaemic heart disease and cerebrovascular disease were more common in diabetics. Similar proportions of diabetic and non-diabetic patients were smokers at the time of initiation of RRT (13.3% and 13.0% respectively). Malignancy was more common in non-diabetic patients ($p < 0.0001$) and may reflect "competing risks", with diabetics tending to die at a younger age with cardiovascular disease, rather than developing malignancy in older age.

Table 4.4. Number of reported comorbidities in patients starting RRT, as a percentage of those for whom comorbidity data were available 2009–2010

Number of comorbidities	0	1	2	3	4	5+
Percentage	44.6	28.6	13.6	7.7	3.2	2.4

Late presentation and comorbidity

Table 4.8 shows the referral time for patients with various comorbidities. In total, 4,201 individuals contributed data to this analysis. Patients referred to a nephrologist early had a higher prevalence of peripheral vascular disease, cerebrovascular disease and ischaemic heart disease. There were a higher proportion of patients with malignancy in the late referral group.

Table 4.5. Frequency with which each condition was reported in incident RRT patients 2009–2010

	Age <65 years		Age ⩾65 years			
Comorbidity	N	(%)	N	(%)	p value*	% overall prevalence
Any comorbidity present	1,338	(43.4)	2,058	(67.6)	<0.0001	55.4
Angina	207	(6.8)	538	(18.0)	<0.0001	12.3
MI in past 3 months	49	(1.6)	91	(3.0)	0.0002	2.3
MI >3 months ago	170	(5.6)	453	(15.1)	<0.0001	10.3
CABG/angioplasty	178	(5.8)	327	(10.9)	<0.0001	8.4
Cerebrovascular disease	200	(6.6)	454	(15.1)	<0.0001	10.8
Diabetes (not listed as PRD)	183	(6.0)	385	(12.8)	<0.0001	9.4
Diabetes listed as PRD	824	(27.4)	612	(20.5)	<0.0001	23.9
COPD	148	(4.9)	302	(10.1)	<0.0001	7.4
Liver disease	114	(3.7)	53	(1.8)	<0.0001	2.8
Claudication	129	(4.2)	256	(8.6)	<0.0001	6.4
Ischaemic/neuropathic ulcers	120	(3.9)	94	(3.1)	0.0917	3.5
Angioplasty/vascular graft	76	(2.5)	172	(5.7)	<0.0001	4.1
Amputation	81	(2.7)	66	(2.2)	0.24	2.4
Smoking	453	(15.4)	313	(10.9)	<0.0001	13.2
Malignancy	204	(6.7)	596	(19.8)	<0.0001	13.2

*p values from Chi-squared tests for differences between age groups in the percentage with the 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 than in those starting on peritoneal dialysis (table 4.9). The median age for all patients starting dialysis in England, Wales and N. Ireland in 2009–2010 67.9 years (IQR 55.1–76.6 years) for haemodialysis and 58.4 years (IQR 45.1–69.3 years) for peritoneal dialysis. In comparison, the median age of patients with comorbidity data starting RRT on HD was 67 years compared with 59 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 4.9).

Comorbidity and survival within 90 days of starting RRT

On univariable analysis stratified by age, most comorbidity was associated with an increased risk of death in the first 90 days after starting RRT when

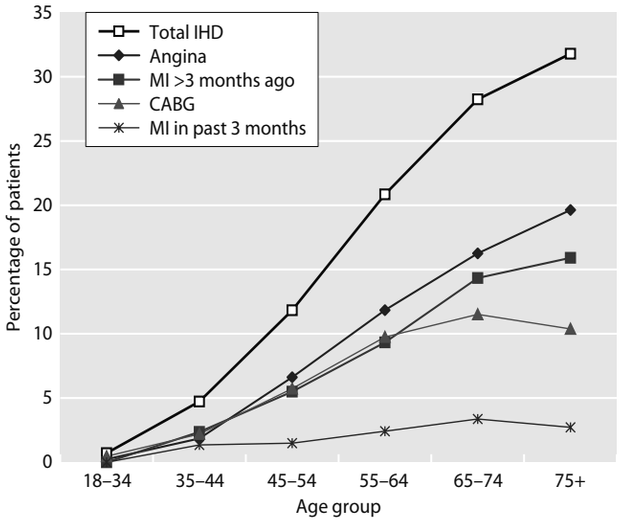

Fig. 4.2. Prevalence of ischaemic heart disease amongst incident patients 2009–2010 by age at start of RRT

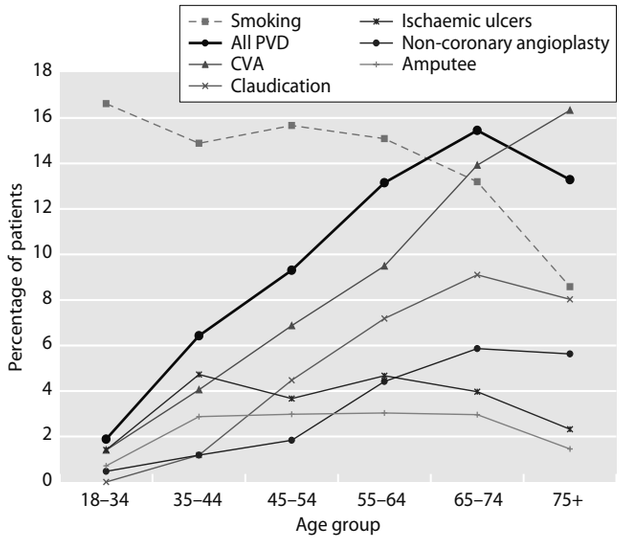

Fig. 4.3. Prevalence of non-coronary vascular disease amongst incident patients 2009–2010 by age at start of RRT

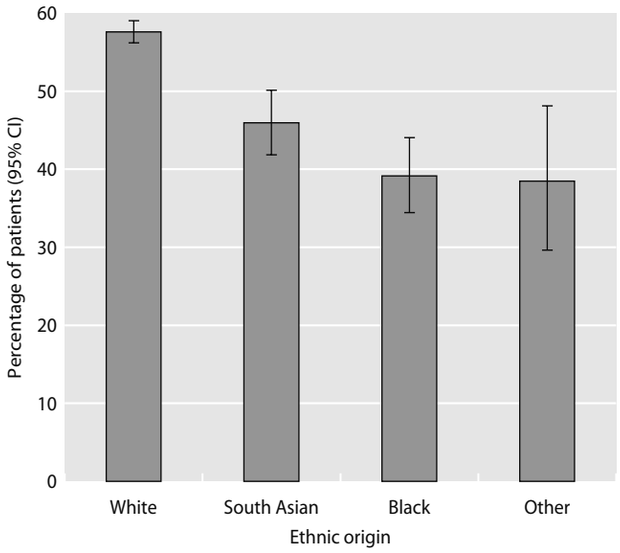

Fig. 4.4. Presence of comorbid conditions at the start of RRT by ethnic origin amongst patients starting RRT 2009–2010

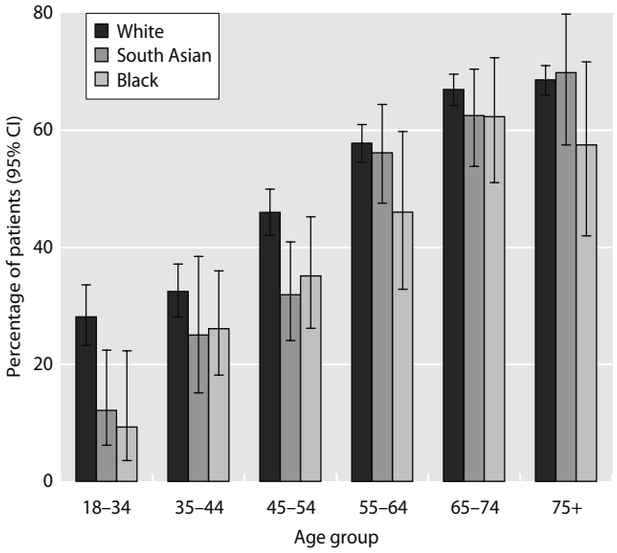

Fig. 4.5. Percentage of patients with comorbidity by ethnic origin in each age group at the start of RRT 2009–2010

Table 4.6. Prevalence of comorbidities amongst incident patients starting RRT 2009–2010 by ethnic group, as percentages of the total number of patients in that ethnic group for whom comorbidity data was available

	Number of patients (%) with comorbidity								
	White		South Asian		Black		Other		p value*
Ischaemic heart disease	1,002	(21.5)	146	(26.7)	34	(8.7)	9	(8.7)	<0.0001
Cerebrovascular disease	516	(11.0)	52	(9.6)	48	(12.3)	7	(6.7)	0.30
Diabetes (not listed as PRD)	426	(9.1)	54	(9.9)	27	(6.9)	6	(5.8)	0.26
Diabetes listed as PRD	1,000	(21.6)	209	(38.2)	119	(30.2)	22	(21.4)	<0.0001
COPD	394	(8.4)	19	(3.5)	12	(3.1)	2	(1.9)	<0.0001
Liver disease	119	(2.5)	16	(2.9)	20	(5.1)	3	(2.9)	0.030
Peripheral vascular disease	584	(12.5)	46	(8.6)	31	(8.1)	5	(4.8)	0.001
Smoking	639	(14.2)	42	(7.9)	31	(8.2)	12	(11.8)	<0.0001
Malignancy	692	(14.8)	21	(3.9)	24	(6.2)	7	(6.7)	<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	653	(16.8)	581	(29.8)	<0.0001
Cerebrovascular disease	342	(8.8)	282	(14.5)	<0.0001
COPD	291	(7.5)	150	(7.7)	0.77
Liver disease	101	(2.6)	52	(2.7)	0.87
Peripheral vascular disease	292	(7.5)	393	(20.3)	<0.0001
Smoking	487	(13.0)	249	(13.3)	0.74
Malignancy	584	(15.0)	184	(9.5)	<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	136	(16.9)	769	(23.0)	0.0002
Cerebrovascular disease	51	(6.3)	384	(11.5)	<0.0001
Diabetes (not listed as PRD)	57	(7.0)	315	(9.4)	0.031
COPD	61	(7.5)	273	(8.1)	0.6
Liver disease	29	(3.6)	86	(2.6)	0.12
Peripheral vascular disease	81	(10.0)	414	(12.4)	0.065
Malignancy	161	(19.9)	398	(11.9)	<0.0001
Smoking	118	(15.2)	415	(12.7)	0.07

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

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). Results of the multivariable stepwise Cox regression analyses stratified by age group (<65 and ⩾65) are shown in tables 4.10 and 4.11. As identified in the univariable models, the relative magnitude of the hazard ratios associated with comorbidity in younger patients tended to be greater than in the older patient group. Diabetes did not emerge as an independent predictor of death, perhaps explained by its close association with, and mediation in the causal pathway by, cardiovascular diseases. Some comorbidities may appear not to be associated with an increased risk of death in this analysis because of the low number of patients in these groups or because of selection within the cohort. For example individuals with severe comorbid disease, and whose prognosis on RRT was considered very poor, may not have been 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 4.10) explain 47% of the variation in survival. For patients aged ⩾65, the final eight variables in the model explain 15% of the variation in survival (table 4.11).

Comorbidity and survival 1 year after 90 days of commencing RRT

Age, smoking and five comorbidities were independently associated with an increased hazard of death within the first year after 90 days of commencing RRT for patients aged <65 years and four of these (age,

Table 4.9. Number (and percentage) of incident patients with comorbid conditions starting PD and HD 2009–2010

	HD			PD			
Comorbidity	N	(%)	Median age	N	(%)	Median age	p value*
Angina	635	(13.9)	72.5	108	(8.5)	70.2	<0.0001
MI in past 3 months	131	(2.9)	69.8	8	(0.6)	61.3	<0.0001
MI > 3 months ago	511	(11.2)	72.5	105	(8.3)	69.8	0.0026
CABG/angioplasty	408	(9.0)	70.6	90	(7.1)	67.0	0.037
Cerebrovascular disease	558	(12.2)	71.9	91	(7.2)	68.2	<0.0001
Diabetes (not listed as PRD)	478	(10.5)	71.6	83	(6.5)	69.1	<0.0001
COPD	393	(8.6)	71.6	56	(4.4)	67.4	<0.0001
Liver disease	138	(3.0)	61.0	23	(1.8)	58.4	0.019
Claudication	326	(7.2)	70.9	57	(4.5)	65.0	0.0007
Ischaemic/neuropathic ulcers	181	(4.0)	64.2	33	(2.6)	55.9	0.022
Angioplasty/vascular graft	223	(4.9)	72.0	22	(1.7)	61.8	<0.0001
Amputation	121	(2.7)	64.8	24	(1.9)	56.8	0.13
Smoking	610	(13.9)	63.4	135	(11.1)	53.1	0.01
Malignancy	697	(15.3)	73.2	99	(7.8)	67.6	<0.0001

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

Table 4.10. Multivariate Cox proportional hazards model* for predictors of death within the first 90 days of starting RRT during 01/01/2005–30/09/2010: patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	3.9	2.6–6.0	<0.0001
Claudication	2.6	1.5–4.4	0.001
Liver disease	2.1	1.1–4.0	0.026
Angina	1.8	1.1–2.9	0.013
Age (per 10 yrs)	1.7	1.4–2.1	<0.0001

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

Table 4.11. Multivariate Cox proportional hazards model* for predictors of death within the first 90 days of starting RRT during 01/01/2005–30/09/2010: patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
Ischaemic/neuropathic ulcers	2.2	1.5–3.3	0.0001
MI in past 3 months	2.0	1.4–2.9	0.0003
Malignancy	1.7	1.4–2.1	<0.0001
MI > 3 months ago	1.6	1.2–2.0	0.0002
COPD	1.6	1.2–2.1	0.0006
Age (per 10 yrs)	1.5	1.3–1.7	<0.0001
Angina	1.4	1.1–1.8	0.003
CABG/angioplasty	0.7	0.5–1.0	0.04

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

malignancy, liver disease and COPD) were among the eight variables independently associated with mortality beyond day 90 in patients ⩾65 years (tables 4.12, 4.13). Diabetes mellitus was independently associated with increased mortality in patients <65 years but not in those aged ⩾65 years. Overall the final seven variables in the model exploring death in the year after the first 90 days of starting RRT in patients <65 years explain 30% of the variation in survival. For patients' ⩾65 years, only 14% of the variation in survival was explained by the eight variables included in the final model.

Table 4.12. Multivariate Cox proportional hazards model* for predictors of death in the year after the first 90 days of starting RRT during 01/01/2005–30/09/2009: patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	3.1	2.3–4.2	<0.0001
Ischaemic/neuropathic ulcers	2.3	1.6–3.4	<0.0001
Diabetes of either category	1.7	1.4–2.2	<0.0001
Liver disease	1.6	1.1–2.5	0.021
COPD	1.6	1.1–2.3	0.024
Age (per 10 yrs)	1.4	1.2–1.5	<0.0001
Smoking	1.3	1.0–1.7	0.047

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

Table 4.13. Multivariate Cox proportional hazards model* for predictors of death in the year after the first 90 days of starting RRT during 01/01/2005–30/09/2009: patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
Amputation	2.0	1.3–3.1	0.002
Liver disease	2.0	1.3–2.9	0.001
Malignancy	1.8	1.6–2.1	<0.0001
Age (per 10 yrs)	1.7	1.6–1.9	<0.0001
COPD	1.5	1.2–1.8	<0.0001
Cerebrovascular disease	1.4	1.2–1.6	0.0002
Angina	1.3	1.1–1.5	0.005
Claudication	1.3	1.0–1.5	0.04

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

Discussion

Comorbidity data completeness has been a cause for concern since comorbidities were first reported by the UKRR in 1999 [11]. Overall the completeness of comorbidity reporting to the UKRR is fairly static. The current prevalence of comorbidity reporting of 49.3% in the UK compares with 85% in Canada, 95–100% in Australia and New Zealand and 100% in the US. Some work has recently been undertaken to learn from experience in these countries [12]. Missing data may hamper case-mix adjustment but also introduce the risk of selection bias, so caution must be used in interpreting the influence of comorbidity on patient outcomes. A recent study based on UKRR data suggested that patients with comorbidity recorded have significantly better health outcomes than those with missing comorbidity [6], so the findings from the selected group of patients reported in this chapter cannot be assumed to be representative of the whole dialysis population. 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, given that comorbidity items form part of the mandatory National Renal Dataset. In addition, ongoing efforts to understand the barriers to data capture and to optimise the processes utilised, involving all relevant stakeholders from individual clinicians, data managers, system suppliers and the UKRR team, are required to help improve the quality and completeness of this important information.

An interesting recurrent finding in several of the survival analyses is the lack of independent association of smoking or diabetes with mortality. This highlights the need for caution when interpreting the results of multivariable analyses in which co-variables are included in the model that may lie on the causal pathway. For example smoking and diabetes both contribute to vascular disease which may result in death. Therefore by including ischaemic heart disease or peripheral vascular disease in the model, the association between diabetes and smoking and mortality will be attenuated. The absence of an independent association should not however be interpreted as meaning smoking (for example) does not increase a dialysis patient's risk of death [13]. The observation that 13% of new RRT patients are recorded as current smokers remains a concern given the recognised substantial excess in cardiovascular risk that dialysis patients have compared with those with CKD or normal renal function [14, 15].

A 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. The UKRR is currently undertaking work exploring the associations between comorbidity and survival in greater detail. Future studies of survival should consider other factors such as nutrition, mobility, cognition and socio-economic status in addition to centre level factors at the start of dialysis to better assess the risk factors and outcomes for RRT patients.

Conflicts of interest: none

References

1 Ansell D, Roderick P, Hodsman A, Steenkamp R, Tomson C: Chapter 6: Survival of Incident and Prevalent patients; in Ansell D, Feehally J, Feest TG, Tomson C, Williams AJ, Warwick G: UK Renal Registry Report 2007, UK Renal Registry, Bristol, UK, 2007

2 Khan IH, Campbell MK, Cantarovich D, Catto GR, Delcroix C, Edward N, Fontenaille C, Fleming LW, Gerlag PG, van Hamersvelt HW, Henderson IS, Koene RA, Papadimitriou M, Ritz E, Russell IT, Stier E, Tsakiris D, MacLeod AM: Survival on renal replacement therapy in Europe: Is there a 'centre effect'? Nephrol Dial Transplant 1996;11:300–307

3 Hodsman A, Ben-Shlomo Y, Roderick P, Tomson CRV: The 'centre effect' in nephrology: What do differences between nephrology centres tell us about clinical performance in patient management? Nephron Clin Pract 2011;119:1: c10–c17

4 Marcelli D, Stannard D, Conte F, Held PJ, Locatelli F, Port FK: ESRD patient mortality with adjustment for comorbid conditions in Lombardy (Italy) versus the United States. Kidney Int 1996;50:1013–1018

5 Jager KJ, Zoccali C. Comorbidity data collection by renal registries – a remaining challenge. Nephrol Dial Transplant 2009;24: 2311–2313

6 Collier T, Steenkamp R, Tomson C, Caskey F, Ansell D, Roderick P, Nitsch D: Patterns and effects if missing comorbidity data for patients starting renal replacement therapy in England, Wales and Northern Ireland. Nephrol Dial Transplant 2011;26:3651–3658

7 Ansell D, Tomson CRV: UK Renal Registry 11th Annual Report (December 2008): Chapter 15 The UK Renal Registry, UKRR database, validation and methodology. Nephron Clin Pract 2009;111(suppl 1): c277–c285

8 Office for National Statistics: The classification of ethnic groups (www.statistics.gov.uk). 2005

9 Ford DJ, Fogarty DG, Steenkamp R, Tomson CR, Ben-Shlomo Y, Ansell D: UK Renal Registry 12th Annual Report (December 2009): Chapter 13: the UK Renal Registry advanced CKD study: frequency of incorrect reporting of date of start of RRT. Nephron Clin Pract 2010;115(suppl 1): c271–c278

10 Royston P, Sauerbrei W: A new measure of prognostic separation in survival data. Statistics in medicine 2004;23:723–748

11 Ansell D, Feest TG: Chapter 12: Co-morbidity of new patients: UK Renal Registry report 1999, UK Renal Registry, Bristol, UK, 1999

12 Karamadoukis L, Ansell D, Foley RN, McDonald SP, Tomson CRV, Trpeski L, Caskey FJ: Towards case-mix-adjusted international renal registry comparisons: How can we improve data collection practice? Nephrol Dial Transplant 2009;24:2306–2311

13 Caskey F, Webb L, Gilg J, Fogarty D: Chapter 6: Comorbidities and Current Smoking Status amongst Patients starting Renal Replacement Therapy in England, Wales and Northern Ireland from 2002–2008: national and centre-specific analyses. Nephron Clin Pract 2010; 115(suppl 1):c103–c116

14 Foley RN, Herzog CA, Collins AJ: Smoking and cardiovascular outcomes in dialysis patients: The United States Renal Data System Wave 2 study. Kidney Int 2003;63: 1462–1467

15 Zoccali C, Tripepi G, Mallamaci F: Predictors of cardiovascular death in ESRD. Semin Nephrol 2005;25:358–362

UK Renal Registry 14th Annual Report: Chapter 5 Demography of the UK Paediatric Renal Replacement Therapy population in 2010

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Key Words
Aetiology · Children · Demography · End stage renal disease · Established renal failure · Incidence · Prevalence · Ethnicity · Renal replacement therapy

Summary

- A total of 870 children and young people under 18 with ERF were receiving treatment at paediatric nephrology centres in 2010.
- At the census date, 76.7% had a functioning transplant, 14.3% were receiving peritoneal dialysis (PD) and 9% were receiving haemodialysis (HD).
- In patients aged <16 years the prevalence of ERF was 59.3 pmarp and the incidence 8.1 pmarp.
- Analysis of trends over the last 15 years shows that both incidence and prevalence are increasing with the most marked increases in children aged 12–16 years and in ethnic minority groups.
- A third of patients have one or more reported comorbidities.
- At transfer to adult services 84.9% of patients had a functioning renal transplant.

Introduction

Established renal failure (ERF) requiring renal replacement therapy (RRT) is a rare but significant cause of long term morbidity and mortality during childhood, with specialist care being provided in 13 paediatric nephrology centres throughout the UK. All centres are equipped to provide peritoneal dialysis and haemodialysis, with ten centres also undertaking transplantation for children. In the United Kingdom (UK), prevalence rates of treated ERF in children aged under 16 have risen steadily over the last 15 years to 65 per million age related population (pmarp) in 2009 [1]. This increase in prevalence is a consequence 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. Incidence rates for ERF have also shown an increasing trend during this time period rising to 9.3 pmarp in 2009 [1].

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 2010 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 2010. As previously, most centres submitted data electronically to the UK Renal Registry (UKRR) with only four centres submitting data using paper-based data returns. These data items were then manually entered into the current paediatric UKRR database. Southampton, Newcastle and Manchester were only able to provide a limited electronic dataset this year due to a combination of technical difficulties and limited resources.

In this report, patient groups are described as follows: patients who were receiving RRT on the 31st December 2010 are the 'prevalent' group; patients who started RRT between 1st January and 31st December 2010 are the 'incident' group; and patients that started RRT in the periods of 1996–2000, 2001–2005 and 2006–2010 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-2010 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 1996–2000, 2001–2005 and 2006–2010 '5 year' groups.

Statistical analyses were performed using SAS 9.2, with group analyses using Fischer's exact test and median analyses using Kruskal-Wallis test.

Results

Accuracy and completeness of data returns

This year a significant amount of effort has been put into improving the overall accuracy of the entire paediatric dataset by clinical teams, data managers and statisticians. Problems identified in this process pertained largely to some patients being incorrectly registered as having started RRT whilst some patients were found to be duplicates within the prevalent RRT cohort (identified by combining the British Association of Paediatric Nephrology (BAPN) database and National Care Records) leading to historical over-estimation of prevalence rates. Subsequent corrections have undoubtedly led to achieving a more accurate dataset this year with more reliable analyses and conclusions. As for data returns the procedures for data collection and processing are still evolving but there was good completion of the core data items from most centres as shown in table 5.1.

The UK paediatric prevalent ERF population in 2010

A total of 870 children and young people under 18 with ERF were receiving treatment at paediatric nephrology centres in 2010. At the census date, 76.7% had a functioning transplant, 14.3% were receiving peritoneal dialysis (PD) and 9% were receiving haemodialysis (HD).

Patients aged 16–18 years may receive their medical care either in a paediatric or in an adult nephrology centre. As data was incomplete for the 16–18 year old adolescent patients they have been excluded from the majority of subsequent analyses (particularly when describing incidence and prevalence rates) so as to avoid misrepresentation. This report therefore presents data largely relating to patients less than 16 years of age only.

There were 688 children under 16 years of age receiving RRT in the UK in 2010. Table 5.2 shows the number of patients receiving RRT by age groups and gender plus rate of RRT pmarp. The prevalence of RRT increased with age and was higher in males across all age groups. The reported prevalence rate of 59.3 pmarp in under

Table 5.1. Data completeness for paediatric prevalent ERF population in 2010

	Percentage completeness							
Centre	N	First seen date	RRT start date	Height at RRT start	Creatinine at RRT start	Treatment modality at 90 days	Ethnicity	Gender
Blfst_P	34	88.2	100.0	88.2	91.2	100.0	100.0	100.0
Bham_P	84	94.1	100.0	84.5	95.2	100.0	100.0	100.0
Brstl_P	58	100.0	100.0	94.8	100.0	100.0	100.0	100.0
Cardf_P	25	84.0	100.0	88.0	80.0	96.0	100.0	100.0
Glasg_P	59	91.5	100.0	71.2	89.8	88.1	94.9	100.0
L Eve_P	101	99.0	100.0	59.4	69.3	100.0	100.0	100.0
L GOSH_P	175	86.9	100.0	74.3	69.1	99.4	88.0	100.0
Leeds_P	79	98.7	100.0	83.5	96.2	98.7	92.4	100.0
Livpl_P	34	97.1	100.0	79.4	85.3	94.1	100.0	100.0
Manch_P	69	82.6	100.0	84.1	81.2	95.7	95.7	100.0
Newc_P	36	100.0	100.0	72.2	69.4	100.0	100.0	100.0
Nottm_P	93	87.1	100.0	69.9	95.7	98.9	100.0	100.0
Soton_P	23	91.3	100.0	26.1	26.1	100.0	91.3	100.0
UK	**870**	**91.8**	**100.0**	**75.5**	**82.0**	**98.0**	**96.0**	**100.0**

Table 5.2. UK paediatric prevalent ERF population in 2010, by age group and gender

	All patients		Males		Females		
Age group	N	pmarp	N	pmarp	N	pmarp	Ratio M:F
0–1.99 years	25	15.8	19	23.5	6	7.8	3.0
2–3.99 years	48	31.1	27	34.1	21	27.9	1.2
4–7.99 years	131	46.0	86	59.0	45	32.4	1.8
8–11.99 years	174	64.0	105	75.6	69	51.8	1.5
12–15.99 years	310	106.3	175	117.1	135	94.9	1.2
Under 16 years	**688**	**59.3**	**412**	**69.3**	**276**	**48.7**	**1.4**

pmarp – per million age related population

16 year olds was lower than 65 pmarp reported in the 2009 cohort because of the improved accuracy in patient identification.

Table 5.3 shows the ethnic origin of RRT patients and their prevalence rates. Increasing prevalence pmarp was observed with increasing age in all ethnic groups. Children from ethnic minorities displayed higher prevalent rates of RRT when compared with White children, with South Asian children displaying the highest prevalence rates.

Table 5.3. UK paediatric prevalent ERF population by age and ethnic group in 2010*

	White		South Asian		Black	
Age group	N	pmarp	N	pmarp	N	pmarp
0–3.99 years	48	18.6	10	47.4	1	11.9
4–7.99 years	95	39.7	22	112.8	3	38.5
8–11.99 years	131	51.2	21	100.7	8	95.9
12–15.99 years	227	84.3	43	195.8	11	125.2
Under 16 years	**501**	**49.0**	**96**	**115.1**	**23**	**68.9**

pmarp – per million age related population
*ethnicity data missing in 29 children who are not included in this table

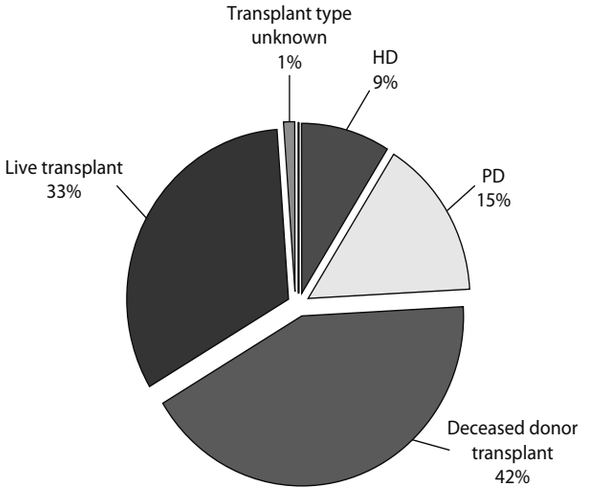

Fig. 5.1. RRT treatment used by prevalent paediatric patients <16 years old in 2010

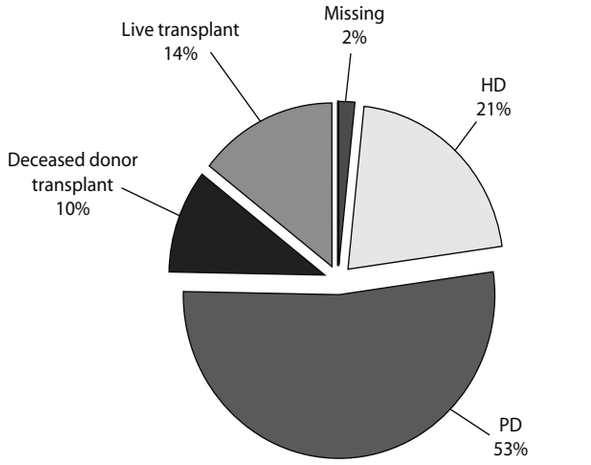

Fig. 5.2. Treatment modality at 90 days following commencement of RRT in prevalent paediatric patients under 16 years of age in 2010

Modality of treatment

Current treatment modality in the prevalent paediatric population less than 16 years old in 2010 is displayed in figure 5.1. Of the 76% with a functioning transplant, 56% of these were deceased donor transplantations.

The treatment modality in use at 90-days following commencement of RRT is displayed in figure 5.2. This shows that 53% of patients were treated with PD at 90 days whilst 21% of patients were treated with HD. Twenty-four percent of children under 16 were reported to have received a transplant either pre-emptively or by 90 days.

Further treatment modality analysis by age is shown in table 5.4 which demonstrates that in the under 2 year olds the majority of patients were being treated with PD (80%). This contrasts with older children in the 12 to 15.99 year age group where 84.6% had a functioning graft and where identical numbers were on HD and PD (7.7%). Subsequent analysis of RRT modality by gender showed no difference. Similarly there was no difference in RRT modality when comparing different ethnic groups, though South Asian children had a trend for higher rates of deceased donor versus living donor transplantation when compared with White children ($p = 0.08$).

Table 5.4. Current treatment modality by age in the prevalent paediatric ERF population in 2010

	Current treatment									
	HD		PD		Live transplant		Deceased donor transplant		Transplant type unknown	
Age group	N	%	N	%	N	%	N	%	N	%
0–1.99 years	3	12.0	20	80.0	2	8.0	0	0.0	0	0.0
2–3.99 years	9	18.8	21	43.7	15	31.2	3	6.3	0	0.0
4–7.99 years	14	10.7	20	15.3	50	38.1	46	35.1	1	0.8
8–11.99 years	12	6.9	20	11.5	49	28.2	89	51.1	4	2.3
12–15.99 years	24	7.7	24	7.7	108	34.9	152	49.1	2	0.6
16–17.99 years	16	8.8	19	10.4	56	30.8	90	49.5	1	0.5
Under 16 years	**62**	**9.0**	**105**	**15.3**	**224**	**32.5**	**290**	**42.2**	**7**	**1.0**
Under 18 years	**78**	**9.0**	**124**	**14.2**	**280**	**32.2**	**380**	**43.7**	**8**	**0.9**

Table 5.5. Number, percentage and gender by primary renal disease as cause of ERF in the prevalent paediatric ERF population under 16 years in 2010

Diagnostic group	Total	%	Males	Females	M:F ratio
Renal dysplasia ± reflux	224	32.6	141	83	1.7
Obstructive uropathy	119	17.3	109	10	10.9
Glomerular disease	104	15.1	45	59	0.8
Congenital nephrotic syndrome	62	9.0	33	29	1.1
Tubulo-interstitial diseases	43	6.3	19	24	0.8
Renovascular disease	32	4.7	20	12	1.7
Uncertain aetiology	24	3.5	11	13	0.8
Metabolic	22	3.2	8	14	0.6
Polycystic kidney disease	21	3.1	8	13	0.6
Malignancy & associated disease	16	2.3	5	11	0.5
Drug nephrotoxicity	1	0.1	0	1	0.0
Missing	20	2.9	13	7	1.9

Cause of ERF

Table 5.5 and figure 5.3 show the diagnostic categories for the prevalent ERF population under 16 years in 2010. There has been a marked improvement in data collection in this category with missing data falling from 15.5% of patients in the 2009 cohort to only 2.9% in 2010. Of the 668 patients, renal dysplasia ± reflux remained the commonest condition causing ERF (32.6%), whilst drug nephrotoxicity was documented in only a single child.

As for associated comorbidities at the onset of RRT, table 5.6 shows that congenital abnormalities were the commonest, reported in 9% of patients, whilst both developmental delay and syndromic diagnoses were reported in over 7% of patients. Prematurity was also frequently reported (7.6%), whilst neural tube defects were least common in 0.4% of patients. Overall 66.7% of patients had no registered comorbidities, with 22.2% having one comorbidity listed, and 11.1% having two or more comorbidities.

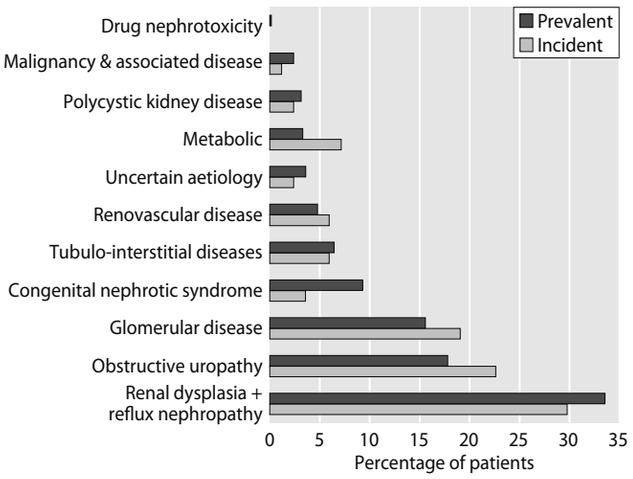

Fig. 5.3. Primary renal disease percentage in incident and prevalent paediatric ERF patients in 2010 for whom a causative diagnosis was reported

The UK incident paediatric ERF population in 2010

There were 106 patients under 18 years of age who commenced RRT at paediatric renal centres in 2010. As previously, the following analyses are restricted to the 94 patients who were under 16 years of age.

Table 5.6. Registered comorbidities at onset of RRT in prevalent paediatric patients with ERF in 2010

Comorbidity	N	Percentage all RRT patients
Cerebral palsy	10	1.5
Chromosomal abnormality	21	3.1
Congenital abnormality	62	9.0
Congenital heart disease	15	2.2
Consanguinity	27	3.9
Developmental delay	53	7.7
Diabetes	2	0.3
Liver disease	11	1.6
Malignancy	8	1.2
Neural tube defect	3	0.4
Family member with ERF	19	2.8
Prematurity	52	7.6
Psychological disorder	8	1.2
Syndromic diagnosis	49	7.1
No reported comorbidity	459	66.7
One reported comorbidity	153	22.2
Two or more reported comorbidities	76	11.1

Table 5.7. The incident paediatric ERF population in the UK in 2010, by age group and gender

	All patients		Males		Females		
Age group	N	pmarp	N	pmarp	N	pmarp	M:F ratio
0–1.99 years	21	13.3	16	19.8	5	6.5	3.0
2–3.99 years	10	6.5	4	5.1	6	8.0	0.6
4–7.99 years	16	5.6	9	6.2	7	5.0	1.2
8–11.99 years	16	5.9	6	4.3	10	7.5	0.6
12–15.99 years	31	10.6	18	12.0	13	9.1	1.3
Under 16 years	**94**	**8.1**	**53**	**8.9**	**41**	**7.2**	**1.2**

pmarp – per million age related population

The incidence rate of RRT was 8.1 pmarp in 2010. These patients commencing RRT in 2010 are displayed by age and gender in table 5.7.

Table 5.8 shows that the reported incidence of RRT has been rising since 1996, with the highest incidence rates seen in the 12–15.99 year age group, with the 0–1.99 year age group having the next highest rates.

Trends in ERF demographics

Analysis of ERF demographics for children less than 16 years of age over the past 15 years confirmed that there were 512 patients reported to the paediatric registry between 1996–2000, 548 between 2001–2005 and 591 between 2006–2010. Comparing the current 5 year 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 0 to 1.99 years (table 5.9). The percentage of children on RRT who are from South Asian or Black ethnic backgrounds has also increased during this period (table 5.10). The reported patient population at most paediatric renal centres has similarly grown in size since 1996–2000 with Belfast and Birmingham showing the largest proportional rises (table 5.11).

Table 5.8. Reported average incident 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	1996–2000	2001–2005	2006–2010
0–1.99 years	9.9	13.6	13.5
2–3.99 years	6.2	5.7	7.6
4–7.99 years	4.9	6.2	6.6
8–11.99 years	7.9	8.2	8.8
12–15.99 years	13.3	13.1	14.6
Under 16 years	**8.5**	**9.4**	**10.3**

Table 5.12 shows the number and percentage of children receiving RRT with each of the major reported comorbidities over the last 15 years. Whilst congenital abnormalities (8.6%), developmental delay (7.1%) and syndromic diagnoses (6.8%) were the most common reported comorbidities in 2006–2010, there has been little change in the percentage of children receiving RRT with a reported comorbidity over the last 15 years.

As for changes in modality at day 90 after starting RRT, figure 5.4 shows that the percentage of children who were using PD at 90 days has fallen slightly from 48.7% in 1996–2000 to 46.8% in 2006–2010 whilst the

Table 5.9. Number and percentage of children who commenced RRT, by age group and 5 year period

	1996–2000		2001–2005		2006–2010		1996–2010
Age group	N	%	N	%	N	%	% change
0–1.99 years	70	13.7	91	16.6	104	17.6	3.9
2–3.99 years	45	8.8	38	6.9	55	9.3	0.5
4–7.99 years	74	14.5	89	16.2	90	15.2	0.8
8–11.99 years	123	24.0	124	22.6	125	21.2	−2.9
12–15.99 years	200	39.1	206	37.6	217	36.7	−2.3
under 16 years	**512**		**548**		**591**		

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

	1996–2000		2001–2005		2006–2010		1996–2010
Ethnic group	N	%	N	%	N	%	% change
White	400	79.1	422	78.6	424	75.6	−3.5
S Asian	78	15.4	81	15.1	90	16.0	0.6
Black	11	2.2	12	2.2	20	3.6	1.4
Other	17	3.4	22	4.1	27	4.8	1.5
Under 16 years	**506**		**537**		**561**		

* There were 6 children in 1996–2000, 11 in 2001–2005 and 30 in 2006-2010 with no ethnicity recorded and these are not included in this table

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

	1996–2000		2001–2005		2006–2010		1996–2010
Centre	N	%	N	%	N	%	% change
Blfst_P	14	2.8	17	3.1	27	4.6	1.8
Bham_P	41	8.1	55	10.1	62	10.5	2.4
Brstl_P	35	6.9	44	8.0	34	5.8	−1.1
Cardf_P	15	2.9	17	3.1	17	2.9	−0.1
Glasg_P	39	7.7	31	5.7	43	7.3	−0.4
L Eve_P	54	10.6	45	8.2	63	10.7	0.1
L GOSH_P	97	19.1	98	17.9	117	19.8	0.7
Leeds_P	40	7.9	49	9.0	54	9.1	1.3
Livpl_P	23	4.5	31	5.7	19	3.2	−1.3
Manch_P	51	10.0	53	9.7	45	7.6	−2.4
Newc_P	28	5.5	32	5.9	27	4.6	−0.9
Nottm_P	58	11.4	48	8.8	66	11.2	−0.2
Soton_P	14	2.8	27	4.9	17	2.9	0.1
Total <16	**509**		**547**		**591**		

* There were 3 children in 1996–2000 and 1 in 2001–2005 with unknown centre of RRT start and these are not included in this table

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

	1996–2000		2001–2005		2006–2010		1996–2010
Comorbidity	N	%	N	%	N	%	% change
Cerebral palsy	5	1.0	9	1.6	7	1.2	0.2
Chromosomal abnormality	14	2.7	13	2.4	18	3.1	0.3
Congenital abnormality	31	6.1	50	9.1	51	8.6	2.6
Congenital heart disease	14	2.7	12	2.2	18	3.1	0.3
Consanguinity	23	4.5	21	3.8	16	2.7	−1.8
Developmental delay	51	10.0	39	7.1	42	7.1	−2.9
Diabetes	4	0.8	5	0.9	2	0.3	−0.4
Liver disease	0	0.0	9	1.6	11	1.9	1.9
Malignancy	9	1.8	8	1.5	2	0.3	−1.4
Neural tube defect	3	0.6	3	0.6	3	0.5	−0.1
Family member with ERF	24	4.7	20	3.7	10	1.7	−3.0
Prematurity	31	6.1	27	4.9	29	4.9	−1.1
Psychological disorder	13	2.5	9	1.6	7	1.2	−1.4
Syndromic diagnosis	34	6.6	49	8.9	40	6.8	0.1
No reported comorbidity	350	68	347	63.3	425	71.9	3.9
One reported comorbidity	97	19	147	26.8	109	18.4	−0.6
Two or more reported comorbidities	65	13	54	9.9	57	9.6	−3.4

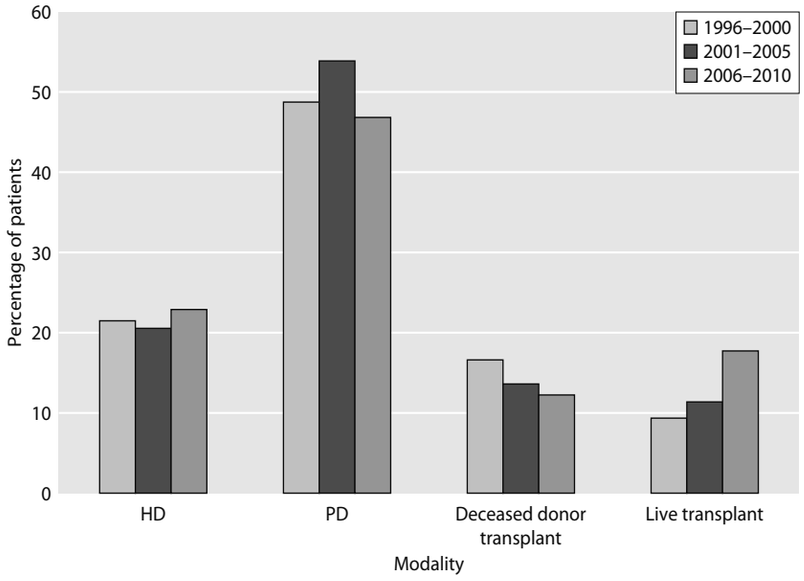

Fig. 5.4. Treatment modality at day 90 after starting RRT by 5 year time period

percentage commencing RRT on HD has increased from 21.5% in 1996–2000 to 22.9% in 2006–2010. During this period the overall percentage receiving a transplant before 90 days has remained largely unchanged though living donation has risen from 9.4% in 1996–2000 to 17.7% in 2006–2010, with a corresponding fall in deceased donor transplantation from 16.6% to 12.2% for the same time period.

Table 5.13 shows the diagnostic categories for 493 of the 512 (96.3%) patients in 1996–2000, for 523 of the 548 (95.4%) patients in 2001–2005 and 550 of the 591 (93.1%) patients in 2006–2010 aged <16 years for whom a causative diagnosis was reported.

Overall there has been an increase in the percentage of children receiving RRT with unknown aetiology between 1996–2000 and 2006–2010 (2.2% vs. 5.1%) and a decrease in metabolic diseases (5.9% vs. 4.5%) though absolute numbers are very small (table 5.13).

Transfer of patients to adult renal services in 2010

A total of 73 patients were reported by paediatric nephrology centres to have been transferred to adult renal services in 2010. The median age of patients transferred out was 18.0 years with a range of 16.1 years to 20.1 years. As expected the largest numbers of

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*

	1996–2000		2001–2005		2006–2010		1996–2010
Primary renal diagnosis	N	%	N	%	N	%	% change
Renal dysplasia ± reflux	163	33.1	172	32.9	176	32.0	−1.1
Obstructive uropathy	77	15.6	78	14.9	89	16.2	0.6
Glomerular disease	103	20.9	110	21.0	114	20.7	−0.2
Congenital nephrotic syndrome	28	5.7	29	5.5	29	5.3	−0.4
Tubulo-interstitial diseases	37	7.5	42	8.0	41	7.5	−0.1
Renovascular disease	18	3.7	18	3.4	21	3.8	0.2
Uncertain aetiology	11	2.2	19	3.6	28	5.1	2.9
Metabolic	29	5.9	23	4.4	25	4.5	−1.3
Polycystic kidney disease	14	2.8	13	2.5	16	2.9	0.1
Malignancy & associated disease	5	1.0	10	1.9	8	1.5	0.4
Drug nephrotoxicity	8	1.6	9	1.7	3	0.5	−1.1

* There were 19 children in 1996–2000, 25 in 2001–2005 and 41 in 2006–2010 with no PRD recorded and these are not included in this table

Table 5.14. Modality, gender, ethnicity and primary renal diagnosis of patients transferred out of paediatric nephrology centres in 2010

	N	% distribution
Modality		
HD	7	9.6
PD	4	5.5
Transplant	62	84.9
Gender		
Female	33	45.2
Male	40	54.8
Ethnicity*		
Black	2	2.8
Asian	10	13.9
White	60	83.3
Primary Renal Diagnosis*		
Renal dysplasia ± reflux	23	32.9
Obstructive uropathy	8	11.4
Glomerular disease	14	20
Tubulo-interstitial diseases	6	8.6
Renovascular disease	2	2.9
Uncertain aetiology	6	8.6
Metabolic	4	5.7
Polycystic kidney disease	2	2.9
Congenital nephrotic syndrome	5	7.1

* ethnicity missing in 1 patient, and PRD missing in 3 patients

adolescents transferred to adult services were from the centres with the largest cohort of patients with ERF.

Table 15.14 shows that of the transferred patients 54.8% were male, with ethnic minorities constituting 16.7% of patients. The vast majority (84.9%) had a functioning renal transplant at the time of transfer to an adult renal centre. Renal dysplasia ± reflux was the primary renal diagnosis in nearly a third of patients.

Mortality data in 2010

There were seven deaths in renal paediatric centres in 2010. The reported mortality of children with treated ERF in 2010 in the UK was 1% (7/688). The median age at death was 1.2 years (range: 0.2 years to 15.5 years) and 57% were less than 16 months old. Sepsis was cited as a cause of death in two patients on dialysis, and one patient died after developing cardiac complications after undergoing bilateral nephrectomies. In four children the cause of death was related to opting for withdrawing from dialysis and receiving palliative care following a combination of reasons including failure of transplant, cerebrovascular accident or complications related to dialysis.

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 renal registry 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 electronic annual returns from all paediatric centres.

On this background of continuing 'process transition', 87.5% (602/688) of patients from 10 of 13 paediatric nephrology centres had their data submitted electronically. This report focuses on 688 children and adolescents <16 years of age, who were receiving RRT in 2010. The sub-section on the trends in demographics includes 512 from 1996–2000, 548 from 2001–2005 and 591 from 2006–2010 children and adolescents <16 years of age on RRT.

Completeness of data

As shown in table 5.1, completeness of data was >90% for key variables with the exception of two, height or length at start of RRT and plasma creatinine at start of RRT had lower completion rates at 75.5% and 82% respectively. This is an improvement from last year's report and reflects results of ongoing efforts within the UKRR to complete missing key data variables. The authors hope to continue to make steady progress with this in future reports.

Incidence, prevalence and trends

As shown in table 5.7, the incident paediatric ERF population <16 years of age is lower at 8.1 pmarp than that reported last year [1]. This is probably a result of merging of databases and removal of inaccuracies within the database. 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 reports from other renal registries [3] the increasing trend in average 5-year incidence rates of children on RRT is in keeping with our observations last year [1].

Analysis of the incidence rates in different age bands as displayed in table 5.8 suggests this has been maximal in the 12–15.99 year age band followed by the 0–1.99 year age band. 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 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 has led to a steady increase in the prevalent ERF population (table 5.9). This trend has been observed nationally and across most 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 and variations in the systems in place to support data collection.

Treatment modality of ERF and observed trends 1996–2010

The majority of prevalent children (76%) 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).

In 2010, the treatment modality at 90 days for peritoneal dialysis was 53%, haemodialysis 21% and transplantation at 24% (figure 5.2). Analysis of these trends in 'modality at 90 days' over the past 15-years (figure 5.4) shows that whilst there has been a modest rise overall in the proportion of patients who have commenced RRT with transplantation (26.0% in 1996–2000 to 29.9% in 2005–2009), living donation has shown the greatest rise of 8.3% (from 9.4% in 1996–2000 to 17.7% in 2006–2010). This near doubling of living donation rates over the past 15 years is obviously welcome news given the well documented advantages of living versus deceased donor renal transplantation.

The reasons for the continued high prevalence rates of dialysis as treatment modality at 90 days are complex and it can only be speculated on the possible reasons for the findings here. As discussed previously [1], these reasons may 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 [4] 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.

Comorbidities

Comorbidities have been reported as previously with the addition of an analysis showing the percentage of children with no, one or two reported comorbidities. This may be helpful in better understanding the burden of disease faced by the patients, their families and the professionals looking after them.

Causes of ERF and observed trends 1996–2010

Overall, renal dysplasia ± reflux at 32.6%, glomerulonephritis at 15.1% and obstructive uropathy at 17.3% were the commonest listed aetiologies for children with ERF, these accounted for 65% of all patients for whom a primary diagnosis had been reported. Renal dysplasia ± reflux and obstructive uropathy were both more common in males with a male:female ratio of 2:1 and 11:1 respectively. Observation of trends over the 15-year period showed an increase in the percentage of children receiving RRT with unknown aetiology between 1996–2000 and 2006–2010 (2.2% vs. 5.1%), and a decrease in metabolic diseases (5.9% vs. 4.5%) although absolute numbers remained small making it difficult to analyse possible reasons (table 5.13).

Transfer out and mortality in 2010

In this report for the first time, data are reported on the transfer of adolescents and young adults with childhood onset ERF to adult renal centres across the UK. Seventy three young adults transferred from paediatric to adult renal centres in 2010. The median age at transfer was 18 years with a range of 16.1 to 20.1 years. This may reflect patient choice or differing policies for transition and transfer. There is increasing recognition of the specific needs of this age group and further work in this area is in progress.

The incident mortality rate in 'childhood onset' ERF during childhood at 1% underscores the 'high-risk' nature of this population with the underlying cause of death in these children reflecting the practical issues involved in managing them.

With the ongoing merger of the UKRR adult and paediatric databases, future reports will provide greater detail regarding this cohort and lead to important outcome including survival data in this population. The authors also hope that inclusion of this data in future reports will improve reporting by individual centres.

Conflicts of interest: none

References

1 Sinha MD, Castledine C, van Schalkwyk D, Farida Hussain F, Lewis M, Inward C. UK Renal Registry 13th Annual Report (December 2010): Chapter 5 Demography of the UK Paediatric Renal Replacement Therapy Population in 2009. Nephron Clin Pract 2011;119(suppl 2):c97–c106. DOI: 10.1159/000331755

2 http://www.Ons.Gov.Uk/census

3 McTaggart S, Dent H, Kennedy S, Johnstone L, McDonald S. Chapter 11 Paediatric Report. ANZDATA Registry Report 2010, Australia and New Zealand Dialysis and Transplant Registry, Adelaide, South Australia

4 Lewis MA, Shaw J, Sinha MD, Adalat S, Hussain F, Castledine C, Schalkwyk DV, Inward C. UK Renal Registry 12th Annual Report (December 2009): Chapter 14 Demography of the UK Paediatric Renal Replacement Therapy population in 2008. Nephron Clin Pract 2010; 115(suppl 1):c279–c288

UK Renal Registry 14th Annual Report: Chapter 6 Survival and Causes of Death of UK Adult Patients on Renal Replacement Therapy in 2010: 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

- Unadjusted 1 year after 90 day survival for patients starting RRT in 2009 was 86.6%.
- Unadjusted 1 year survival for incident patients aged <65 years declined slightly from 91.9% in 2008 to 91.3% in 2009 although the decline was not statistically significant.
- In incident patients aged ⩾65 years, unadjusted 1 year survival has increased from 64.1% in 1997 to 76.2% in 2009 and also increased year on year in 2008 and 2009.
- Prevalent patient survival was the same as in 2009 (89.0% in 2009 and 89.1% in 2010).
- Prevalent diabetic patient survival at one year increased from 77.1% in 2001 to 83.2% in 2010.
- RRT patients aged 30–34 had a mortality rate 25 times higher than the age matched general population, whereas RRT patients aged 85+ had a mortality rate 2.7 times higher.
- In the prevalent RRT dialysis population, cardiovascular disease accounted for 22% of deaths, infection 19% and treatment withdrawal 15%; 21% were recorded as uncertain.
- The median life years remaining for an incident patient aged 25–29 years was 18 years and was about three years for a 75 year old.
- The one-year death rate for prevalent dialysis patients in the UK appear to be lower than in similar patients in the USA.

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 2010; c) causes of death for incident and prevalent patients and d) projected life years remaining for patients starting RRT. 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 7% who received a pre-emptive renal transplant. These results are therefore a true reflection of the outcomes in the whole UK RRT population. Analyses of survival within the 1st year of starting RRT 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. As is common in other countries survival analyses are also presented for the first year after 90 days.

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, alive and receiving renal replacement therapy on 31st December 2009 who had been on RRT for at least 90 days at one of the UK adult renal centres.

Since 2006 the UK has openly reported and published centre-attributable RRT data. It is again stressed that these are raw data which continue to require very cautious interpretation. The UKRR can adjust for the effects of the different age distributions of patients in different centres, but lacks sufficient data from many participating centres to enable adjustment for primary renal diagnosis, other comorbidities at start of RRT 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 UKR 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. 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 hazard 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 the hazard ratio remains constant throughout the period under consideration. Whenever used, the assumptions of the proportional hazards model were tested.

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 15 years ago at the start of the UKRR'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 UKRR has maintained age adjustment to 60 years for comparability with all previous years' analyses. Diabetic patients are included in all analyses unless otherwise stated and diabetic patients are also analysed separately and compared to non-diabetic patients. All analyses were undertaken using SAS v 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 may 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 UKRR 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 UKRR being later than the actual date of start. These findings are described in detail in chapter 13 of the 2009 Report. 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 these problems of defining day 0 within one country, there is international variability on when patient data are collected by national registries with some countries (often for financial re-imbursement or administrative reasons) defining the 90th day after starting RRT as day 0 whilst others collect data only on those who have survived 90 days and report 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.

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 incident survival cohort was **NOT** censored at the time of transplantation and therefore included the survival of the 7% 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 [5].

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.

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

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 2006 to 2009 was also undertaken. For those centres which had joined the UKRR after 2006, data are not available for all the years but the available data were included.

The death rate per 1,000 patient years was calculated by dividing the number of deaths by the person years exposed. Person years exposed are the sum of the days at risk for each patient (until death, recovery or lost to follow-up) divided by 365. All patients, even those who died within the first 90 days of RRT, were included in the death rate calculation.

Adjustment of 1 year after 90 day survival for the effect of comorbidity was undertaken using a rolling 5 year combined incident cohort from 2005 to 2009. Fourteen centres 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 fourteen 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

Dialysis patients

For prevalent dialysis patients, all patients on dialysis who had been established on RRT for at least 90 days on 1st January 2010 were included in these analyses with one exception. Prevalent dialysis patients that had received a transplant in the previous six months (1st July 2009 to 31st December 2009) which had failed were excluded from the analyses as this period is associated with an increased risk of death which is attributed to the act of transplantation. Prevalent dialysis patients on 1st January 2010 were followed up in 2010 and were censored when transplanted. This means that the patient is considered as alive up to the point of transplantation, but the patient's status post-transplant is not considered.

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 and it is common practice in some registries to censor at transplantation. 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 12% of the dialysis population aged under 65 and 2% of the population aged 65 years and over). However, to allow comparisons with other registries the survival results for prevalent dialysis patients **CENSORED** for transplantation have been quoted. To understand survival of patients, including survival following transplantation, the incident patient analyses should be viewed.

Transplant patients

The survival analyses for prevalent transplant patients included all patients who had been established on a transplant for at least 6 months on the 1st January 2010 unless transplantation was the first treatment modality in which case they were included in the analyses 3 months after transplantation. The months immediately following transplant have been shown to be associated with an increased risk of death and these analyses attempt to remove this high risk period to examine stable transplant patients only. However, this methodology results in including pre-emptively transplanted patients after 3 months and all other transplants only after 6 months. The methodology will be changed in the next report to treat pre-emptive transplants and transplants after start of dialysis in the same manner.

Methodology of causes of death

The EDTA-ERA 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 for cause of death, whilst others returned no information. Completeness of cause of death data were calculated for prevalent patients on RRT on 1st January 2010 as the percentage of patients that died in 2010 with cause of death data completed.

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 2000–2009. Previously data analysis was limited to centres with a high rate of return for cause of death. When this was compared with an analysis of all the cause of death data on the database, the percentages in corresponding EDTA-ERA 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 January 2010. The death rate was calculated for the UK general population (data from the Office of National Statistics) by age group and compared with the same age group for prevalent patients on RRT on 1st January 2010.

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 2000–2007, with at least three years follow-up from 2008 to 2010. The patient cohort inclusion criteria are the same to that of the incident cohort described above. Patients were then followed until death, censoring (recovery or lost to follow-up) or end of the study period. Life expectancy which gives the probability of surviving until the next time period was calculated as: 1 – hazard of death. 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–2010 and the number of deaths in each age group in 2010 were obtained from the Office of National Statistics for each nation separately and added together. The age-specific UK death rate was calculated as the number of deaths in the UK per thousand people in the population. The age-specific expected number of deaths in the RRT population was calculated by applying the UK age specific death rate to the sum total of years alive (exposed) of the RRT patients in that age group. This is expressed as deaths per 1,000 patient years. The age-specific number of RRT deaths was the actual number of deaths observed in 2010 in RRT patients. The RRT observed death rate was calculated as number of deaths observed in 2010 per 1,000 patient years exposed. The relative risk of death is the ratio of the observed and expected death rates for RRT patients.

Results of incident (new RRT) patient survival

The 2009 cohort included 6,827 patients who started RRT, without any periods of renal function recovery lasting more than 90 days. The unadjusted 1 year after 90 day survival for incident patients starting RRT in 2009 (table 6.1) was similar to that observed last year (86.6% in 2009 and 87.3% in 2008).

Comparison of survival between UK countries

Two year's incident data have been combined to increase the size of the patient cohort, so that any differences between the four UK countries are more likely to be reliably identified (table 6.2). These data have not been adjusted for differences in primary renal diagnosis,

Table 6.1. Unadjusted survival of incident patients, 2009 cohort

Interval	KM* survival (%)	*95% CI*	N
Survival at 90 day (%)	93.9	*93.3–94.4*	6,827
Survival 1 year after 90 days (%)	86.6	*85.7–87.4*	6,389

*KM = Kaplan–Meier

Table 6.2. Incident patient survival across the UK countries, combined 2 year cohort (2008–2009), adjusted to age 60

Interval	England	N Ireland	Scotland	Wales	UK
Survival at 90 day (%)	95.9	97.5	94.0	95.6	95.8
95% CI	*95.5–96.3*	*96.2–98.9*	*92.7–95.2*	*94.4–96.9*	*95.4–96.2*
Survival 1 year after 90 days (%)	89.9	90.8	87.5	86.0	89.5
95% CI	*89.2–90.5*	*88.1–93.6*	*85.6–89.4*	*83.6–88.4*	*88.9–90.1*

Table 6.3. Life expectancy in years in UK countries, 2007–2009 (source ONS [6])

	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 6.4. One year after 90 day survival by first established modality 2003–2009 (adjusted to age 60) (excluding patients whose first modality was transplantation)

	Age adjusted 1 year after 90 days % survival[a] *95% CI*	
Year	HD	PD
2009	87.4	92.7
	86.4–88.5	*91.2–94.2*
2008	87.9	93.9
	86.9–89.0	*92.7–95.2*
2007	87.0	94.0
	85.9–88.1	*92.8–95.3*
2006	86.9	94.2
	85.7–88.0	*92.9–95.5*
2005	85.8	93.2
	84.6–87.0	*91.8–94.6*
2004	85.8	90.5
	84.5–87.1	*88.8–92.1*
2003	85.7	92.2
	84.3–87.1	*90.7–93.8*

[a]Includes Northern Ireland from 2005 onwards

ethnicity, socio-economic status or comorbidity, nor for differences in life expectancy in the general populations of the four UK countries. There was a significant difference in 90 day survival in the UK countries with survival in Scotland significantly lower compared to survival in England and Northern Ireland. One year after 90 day survival was also significantly lower in Wales compared to England. It is postulated that greater prevalence of cardiovascular disease in Wales and Scotland compared with England may account for these differences.

There are known regional differences in the life expectancy of the general population within the UK. Table 6.3 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.

Modality

It is impossible to obtain truly valid comparisons of survival of patients starting on different modalities, as

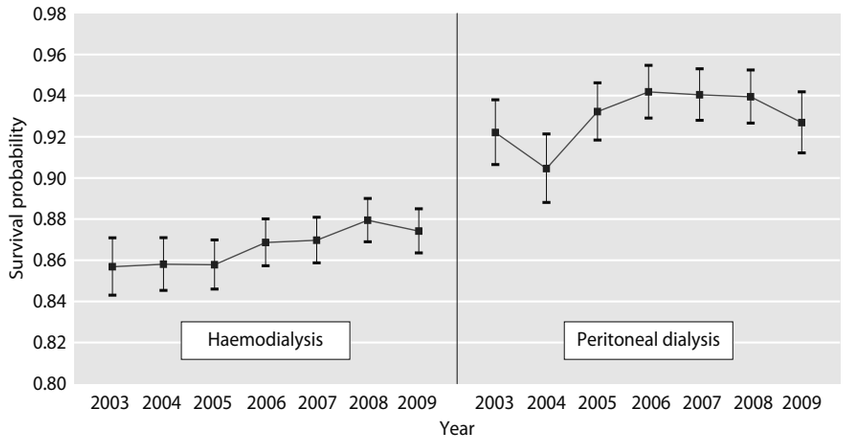

Fig. 6.1. Trend in 1 year after 90 day survival by first established modality 2003–2009 (adjusted to age 60) (excluding patients whose first modality was transplantation)

Table 6.5. Unadjusted 90 day survival of incident patients, 2009 cohort, by age

Age	KM* survival (%)	*95% CI*	N
18–64	97.1	*96.5–97.6*	3,435
⩾65	90.6	*89.5–91.5*	3,392
All ages	93.9	*93.3–94.4*	6,827

*KM = Kaplan–Meier

Table 6.6. Unadjusted 1 year after day 90 survival of incident patients, 2009 cohort, by age

Age	KM* survival (%)	*95% CI*	N
18–14	92.4	*91.4–93.2*	3,324
⩾65	80.4	*78.9–81.8*	3,065
All ages	86.6	*85.7–87.4*	6,389

*KM = Kaplan–Meier

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 87.4% and 92.7% respectively which both show a slight decline compared to last year (figure 6.1, table 6.4) although not statistically significant. The inclusion of Northern

Table 6.7. Increase in proportional hazard of death for each 10 year increase in age, at 90 days and for 1 year thereafter, 2009 cohort

Interval	Hazard of death for 10 year age increase	*95% CI*
First 90 days	1.61	*1.49–1.74*
1 year after first 90 days	1.50	*1.42–1.58*

Table 6.8. Unadjusted KM survival of incident patients, 1997–2009 cohort for patients aged 18–64

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	*95% CI for latest year*	N
2009	**91.3**										***90.3–92.2***	**3,435**
2008	91.9	86.5									*85.3–87.6*	3,503
2007	92.4	86.5	81.2								*79.8–82.5*	3,492
2006	91.4	85.7	81.0	76.2							*74.7–77.7*	3,207
2005	89.7	83.9	79.3	75.0	70.6						*68.9–72.2*	3,028
2004	89.9	84.2	78.1	72.6	68.0	64.0					*62.1–65.8*	2,688
2003	89.6	82.8	77.6	72.5	67.5	63.4	59.8				*57.8–61.8*	2,400
2002	88.6	81.8	76.4	71.3	66.6	62.8	59.1	56.4			*54.2–58.6*	2,102
2001	87.5	80.0	74.4	68.8	64.2	59.8	56.5	53.3	49.7		*47.4–52.0*	1,879
2000	89.5	81.9	75.3	70.5	65.3	60.4	56.4	53.2	51.0	48.3	*45.8–50.8*	1,609
1999	87.7	81.7	74.4	68.5	63.6	59.6	55.5	52.6	50.2	47.8	*45.1–50.5*	1,386
1998	86.8	79.4	72.7	67.6	61.6	56.9	52.9	50.5	47.6	46.3	*43.5–49.0*	1,285
1997	86.0	78.5	71.4	66.0	60.9	56.1	52.7	50.6	48.5	44.4	*40.9–47.9*	802

Table 6.9. Unadjusted KM survival of incident patients, 1997–2009 cohort for patients aged ⩾65

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	*95% CI for latest year*	N
2009	**76.2**										***74.7–77.6***	**3,392**
2008	75.8	62.9									*61.2–64.6*	3,252
2007	74.9	61.1	49.3								*47.6–51.0*	3,205
2006	72.5	59.4	48.4	38.4							*36.7–40.1*	3,172
2005	72.9	58.8	46.7	37.8	29.3						*27.7–30.9*	3,084
2004	68.7	54.8	43.3	34.4	26.8	20.8					*19.3–22.4*	2,732
2003	69.2	53.9	42.4	32.5	24.9	19.6	15.4				*14.0–16.9*	2,383
2002	66.1	51.5	40.9	32.6	25.2	19.0	14.7	11.8			*10.4–13.2*	2,181
2001	67.2	52.1	39.5	30.4	23.1	17.2	13.1	10.1	8.0		*6.8–9.4*	1,864
2000	66.2	52.9	40.1	29.2	22.9	18.2	14.1	10.2	7.9	6.1	*4.9–7.4*	1,519
1999	66.2	50.8	38.5	28.9	21.6	15.6	11.3	9.0	7.1	5.8	*4.6–7.2*	1,268
1998	63.8	46.8	36.2	27.5	20.6	14.8	10.7	7.5	5.3	4.1	*3.0–5.3*	1,148
1997	64.1	46.4	33.4	24.0	16.2	11.5	7.8	6.3	4.5	3.8	*2.5–5.6*	589

Table 6.10. Unadjusted KM survival of incident patients, 1997–2009 cohort for patients of all ages

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	*95% CI for latest year*	N
2009	**83.8**										***82.9–84.6***	**6,827**
2008	84.1	75.1									*74.0–76.1*	6,755
2007	84.0	74.3	65.9								*64.7–67.0*	6,697
2006	82.0	72.6	64.8	57.4							*56.1–58.6*	6,379
2005	81.3	71.2	62.9	56.2	49.7						*48.4–51.0*	6,112
2004	79.2	69.4	60.6	53.3	47.3	42.2					*40.9–43.5*	5,420
2003	79.5	68.4	60.1	52.6	46.3	41.6	37.7				*36.3–39.1*	4,783
2002	77.1	66.3	58.3	51.6	45.5	40.4	36.4	33.6			*32.2–35.1*	4,283
2001	77.4	66.1	57.0	49.7	43.7	38.6	34.9	31.8	29.0		*27.5–30.5*	3,743
2000	78.2	67.9	58.3	50.5	44.8	40.0	35.9	32.4	30.1	27.9	*26.3–29.5*	3,128
1999	77.4	66.9	57.2	49.6	43.5	38.5	34.3	31.7	29.5	27.7	*26.0–29.4*	2,654
1998	76.0	64.1	55.6	48.7	42.3	37.0	33.0	30.2	27.7	26.4	*24.6–28.1*	2,433
1997	76.8	65.0	55.4	48.3	42.1	37.3	33.8	31.9	30.0	27.3	*25.0–29.7*	1,391

Ireland from 2005 did not significantly affect the survival for the UK in that year (table 6.4).

Age

Tables 6.5 to 6.9 show survival of all patients, those aged 65 and above and those aged below 65 years, for up to ten years after start of renal replacement therapy. In the UK, short term survival (survival at 90 days) remained similar to last year (table 6.5). Survival 1 year after 90 days declined compared to last year and this was due mainly to a decline in survival for patients aged 65 years and younger (tables 6.6, 6.8). Longer term survival of patients on RRT continued to improve (tables 6.8, 6.9, 6.10). There was a steep decline in

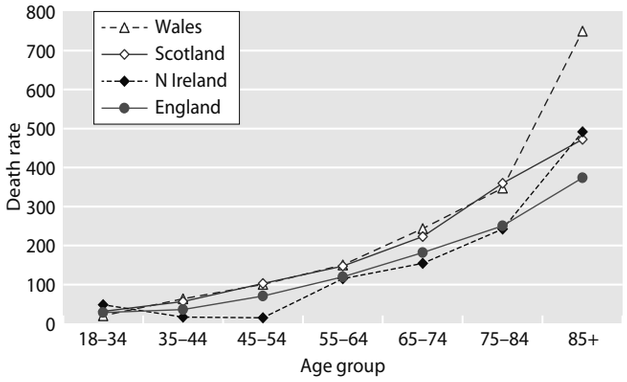

Fig. 6.3. One year after 90 days death rate per 1,000 patients years by UK country and age group for incident patients, 2006–2009 cohort

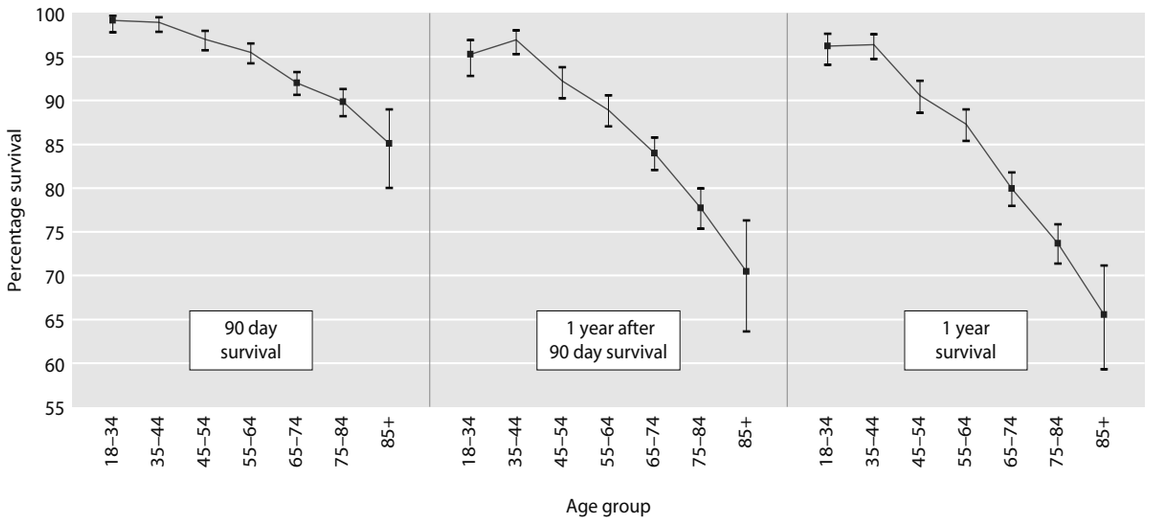

Fig. 6.2. Unadjusted survival of all incident patients by age group, 2009 cohort

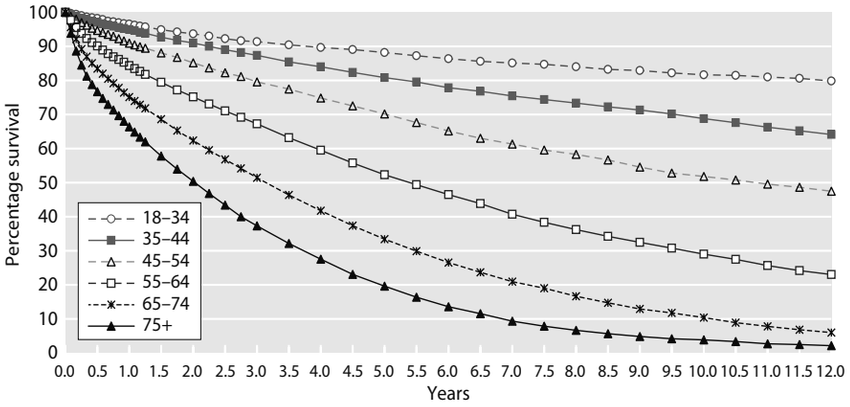

Fig. 6.4. Kaplan–Meier survival of incident patients 1997–2009 cohort (from day 0), without censoring at transplantation

survival with advancing age (figures 6.2, 6.3). Survival for patients aged 65 years and younger were lower but not significantly different compared to the previous year (tables 6.6, 6.8).

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. The death rate in Scotland and Northern Ireland decreased for patients aged 85+ compared to last year. There are differences between the overall death rates (all age groups) between some of the nations: Scotland significantly higher than England, Wales significantly higher than England and Northern Ireland.

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 the methodology and was misleading as 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 81.6% (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 [7].

From figure 6.4, it can be seen that 50% of patients starting RRT aged between 45–54 survived for 10.5 years, 50% of patients starting RRT aged between 55–64 survived for 5.6 years and 50% of patients starting RRT aged between 65–74 survived for 3 years. The comparative figures when censoring for transplantation are only different for the younger age groups where patients starting RRT aged between 45–54 survived for 6.5 years and patients aged between 55–64 years survived for 4.5 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 between 55–64 survived for 5.5 years and 50% of patients aged between 65 and 74 survived for 3.5 years.

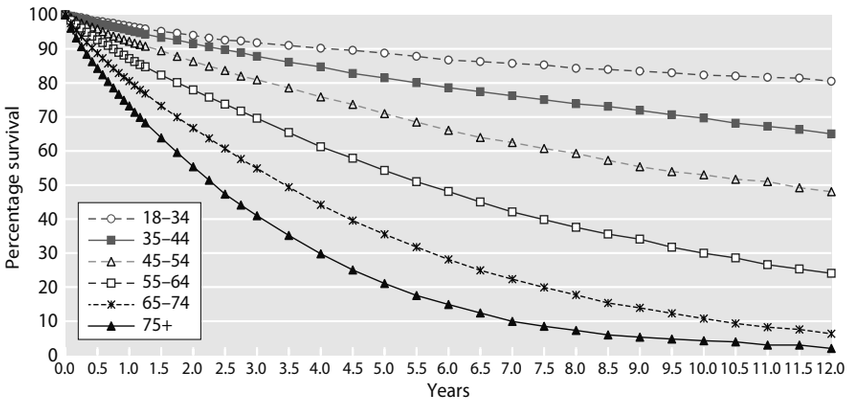

Fig. 6.5. Kaplan–Meier survival of incident patients 1997–2009 cohort (from day 90), without censoring at transplantation

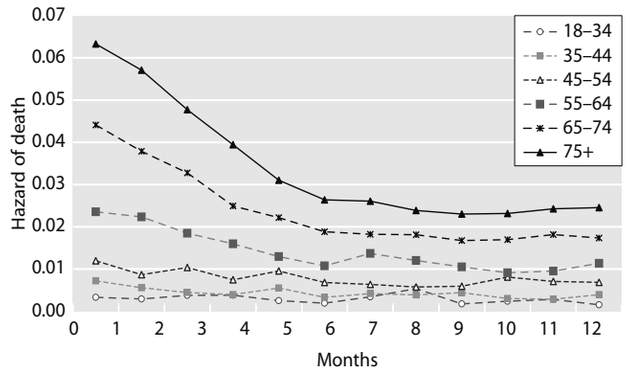

Fig. 6.6. First year monthly hazard of death, by age group 1997–2009 combined incident cohort

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

Figure 6.6 shows the monthly hazard of death from the first day of starting RRT by age, which falls sharply during the first 4–5 months particularly for older patients.

A 10 year increase in patient age was associated with a 1.6 times increased risk of death within 90 days and a 1.5 times increased risk of death within 1 year after 90 days (table 6.7).

Changes in survival from 1997–2009

The death rate per 1,000 patient years for the first year of starting RRT is shown in figure 6.7. There was a continued fall in the overall death rate with a steeper rate of decline in the older age group (aged 65 years and older). Although the death rate for all patients starting RRT in 2009 and followed up in 2010 increased slightly compared to the previous year, this increase was not significant.

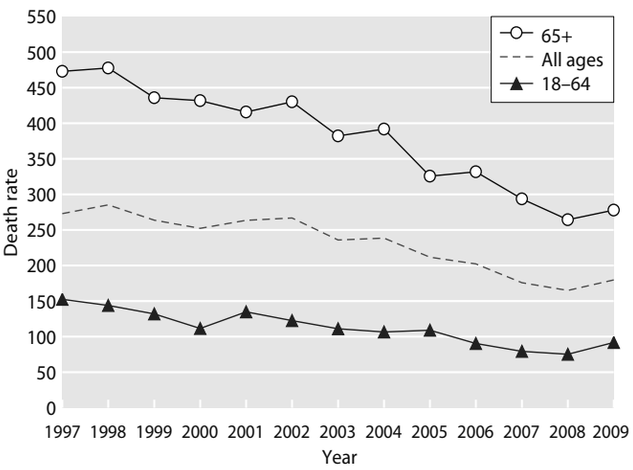

Fig. 6.7. One-year incident death rate per 1,000 patient years by age group

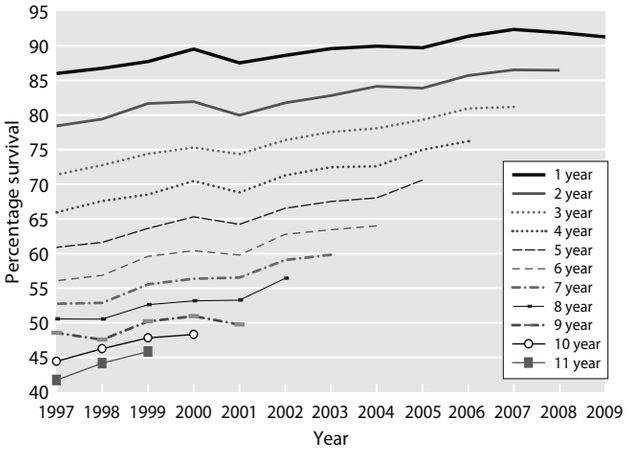

Fig. 6.8. Change in KM long term survival by year of starting RRT, for incident patients aged 18–64 years

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 6.8, 6.9, 6.10, figures 6.7, 6.8, 6.9) and annual death rates show a large improvement in 1 to 10 year survival across the years for both those under and those aged 65 years and over. Although one year survival amongst patients aged less than 65 years at start of RRT has improved from 86.0% in 1997 to 91.3% in 2009, survival in this age group has plateaued since 2006.

Similarly for patients aged 65 years and over there has been a 12.1% absolute improvement in one year survival from 1997 to 2009. Survival for patients aged 65 years

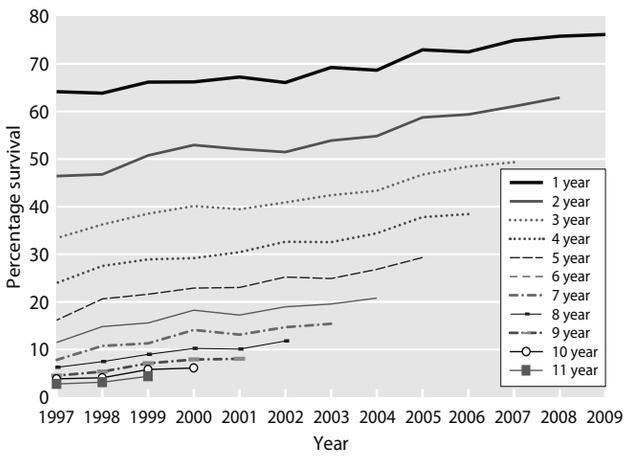

Fig. 6.9. Change in KM long term survival by year of starting RRT, for incident patients aged ⩾65 years

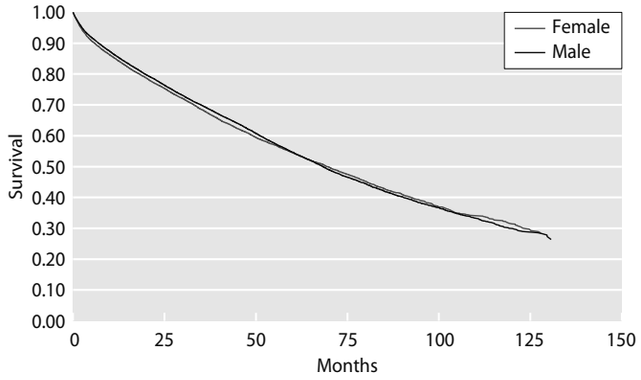

Fig. 6.10. Long term survival of incident patients by gender, 2000–2007 combined incident cohort, adjusted to age 60

and over continued to improve in both 2008 and 2009 unlike the levelling off of survival for patients aged 18–64 (see table 6.8). As these are observational data it remains difficult to attribute this reduction in risk of death to any specific improvements in care.

Gender

There were no survival differences between genders and these data are shown in figure 6.10 in an incident cohort of patients starting RRT from 2000 to 2007 and followed up for a minimum of 3 years until 2010. Gender differences were also investigated in the first 90 days and 1 year after the first 90 days and there was also no evidence of a survival difference (data not shown).

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) when comparing survival without censoring for transplantation. Figure 6.11 shows the instantaneous hazard of death and demonstrates this for all patients. The apparent vintage effect when censoring for transplantation is at least in part because these younger and healthier patients are only included in the survival calculation up to the date of transplantation (data not shown). In the older age groups, there were decreasing numbers remaining alive beyond 7 years accounting for the increased variability seen. Figures 6.12 and 6.13 show these data for the non-diabetic and diabetic patients respectively. Non-diabetic patients were defined as all incident patients excluding patients with diabetes as primary renal disease and patients with a missing primary renal diagnosis.

Time trend changes in incident patient survival, 1999–2009

The time trend changes are shown in figure 6.14. 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 are analysed.

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2009 incident cohort is shown in figure 6.15 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 6.25, 6.26). The age-adjusted individual centre survival for each of the last 9 years can also be found in appendix 1, table 6.27. There was much variability in survival between centres, but these results have to be interpreted cautiously as they were not adjusted for

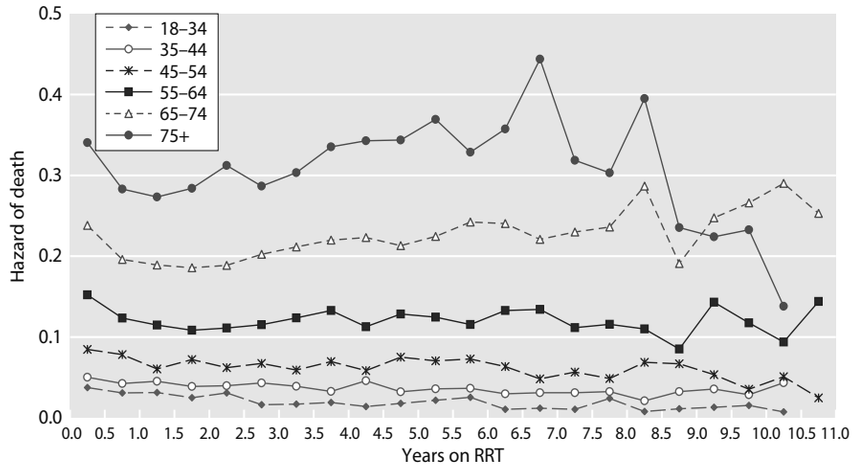

Fig. 6.11. Six monthly hazard of death, by vintage and age group, 1997–2009 incident cohort after day 90 (not censored at transplantation)

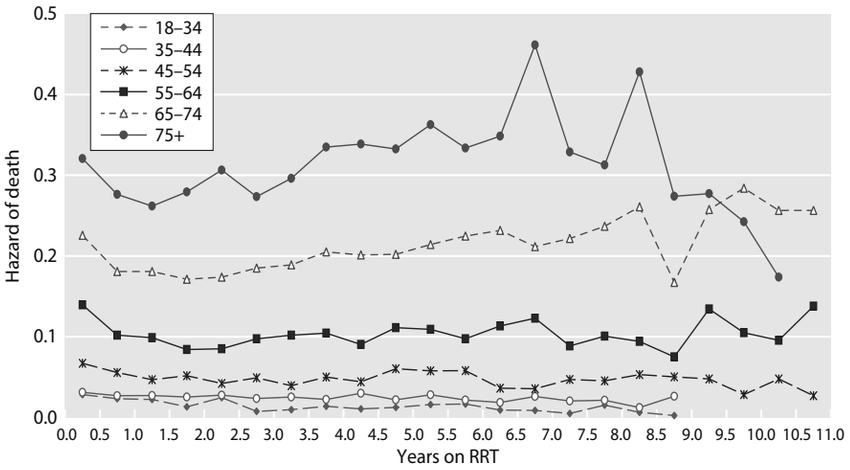

Fig. 6.12. Six monthly hazard of death, by vintage and age group, 1997–2009 non-diabetic incident cohort after day 90 (not censored at transplantation)

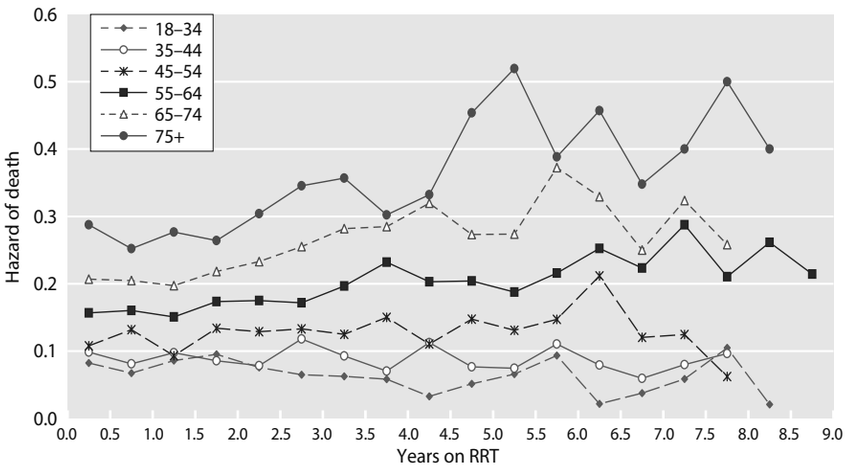

Fig. 6.13. Six monthly hazard of death, by vintage and age group, 1997–2009 diabetic incident cohort after day 90 (not censored at transplantation)

comorbidity, ethnicity nor primary renal disease and patient numbers were small in many centres. Survival results for centres with less than 20 incident patients in 2009 (Clwyd, Colchester, Dumfries & Galloway, Derry, Inverness, Newry, Tyrone, Ulster, Wrexham) are not shown in figure 6.15, although they were included in the national and UK survival calculation.

In the analysis of 2009 survival data, some of the smaller centres had wide confidence intervals (figure 6.15) due to small numbers of patients. This was addressed

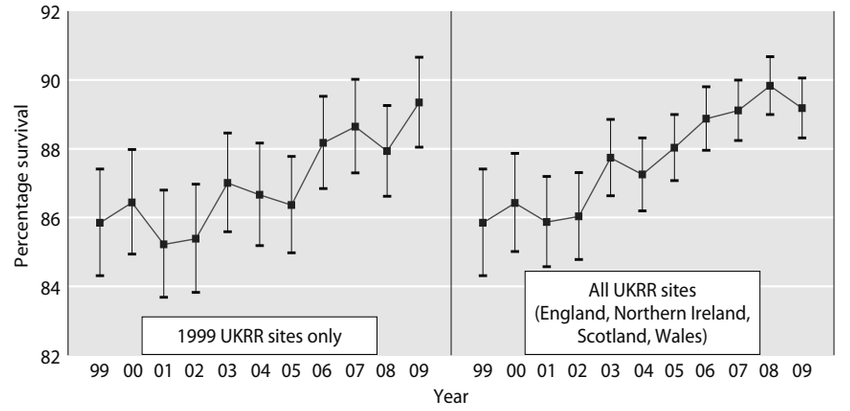

Fig. 6.14. Change in one-year after 90 day incident survival, 1999–2009 (adjusted to age 60)
Showing 95% confidence intervals

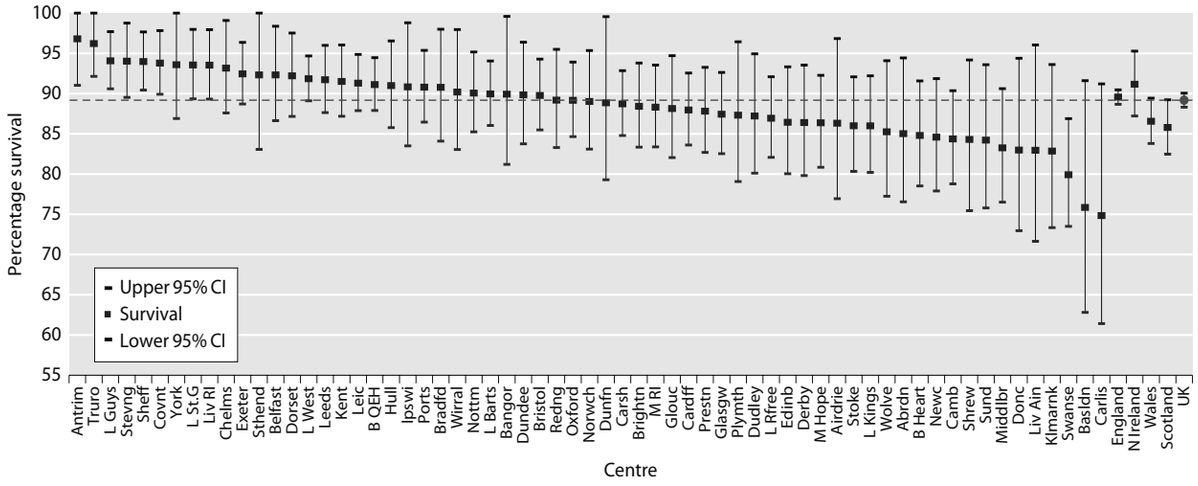

Fig. 6.15. Survival one-year after 90 days, adjusted to age 60, 2009 incident cohort

by including a larger cohort across several years, which will also assess sustained performance. Similar to previous years, this is shown as a rolling four year cohort from 2006 to 2009. These data are presented as a funnel plot in figure 6.16. For any number of patients in the 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 6.11 allows centres to be identified on this graph by finding the number of patients treated by the centre and then looking up this number on the x-axis. Six centres had significantly lower than average survival and seven centres had significantly higher than average survival. However with 72 centres it would be expected that three centres would be outside these limits by chance. These data have not been adjusted for any patient related factor except age (i.e. not comorbidity, primary renal disease nor ethnicity) and have not been censored at transplantation, so the effect of differing centre rates of transplantation was not taken into account.

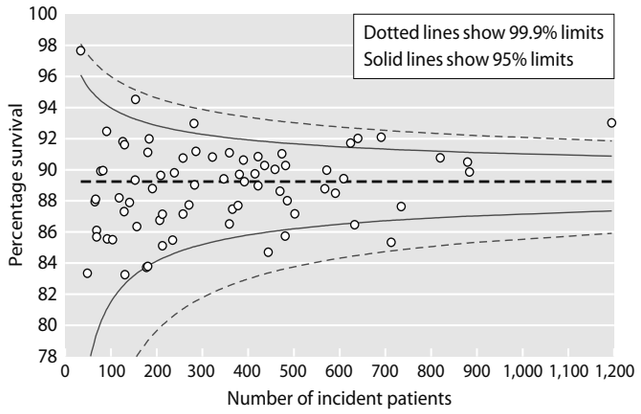

Fig. 6.16. Funnel plot for age adjusted 1 year after 90 days survival, 2006–2009 incident cohort

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

Although comorbidity returns to the UKRR have remained poor, there was an increase in the number of centres returning more than 85% of comorbidity data to the UKRR in 2009. Using the combined incident cohort from 2005–2009, it was found that 14 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 14 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, most notably in those with the lower survival in the unadjusted figures. There were only minor differences for most centres after adjustment for primary renal diagnosis. In four centres (Swansea, Carlisle, Bradford and Middlesbrough) adjustment for comorbidity had a noticeable effect on adjusted survival (table 6.12, figure 6.17) explaining the lower survival noted in figure 6.15.

Survival in patients with diabetes

Although it has been shown that diabetic patients have worse survival compared to non-diabetic patients,

Table 6.11. Adjusted (to age 60) 1 year after 90 day survival, 2006–2009 incident cohort

Centre	N	1 year after 90 day survival %	Centre	N	1 year after 90 day survival %
Abrdn	207	86.8	L Barts	820	90.8
Airdrie	181	83.8	L Guys	640	92.0
Antrim	126	91.8	L Kings	486	88.0
B Heart	381	89.7	L Rfree	691	92.1
B QEH	880	90.5	L St.G	282	93.0
Bangor	118	88.2	L West	1,195	93.0
Basldn	141	87.9	Leeds	568	88.8
Belfast	322	90.8	Leic	884	89.9
Bradfd	235	85.5	Liv Ain	131	83.3
Brightn	459	90.0	Liv RI	436	90.3
Bristol	609	89.4	M Hope	502	87.2
Camb	482	90.3	M RI	422	89.0
Cardff	713	85.3	Middlbr	359	86.5
Carlis	104	85.5	Newc	378	87.7
Carsh	735	87.6	Newry	65	87.9
Chelms	181	91.1	Norwch	347	89.4
Clwyd	67	88.1	Nottm	474	91.0
Colchr	69	86.1	Oxford	572	90.0
Covnt	415	89.7	Plymth	271	87.7
D & Gall	69	85.7	Ports	591	88.5
Derby	286	91.2	Prestn	481	85.7
Derry	34	97.6	Redng	359	91.1
Donc	78	89.9	Sheff	624	91.7
Dorset	258	90.7	Shrew	209	89.6
Dudley	178	83.7	Stevng	390	90.6
Dundee	213	87.1	Sthend	130	91.6
Dunfn	129	87.3	Stoke	258	87.2
Edinb	366	87.5	Sund	213	85.1
Exeter	470	88.6	Swanse	444	84.7
Glasgw	633	86.5	Truro	184	92.0
Glouc	239	89.8	Tyrone	91	92.5
Hull	392	89.2	Ulster	49	83.3
Inverns	92	85.5	Wirral	191	88.8
Ipswi	154	94.5	Wolve	283	89.0
Kent	422	90.8	Wrexm	83	89.9
Klmarnk	157	86.3	York	153	89.3

non-diabetic patient survival in the older age group (65 years and older) was worse compared to diabetic patients in the same age group during the first 90 days for patients starting RRT in 2009 (figure 6.18) presumably due to patient selection. When excluding the first 90 days from the analysis and following patients up for 1 year, survival was lower for diabetic patients in the younger age group (less than 65 years) with 92% of patients alive at 1 year compared to 97% for non-diabetic patients. Survival 1 year after 90 days was similar for diabetic and non-diabetic patients aged 45–64 and 65+ (figure 6.19).

Long term survival for diabetic and non-diabetic patients was evaluated in a cohort of patients starting RRT from 2000 to 2007 with a minimum of 3 years follow-up until 2010. These data show that long term diabetic patient survival was worse compared to non-diabetic patients in the 18–44 year and the 45–64 year age groups; 89% of non-diabetic patients in age group 18–44 were alive at 5 years after start of RRT compared to 69% for diabetic patients and 66% of non-diabetic patients in age group 45–64 were alive at 5 years after start of RRT compared to 47% for diabetic patients (figure 6.20).

Standard primary renal disease and survival

It is hard to set survival standards at present because these should be age, gender, ethnicity and comorbidity

Table 6.12. The effect of adjustment for age, PRD and comorbidity on survival, 2005–2009 cohort

	% survival 1 year after 90 days			
Centre[a]	Unadjusted	Age adjusted	Age, PRD adjusted	Age, PRD and comorbidity adjusted
Swanse	80.1	86.7	87.9	89.7
Ulster	80.8	87.0	87.6	88.3
Carlis	81.9	85.1	86.2	87.6
Sund	82.1	85.5	85.9	86.5
Dorset	83.7	89.5	89.5	89.3
Bradfd	84.0	87.0	87.7	88.8
Middlbr	86.1	89.0	89.3	90.2
L Kings	86.3	88.4	89.6	89.7
Hull	86.9	89.9	90.3	90.5
Glouc	87.1	91.3	91.8	92.1
Bristol	88.4	91.3	91.6	91.7
Nottm	88.7	91.3	92.0	92.4
Wolve	88.9	91.4	91.8	91.9
L Barts	96.0	96.0	96.4	96.2
All centres	**86.4**	**90.3**	**90.0**	**90.4**

[a]Centres included if >85% comorbidity data available

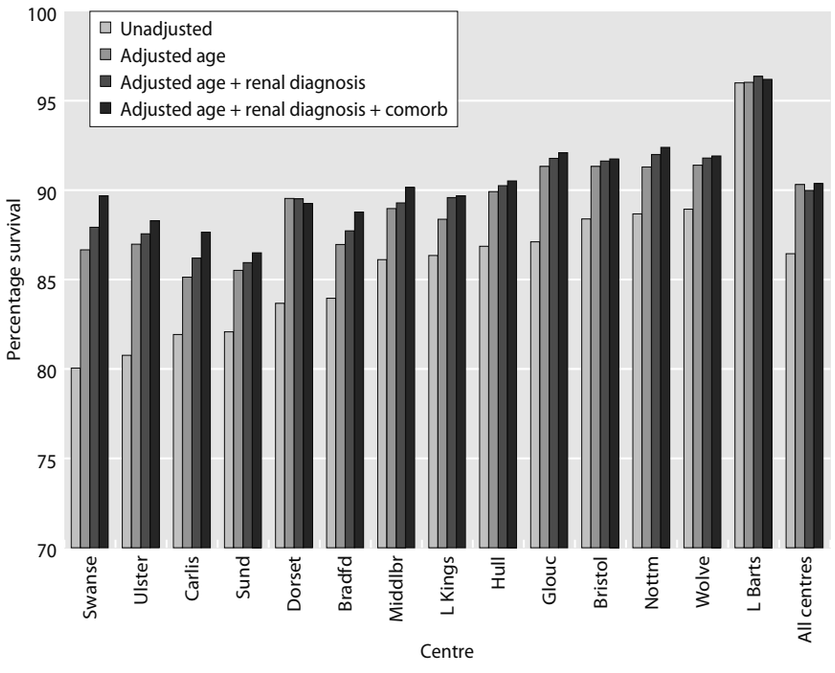

Fig. 6.17. The effect on survival after sequential adjustment for age, PRD and comorbidity, 2005–2009 cohort

adjusted and this is not yet possible from UKRR data. The current 5th edition of the Renal Association Clinical Practice Guidelines [8] does not set any standards for audit of patient survival.

The 3rd Renal Standards document defined standard primary renal disease using the EDTA-ERA 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 survival for patients starting RRT in 2009 in younger age groups (aged 18–54) and followed-up for a maximum of one year is shown in table 6.13. For a longer term comparison, the 2002 cohort is also included (table 6.13).

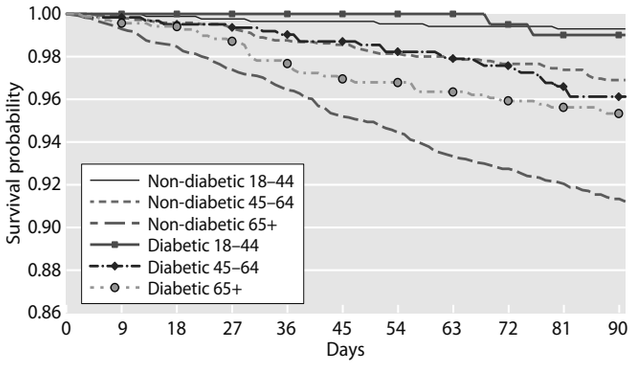

Fig. 6.18. Survival at 90 days for incident diabetic and non-diabetic patients by age group in 2009

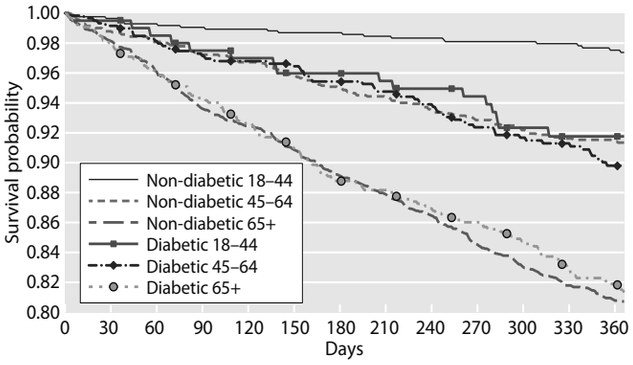

Fig. 6.19. Survival at 1 year after 90 days for incident diabetic and non-diabetic patients by age group in 2009

Results of prevalent patient survival analyses

Table 6.14 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. One year survival for prevalent patients was similar to 2009 (89.0%).

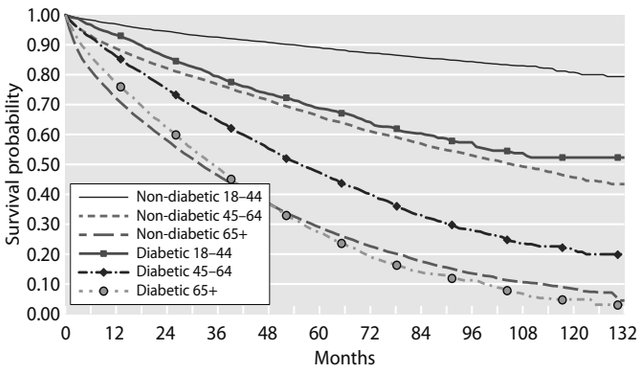

Fig. 6.20. Long term survival for incident diabetic and non-diabetic patients by age group, cohort 2000–2007, followed up for a minimum of 3 years

Table 6.15 gives the 2009 one-year death rate for prevalent dialysis patients in each UK country. The one-year death rate in Wales was significantly higher than in England and Scotland: the higher median age in Wales together with socio-economic reasons probably explains this. The one-year death rate for prevalent dialysis patients in the UK appear to be lower than similar patients in the USA [9].

Table 6.16 shows the 2009 one-year survival for transplanted patients.

Figure 6.21 shows the one year survival of dialysis patients who were alive and receiving dialysis on 1st January 2010.

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 6.14 and is illustrated in figures 6.22 and 6.23; the data for those patients aged <65 years and those aged 65 years and over are separated.

Table 6.13. One-year incident dialysis patient survival (from day 0–365), patients aged 18–54, 2009 and 2002 cohort (excludes patients whose first modality was transplantation)

	2009 cohort		2002 cohort	
First treatment	Standard primary renal disease[a]	All primary renal diseases except diabetes[b]	Standard primary renal disease[a]	All primary renal diseases except diabetes[b]
All dialysis %	95.3	93.4	95.4	93.9
95% CI	*93.7–96.5*	*92.0–94.6*	*93.7–97.1*	*92.2–95.5*
HD %	93.8	92.0	93.4	91.6
95% CI	*91.6–95.5*	*90.1–93.5*	*90.7–96.0*	*89.2–94.0*
PD %	98.9	97.2	98.6	97.9
95% CI	*96.5–99.6*	*95.0–98.4*	*71.1–100*	*96.3–99.6*

[a]Exclude patients with a missing primary renal disease
[b]Exclude patients with diabetes as primary renal disease and patients with a missing primary renal disease

Table 6.14. One year survival of prevalent dialysis patients in each centre (adjusted to age 60), 2010

Centre	N	Adjusted 1 year survival	*Lower 95% CI*	*Upper 95% CI*
Abrdn	221	90.3	*86.8*	*93.9*
Airdrie	165	89.1	*84.5*	*93.8*
Antrim	142	88.6	*84.4*	*93.0*
B Heart	442	87.2	*84.5*	*90.0*
B QEH	1,008	89.8	*88.1*	*91.5*
Bangor	105	86.3	*80.7*	*92.2*
Basldn	165	89.6	*85.7*	*93.7*
Belfast	287	86.9	*83.3*	*90.6*
Bradfd	206	89.5	*85.7*	*93.6*
Brightn	409	90.2	*87.8*	*92.7*
Bristol	494	86.0	*83.3*	*88.7*
Camb	458	91.3	*89.1*	*93.6*
Cardff	585	86.0	*83.5*	*88.6*
Carlis	77	80.7	*73.0*	*89.2*
Carsh	801	90.0	*88.2*	*91.9*
Chelms	150	90.9	*87.1*	*94.9*
Clwyd	79	77.1	*69.1*	*86.1*
Colchr	114	84.8	*79.3*	*90.6*
Covnt	416	90.4	*87.9*	*93.0*
D & Gall	66	87.3	*80.8*	*94.3*
Derby	339	90.4	*87.6*	*93.2*
Derry	65	87.8	*80.9*	*95.2*
Donc	124	89.6	*85.0*	*94.4*
Dorset	271	92.3	*89.7*	*95.0*
Dudley	194	90.6	*87.0*	*94.4*
Dundee	216	88.0	*84.4*	*91.7*
Dunfn	144	87.9	*83.2*	*92.8*
Edinb	340	89.6	*86.5*	*92.7*
Exeter	380	86.5	*83.7*	*89.5*
Glasgw	678	88.8	*86.6*	*91.0*
Glouc	220	91.9	*88.9*	*94.9*
Hull	381	87.4	*84.4*	*90.5*
Inverns	110	88.9	*84.1*	*94.1*
Ipswi	149	88.1	*83.5*	*92.9*
Kent	399	90.8	*88.3*	*93.3*
Klmarnk	180	88.5	*84.4*	*92.7*
L Barts	895	92.8	*91.2*	*94.5*
L Guys	594	90.9	*88.7*	*93.0*
L Kings	495	89.0	*86.5*	*91.6*
L Rfree	698	90.5	*88.5*	*92.5*
L St.G	317	91.0	*88.2*	*93.8*
L West	1,315	91.0	*89.6*	*92.4*
Leeds	568	90.9	*88.8*	*93.0*
Leic	908	90.7	*89.0*	*92.4*
Liv Ain	100	88.3	*82.5*	*94.5*
Liv RI	521	89.5	*87.0*	*92.0*
M Hope	493	86.2	*83.3*	*89.2*
M RI	516	87.0	*84.2*	*89.9*
Middlbr	295	84.2	*80.5*	*88.0*
Newc	333	86.8	*83.5*	*90.2*
Newry	110	86.2	*80.5*	*92.2*
Norwch	355	90.0	*87.4*	*92.7*
Nottm	488	89.5	*87.0*	*92.0*
Oxford	507	87.2	*84.6*	*89.9*
Plymth	168	85.4	*80.9*	*90.2*
Ports	527	88.3	*85.9*	*90.9*
Prestn	523	90.2	*87.9*	*92.6*
Redng	307	89.0	*85.9*	*92.1*
Sheff	658	89.6	*87.5*	*91.7*
Shrew	220	86.3	*82.3*	*90.6*
Stevng	467	90.1	*87.7*	*92.5*
Sthend	135	92.3	*88.5*	*96.3*
Stoke	357	87.1	*84.0*	*90.3*
Sund	193	85.5	*80.9*	*90.4*
Swanse	409	87.9	*85.2*	*90.7*
Truro	155	90.7	*87.0*	*94.5*
Tyrone	99	93.0	*88.6*	*97.5*
Ulster	94	89.4	*84.4*	*94.6*
Wirral	204	88.4	*84.5*	*92.5*
Wolve	342	87.8	*84.8*	*91.0*
Wrexm	110	88.1	*82.9*	*93.6*
York	155	89.4	*85.3*	*93.7*
England	**21,006**	**89.4**	***88.9***	***89.8***
N Ireland	**797**	**88.2**	***86.3***	***90.3***
Scotland	**2,120**	**88.8**	***87.6***	***90.1***
Wales	**1,288**	**86.3**	***84.6***	***88.0***
UK	**25,211**	**89.1**	***88.7***	***89.6***

Survival for Derry is not shown on figure 6.22 as no deaths were recorded for patients aged <65 years. Figure 6.24 shows the age adjusted (adjusted to age 60) data and in figure 6.25 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. Four centres had survival that was significantly below average and two centres had survival that was significantly above average. Figures 6.22 to 6.25 and 6.27 exclude patients once they were transplanted.

Table 6.14 allows centres in figure 6.25 to be identified by finding the number of patients treated by the centre and the corresponding survival and then looking this up on the axes of the funnel plot.

Table 6.15. One-year death rate per 1,000 prevalent dialysis patient years in 2010 and median age of prevalent patients by country

	England	N Ireland	Scotland	Wales
Death rate	149	170	155	207
95% CI	143–154	141–203	138–174	181–235
Median age	65.1	66.6	63.9	66.9

Table 6.16. 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 2010				
Censored at dialysis	22,556	530	97.6	*97.4–97.8*
Not censored at dialysis	22,556	566	97.5	*97.3–97.7*
Dialysis patients 2010				
All	25,211	3,426	85.8	*85.4–86.3*
All adjusted age = 60	25,211	3,426	89.1	*88.7–89.6*
2 year survival – dialysis patients				
All alive on 1/1/2009 (2 year)	24,287	5,869	73.8	*73.2–74.4*
Dialysis patients 2010				
All age <65	12,515	941	91.9	*91.4–92.4*
All age 65+	12,696	2,485	80.2	*79.5–80.9*
Non-diabetic <55	6,021	239	95.7	*95.1–96.2*
Non-diabetic 55–14	3,568	314	90.7	*89.7–91.6*
Non-diabetic 65–14	4,524	652	85.2	*84.2–86.3*
Non-diabetic 75+	5,171	1,189	76.9	*75.8–78.1*
Non-diabetic <65	9,589	553	93.8	*93.3–94.3*
Diabetic <65	2,406	343	85.1	*83.6–86.5*
Non-diabetic 65+	9,695	1,841	80.8	*80.0–81.5*
Diabetic 65+	2,479	533	78.4	*76.7–79.9*

KM = Kaplan–Meier survival
Cohorts of patients alive on 1/1/2010 unless indicated otherwise

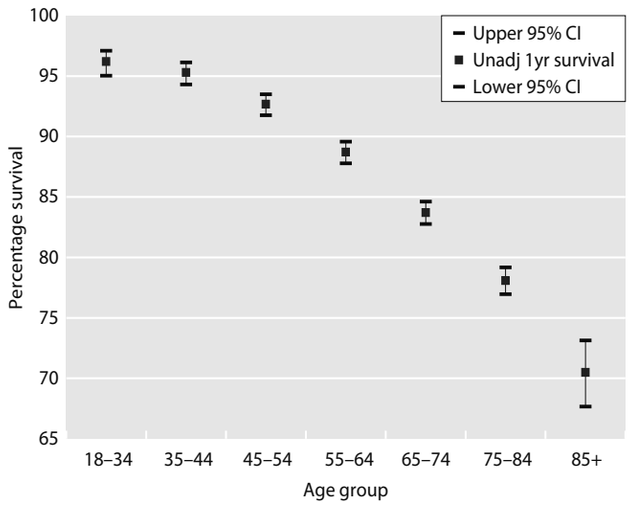

Fig. 6.21. One year survival of prevalent dialysis patients in different age groups, 2010

The one year death rate in prevalent dialysis patients in 2010 by age group

The death rates on dialysis by age group are shown in figure 6.26. 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 the death rate was not linear with age: with a 10 year increase in age in the younger patients, the death rate increased by about 20 per 1,000 patient years compared with an increase of 100 per 1,000 patient years in the older age groups. The apparent differences between the countries were not statistically significant except for Wales where the death rate was significantly higher compared to England and Scotland.

One year survival of prevalent dialysis patients by UK country from 1997 to 2010

One year survival improvement for prevalent patients seems to have stabilised in England and possibly in Scotland (figure 6.27). In Northern Ireland and Wales numbers are much smaller, the death rate is therefore more variable with very wide confidence intervals and it is difficult to draw conclusions on trends in these countries. The change in prevalent survival by centre over the years 2001 to 2009 is shown in this chapter, appendix 1, table 6.28.

One year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2001 to 2010

The previously improving age-adjusted survival in patients with diabetic renal disease in the UK seems to have plateaued since 2008 and declined slightly in 2010

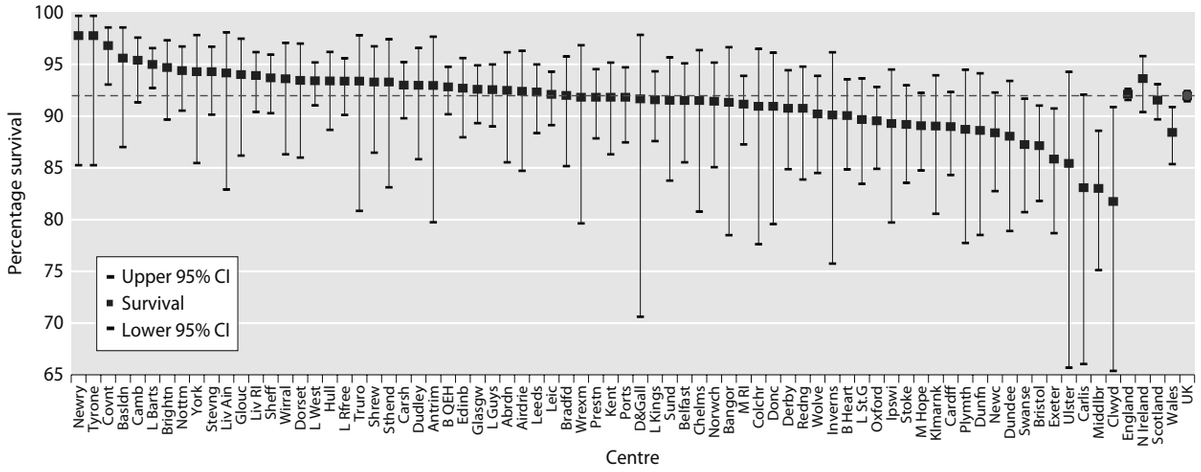

Fig. 6.22. One year survival of prevalent dialysis patients aged under 65 in each centre, 2010

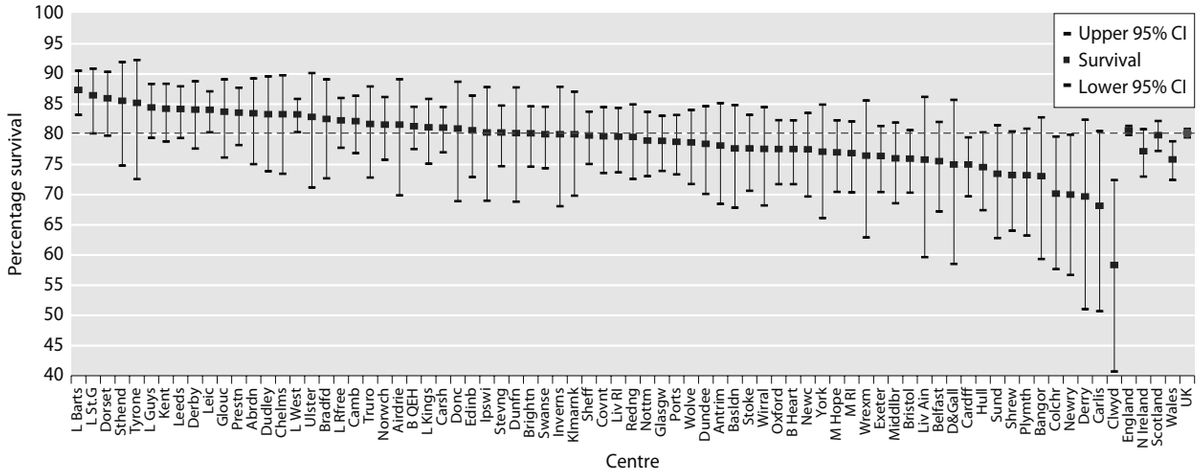

Fig. 6.23. One year survival of prevalent dialysis patients aged 65 years and over in each centre, 2010

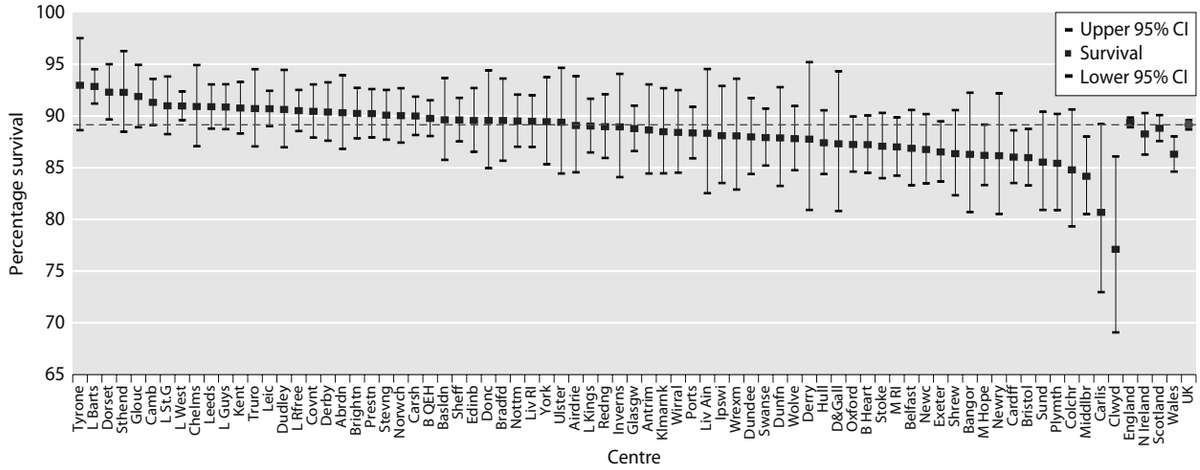

Fig. 6.24. One year survival of prevalent dialysis patients in each centre adjusted to age 60, 2010

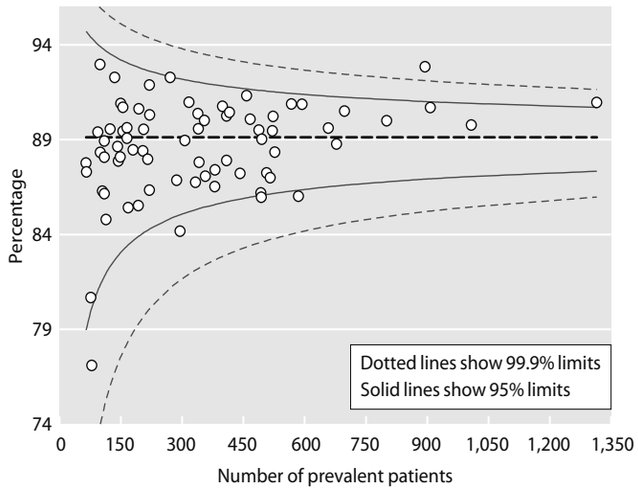

Fig. 6.25. One year funnel plot of prevalent dialysis patients in each centre adjusted to age 60, 2010

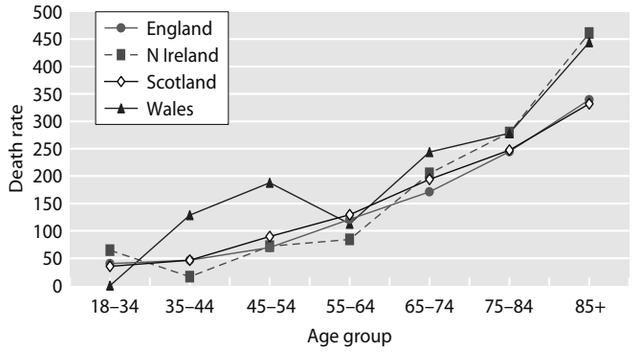

Fig. 6.26. One year death rate per 1,000 patient years by UK country and age group for prevalent dialysis patients

(table 6.17), although this decline was not statistically significant.

Death rate on RRT compared with the UK general population

The death rate compared to the general population is shown in table 6.18. Figure 6.28 shows that the relative risk of death on RRT decreased with age from 25 times that of the general population at age 30 to 34 to 2.7 times the general population at age 85+. With the reduction in rates of death on RRT over the last 10 years, the age-standardised mortality ratios compared with the general population are falling (7.7 in 2001, 6.6 in 2010).

Results of analyses on causes of death

Data completeness

Data completeness for cause of death data in the UK has increased by almost 18% from 2009 (table 6.19) with both Northern Ireland and Scotland recording more than 80% of cause of death data. Northern Ireland centres overall had the highest rate of data return (93%) and their cause of death completeness improved by about 50% from 2009. The completeness of cause of death is not comparable with last year's report because of a

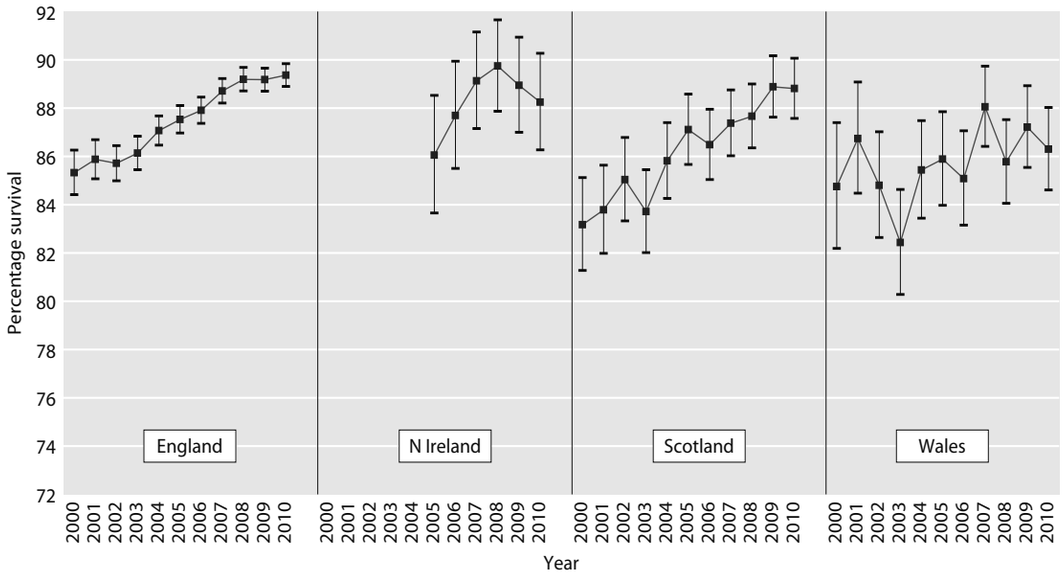

Fig. 6.27. Serial 1 year survival for prevalent dialysis patients by UK country from 2000–2010 adjusted to age 60

Table 6.17. Serial 1 year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2001–2010

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 year survival	77.1	78.5	77.9	80.6	82.7	82.0	84.9	83.5	83.6	83.2

Table 6.18. Death rate by age for all prevalent RRT patients on 1/1/2010, compared with the general population and with previous analyses in the 1998–2001 cohort

Age group	UK population mid 2010 (thousands)	UK deaths in 2010	Death rate per 1,000 population	Expected number of deaths in UK RR population	UKRR deaths in 2010	UKRR death rate per 1,000 prevalent RRT patients	Relative risk of death[1] in 2010	Relative risk of death[1] 1998–2001
20–24	4,310	1,811	0.4	0	8	9	20.4	41.1
25–29	4,249	2,121	0.5	1	22	15	29.0	41.8
30–34	3,891	2,811	0.7	1	35	18	24.8	31.2
35–39	4,202	4,305	1.0	3	47	16	15.4	26.0
40–44	4,633	6,901	1.5	6	107	26	17.4	22.6
45–49	4,566	9,899	2.2	11	167	34	15.7	19.0
50–54	3,981	13,752	3.5	17	230	46	13.4	12.8
55–59	3,579	19,568	5.5	26	305	64	11.7	10.1
60–64	3,763	31,385	8.3	44	437	84	10.0	10.4
65–69	2,932	38,723	13.2	60	496	108	8.2	7.9
70–74	2,468	53,534	21.7	93	757	177	8.2	7.2
75–79	2,002	73,431	36.7	124	715	211	5.7	5.3
80–84	1,492	95,798	64.2	128	596	298	4.6	4.0
85+	1,411	201,716	143.0	125	331	380	2.7	3.0
Total	**47,479**	**555,755**	**11.7**	**640**	**4,253**	**91**	**6.6**	**7.7**

[1]Relative risk of death for prevalent RRT patients compared with the UK general population

change in the cohort of patients included. This year the calculation is based on all prevalent patients receiving RRT in a calendar year, including incident patients for that year, and for which a death was recorded compared to the previous year when completeness was based on incident patients only. Patterns of cause of death must be cautiously interpreted, as there are significant differences between the causes of death for centres with a high proportion of non-returns when compared to centres with good ($\geqslant$70% causes of death returned) returns. Some centres consistently achieve a very high rate of data return for cause of death because a process is in place to ensure that these data were entered. Several centres have shown significant improvement in data returns and some centres that were not reporting these data in previous years have started collecting and reporting cause of death data. There is still much variability between the centres regarding the completeness of cause of death with some centres returning no data and other centres having 100% completeness (table 6.19).

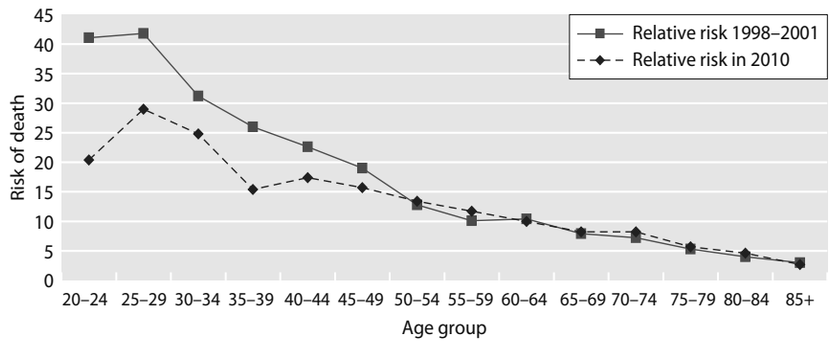

Fig. 6.28. Relative risk of death in all prevalent RRT patients in 2010 compared with the UK general population in 2010

Table 6.19. Percentage completeness of EDTA causes of death for incident patients by centre and year

Centre	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Abrdn	4.8	41.4	38.6	24.4	2.8	0.0	0.0	82.9	97.7	89.2
Airdrie	37.0	50.0	26.7	10.3	40.0	26.3	26.8	79.3	100.0	96.8
Antrim					4.3	10.0	8.6	3.8	26.9	100.0
B Heart	77.2	83.0	75.9	75.0	65.8	83.1	84.5	93.9	100.0	96.6
B QEH				0.0	60.2	3.4	3.2	2.3	0.7	0.6
Bangor		37.5	39.1	42.1	66.7	35.0	86.2	52.4	76.9	73.9
Basldn			96.0	84.0	47.4	23.8	43.5	50.0	80.0	71.0
Belfast					17.5	34.8	38.6	20.7	26.2	82.8
Bradfd	77.8	71.4	86.0	83.3	87.8	90.2	90.0	92.3	77.8	87.9
Brightn				0.0	0.0	0.0	12.0	0.0	1.1	2.4
Bristol	11.7	60.9	85.0	89.9	76.7	60.2	59.2	65.8	69.5	89.4
Camb	0.0	0.0	0.0	1.6	1.5	1.3	0.0	0.0	2.5	10.4
Cardff	5.4	0.9	1.4	0.9	2.8	2.2	2.5	0.0	0.0	2.0
Carlis	35.3	36.8	44.0	68.2	78.3	82.6	65.2	38.1	71.0	100.0
Carsh	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	6.7
Chelms				35.0	69.7	64.0	76.5	71.4	86.7	86.7
Clwyd		28.6	22.2	0.0	0.0	11.1	45.5	83.3	83.3	100.0
Colchr								0.0	0.0	69.6
Covnt	33.9	43.3	4.4	1.7	0.0	0.0	0.0	1.2	0.0	0.0
D & Gall	100.0	61.5	69.2	76.9	80.0	76.9	100.0	93.3	94.1	100.0
Derby	0.0	5.9	10.0	69.0	77.6	75.6	83.3	97.8	71.4	84.2
Derry						100.0	33.3	16.7	71.4	100.0
Donc								100.0	94.3	90.9
Dorset			0.0	30.6	61.5	64.3	84.6	86.7	81.5	95.7
Dudley	52.9	39.5	0.0	12.2	0.0	0.0	0.0	0.0	0.0	94.3
Dundee	94.1	47.1	92.1	92.1	88.6	2.8	0.0	50.0	90.6	85.7
Dunfn	100.0	95.5	80.0	66.7	81.3	50.0	53.8	61.9	89.3	72.4
Edinb	78.8	58.2	60.4	44.2	50.9	29.3	45.0	85.9	96.2	98.3
Exeter	5.1	23.3	35.1	38.0	31.6	15.8	3.5	2.1	3.0	89.5
Glasgw	63.6	53.6	49.6	41.9	40.2	52.9	55.3	75.4	88.0	66.4
Glouc	60.4	72.2	63.0	43.2	48.4	36.1	48.9	52.1	65.8	97.3
Hull	85.7	90.7	38.4	83.6	81.5	77.3	76.5	48.4	15.8	90.9
Inverns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.2	89.5	91.7
Ipswi		60.0	48.5	30.4	10.3	21.9	35.5	13.0	18.8	70.0
Kent								54.4	88.0	89.0
Klmarnk	0.0	4.0	4.0	10.0	0.0	11.1	9.4	95.8	93.3	93.9
L Barts				87.4	83.3	86.3	74.4	76.1	70.1	73.9
L Guys	0.0	0.9	1.2	0.0	0.0	0.0	2.4	1.2	0.0	67.3
L Kings		100.0	31.9	66.7	85.7	90.6	75.6	88.2	67.1	96.1
L Rfree						0.0	0.0	0.0	0.9	1.7
L St.G							16.7	14.8	21.4	53.1
L West		76.4	79.1	67.5	79.5	31.5	16.7	5.8	2.2	0.5
Leeds	52.6	52.4	59.1	68.2	67.2	64.4	27.4	27.0	30.7	95.9
Leic	66.9	78.4	76.8	88.2	71.7	74.1	64.1	63.2	64.7	70.1
Liv Ain				66.7	50.0	81.3	73.3	66.7	100.0	80.0
Liv RI	82.6	81.4	71.0	70.6	39.8	63.6	77.0	74.4	79.2	71.6
M Hope			1.7	1.3	0.0	0.0	1.3	0.0	1.3	0.0
M RI							4.0	0.9	0.0	4.7
Middlbr	84.8	93.7	66.7	42.0	76.1	61.9	50.7	18.2	41.3	88.2
Newc		78.3	30.7	27.4	20.8	29.8	49.4	35.7	43.6	14.3
Newry					0.0	45.0	16.7	15.4	85.7	95.2
Norwch				30.8	21.0	21.4	18.2	21.2	44.4	77.0
Nottm	86.3	94.8	91.5	93.3	96.9	87.5	85.9	98.8	97.1	98.8
Oxford	2.0	3.0	0.8	1.9	1.9	0.0	0.0	1.0	0.0	84.6
Plymth	46.8	44.9	41.5	42.9	35.1	39.6	56.7	70.0	40.0	78.7
Ports	58.3	30.2	32.7	32.6	9.3	4.5	14.6	5.0	41.8	67.0
Prestn	78.7	82.1	73.8	75.9	50.0	55.4	47.8	38.1	17.9	95.7

Table 6.19. Continued

Centre	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Redng	64.3	46.9	86.0	77.1	81.5	77.1	97.8	89.6	83.0	97.3
Sheff	100.0	95.7	97.6	19.6	0.0	0.9	0.8	0.9	0.9	3.0
Shrew				25.0	63.6	53.1	82.1	56.3	20.5	46.0
Stevng	8.5	63.4	63.8	64.2	73.8	55.6	46.4	61.8	64.3	84.9
Sthend	30.8	48.4	66.7	25.0	41.2	9.4	3.2	57.7	75.0	92.3
Stoke							16.1	21.0	28.6	53.9
Sund	58.1	69.2	51.1	54.8	54.8	60.0	60.5	50.0	78.4	93.5
Swanse	74.5	94.9	92.0	89.2	85.7	92.4	97.3	96.1	89.8	96.9
Truro	25.0	67.5	80.6	57.1	2.3	6.9	0.0	18.4	27.0	93.3
Tyrone					46.2	56.0	41.7	30.0	35.3	100.0
Ulster					100.0	85.7	93.3	90.0	78.9	100.0
Wirral		36.4	82.9	64.5	31.3	79.4	60.5	84.4	3.0	54.1
Wolve	97.6	98.2	98.5	96.6	89.1	43.9	52.3	63.2	70.9	96.9
Wrexm	14.8	10.3	0.0	0.0	3.8	0.0	18.2	70.4	100.0	95.7
York	0.0	33.3	82.5	65.8	41.4	83.3	38.5	60.0	60.7	88.9
England	**46.6**	**53.7**	**51.1**	**50.1**	**45.7**	**39.7**	**35.6**	**34.9**	**36.3**	**57.2**
N Ireland					**20.5**	**39.6**	**33.8**	**22.8**	**42.4**	**92.7**
Scotland	**61.5**	**49.6**	**49.5**	**41.7**	**40.4**	**32.1**	**33.6**	**75.2**	**92.5**	**82.9**
Wales	**28.7**	**36.7**	**32.3**	**29.4**	**28.3**	**30.1**	**42.0**	**36.4**	**46.5**	**50.2**
UK	**47.3**	**51.8**	**49.2**	**47.7**	**43.3**	**38.3**	**35.7**	**38.4**	**42.2**	**60.1**

Blank cells, data not available for that year

Table 6.20. Cause of death in the first 90 days for incident patients by age, 2000–2009

	All age groups		<65 years		⩾65 years	
Cause of death	N	%	N	%	N	%
Cardiac disease	526	28	123	30	403	27
Cerebrovascular disease	95	5	21	5	74	5
Infection	327	17	58	14	269	18
Malignancy	158	8	43	10	115	8
Treatment withdrawal	284	15	45	11	239	16
Other	168	9	37	9	131	9
Uncertain	325	17	85	21	240	16
Total	**1,883**		**412**		**1,471**	
No cause of death data	2,341	55	522	56	1,819	55

Table 6.21. Cause of death in 1 year after 90 days for incident patients by age, 2000–2009

	All age groups		<65 years		⩾65 years	
Cause of death	N	%	N	%	N	%
Cardiac disease	787	24	247	26	540	23
Cerebrovascular disease	175	5	44	5	131	6
Infection	593	18	177	19	416	18
Malignancy	342	10	126	13	216	9
Treatment withdrawal	522	16	78	8	444	19
Other	243	7	85	9	158	7
Uncertain	625	19	190	20	435	19
Total	**3,287**		**947**		**2,340**	
No cause of death data	3,991	55	1,145	55	2,846	55

Table 6.22 Cause of death in prevalent RRT patients by age and modality on 1/1/2010

	All modalities		Dialysis		Transplant	
Cause of death	N	%	N	%	N	%
Cardiac disease	572	22	510	23	62	17
Cerebrovascular disease	122	5	101	5	21	6
Infection	498	19	419	19	79	22
Malignancy	279	11	196	9	83	23
Treatment withdrawal	351	14	337	15	14	4
Other	233	9	196	9	37	10
Uncertain	535	21	466	21	69	19
Total	**2,590**		**2,225**		**365**	
No cause of death data	1,666	39	1,393	39	273	43

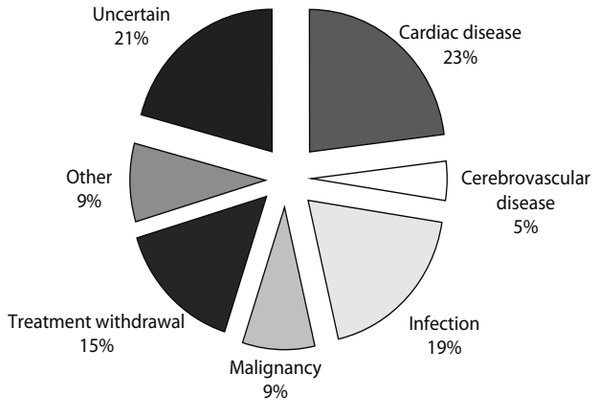

Fig. 6.29. Percentage contribution to cause of death for prevalent dialysis patients in 2010

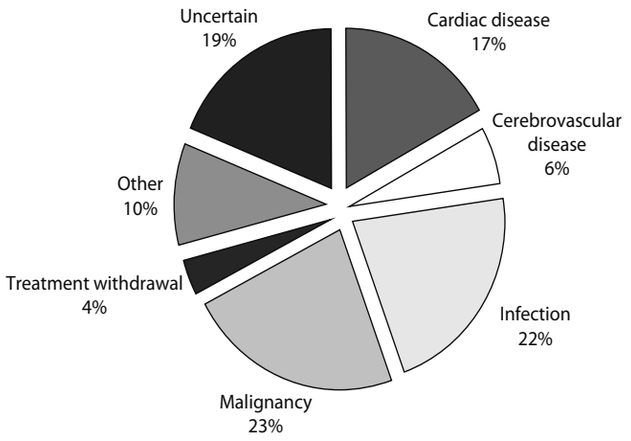

Fig. 6.30. Percentage contribution to cause of death for prevalent transplant patients in 2010

Causes of death in incident RRT patients

Causes of death within the first 90 days

See table 6.20.

Causes of death within one year after 90 days

Treatment withdrawal as a cause of death (tables 6.20, 6.21) in incident patients in the first 90 days and one year after 90 days was more common in older (aged 65+) patients and malignancy more common in younger patients (<65 years old). Infection within the first 90 days as cause of death was more common in older patients.

Causes of death in prevalent RRT patients in 2010

Table 6.22, figures 6.29 and 6.30 show the causes of death for both prevalent dialysis and transplant patients. These data are neither age-adjusted nor adjusted for differences in the comorbidity between the two groups. Cardiac disease as a cause of death was less common in 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 prevalent transplanted patients. There was an increase in treatment withdrawal in the transplanted group compared to 2009 indicating more patients choose not to restart dialysis when their renal transplant fails.

Table 6.23 shows that infection as the cause of death in prevalent patients was much more common in older (⩾65 years old) transplanted patients and malignancy more common in the younger (<65 years old) transplanted patients.

Table 6.24 shows the cause of death for prevalent dialysis patients. Prevalent dialysis patients aged 65 years and over were significantly more likely to withdraw from treatment than younger patients and cardiac disease was much more common as a cause of death in younger (<65 years old) dialysis patients. Figure 6.31 shows cause of death for prevalent patients over the time period 1998 to 2010. Over time, cardiac disease as cause of death has decreased markedly, unknown cause of death increased and cerebrovascular disease gradually declined (figure 6.31).

Table 6.23. Cause of death in prevalent transplanted patients by age on 1/1/2010

	All age groups		<65 years		⩾65 years	
Cause of death	N	%	N	%	N	%
Cardiac disease	62	17	37	18	25	16
Cerebrovascular disease	21	6	12	6	9	6
Infection	79	22	38	18	41	26
Malignancy	83	23	54	26	29	19
Treatment withdrawal	14	4	6	3	8	5
Other	37	10	24	11	13	8
Uncertain	69	19	38	18	31	20
Total	**365**		**209**		**156**	
No cause of death data	273	43	157	57	116	43

Table 6.24. Cause of death in prevalent dialysis patients by age on 1/1/2010

	All age groups		<65 years		⩾65 years	
Cause of death	N	%	N	%	N	%
Cardiac disease	510	23	194	31	316	20
Cerebrovascular disease	101	5	22	3	79	5
Infection	419	19	124	20	295	19
Malignancy	196	9	47	7	149	9
Treatment withdrawal	337	15	43	7	294	18
Other	196	9	68	11	128	8
Uncertain	466	21	136	21	330	21
Total	**2,225**		**634**		**1,591**	
No cause of death data	1,393	39	361	36	1,032	39

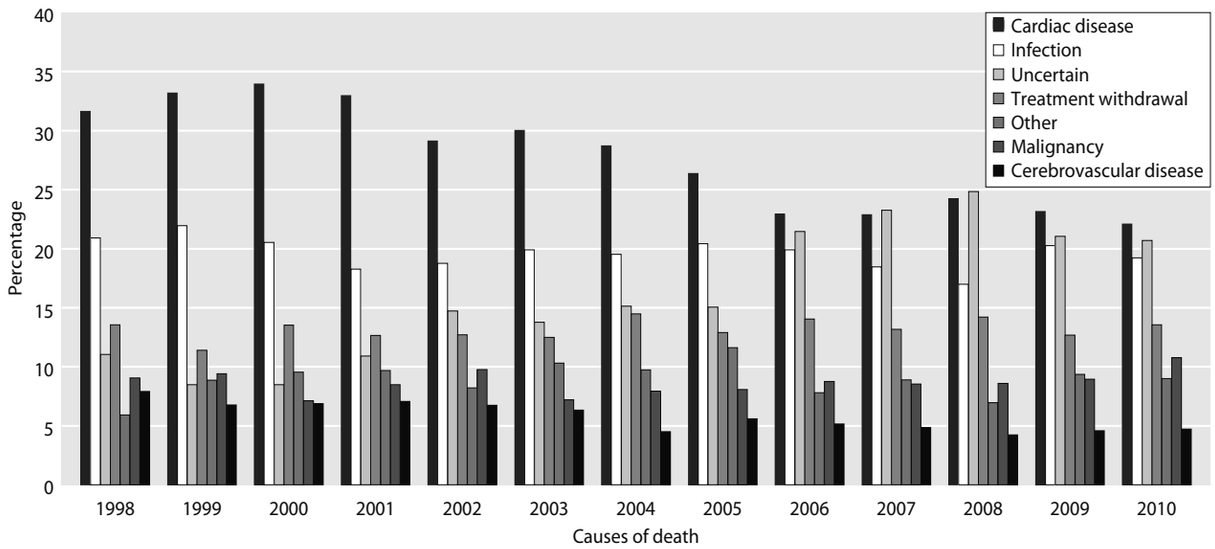

Fig. 6.31. Cause of death in prevalent RRT patients by year

Median life expectancy on RRT

The statistical methodology for this analysis is described in the methodology section at the start of this chapter. Figure 6.32 shows median life expectancy by age group. All incident patients starting RRT from 2000 to 2007 have been included in this analysis and patients were followed up for a minimum of 3 years.

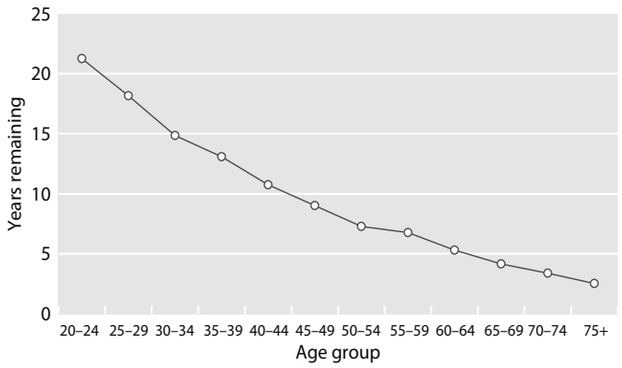

Fig. 6.32. Median life expectancy on RRT by age group, incident patients starting RRT from 2000–2007

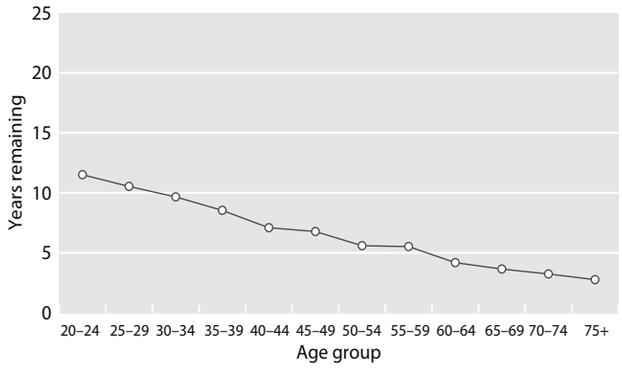

Fig. 6.33. Median life expectancy on RRT by age group, incident diabetic patients starting RRT from 2000–2007

The estimated median survival will be different for low risk patients (e.g. polycystic kidney disease with a transplant) vs. high risk (diabetic with previous myocardial infarction on dialysis) even within the same age group. Median life years remaining for non-diabetic and diabetic patients were also calculated and show that median life expectancy for patients younger than 45 is on average nine years more for non-diabetic patients compared to diabetic patients (figure 6.33). In the older age group ($\geqslant$65 years old) the median life years remaining were similar between diabetic and non-diabetic patients.

Conflicts of interest: none

References

1 Miskulin DC, Meyer KB, Martin AA, et al. Comorbidity and its change predict survival in incident dialysis patients. American journal of kidney diseases: the official journal of the National Kidney Foundation 2003;**41**(1):149–161

2 Plantinga LC, Fink NE, Levin NW, et al. Early, Intermediate, and Long-Term Risk Factors for Mortality in Incident Dialysis Patients: The Choices for Healthy Outcomes in Caring for ESRD (CHOICE) Study. American journal of kidney diseases: the official journal of the National Kidney Foundation 2007;**49**(6):831–840

3 Tomson C, Maggs C. UK Renal Registry 12th Annual Report (December 2009): chapter 2: introduction. Nephron Clin Pract. 2010;**115**(suppl 1): c3–c8

4 Ford DJ, Fogarty DG, Steenkamp R, Tomson CRV, Ben-Shlomo Y, Ansell D. Chapter 13: The UK Renal Registry Advanced CKD Study: frequency of incorrect reporting of date of start of RRT. Nephron Clinical Practice;**115**(suppl. 1):c271–278

5 Malek SK, Keys BJ, Kumar S, Milford E, Tullius SG. Racial and ethnic disparities in kidney transplantation. Transplant International 2011; **24**(5):419–24 doi: 10.1111/j.1432-2277.2010.01205.x[published Online First: Epub Date]

6 Office for National Statistics. www.ons.gov.uk

7 Ansell D, Roderick P, Hodsman A, Ford D, Steenkamp R, Tomson C. UK Renal Registry 11th Annual Report (December 2008): Chapter 7 Survival and causes of death of UK adult patients on renal replacement therapy in 2007: national and centre-specific analyses. Nephron Clin Pract. 2009; **111**(suppl 1):c113–139

8 Renal Association. Clinical Practice Guidelines. 5th edition. 2010;http://www.renal.org/Clinical/GuidelinesSection/Guidelines.aspx

9 US Renal Data System, USRDS 2011 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2011

Appendix 1: Survival tables

Table 6.25. One-year after 90-day incident survival by centre for 2009, unadjusted and adjusted to age 60

Centre	Unadjusted 1 year after 90 days survival	Adjusted 1 year after 90 days survival	Adjusted 1 year after 90 days 95% CI
Abrdn	82.00	85.01	*76.5–94.4*
Airdrie	86.30	86.31	*76.9–96.8*
Antrim	95.00	96.80	*91.0–100.0*
B Heart	80.71	84.78	*78.5–91.6*
B QEH	89.26	91.12	*87.9–94.5*
Bangor	86.21	89.92	*81.2–99.6*
Basldn	66.41	75.84	*62.8–91.6*
Belfast	89.83	92.31	*86.6–98.4*
Bradfd	89.22	90.78	*84.1–98.0*
Brightn	84.16	88.41	*83.3–93.8*
Bristol	86.50	89.77	*85.5–94.3*
Camb	80.91	84.36	*78.8–90.4*
Cardff	84.61	87.96	*83.6–92.5*
Carlis	66.41	74.84	*61.4–91.2*
Carsh	84.30	88.72	*84.8–92.8*
Chelms	90.20	93.16	*87.6–99.1*
Covnt	91.35	93.78	*89.9–97.8*
Derby	82.04	86.40	*79.8–93.5*
Donc	76.52	82.97	*72.9–94.4*
Dorset	88.82	92.19	*87.2–97.5*
Dudley	82.20	87.20	*80.1–94.9*
Dundee	84.99	89.84	*83.7–96.4*
Dunfn	85.71	88.85	*79.3–99.6*
Edinb	83.76	86.42	*80.0–93.3*
Exeter	89.05	92.44	*88.7–96.4*
Glasgw	86.16	87.43	*82.5–92.6*
Glouc	83.41	88.14	*82.0–94.7*
Hull	88.68	90.99	*85.8–96.5*
Ipswi	86.20	90.82	*83.5–98.8*
Kent	88.65	91.50	*87.2–96.0*
Klmarnk	76.32	82.85	*73.3–93.6*
L Barts	89.96	89.95	*86.0–94.0*
L Guys	93.92	94.07	*90.6–97.7*
L Kings	85.48	85.99	*80.2–92.2*
L Rfree	85.13	86.93	*82.1–92.1*
L St.G	91.81	93.56	*89.3–98.0*
L West	90.44	91.85	*89.1–94.7*
Leeds	89.87	91.72	*87.6–96.0*
Leic	89.32	91.30	*87.9–94.9*
Liv Ain	79.86	82.94	*71.6–96.0*
Liv RI	92.41	93.53	*89.3–97.9*
M Hope	84.17	86.36	*80.8–92.3*
M RI	86.97	88.31	*83.4–93.5*
Middlbr	79.46	83.25	*76.5–90.6*
Newc	81.92	84.75	*78.1–91.9*
Norwch	84.15	89.01	*83.1–95.3*
Nottm	88.27	90.06	*85.2–95.2*
Oxford	87.34	89.16	*84.6–93.9*
Plymth	85.49	87.31	*79.1–96.4*
Ports	88.79	90.80	*86.4–95.4*
Prestn	86.46	87.81	*82.7–93.3*
Redng	86.78	89.18	*83.3–95.5*
Sheff	92.71	93.97	*90.4–97.7*
Shrew	78.25	84.29	*75.4–94.2*
Stevng	93.29	94.03	*89.5–98.8*
Sthend	90.87	92.32	*83.1–100.0*
Stoke	81.27	85.99	*80.3–92.1*
Sund	83.33	84.21	*75.8–93.6*
Swanse	72.20	79.90	*73.5–86.9*
Truro	94.44	96.21	*92.1–100.0*
Wirral	88.64	90.19	*83.0–97.9*
Wolve	83.22	85.24	*77.2–94.1*
York	91.84	93.58	*86.9–100.0*
England	**87.18**	**89.56**	***88.7–90.5***
N Ireland	**88.36**	**91.15**	***87.2–95.3***
Scotland	**83.69**	**86.56**	***83.8–89.4***
Wales	**80.77**	**85.79**	***82.5–89.2***
UK	**86.59**	**89.18**	***88.3–90.0***

Excluded: Data from centres with less than 20 patients (Clwyd, Colchr, D & Gall, Derry, Invern, Newry, Tyrone, Ulster, Wrexm)

Table 6.26. Ninety day incident survival by centre for 2009, unadjusted and adjusted to age 60

Centre	Unadjusted 90 day survival	Adjusted 90 day survival	Adjusted 90 day 95% CI
Abrdn	90.9	93.3	*87.8–99.1*
Airdrie	91.7	92.4	*85.5–99.8*
Antrim	95.2	97.3	*92.2–100.0*
B Heart	96.0	97.2	*94.6–99.9*
B QEH	97.6	98.2	*96.8–99.6*
Bangor	96.7	97.8	*93.9–100.0*
Basldn	92.3	95.4	*89.5–100.0*
Belfast	96.7	97.8	*94.8–100.0*
Bradfd	93.4	95.0	*90.3–99.9*
Brightn	92.5	95.1	*92.0–98.3*
Bristol	91.8	94.4	*91.5–97.5*
Camb	94.9	96.3	*93.6–99.0*
Cardff	94.9	96.5	*94.3–98.8*
Carsh	93.2	95.6	*93.4–97.9*
Covnt	92.4	95.1	*92.0–98.3*
Derby	93.6	95.7	*92.1–99.4*
Donc	87.5	91.9	*85.4–98.9*
Dorset	94.7	96.7	*93.6–99.9*
Dudley	84.1	89.9	*84.4–95.8*
Dundee	89.9	94.2	*90.0–98.5*
Dunfn	84.8	89.6	*81.6–98.5*
Edinb	90.7	93.0	*88.7–97.5*
Exeter	90.3	94.1	*91.1–97.2*
Glasgw	88.6	90.8	*87.0–94.8*
Glouc	93.7	96.0	*92.6–99.5*
Hull	94.0	95.6	*92.2–99.1*
Inverns	85.7	89.5	*79.2–100.0*
Kent	91.5	94.4	*91.3–97.7*
Klmarnk	97.4	98.4	*95.3–100.0*
L Barts	96.7	96.8	*94.7–99.0*
L Guys	97.2	97.4	*95.2–99.7*
L Kings	98.4	98.6	*96.6–100.0*
L Rfree	95.3	96.1	*93.6–98.8*
L St.G	95.3	96.6	*93.8–99.6*
L West	95.5	96.5	*94.8–98.2*
Leeds	94.1	95.7	*93.0–98.5*
Leic	93.4	95.1	*92.7–97.6*
Liv Ain	78.9	85.3	*76.5–95.2*
Liv RI	98.2	98.6	*96.6–100.0*
M Hope	96.8	97.5	*95.0–99.9*
M RI	99.3	99.4	*98.3–100.0*
Middlbr	92.6	94.7	*91.0–98.6*
Newc	91.0	93.2	*89.0–97.6*
Newry	95.0	96.2	*89.4–100.0*
Norwch	98.6	99.2	*97.6–100.0*
Nottm	95.5	96.6	*93.9–99.3*
Oxford	87.0	90.2	*86.4–94.2*
Plymth	92.9	94.5	*89.5–99.9*
Ports	94.6	96.0	*93.3–98.8*
Prestn	93.9	94.8	*91.5–98.2*
Redng	90.7	93.4	*89.4–97.7*
Sheff	94.0	95.5	*92.6–98.4*
Shrew	93.6	95.9	*91.6–100.0*
Stevng	96.9	97.5	*94.7–100.0*
Stoke	93.6	95.8	*92.8–98.9*
Sund	93.8	94.5	*89.4–99.9*
Swanse	93.0	95.8	*92.9–98.7*
Truro	93.1	95.8	*91.8–99.9*
Wirral	90.5	92.4	*86.8–98.4*
Wolve	93.8	95.1	*90.6–99.9*
Wrexm	85.0	91.2	*82.3–100.0*
York	87.2	90.7	*83.9–98.0*
England	**94.2**	**95.8**	***95.2–96.4***
N Ireland	**96.7**	**97.8**	***95.9–99.7***
Scotland	**90.1**	**92.8**	***90.9–94.8***
Wales	**93.9**	**96.2**	***94.6–97.8***
UK	**93.9**	**95.6**	***95.1–96.2***

Excluded: centres with data from less than 20 incident patients (Clwyd, Colchr, D & Gall, Derry, Tyrone, Ulster) and centres with no deaths in the first 90 days of RRT (Carlis, Chelms, Ipswi, Sthend)

Table 6.27. One year after 90-day incident survival by centre for incident cohort years 2001–2009, adjusted to age 60

	One year after 90 days survival								
Centre	2001	2002	2003	2004	2005	2006	2007	2008	2009
Abrdn	92.4	88.0	82.9	89.7	79.5	82.8	85.1	94.0	85.0
Airdrie	84.8	79.5	78.8	85.7	72.3	75.6	84.2	90.9	86.3
Antrim					86.2	94.4	84.9	94.9	96.8
B Heart	85.9	88.7	86.5	87.6	85.0	90.0	90.9	93.2	84.8
B QEH				88.5	90.3	87.7	93.3	89.3	91.1
Bangor		83.1	88.9	84.2	81.4	81.5	92.7	88.6	89.9
Basldn			91.9	95.1	92.4	91.0	87.8	92.4	75.8
Belfast					90.4	92.4	90.3	88.3	92.3
Bradfd	93.4	86.3	84.5	84.6	85.7	76.9	86.8	85.3	90.8
Brightn				88.1	83.2	90.4	94.3	87.1	88.4
Bristol	85.7	87.9	87.2	87.9	83.5	93.2	90.9	83.5	89.8
Camb	90.7	82.4	88.9	87.6	90.9	92.4	91.7	92.6	84.4
Cardff	83.3	83.0	89.3	86.3	88.4	85.9	82.2	86.7	88.0
Carlis		87.8	78.3	87.0	82.8	91.1	92.8	85.5	75.0
Carsh	76.2	84.7	90.8	87.0	91.6	85.8	89.1	86.5	88.7
Chelms				81.5	86.6	87.4	90.3	94.5	93.2
Clwyd					80.1		82.8		
Colchr								85.4	
Covnt	87.8	90.5	82.9	85.7	87.3	85.0	91.3	87.5	93.8
D & Gall	74.0	78.2							
Derby	85.1		83.6	87.2	89.2	92.8	94.2	91.8	86.4
Derry									
Donc								92.8	83.0
Dorset			86.3	91.3	82.7	90.0	86.1	92.8	92.2
Dudley	90.6	89.4	89.2	85.9	96.7	89.5	84.9	65.4	87.2
Dundee	86.9	84.0	89.7	84.2	86.4	89.7	79.4	89.0	89.8
Dunfn	70.4	86.2	85.7	88.0	77.1	83.2	85.3	93.0	88.8
Edinb	80.5	82.6	83.2	79.7	86.0	87.9	92.4	83.4	86.4
Exeter	85.6	87.1	85.2	86.8	86.2	87.7	86.8	87.2	92.4
Glasgw	79.9	83.8	85.4	81.4	84.8	84.5	88.0	86.5	87.4
Glouc	82.6	82.4	85.0	87.0	93.4	89.9	86.6	96.5	88.1
Hull	88.9	85.8	87.6	86.3	89.5	92.1	86.4	87.3	91.0
Inverns	91.7	83.7	88.0	83.6	85.4	90.9	80.1	90.9	
Ipswi		98.3	93.7	91.2	85.4	96.1	94.3	97.5	90.8
Kent							92.4	88.3	91.5
Klmarnk	88.3	87.4	85.3	84.1	93.9	84.0	90.4	91.4	82.9
L Barts				87.7	93.1	91.6	88.0	93.7	90.0
L Guys	88.5	86.6	93.9	88.0	93.1	91.0	92.8	90.4	94.1
L Kings		88.0	86.0	88.8	88.8	88.8	88.0	89.1	86.0
L Rfree					91.6	92.3	93.4	95.3	86.9
L St.G							92.4	92.6	93.6
L West		93.1	95.9	92.0	93.9	94.0	92.0	94.0	91.8
Leeds	89.8	85.7	88.9	89.8	89.7	85.3	87.4	91.2	91.7
Leic	87.4	88.0	90.7	85.9	85.6	87.6	88.8	91.8	91.3
Liv Ain					85.5	86.3	80.4	84.5	82.9
Liv RI	87.3	85.0	83.3	84.8	91.2	83.8	89.6	95.5	93.5
M Hope			88.7	82.9	92.1	91.7	82.8	87.1	86.4
M RI							87.6	91.1	88.3
Middlbr	83.3	78.5	82.5	85.6	83.2	89.6	87.4	85.9	83.3
Newc		87.1	86.8	83.9	83.6	87.0	86.4	92.7	84.7
Newry					86.6			88.4	
Norwch				86.2	90.2	89.1	88.8	91.0	89.0
Nottm	90.0	86.8	86.4	84.8	86.8	94.6	88.6	90.3	90.1
Oxford	86.8	89.0	87.9	90.6	87.0	90.7	89.0	91.2	89.2
Plymth	73.3	82.0	81.5	81.2	82.0	83.9	89.7	91.6	87.3

Table 6.27. Continued

	One year after 90 days survival								
Centre	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ports	86.7	86.1	87.9	89.4	83.5	86.3	89.9	87.7	90.8
Prestn	87.1	86.6	86.0	84.1	91.9	84.8	89.2	80.6	87.8
Redng	83.3	92.5	92.0	93.8	88.7	90.5	90.2	94.5	89.2
Sheff	94.3	84.4	90.1	89.9	92.1	89.5	86.9	96.0	94.0
Shrew				88.0	89.7	90.0	89.5	92.5	84.3
Stevng	81.3	87.6	94.8	88.7	78.9	88.4	88.8	91.9	94.0
Sthend	80.7	87.7	90.8	87.4	92.3	96.4	91.9	84.0	92.3
Stoke							85.5	90.4	86.0
Sund	85.2	71.3	81.3	88.2	82.6	82.4	87.6	86.2	84.2
Swanse	85.7	83.4	82.4	82.3	84.2	83.5	89.6	85.1	79.9
Truro	91.4	83.6	88.5	92.4	88.1	92.8	86.6	92.2	96.2
Tyrone						89.7	89.5	97.2	
Ulster									
Wirral		78.4	94.9	82.6	88.2	90.9	86.8	87.1	90.2
Wolve	77.4	88.0	82.7	88.0	86.0	90.0	90.8	89.2	85.2
Wrexm	83.3	93.2	83.9	91.9	91.8	90.8	90.7		
York	87.1	82.4	78.9	90.1	85.4	83.4	94.6	85.3	93.6
England	**86.6**	**86.6**	**88.3**	**87.8**	**88.6**	**89.4**	**89.6**	**90.1**	**89.6**
N Ireland					**89.8**	**91.8**	**89.7**	**90.7**	**91.2**
Scotland	**82.7**	**83.8**	**85.4**	**83.8**	**84.2**	**84.9**	**86.5**	**88.5**	**86.6**
Wales	**84.3**	**84.5**	**85.9**	**85.7**	**86.3**	**85.6**	**85.9**	**86.2**	**85.8**
UK	**85.9**	**86.0**	**87.7**	**87.2**	**88.0**	**88.9**	**89.1**	**89.8**	**89.2**

Blank cells: centres with <20 patients for that year or centres with no data available for that year

Table 6.28. One year prevalent survival percentage by centre for prevalent cohort years 2001–2010, adjusted to age 60

	One-year prevalent survival									
Centre	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Abrdn	89.4	87.2	80.6	85.6	87.6	86.9	87.1	89.7	89.6	90.3
Airdrie	78.6	82.1	84.8	84.3	83.1	79.8	79.4	85.7	85.7	89.1
Antrim					83.6	92.0	85.6	89.0	89.6	88.6
B Heart	87.5	88.0	87.8	86.9	88.0	86.3	87.8	90.4	90.8	87.2
B QEH				89.1	89.0	88.7	88.4	88.4	90.0	89.8
Bangor		86.2	81.3	89.6	86.4	89.3	80.6	88.6	84.5	86.3
Basldn			82.8	87.7	90.9	90.5	91.1	93.2	91.9	89.6
Belfast					86.1	86.6	90.7	87.5	87.3	86.9
Bradfd	78.8	88.4	82.7	87.8	86.2	82.0	84.0	88.1	84.8	89.5
Brightn				87.1	84.5	87.6	87.3	89.4	87.6	90.2
Bristol	86.1	87.7	88.8	86.8	87.6	87.7	89.2	87.1	84.9	86.0
Camb	86.2	86.8	87.0	87.6	87.7	89.0	88.2	92.8	90.4	91.3
Cardff	85.7	85.9	80.8	84.4	84.4	84.3	88.8	82.6	86.7	86.0
Carlis	89.2	81.3	83.2	82.4	84.7	84.0	85.9	86.6	80.1	80.7
Carsh	83.7	82.7	85.0	87.9	86.4	89.2	88.9	90.0	89.3	90.0
Chelms				87.0	82.3	85.7	86.3	84.6	85.7	90.9
Clwyd		88.1	89.0	75.7	81.8	78.9	90.6	87.8	89.0	77.1
Colchr									91.0	84.8
Covnt	85.3	85.5	87.8	88.7	89.2	85.8	87.2	87.5	91.0	90.4
D&Gall	83.4	83.4	85.3	83.2	92.0	83.2	90.3	85.7	88.4	87.3
Derby	89.6		86.6	89.0	88.5	89.1	87.5	90.9	91.0	90.4
Derry							86.8	92.4	90.8	87.8
Donc								93.9	83.9	89.6
Dorset			90.2	88.1	90.4	86.3	87.4	89.8	89.8	92.3
Dudley	83.3	83.4	84.8	86.9	86.4	87.3	87.0	88.9	88.5	90.6
Dundee	86.2	85.2	83.7	85.8	87.9	87.6	83.9	84.1	93.8	88.0
Dunfn	78.9	82.3	84.2	88.9	90.9	88.6	88.8	89.9	87.8	87.9
Edinb	81.9	84.0	83.4	86.3	86.2	86.9	88.3	88.2	86.9	89.6
Exeter	85.2	87.5	86.7	86.1	84.3	90.9	87.4	85.5	85.1	86.5
Glasgw	83.5	86.0	83.9	85.5	87.5	86.4	88.2	87.6	88.5	88.8
Glouc	79.8	84.0	82.2	89.2	88.2	91.6	88.0	87.3	92.0	91.9
Hull	87.1	87.5	85.6	85.7	84.9	85.8	90.1	87.0	87.9	87.4
Inverns	89.0	88.5	87.6	86.9	87.2	86.4	94.4	89.1	92.1	88.9
Ipswi		82.2	84.6	90.4	86.0	84.8	85.3	91.6	85.0	88.1
Kent								86.6	87.9	90.8
Klmarnk	86.4	83.0	82.7	87.5	85.1	91.7	87.2	88.9	88.5	88.5
L Barts				83.9	85.6	88.3	89.2	88.7	90.7	92.8
L Guys	86.8	86.3	88.7	88.5	89.2	87.5	90.5	90.1	91.3	90.9
L Kings		81.1	77.5	81.6	86.5	89.1	84.9	88.4	87.9	89.0
L Rfree					90.1	90.7	90.4	91.3	89.7	90.5
L St.G							95.9	94.3	89.9	91.0
L West		89.8	91.4	91.1	91.7	91.6	92.1	90.5	92.4	91.0
Leeds	85.4	87.0	86.1	84.9	88.8	88.7	88.0	87.5	89.1	90.9
Leic	84.6	84.0	83.8	85.2	87.3	84.6	90.1	89.6	88.7	90.7
Liv Ain		90.8	90.9	90.4	97.0	86.7	91.0	88.9	92.1	88.3
Liv RI	81.3	82.4	84.8	85.9	84.2	88.3	85.5	87.2	89.2	89.5
M Hope			84.7	82.3	84.5	86.4	88.4	87.3	88.4	86.2
M RI							85.9	86.7	87.5	87.0
Middlbr	84.1	84.3	84.5	83.2	86.2	85.5	87.2	87.2	86.9	84.2
Newc		83.2	81.3	82.4	89.4	88.4	90.0	90.5	88.8	86.8
Newry					86.2	88.1	87.2	90.6	94.7	86.2
Norwch				87.2	87.9	90.0	87.1	91.0	89.1	90.0
Nottm	86.9	82.9	85.0	86.3	85.1	83.3	89.4	88.3	87.8	89.5
Oxford	88.3	85.5	86.5	88.1	87.7	87.7	87.1	88.2	89.0	87.2
Plymth	87.4	76.7	84.4	86.9	88.0	83.5	82.8	88.7	85.6	85.4

Table 6.28. Continued

	One-year prevalent survival									
Centre	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Ports	84.0	80.9	81.8	89.2	85.7	84.9	89.9	88.7	89.1	88.3
Prestn	87.3	86.4	84.8	85.9	85.5	86.6	90.9	90.4	89.7	90.2
Redng	78.0	85.8	83.7	89.7	87.0	89.5	90.0	89.5	92.3	89.0
Sheff	88.0	90.5	91.0	87.8	87.2	89.2	88.6	88.7	89.5	89.6
Shrew				85.2	87.4	86.3	89.5	89.0	88.1	86.3
Stevng	91.2	86.5	88.4	89.5	88.7	89.7	89.5	92.9	90.5	90.1
Sthend	88.9	89.6	87.2	89.4	86.6	83.7	85.2	90.1	90.9	92.3
Stoke							84.5	87.3	88.2	87.1
Sund	78.6	78.6	76.1	82.8	86.6	79.6	83.3	87.7	85.7	85.5
Swanse	87.6	80.8	82.4	87.6	89.3	86.3	88.3	89.7	87.5	87.9
Truro	89.0	82.6	90.2	89.9	85.7	91.7	88.7	90.1	88.7	90.7
Tyrone					89.0	82.8	93.1	93.5	87.3	93.0
Ulster					86.2	91.6	89.4	92.3	87.4	89.4
Wirral		93.2	83.7	87.9	89.4	89.2	87.7	89.3	90.6	88.4
Wolve	90.1	86.7	83.8	86.3	87.4	89.4	87.9	93.2	89.6	87.8
Wrexm	88.1	87.3	86.0	86.2	84.6	85.1	88.9	86.0	90.2	88.1
York	79.8	85.5	82.1	83.5	89.0	84.1	89.1	88.5	88.6	89.4
England	85.9	85.7	86.1	87.1	87.5	87.9	88.7	89.2	89.2	89.4
N Ireland					86.1	87.7	89.1	89.7	88.9	88.2
Scotland	83.8	85.0	83.7	85.8	87.1	86.5	87.4	87.7	88.9	88.8
Wales	86.7	84.8	82.4	85.4	85.9	85.1	88.1	85.8	87.2	86.3
UK	85.6	85.6	85.6	86.8	87.3	87.6	88.6	88.9	89.0	89.1

Blank cells: data not available for that year or less than 20 patients in that year

UK Renal Registry 14th Annual Report: Chapter 7 Adequacy of Haemodialysis in UK Adult Patients in 2010: national and centre-specific analyses

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Key Words
Adequacy · Haemodialysis · Urea reduction ratio

Summary

- Data suitable for urea reduction ratio (URR) analyses were available in 14,555 (74%) of the 19,686 adult patients receiving haemodialysis (HD) in the UK at the end of 2010.
- In 2010, 86% of prevalent (HD) patients achieved a URR >65%. The between centre range of prevalent patients achieving this target was wide (between 63% and 98%).
- The median URR in 2010 was 74% (unchanged from 2009).
- URR was greater in those with longer dialysis vintage. Eighty nine percent of patients who had survived on dialysis for more than two years achieved a URR >65% compared with only 70% of those on dialysis for only 6 months.
- Large variation between centres in the percentage of patients achieving the UK Renal Association's URR guideline persists. 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 UK renal centres. The UKRR has chosen URR rather than Kt/V for comparative audit of haemodialysis adequacy as these results are more widely available. Historical use of this measure has enabled temporal trends to be examined.

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 submitted 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. Data from two groups of patients were analysed. Firstly, analysis was undertaken using data from the prevalent HD patient population as of the 31st December 2010. For this analysis, data for URR were taken from the last quarter of 2010 unless that data point was missing in which case data from the 3rd quarter were taken. The prevalent population only included patients receiving HD who were alive on December 31st 2010. 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 commenced treatment with HD during 2010. 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 the analyses. 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 HD 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 HD twice weekly for reasons of geography should receive a higher sessional dose of HD. If this cannot be achieved, then it should be recognised that there is a compromise between the practicalities of HD 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].

Results

Data completeness

Data providing HD dose (URR) were available from 64 of the 72 renal centres which submitted data to the UKRR (table 7.1). Data were available for 74% (14,555) of the total prevalent population (19,686) treated with HD who met the inclusion criteria for these analyses.

Completeness in the 64 centres reporting URR data was generally good, with 49 centres reporting on more than 90% of patients. Six centres reported URR data on less than 50% of prevalent patients (Dorset, Liverpool Aintree, Manchester Hope, Manchester Royal Infirmary, Swansea, Wirral) and their data were not included in the centre-level analyses although the patients were included in the national analyses. URR data were not received from eight centres (Brighton, Cardiff, Inverness, London Barts, London Kings, London Royal Free, London St Georges and Newcastle). The number preceding the centre name in each figure indicates the percentage of missing data from that centre.

Several centres had a reduction in the completeness of URR data submitted to the UKRR in 2010 compared with 2009. These changes may represent changes in data extraction, or a move by centres to utilising Kt/V rather than URR as the preferred measure of dialysis dose.

Of the total incident patient population (4,492) starting HD during 2010 and meeting the inclusion criteria for URR analyses, 48% (2,163) had URR data available during the first quarter of treatment.

Table 7.1. Percentage completeness of URR data returns

Centre	% complete	Centre	% complete
Abrdn	98	L Rfree	0
Airdrie	99	L St.G	0
Antrim	99	L West	92
B Heart	99	Leeds	100
B QEH	77	Leic	99
Bangor	99	Liv Ain	1
Basldn	97	Liv RI	97
Belfast	94	M Hope	43
Bradfd	97	M RI	13
Brightn	0	Middlbr	96
Bristol	100	Newc	0
Camb	97	Newry	98
Cardff	0	Norwch	96
Carlis	96	Nottm	99
Carsh	91	Oxford	85
Chelms	92	Plymth	97
Clwyd	97	Ports	95
Colchr	97	Prestn	85
Covnt	97	Redng	97
D & Gall	88	Sheff	96
Derby	92	Shrew	91
Derry	92	Stevng	98
Donc	98	Sthend	95
Dorset	42	Stoke	100
Dudley	93	Sund	97
Dundee	98	Swanse	42
Dunfn	96	Truro	100
Edinb	100	Tyrone	93
Exeter	100	Ulster	99
Glasgw	92	Wirral	29
Glouc	100	Wolve	67
Hull	96	Wrexm	86
Inverns	0	York	88
Ipswi	99	**England**	**74**
Kent	92	**N Ireland**	**96**
Klmarnk	88	**Scotland**	**91**
L Barts	0	**Wales**	**34**
L Guys	72	**UK**	**74**
L Kings	0		

Achieved URR

For prevalent patients, the median URR (74% for UK; centre range 67%–80%) and percentage of patients attaining the RA guideline of a URR >65% (86% for UK; centre range 63%–98%) from 58 renal centres are shown in figures 7.1 and 7.2. Figure 7.3 illustrates the intuitive relationship between these two descriptive measures. As the proportion of patients achieving URR > 65% increased, the median URR also increased. As previously reported, there continued to be variation between renal centres, with 18 centres attaining the RA clinical practice guideline in >90% of patients, 39 centres attaining the guideline in 70–90% of patients and 1 centre in less than 70% of patients. This represents an improvement compared with 2009, when 5 centres achieved this target in <70% of patients. The 95% confidence intervals were wide however, with overlap between centres illustrated in figure 7.2.

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 2010 is shown in figure 7.4. Northern Ireland has provided data since 2005 and was included in these analyses. The proportion of patients attaining the RA guideline increased from 56% to 86% whilst the median URR has risen from 67% to 74% during the same time period. There has

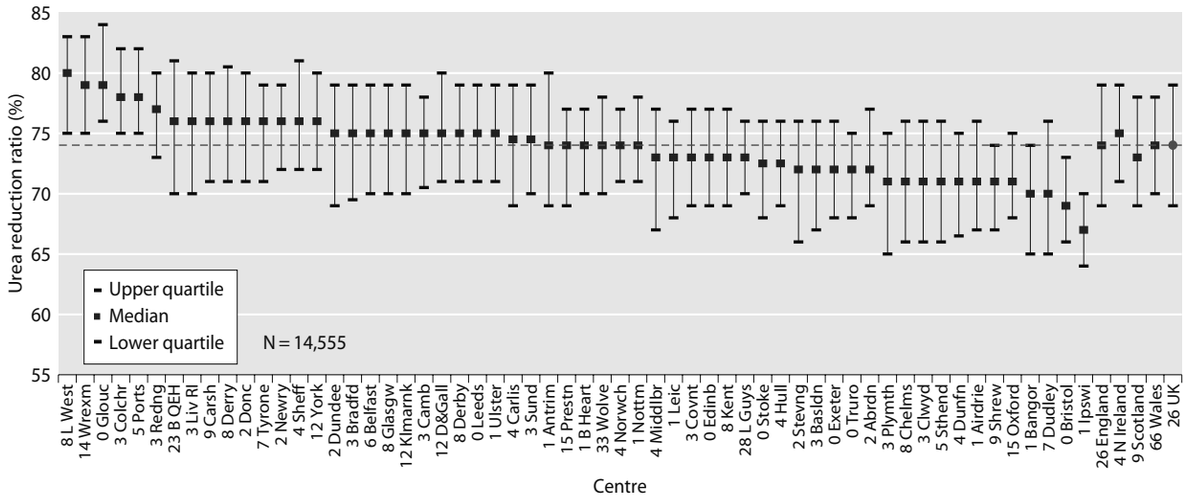

Fig. 7.1. Median URR achieved in prevalent patients in each centre, 2010

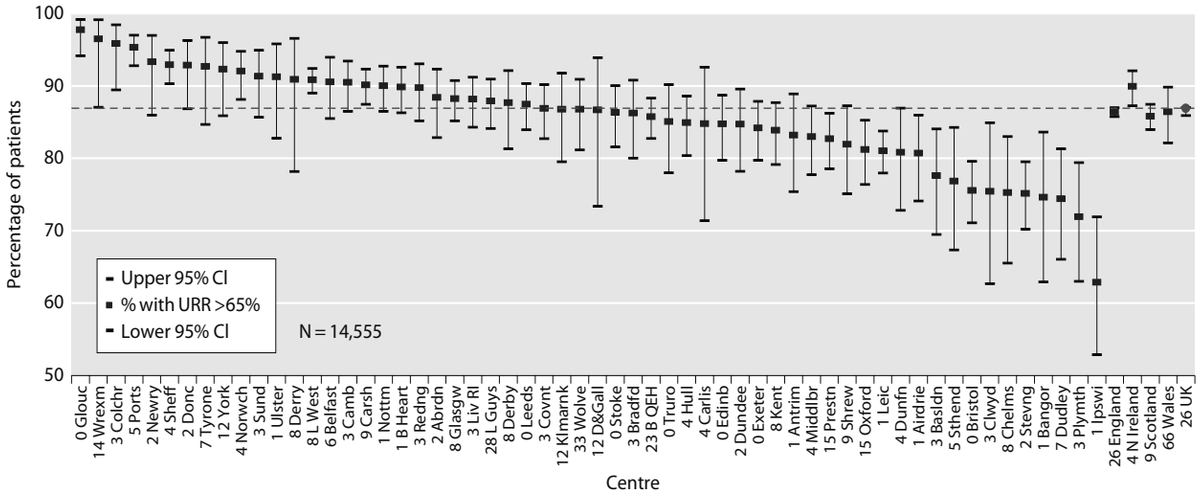

Fig. 7.2. Percentage of prevalent patients with URR >65% in each centre, 2010

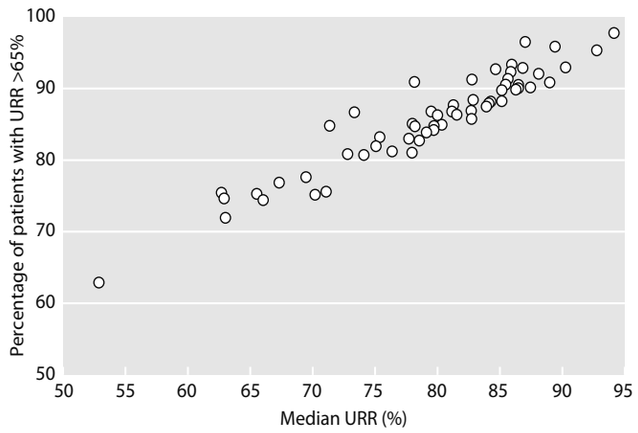

Fig. 7.3. Relationship between achievement of the Renal Association guideline for URR and the median URR in each centre, 2010

been no substantial change in median URR between 2009 and 2010.

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 longest time on HD (figure 7.5). Of those dialysed for less than 6 months, 70% had a URR >65%, whilst 89% of patients who had survived and continued on RRT for more than two years attained the guideline target in 2010. Overall in all strata of time on dialysis, there has been an improvement in the proportion of patients receiving the target dose of HD over the last 12 years.

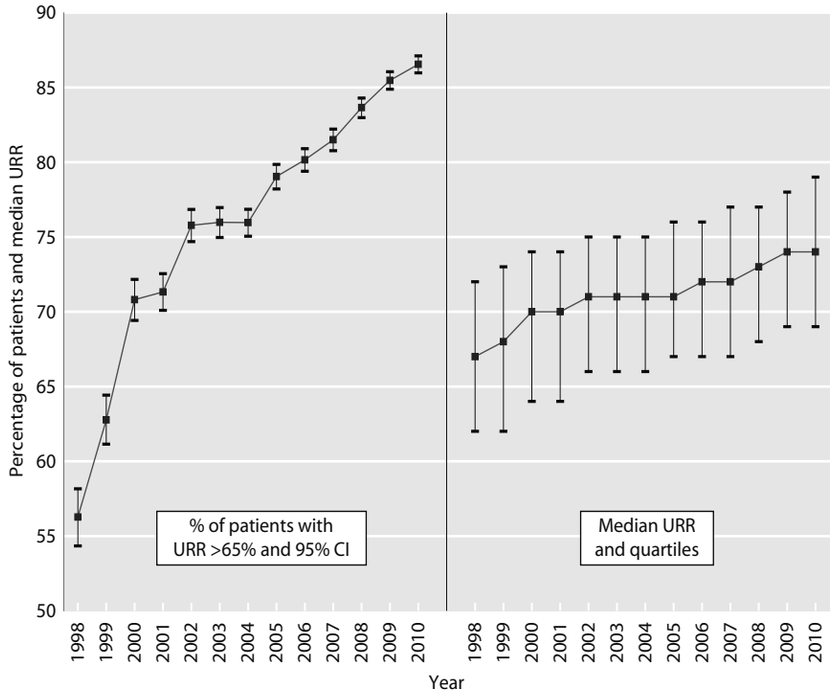

Fig. 7.4. Change in the percentage of patients with URR >65% and the median URR between 1998 and 2010 in the UK

The median URR during the first quarter after starting HD treatment of the incident HD population in the UK in 2010 was 66% (centre range 57%–75%) (figure 7.6).

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 86% of the HD population achieving the URR guideline in 2010. This increment will not only reflect improvements in practice and delivery of dialysis, but also enhanced coverage and quality of the data collected by the UK Renal Registry and renal centres over the years.

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

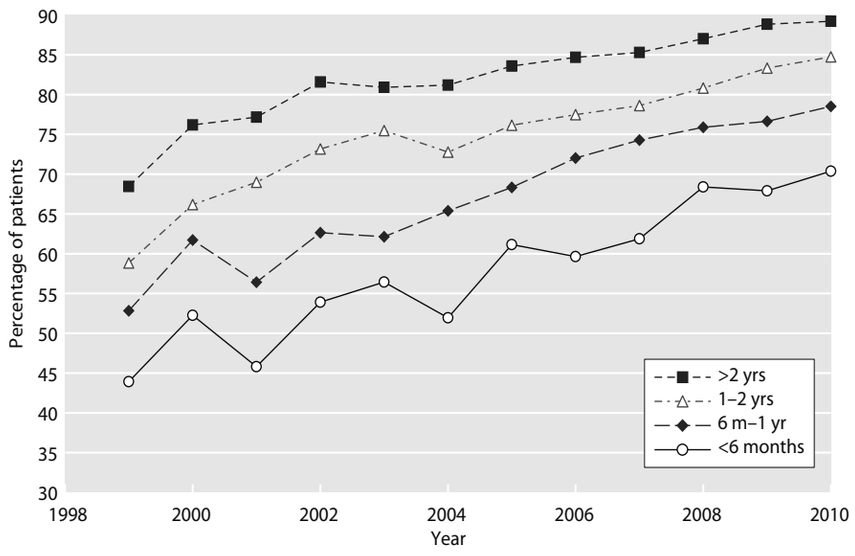

Fig. 7.5. Percentage of prevalent haemodialysis patients achieving URR >65% by survival on haemodialysis between 1999 and 2010

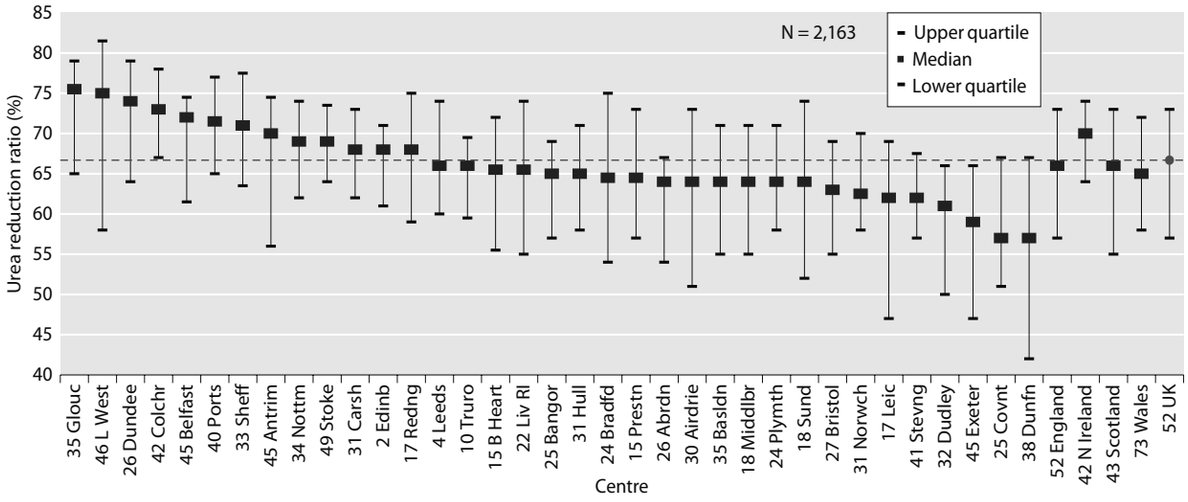

Fig. 7.6. Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2010

70%. The median URR of patients undergoing HD in the UK in 2010 was 74% (centre range of 67%–80%) and only 2 centres had a median URR under 70%. Median URR showed a good correlation with the percentage achievement of URR target by centre.

In 2010, 89% of patients in the UK who had survived on HD for more than 2 years achieved the target of a URR >65%. The figure for patients during the first 6 months after starting treatment was lower (70%).

There was a wide range (63%–98%) of achievement of the RA guideline between different centres which is likely to reflect genuine differences in HD dose with both individual and centre level contributors although inconsistency in sampling methodology for the post-dialysis urea sample may play a part [13]. 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 slow-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 still persist.

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

References

1 Gotch FA, Sargent JA: A mechanistic analysis of the National Cooperative Dialysis Study (NCDS). Kidney Int 1985;28:526–534
2 Owen WF, Lew NL, Liu Y, Lowrie EG, Lazarus JM: The Urea Reduction Ratio and Serum Albumin Concentration as Predictors of Mortality in Patients Undergoing Hemodialysis. N Engl J Med 1993;329:1001–1006
3 Held PJ, Port FK, Wolfe RA, Stannard DC, Carroll CE, Daugirdas JT, Bloembergen WE, Greer JW, Hakim RM: The dose of hemodialysis and patient mortality. Kidney Int 1996;50:550–556
4 Tentori F, Hunt WC, Rohrscheib M, Zhu M, Stidley CA, Servilla K, Miskulin D, Meyer KB, Bedrick EJ, Johnson HK, Zager PG: Which Targets in Clinical Practice Guidelines Are Associated with Improved Survival in a Large Dialysis Organization? J Am Soc Nephrol 2007;18:2377–2384
5 Locatelli F, Buoncristiani U, Canaud B, Kohler H, Petitclerc T, Zucchelli P: Dialysis dose and frequency. Nephrol Dial Transplant 2005;20:285–296
6 Depner TA: Assessing adequacy of hemodialysis: urea modeling. Kidney Int 1994;45:1522–1535
7 Movilli E: Simplified approaches to calculate Kt/V. It's time for agreement. Nephrol Dial Transplant 1996;11:24–27
8 Vanbelleghem H, Vanholder R, Levin NW, Becker G, Craig JC, Ito S, Lau J, Locatelli F, Zoccali C, Solez K, Hales M, Lameire N, Eknoyan G: The Kidney Disease: Improving Global Outcomes website:

Comparison of guidelines as a tool for harmonization. Kidney Int 2007;71:1054–1061
9 UK Renal Association Clinical Practice Guidelines Committee. 2007 Module 3a Haemodialysis, 2007 http://www.renal.org/guidelines/module3a.html
10 European Best Practice Guidelines Expert Group on Haemodialysis. Nephrol Dial Transplant 2002:17(suppl 7):S16–S31
11 NKF-KDOQI clinical practice guidelines; update 2006. Am J Kidney Dis 2006: 48(suppl 1):S2–S90
12 Ansell D, Tomson CR: UK Renal Registry 11th Annual Report (December 2008) Chapter 15 The UK Renal Registry UKRR database, validation and methodology. Nephron Clin Pract 2009;111(suppl 1c):277–85
13 Will E: Adequacy of haemodialysis (urea reduction ratio) Chapter 7; in Ansell D, Feest T (eds): UK Renal Registry 5th Annual Report, 2002, pp 85–100
14 UK Renal Association Standards and Audit subcommittee. Treatment of adults and children with renal failure. 3rd edition. Chapter 3. Haemodialysis: clinical standards and targets, 2002
15 Vanholder R, Eloot S, Van Biesen W: Do we need new indicators of dialysis adequacy based on middle-molecule removal? Nature Clinical Practice Nephrology 2008;4:174–175
16 Tattersall J, Martin-Malo A, Pedrini L, Basci A, Canaud B, Fouque D, Haage P, Konner K, Kooman J, Pizzarelli F, Tordoir J, Vennegoor M, Wanner C, ter Wee P, Vanholder R: EBPG guideline on dialysis strategies. Nephrol Dial Transplant 2007;22:ii5–21
17 Saran R, Bragg-Gresham JL, Levin NW, Twardowski ZJ, Wizemann V, Saito A, Kimata N, Gillespie BW, Combe C, Bommer J, Akiba T, Mapes DL, Young EW, Port FK: Longer treatment time and slower ultrafiltration in hemodialysis: Associations with reduced mortality in the DOPPS. Kidney Int 2006;69:1222–1228
18 Marshall MR, Byrne BG, Kerr PG, McDonald SP: Associations of hemodialysis dose and session length with mortality risk in Australian and New Zealand patients. Kidney Int 2006;69:1229–1236
19 Eloot S, Van Biesen W, Dhondt A, Van de Wynkele H, Glorieux G, Verdonck P, Vanholder R: Impact of hemodialysis duration on the removal of uremic retention solutes. Kidney Int 2007;73:765–770
20 Basile C, Lomonte C: Dialysis time is the crucial factor in the adequacy of hemodialysis. Kidney Int 2008;74:965–966
21 Eloot S, Torremans A, De Smet R, Marescau B, De Deyn PP, Verdonck P, Vanholder R: Complex Compartmental Behavior of Small Water-Soluble Uremic Retention Solutes: Evaluation by Direct Measurements in Plasma and Erythrocytes. Am J Kidney Dis 2007;50:279–288
22 Lowrie EG: The Kinetic Behaviors of Urea and Other Marker Molecules During Hemodialysis. Am J Kidney Dis 2007;50:181–183

UK Renal Registry 14th Annual Report: Chapter 8 Haemoglobin, Ferritin and Erythropoietin amongst UK Adult Dialysis Patients in 2010: 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 · European Best Practice Guidelines · Ferritin · Haemodialysis · Haemoglobin · NICE · Peritoneal dialysis · Renal Association

Summary

- In 2010, the median Hb of patients at the time of starting dialysis in the UK was 10.1 g/dl with 53.6% of patients having a Hb $\geqslant$10.0 g/dl.
- By dialysis modality, median Hb at dialysis start was 9.8 g/dl (IQR 9.0–10.8) for HD patients and 11.1 g/dl (IQR 10.1–12.0) for PD patients.
- The median Hb of prevalent patients on HD in the UK was 11.5 g/dl with an IQR of 10.5–12.3 g/dl.
- The median Hb of prevalent patients on PD in the UK was 11.6 g/dl with an IQR of 10.6–12.5 g/dl.
- In 2010, 52.7% of HD patients had Hb $\geqslant$10 and $\leqslant$12 g/dl and 54.3% of PD patients had Hb 10.5–12.5 g/dl.
- In 2010, 84.6% of HD and 87.2% of PD patients had Hb $\geqslant$10 g/dl.
- In England, Wales and Northern Ireland the median ferritin in HD patients was 444 µg/L (IQR 299–635) and 96% of HD patients had a ferritin $\geqslant$100 µg/L.
- In England, Wales and Northern Ireland the median ferritin in PD patients was 264 µg/L (IQR 148–426) with 86% of PD patients having a ferritin $\geqslant$100 µg/L.
- In 2010, the mean Erythropoietin Stimulating Agent (ESA) dose was higher for HD than PD patients (9,020 vs. 6,202 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 2010. 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 risks associated with low (<10 g/dl) and high (>13 g/dl) Hb are not necessarily equivalent. 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. In 2009, a new target Hb range for haemodialysis (HD) patients was recommended by the 5th edition of the Renal Association Guidelines for Haemodialysis patients [7]. This guidance specified that pre-HD Hb concentration should be maintained between 10 and 12 g/dl. As this chapter analyses 2010 data, HD patients have been compared against this revised target.

The 5th edition of the UK Renal Association's Anaemia in CKD guideline [8] 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 [9]. The target outcome Hb for RRT patients on ESA treatment in these guidelines is between 10 and 12 g/dl. Therefore next year's report will use this standard for peritoneal dialysis (PD) and transplant patients on ESA therapy. The KDIGO website [10] is a useful resource for comparison of international anaemia guidelines.

The analyses in this chapter examine how centres comply with the 10–12 g/dl range (HD patients), 10.5–12.5 g/dl range (PD patients) and the attainment of the minimum standard of Hb $\geqslant$10.0 g/dl.

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) of 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 not all UK renal centres have easy access. Since TSAT is measured infrequently in many centres

and most UK centres continue to use serum ferritin for routine iron management, ferritin remains the chosen index of iron status for this report.

Methods

The incident and prevalent RRT cohorts for 2010 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 2010 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 2010 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 inter-quartile 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 2010.

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.

For the target Hb range in haemodialysis patients the standard specified by the 5th UK RA Clinical Practice Haemodialysis guideline [7] was used, which specifies:

Haemodialysis patients should have a pre-dialysis Hb concentration between 10 and 12 g/dl.

Data regarding ESAs were collected from all renal centres. Erythropoietin data from the last quarter of 2010 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 they 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 8.1. Twelve centres are not included in this analysis due to either being small centres who submitted data on fewer than 20 patients and/or because data completeness was less than 50%.

The median Hb of patients at the time of starting dialysis in the UK was 10.1 g/dl with 53.6% of patients

Table 8.1. Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis during 2010

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Abrdn	75	33	10.0	7.7–11.6	9.2–11.2	52
Airdrie	89	48	9.9	7.7–12.8	8.6–11.0	46
Antrim	97	30	9.4	7.5–11.7	8.4–10.6	33
B Heart	100	93	9.5	7.5–12.3	8.8–11.0	44
B QEH	69	124	10.5	8.0–12.5	9.3–11.3	64
Bangor	96	25	11.3	9.4–13.1	9.9–12.1	72
Basldn	100	26	9.6	6.6–11.7	8.3–10.4	42
Belfast	82	49	10.0	7.8–12.0	8.9–10.6	51
Bradfd	96	53	9.8	7.7–12.6	9.2–11.3	47
Brightn	99	101	10.2	7.8–12.4	9.6–10.9	65
Bristol	99	141	9.6	7.5–12.3	8.7–10.7	44
Camb	95	75	10.3	7.5–13.0	9.5–11.4	63
Cardff	100	160	10.0	8.4–12.6	9.3–11.0	54
Carlis	100	20	10.8	8.6–13.2	9.5–12.2	70
Carsh	97	193	10.4	8.4–12.7	9.7–11.3	65
Chelms	100	41	10.9	8.4–12.7	9.6–11.6	71
Clwyd	100	13				
Colchr	62	16				
Covnt	91	96	10.4	7.6–12.9	9.4–11.3	63
D & Gall	30	3				
Derby	93	71	10.2	8.5–12.5	9.5–11.1	61
Derry	100	15				
Donc	100	43	9.4	7.1–12.6	8.4–11.4	42
Dorset	97	63	10.5	7.7–12.0	9.3–11.1	65
Dudley	97	37	9.5	8.1–12.3	8.6–10.2	32
Dundee	82	37	9.5	7.7–12.2	9.3–10.4	35
Dunfn[a]	19	8				
Edinb	79	48	10.8	7.7–12.9	9.5–11.4	65
Exeter	100	129	9.9	8.2–12.4	9.2–10.9	50
Glasgw	48	70				
Glouc	100	53	10.0	7.7–12.4	9.1–10.9	51
Hull	98	78	9.7	7.6–11.9	9.0–10.4	38
Inverns[a]	50	13				
Ipswi	89	25	9.7	7.8–11.8	8.9–10.4	40
Kent	100	115	9.8	7.6–12.3	8.9–10.8	45
Klmarnk	24	10				
L Barts	97	187	9.8	7.4–13.1	8.8–11.2	46
L Guys	82	91	9.6	7.6–11.5	8.6–10.4	34
L Kings	99	144	9.6	8.1–12.0	9.0–10.5	37
L Rfree	91	127	10.6	8.3–13.3	9.4–11.3	66
L St.G	96	65	9.7	7.7–12.4	9.1–10.9	45
L West	90	281	10.7	8.6–12.8	9.9–11.6	71
Leeds	100	96	9.6	7.2–11.8	8.7–10.6	36
Leic	100	207	9.8	7.5–12.2	8.9–10.8	43
Liv Ain	9	4				
Liv RI	96	77	10.7	8.0–13.3	9.7–11.9	68
M Hope	86	97	9.7	7.6–13.6	9.0–10.9	43
M RI	96	133	9.6	7.8–13.0	8.8–11.2	45
Middlbr	95	87	9.3	7.5–12.5	8.3–10.7	32
Newc	97	70	10.2	7.1–12.8	8.9–11.4	57
Newry	100	23	9.6	8.0–11.4	9.1–10.4	39
Norwch	96	75	10.2	7.8–13.0	9.0–11.4	57
Nottm	100	101	10.0	7.8–12.3	9.0–11.0	51
Oxford	100	132	10.1	7.6–12.3	9.3–11.0	52
Plymth	46	24				
Ports	99	125	10.5	8.5–13.6	9.6–11.6	66
Prestn	91	102	10.1	8.0–12.3	9.0–10.9	55
Redng	100	76	10.1	7.6–12.8	9.1–11.3	51
Sheff	100	109	10.5	7.8–13.1	9.6–11.4	66
Shrew	100	55	10.4	8.4–12.3	9.7–11.1	65
Stevng	100	104	10.0	8.0–12.6	9.1–10.9	51

Table 8.1. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Sthend	100	27	10.3	8.0–12.4	9.1–11.6	56
Stoke	100	89	10.5	7.9–13.4	9.5–11.6	63
Sund	94	48	10.4	8.3–13.2	9.4–11.2	58
Swanse	99	122	10.4	8.2–12.6	9.4–11.3	64
Truro	100	39	10.2	8.0–13.6	9.2–11.6	59
Tyrone	91	10				
Ulster	100	19				
Wirral	90	46	10.2	8.0–12.9	9.4–10.8	54
Wolve	99	96	10.5	7.6–14.3	9.0–11.8	61
Wrexm	100	23	11.5	8.9–13.6	10.9–12.3	83
York	100	28	9.9	7.4–11.6	8.9–11.1	43
England	**94**	**4,535**	**10.1**	**7.7–12.7**	**9.1–11.1**	**54**
N Ireland	**92**	**146**	**9.7**	**7.6–11.7**	**8.9–10.6**	**43**
Scotland[a]	**57**	**270**	**9.9**	**7.5–12.6**	**8.7–11.2**	**49**
Wales	**99**	**343**	**10.3**	**8.4–12.9**	**9.4–11.3**	**61**
UK	**91**	**5,294**	**10.1**	**7.7–12.7**	**9.1–11.1**	**54**

Blank cells = centres excluded from analyses due to poor data completeness or low patient numbers
[a]A data extraction problem resulted in the UKRR not collecting all available data for these centres. The Scottish Renal Registry (www.srr.scot.nhs.uk <http://www.srr.scot.nhs.uk/>) record data completeness >90% for both centres and also for Scotland as a whole

having a Hb ⩾10.0 g/dl (vs. 10.2 g/dl and 55% for 2010 report). The variation between centres remained high (32–83%).

Median Hb of patients at dialysis start by modality was also examined (data not shown). Median Hb at dialysis start was 9.8 g/dl [inter-quartile range (IQR) 9.0–10.8 g/dl)] and 11.1 g/dl (IQR 10.1–12.0 g/dl) for HD and PD patients, respectively. When initiating dialysis, 47.0% of HD patients had a Hb ⩾10.0 g/dl, compared to 78.0% of PD patients.

The median starting Hb by centre is shown in figure 8.1 and the percentage starting with a Hb ⩾10.0 g/dl by centre is given in figure 8.2. The distribution of Hb in incident dialysis patients during 2010 is shown in figure 8.3.

Incident dialysis patients from 2009 were followed for one year and the median haemoglobin (and percentage with a Hb ⩾10.0 g/dl) of survivors at the end of each quarter was calculated (figures 8.4 and 8.5). Hb is higher in those surviving 3 months reflecting both the treatment administered and poor survival of sicker, more anaemic patients.

The annual distribution of Hb in incident dialysis patients is shown in figure 8.6. Since 2006 the proportion

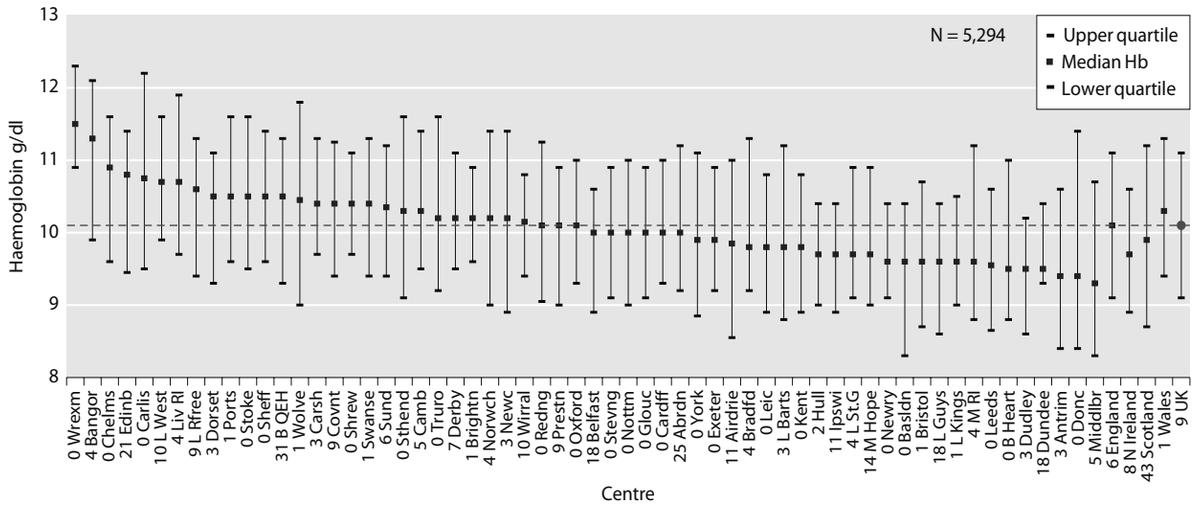

Fig. 8.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2010

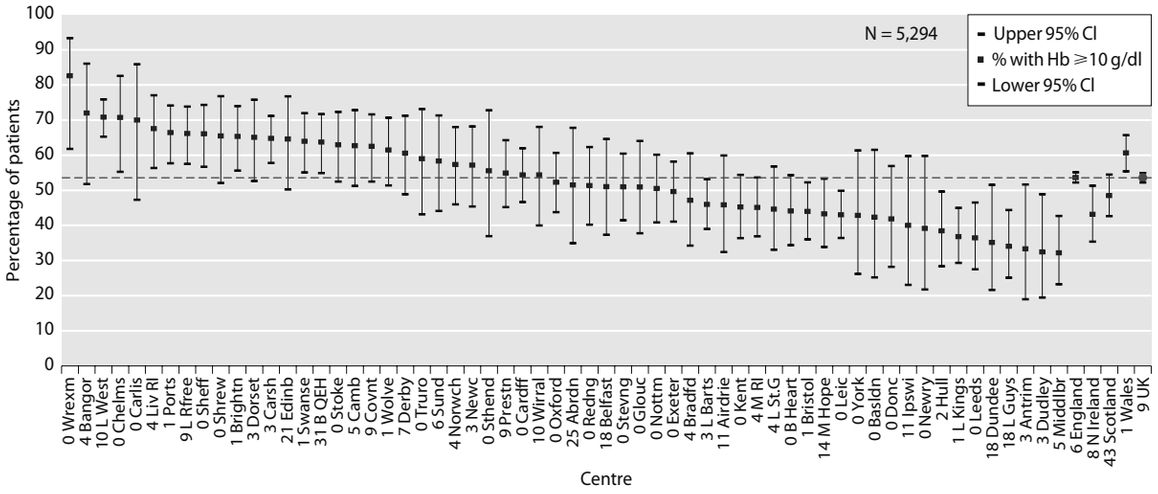

Fig. 8.2. Percentage of incident dialysis patients with Hb ⩾10 g/dl at start of dialysis treatment in 2010

of incident patients with Hb ⩾12 g/dl has fallen from 17.2% to 11.5%.

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 8.2.

The median Hb of patients on HD in the UK was 11.5 g/dl with an IQR of 10.5–12.3 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 published in the last few UKRR reports. 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 8.7, 8.8 and 8.9 respectively. The distribution of Hb in HD patients by centre is shown in figure 8.10. The compliance with the new RA Clinical Practice Guidelines [7] recommended range of 10.0–12.0 g/dl is shown in figure 8.11. In 2010, 52.7% of prevalent HD patients had a Hb within this target range. The majority of centres complied well with respect to both the minimum and target range Hb standards but it was possible to fall within 2–3 SDs of the mean in the funnel plot (figure 8.12) for a percentage of patients with Hb ⩾10 and ⩽12 g/dl and yet have a poor compliance with percentage of Hb ⩾10.0 g/dl (figure 8.13). This demonstrates that compliance with one standard (Hb ⩾10 and ⩽12 g/dl) can be achieved without compliance with another standard (Hb ⩾10.0 g/dl). Table 8.2 can be used in conjunction with figures 8.12 and 8.13 to identify centres.

Haemoglobin in prevalent peritoneal dialysis patients

In the UK 87% of patients on PD had a Hb ⩾10.0 g/dl (table 8.3). The median Hb of patients on PD in the UK was 11.6 g/dl with an IQR of 10.6–12.5 g/dl. These UK averages are very similar to the values published in the last few UKRR reports. 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 8.14, 8.15 and 8.16 respectively. The compliance with RA and NICE [5, 6] recommended range Hb ⩾10.5 and ⩽12.5 g/dl is shown in figure 8.17. In 2010, 54.3% of prevalent PD patients had a Hb within the target range. The distribution of Hb in PD patients by centre is shown in figure 8.18. The funnel plot for percentage Hb ⩾10.0 g/dl is shown in figure 8.19. Table 8.3 can be used to identify centres in the funnel plot.

Relationship between Hb in incident and prevalent dialysis patients in 2010

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 8.20. 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, 85.0% of prevalent patients, compared to 53.6% of incident patients, had a Hb ⩾10.0 g/dl in 2010.

Correlation between median haemoglobin and compliance with clinical guidelines

Rose-Day plots (figures 8.21 to 8.24) are used to

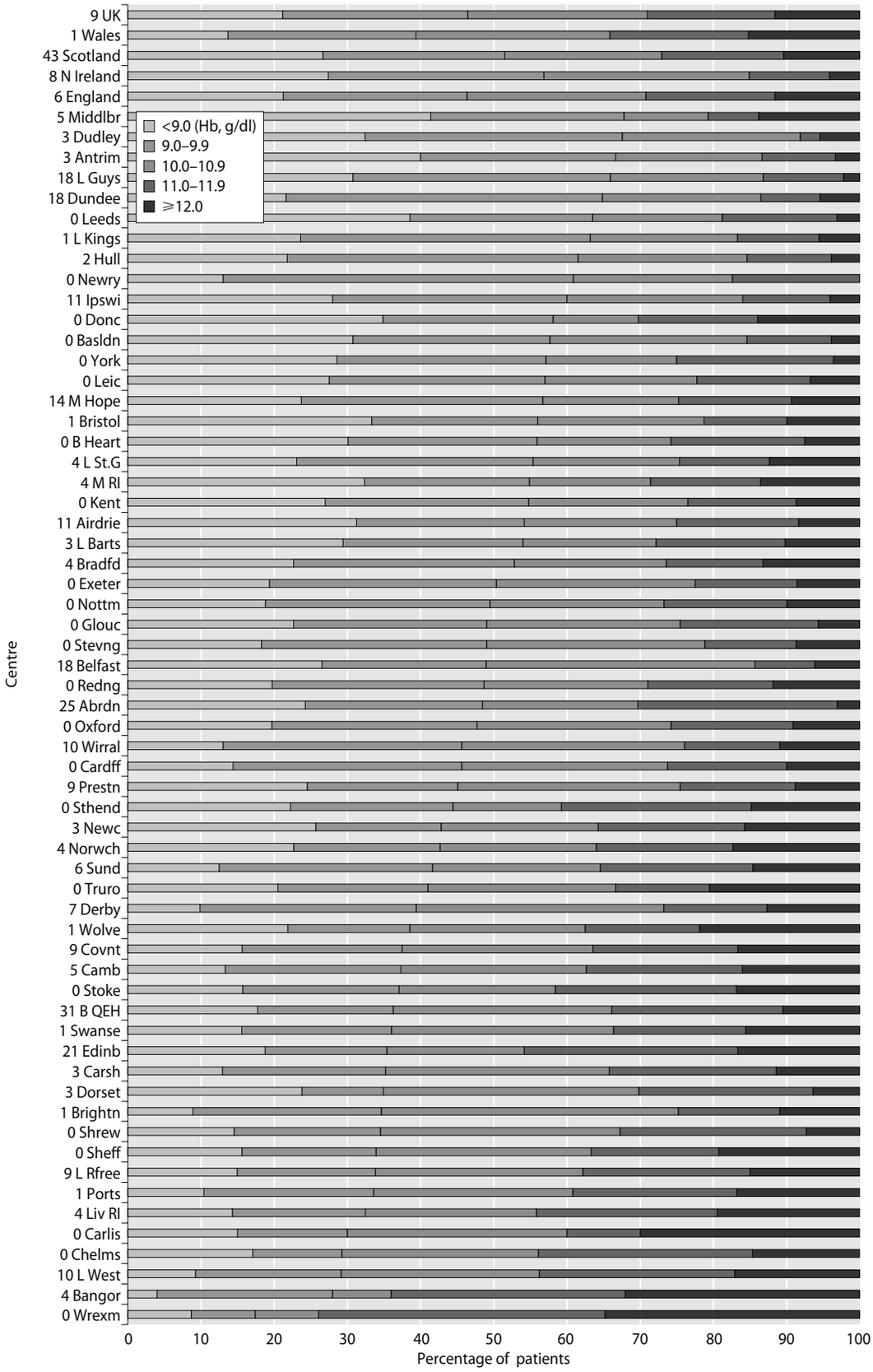

Fig. 8.3. Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment in 2010

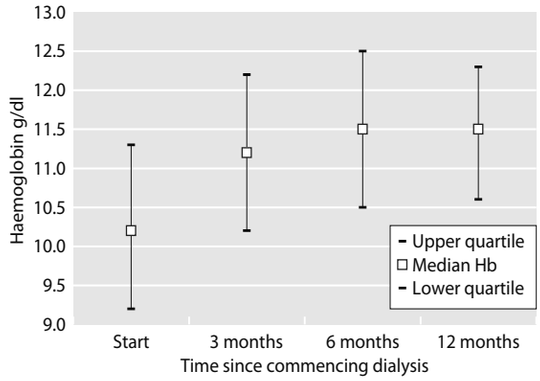

Fig. 8.4. Median haemoglobin, by time on dialysis, for incident dialysis patients in 2009

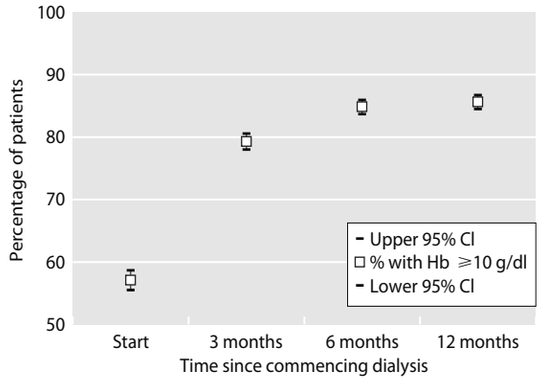

Fig. 8.5. Percentage of incident dialysis patients in 2009 with Hb ⩾10 g/dl, by time on dialysis

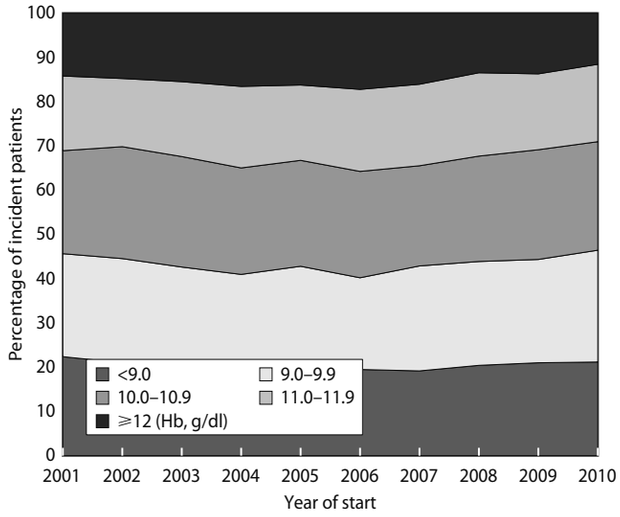

Fig. 8.6. Distribution of haemoglobin in incident dialysis patients by year of start

Table 8.2. Haemoglobin data for prevalent HD patients in 2010

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 10–12 g/dl
Abrdn	98	187	11.1	9.1–13.2	10.2–12.1	11.1	1.3	79	58	53
Airdrie	99	171	11.3	8.6–12.9	10.6–12.1	11.1	1.3	84	60	56
Antrim	100	123	11.4	8.9–13.0	10.6–12.1	11.2	1.3	87	66	62
B Heart	99	391	11.3	8.4–13.1	10.2–12.3	11.2	1.5	79	61	48
B QEH	89	731	11.4	8.7–13.5	10.4–12.2	11.3	1.5	81	62	52
Bangor	99	81	12.0	10.1–13.8	11.1–12.6	11.9	1.1	96	78	47
Basldn	98	129	11.3	8.6–13.1	10.0–12.0	11.0	1.5	76	58	51
Belfast	98	213	11.2	8.4–13.6	10.3–12.0	11.1	1.5	79	62	55
Bradfd	98	161	11.6	8.9–14.0	10.7–12.4	11.5	1.5	88	65	52
Brightn	98	317	11.3	9.2–13.2	10.4–12.1	11.3	1.3	84	62	57
Bristol	100	430	11.6	8.9–13.4	10.7–12.5	11.5	1.5	85	71	51
Camb	99	317	11.5	9.2–13.3	10.8–12.3	11.5	1.3	90	70	61
Cardff	100	452	11.4	8.8–13.6	10.4–12.3	11.3	1.4	83	61	53
Carlis	98	51	11.5	9.6–13.8	10.6–12.1	11.4	1.1	92	65	67
Carsh	97	663	11.4	9.2–13.4	10.6–12.1	11.4	1.3	86	63	59
Chelms	100	112	11.4	9.4–13.1	10.8–12.1	11.4	1.1	90	72	64
Clwyd	97	59	11.6	9.8–13.9	11.0–12.4	11.7	1.3	95	80	56
Colchr	97	96	11.6	9.8–13.3	11.0–12.3	11.7	1.0	93	76	54
Covnt	100	331	11.4	8.5–13.5	10.2–12.3	11.2	1.5	77	62	47
D & Gall	88	45	11.0	9.0–13.0	10.5–12.0	11.3	1.2	89	58	69

Table 8.2. 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 10–12 g/dl
Derby	100	202	11.8	9.3–13.6	10.9–12.5	11.7	1.3	89	73	47
Derry	100	53	11.4	8.6–13.2	10.1–12.1	11.1	1.4	81	62	53
Donc	100	130	11.4	8.8–13.6	10.2–12.1	11.2	1.4	79	58	52
Dorset	100	226	11.7	9.1–14.1	10.8–12.6	11.7	1.5	89	73	52
Dudley	99	142	11.3	8.6–13.5	10.4–12.0	11.2	1.6	80	59	56
Dundee	100	160	11.9	9.1–13.7	11.1–12.4	11.7	1.5	89	77	46
Dunfn[a]	32	40								
Edinb	100	257	11.8	9.0–13.6	10.9–12.5	11.7	1.4	89	74	49
Exeter	100	322	11.3	8.6–13.0	10.3–12.1	11.1	1.4	82	58	56
Glasgw	91	536	11.4	8.6–14.0	10.4–12.3	11.3	1.6	82	63	51
Glouc	100	177	11.4	8.3–13.2	10.6–12.2	11.2	1.4	82	65	55
Hull	99	309	11.6	9.2–13.9	10.7–12.4	11.5	1.4	87	68	53
Inverns[a]	2	2								
Ipswi	100	106	11.5	9.6–13.3	10.9–12.1	11.5	1.2	91	73	63
Kent	99	329	11.5	8.8–13.6	10.6–12.2	11.4	1.4	88	67	56
Klmarnk	89	129	11.7	9.0–14.0	10.8–12.6	11.8	1.4	88	72	47
L Barts	99	743	11.2	8.6–13.3	10.2–12.0	11.0	1.4	78	55	54
L Guys	88	466	11.2	8.3–13.5	10.0–12.1	11.0	1.6	76	56	50
L Kings	100	390	11.0	9.0–13.0	10.1–11.8	11.0	1.3	81	52	60
L Rfree	88	565	11.5	8.8–13.6	10.5–12.4	11.4	1.5	85	64	49
L St.G	99	263	11.1	8.3–12.9	9.7–11.9	10.9	1.4	71	54	52
L West	99	1,233	11.9	9.5–13.6	11.1–12.7	11.8	1.3	92	77	47
Leeds	100	437	11.6	8.9–13.7	10.9–12.4	11.5	1.4	88	73	54
Leic	100	730	11.5	8.8–13.5	10.4–12.4	11.4	1.4	83	63	50
Liv Ain	10	13								
Liv RI	99	362	11.8	9.0–14.4	10.7–12.7	11.7	1.6	87	69	48
M Hope	77	258	11.3	8.0–13.7	10.2–12.3	11.2	1.6	78	60	48
M RI	89	391	11.5	9.1–13.7	10.6–12.4	11.5	1.4	84	66	49
Middlbr	99	260	11.4	8.1–13.8	10.5–12.4	11.3	1.7	79	66	46
Newc	99	245	11.5	8.8–14.2	10.4–12.8	11.5	1.7	82	64	44
Newry	99	99	11.6	9.0–13.0	10.8–12.2	11.4	1.2	91	71	59
Norwch	99	296	11.7	9.3–13.9	10.8–12.4	11.6	1.4	88	72	51
Nottm	100	385	11.5	8.6–13.1	10.7–12.2	11.3	1.3	86	68	56
Oxford	100	352	11.6	8.9–13.8	10.4–12.4	11.4	1.5	85	63	49
Plymth	51	63	11.7	9.7–13.6	10.8–12.7	11.6	1.4	87	70	56
Ports	100	444	12.0	9.3–14.1	10.9–12.9	11.9	1.5	89	74	42
Prestn	98	456	11.3	8.9–13.3	10.3–12.1	11.2	1.4	83	58	57
Redng	100	243	11.5	8.8–13.4	10.5–12.3	11.4	1.4	88	67	57
Sheff	100	565	11.3	8.7–13.3	10.4–12.2	11.2	1.4	82	60	54
Shrew	100	186	11.6	9.4–13.4	11.0–12.4	11.6	1.1	91	76	56
Stevng	100	360	11.3	9.5–13.1	10.6–12.1	11.3	1.2	89	63	63
Sthend	100	119	11.2	8.3–12.6	10.2–11.9	10.9	1.3	77	57	60
Stoke	100	278	11.8	9.1–13.4	10.8–12.3	11.5	1.3	88	71	49
Sund	99	163	11.6	9.1–13.4	10.8–12.4	11.5	1.3	87	70	51
Swanse	100	323	11.7	9.5–13.3	10.8–12.3	11.5	1.2	89	73	57
Truro	100	140	11.5	9.6–13.3	10.7–12.1	11.4	1.1	89	66	64
Tyrone	98	88	11.5	9.6–13.0	10.6–12.2	11.4	1.2	91	67	59
Ulster	100	86	11.0	9.2–12.8	10.4–11.7	11.0	1.3	84	51	67
Wirral	73	126	11.3	8.6–13.4	10.4–12.3	11.2	1.5	83	57	52
Wolve	100	285	11.4	8.8–14.1	10.4–12.5	11.4	1.6	85	63	52
Wrexm	100	72	11.5	9.0–13.9	10.6–12.3	11.4	1.4	88	64	50
York	96	134	11.3	9.0–13.7	10.2–12.1	11.3	1.5	82	60	54
England	**96**	**16,623**	**11.5**	**8.9–13.6**	**10.5–12.3**	**11.4**	**1.4**	**84**	**65**	**52**
N Ireland	**99**	**662**	**11.3**	**8.9–13.2**	**10.5–12.1**	**11.2**	**1.3**	**85**	**63**	**59**
Scotland[a]	**86**	**1,527**	**11.6**	**8.9–13.6**	**10.6–12.4**	**11.4**	**1.5**	**85**	**67**	**53**
Wales	**100**	**987**	**11.6**	**9.1–13.6**	**10.6–12.3**	**11.5**	**1.4**	**87**	**68**	**54**
UK	**95**	**19,799**	**11.5**	**8.9–13.6**	**10.5–12.3**	**11.4**	**1.4**	**85**	**65**	**53**

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

[a]A data extraction problem resulted in the UKRR not collecting all available data for these centres. The Scottish Renal Registry (www.srr.scot.nhs.uk <http://www.srr.scot.nhs.uk/>) record data completeness >90% for both centres and also for Scotland as a whole

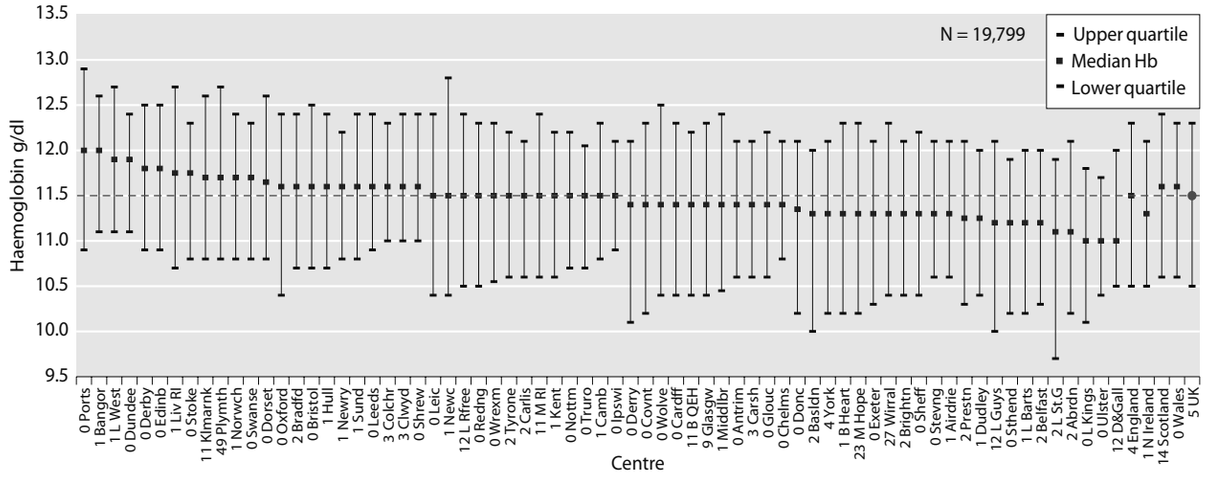

Fig. 8.7. Median haemoglobin in patients treated with HD by centre in 2010

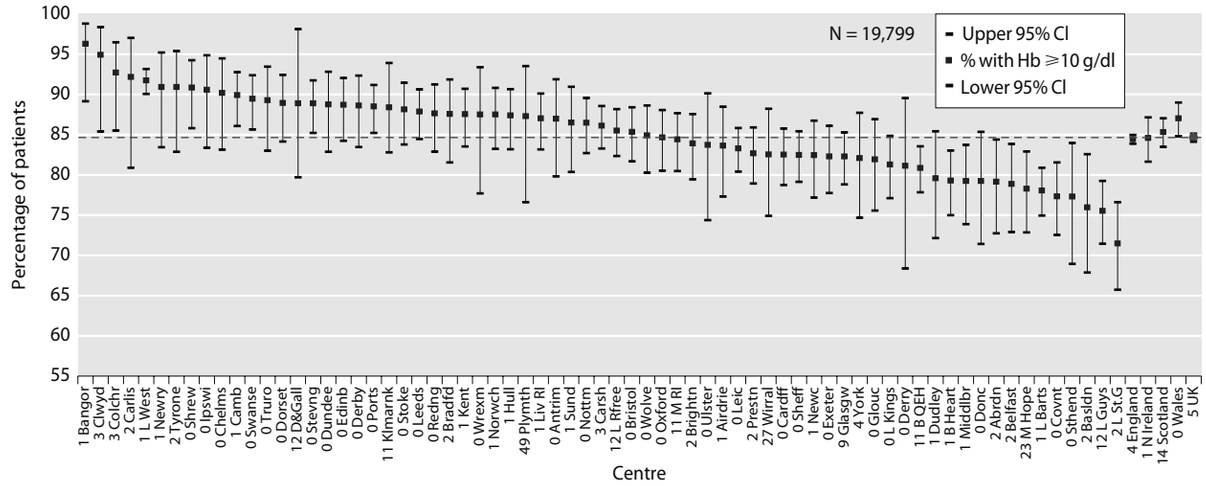

Fig. 8.8. Percentage of HD patients with Hb ⩾10 g/dl by centre in 2010

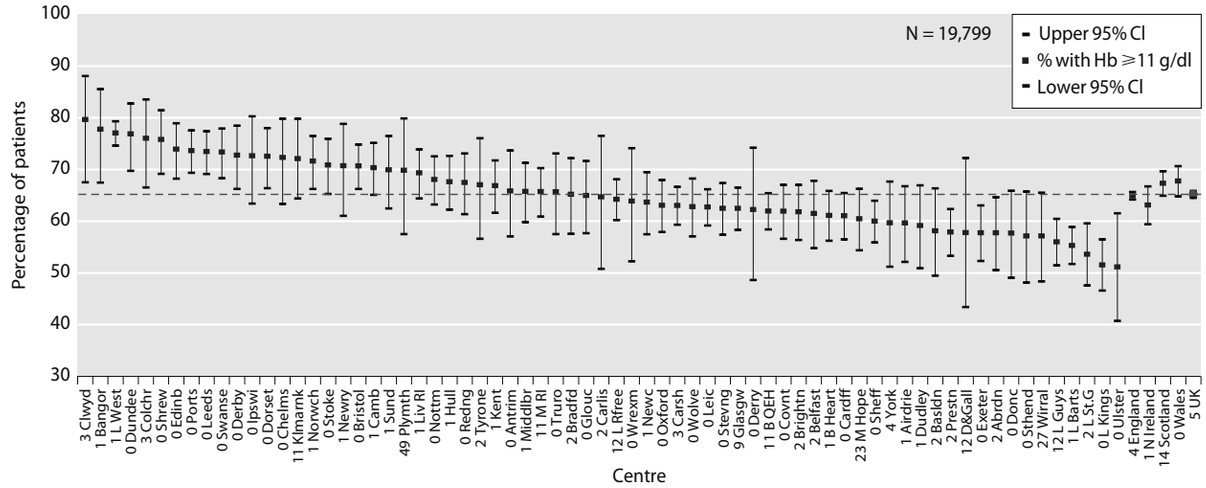

Fig. 8.9. Percentage of HD patients with Hb ⩾11 g/dl by centre in 2010

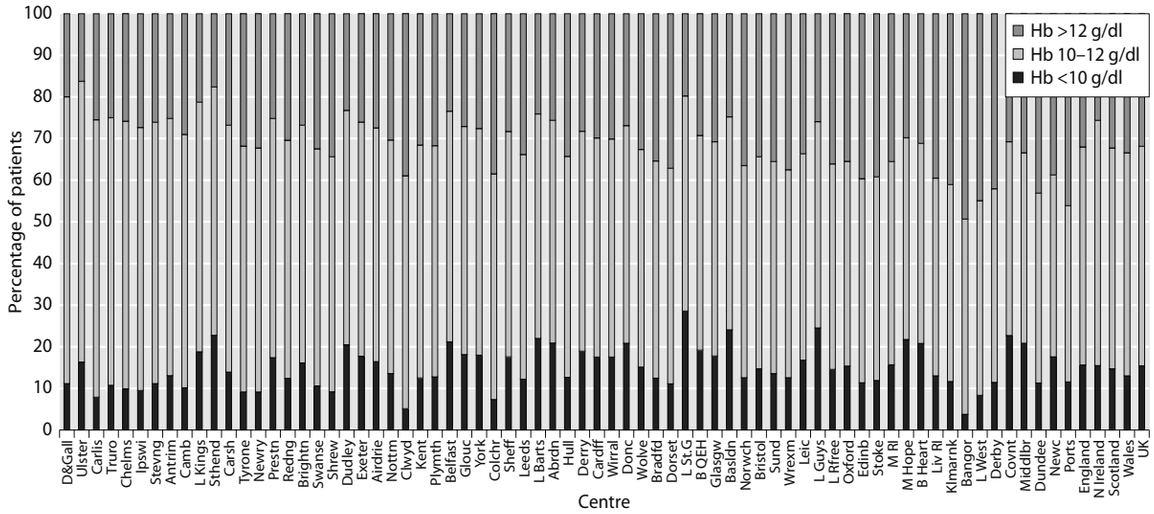

Fig. 8.10. Distribution of haemoglobin in patients treated with HD by centre in 2010

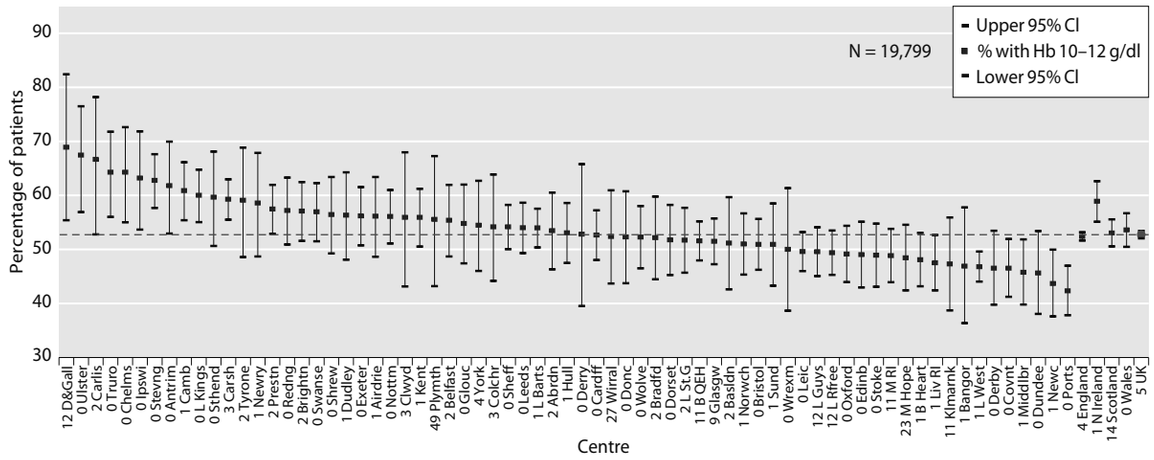

Fig. 8.11. Percentage of HD patients with Hb $\geqslant 10$ and $\leqslant 12$ g/dl by centre in 2010

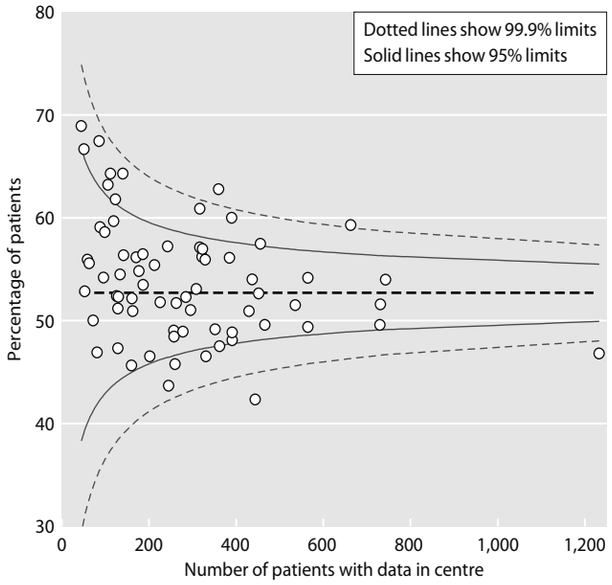

Fig. 8.12. Funnel plot of percentage of HD patients with Hb $\geqslant 10$ and $\leqslant 12$ g/dl by centre in 2010

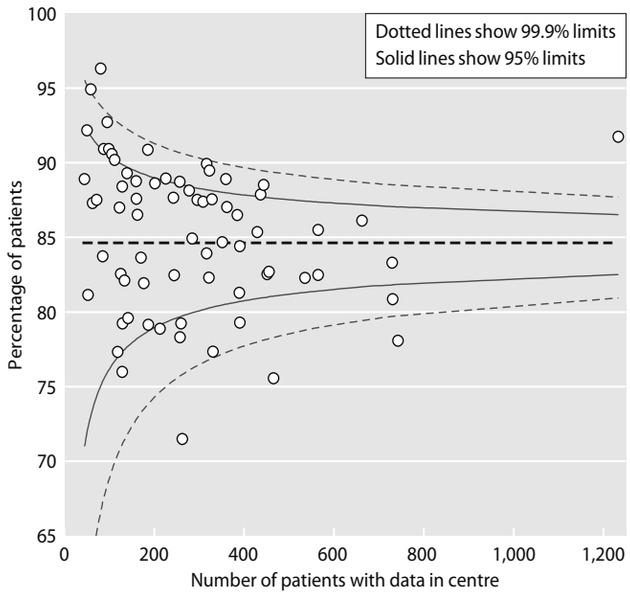

Fig. 8.13. Funnel plot of percentage of HD patients with Hb ⩾10 g/dl by centre in 2010

Table 8.3. Haemoglobin data for prevalent PD patients in 2010

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	96	27	11.4	9.6–13.0	10.6–12.2	11.5	1.1	93	70	67
Airdrie	100	11								
Antrim	100	11								
B Heart	100	36	11.7	8.9–14.4	11.1–12.6	11.7	1.5	86	75	58
B QEH	90	126	11.6	9.4–14.0	10.6–12.6	11.6	1.5	87	66	51
Bangor	100	23	11.9	10.8–13.8	11.4–12.9	12.2	1.1	100	87	61
Basldn	100	24	11.2	9.6–15.1	10.4–12.3	11.6	1.8	88	58	50
Belfast	96	24	11.6	8.9–12.9	10.5–12.1	11.4	1.5	88	67	54
Bradfd	100	33	10.9	7.5–14.4	9.8–12.8	11.2	2.0	73	48	33
Brightn	100	75	11.8	9.7–13.7	11.0–12.5	11.7	1.2	91	76	59
Bristol	100	56	12.0	9.1–14.2	11.3–13.2	12.0	1.5	88	84	54
Camb	100	31	11.8	8.9–14.0	11.2–12.6	11.7	1.6	87	77	61
Cardff	100	87	11.7	9.4–14.0	10.6–12.6	11.6	1.5	85	66	51
Carlis	100	12								
Carsh	94	87	11.0	9.0–14.4	10.3–12.4	11.4	1.6	79	53	49
Chelms	100	32	12.8	10.4–15.5	11.5–13.4	12.6	1.7	97	78	41
Clwyd	80	4								
Colchr	n/a	n/a								
Covnt	97	70	11.1	9.2–14.3	10.4–12.6	11.3	1.6	84	54	47
D & Gall	100	6								
Derby	99	88	11.6	9.3–14.1	10.7–12.8	11.7	1.6	88	73	50
Derry	100	2								
Donc	100	23	11.6	8.8–12.9	10.6–12.2	11.4	1.4	83	70	65
Dorset	100	51	11.9	10.0–14.0	11.0–12.7	12.0	1.3	96	80	53
Dudley	97	56	12.0	9.8–13.6	10.9–12.8	11.8	1.3	91	71	55
Dundee	95	19								
Dunfn	100	26	12.2	9.8–13.6	10.8–12.8	11.9	1.7	92	73	54
Edinb	98	47	11.2	9.6–14.5	10.5–12.2	11.5	1.5	87	62	57
Exeter	100	69	11.6	9.6–13.4	10.8–12.4	11.6	1.3	90	74	61
Glasgw	83	39	11.1	9.7–13.0	10.3–11.8	11.1	0.9	90	51	56
Glouc	100	39	11.0	8.9–13.9	10.2–12.3	11.2	1.5	79	54	54

Table 8.3. 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
Hull	100	62	11.4	9.2–14.0	10.6–12.5	11.6	1.7	89	65	53
Inverns	0	0								
Ipswi	97	34	11.1	8.8–14.9	10.6–12.5	11.5	1.7	88	59	53
Kent	100	67	11.7	8.7–13.5	10.5–12.4	11.4	1.5	85	69	58
Klmarnk	80	32	11.7	10.0–14.0	10.8–12.2	11.7	1.1	97	75	66
L Barts	98	169	11.5	8.7–14.2	10.5–12.8	11.6	1.6	86	65	49
L Guys	98	42	11.1	9.1–13.3	10.0–11.7	11.1	1.3	79	52	57
L Kings	100	84	11.5	9.6–13.4	10.7–12.3	11.4	1.5	86	69	61
L Rfree	98	62	11.4	9.7–13.7	10.6–12.3	11.5	1.4	89	65	58
L St.G	98	53	11.5	8.3–13.5	10.6–12.2	11.4	1.6	83	64	64
L West	100	31	11.2	9.4–12.4	10.3–11.8	11.1	0.9	87	58	71
Leeds	99	83	11.3	9.5–13.1	10.5–12.3	11.4	1.3	88	61	60
Leic	99	140	11.5	8.6–13.9	10.3–12.2	11.3	1.6	84	59	54
Liv Ain	0	0								
Liv RI	99	77	11.7	8.9–14.2	11.0–12.8	11.8	1.4	91	77	53
M Hope	73	80	11.3	8.7–13.6	10.3–12.3	11.3	1.5	79	63	49
M RI	100	75	11.6	8.7–14.4	10.6–12.6	11.5	1.7	85	65	55
Middlbr	94	17								
Newc	100	45	11.3	8.3–12.8	10.3–12.1	11.1	1.5	78	60	60
Newry	100	8								
Norwch	100	46	12.3	9.9–14.9	11.1–13.1	12.3	1.6	93	78	46
Nottm	100	78	11.6	9.0–13.5	10.5–12.2	11.4	1.3	85	65	62
Oxford	100	101	11.6	9.3–13.8	10.8–12.6	11.6	1.5	91	71	54
Plymth	84	36	12.2	9.6–14.5	11.3–13.5	12.3	1.5	94	81	50
Ports	100	91	12.1	8.9–14.1	11.0–12.9	11.9	1.5	89	77	49
Prestn	100	60	11.8	9.6–14.1	10.9–12.6	11.7	1.4	90	73	55
Redng	99	77	11.5	8.6–14.1	10.9–12.0	11.5	1.5	92	70	66
Sheff	100	60	11.6	9.2–14.1	10.5–12.6	11.6	1.5	87	67	52
Shrew	94	17								
Stevng	100	28	11.4	7.4–13.8	9.7–12.9	11.1	1.9	71	64	39
Sthend	100	18								
Stoke	100	65	11.7	9.6–14.1	10.7–12.9	11.9	1.5	89	71	49
Sund	100	29	12.0	8.9–14.9	10.4–13.2	12.0	2.3	76	66	31
Swanse	100	45	12.2	10.2–13.6	11.6–12.7	12.1	1.1	98	89	60
Truro	100	26	11.8	9.4–12.9	10.6–12.3	11.4	1.1	92	69	69
Tyrone	71	5								
Ulster	100	2								
Wirral	54	19								
Wolve	100	62	11.5	9.2–13.8	10.2–12.4	11.5	1.5	84	58	47
Wrexm	95	19								
York	100	17								
England	**97**	**2,859**	**11.6**	**9.0–14.1**	**10.6–12.5**	**11.6**	**1.5**	**87**	**67**	**54**
N Ireland	**95**	**52**	**11.8**	**9.0–14.7**	**11.0–12.4**	**11.7**	**1.4**	**92**	**79**	**62**
Scotland	**84**	**207**	**11.4**	**9.7–14.0**	**10.6–12.3**	**11.6**	**1.3**	**91**	**68**	**58**
Wales	**99**	**178**	**11.9**	**9.6–14.3**	**11.1–12.8**	**12.0**	**1.4**	**92**	**78**	**54**
UK	**96**	**3,296**	**11.6**	**9.1–14.1**	**10.6–12.5**	**11.6**	**1.5**	**87**	**68**	**54**

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

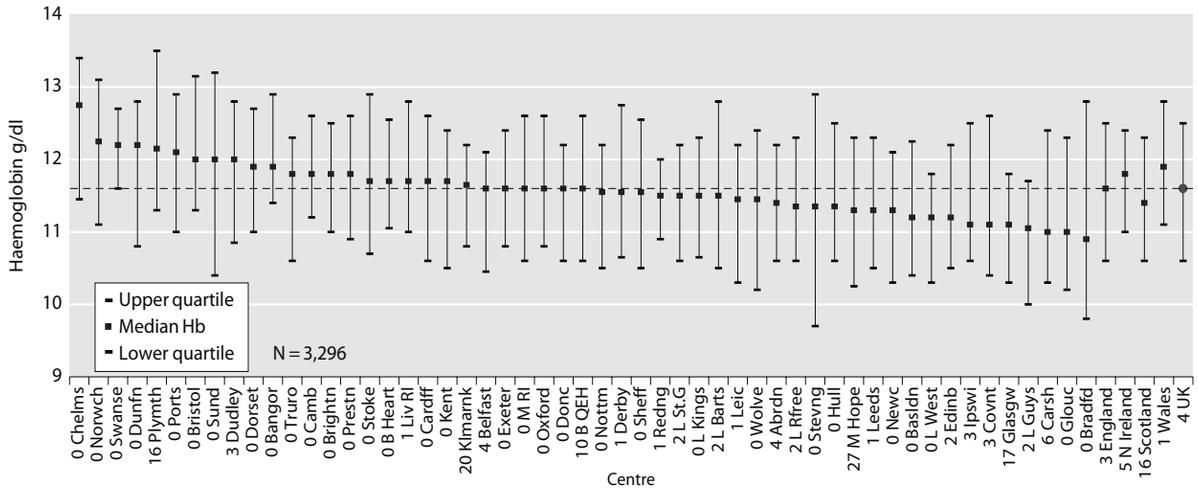

Fig. 8.14. Median haemoglobin in patients treated with PD by centre in 2010

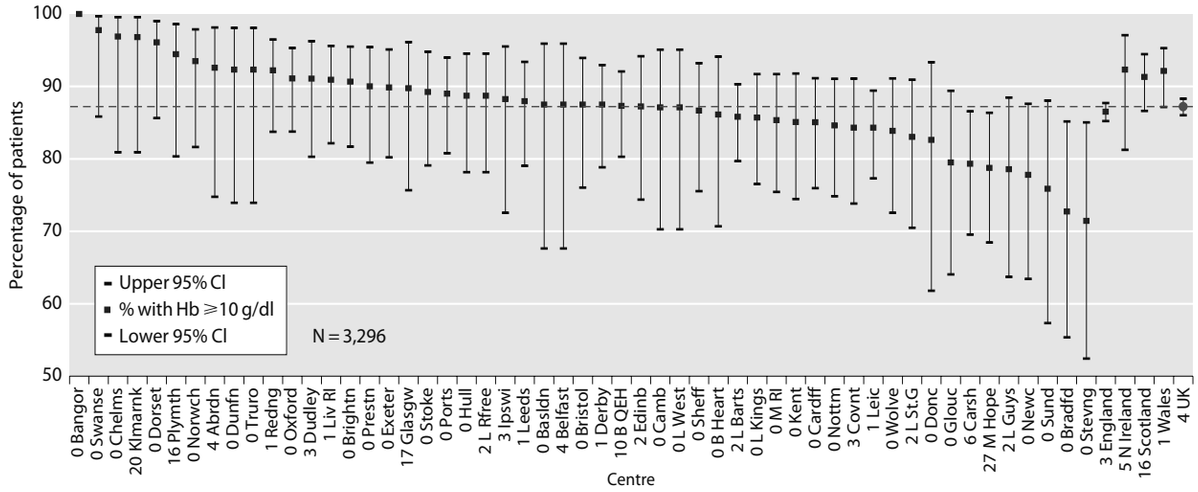

Fig. 8.15. Percentage of PD patients with Hb ⩾10 g/dl by centre in 2010

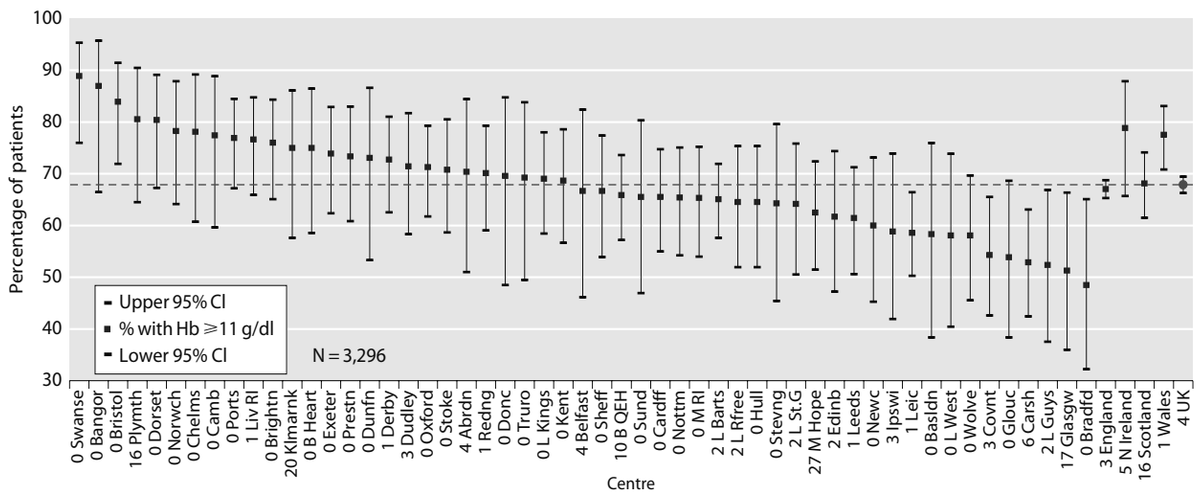

Fig. 8.16. Percentage of PD patients with Hb ⩾11 g/dl by centre in 2010

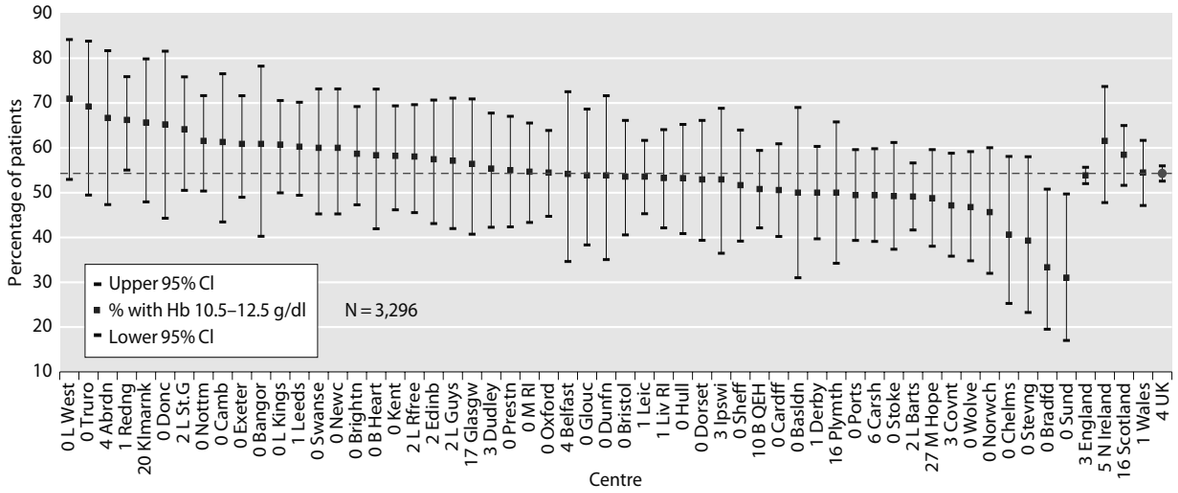

Fig. 8.17. Percentage of PD patients with Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl by centre in 2010

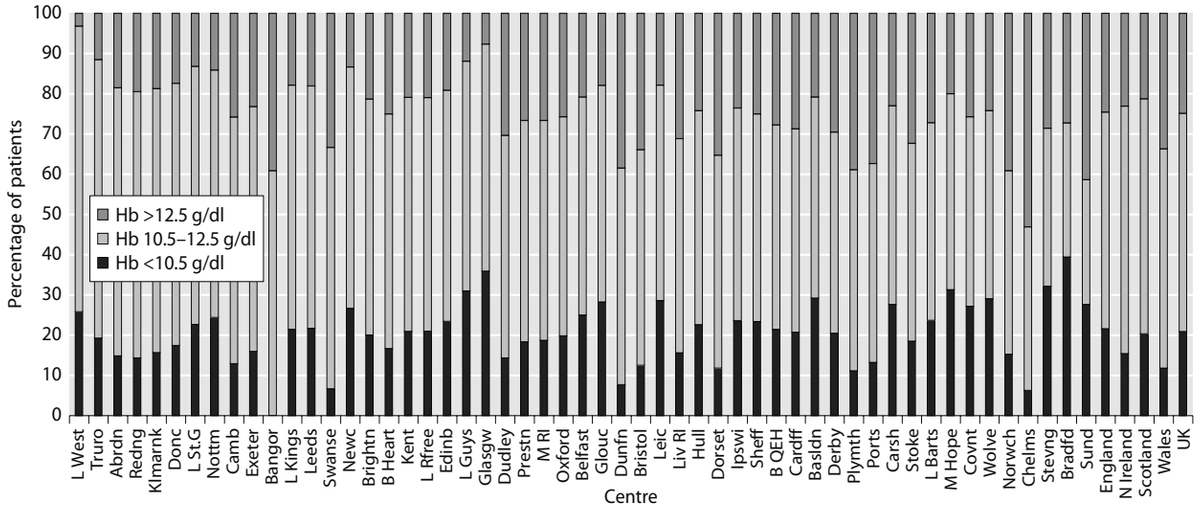

Fig. 8.18. Distribution of haemoglobin in patients treated with PD by centre in 2010

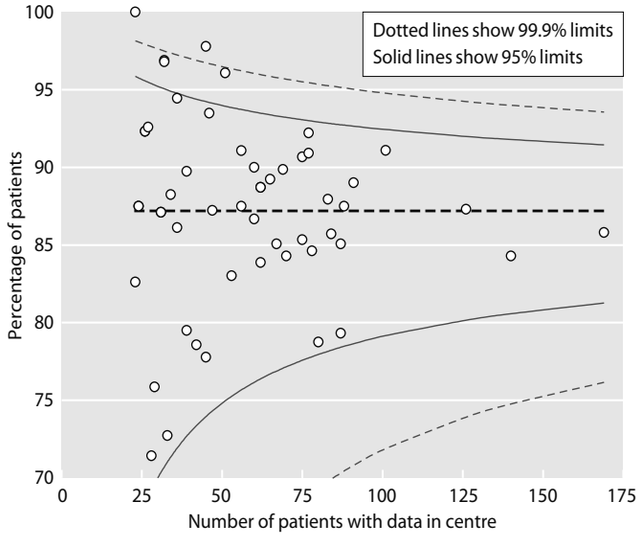

Fig. 8.19. Funnel plot of percentage of PD patients with Hb $\geqslant$10 g/dl by centre in 2010

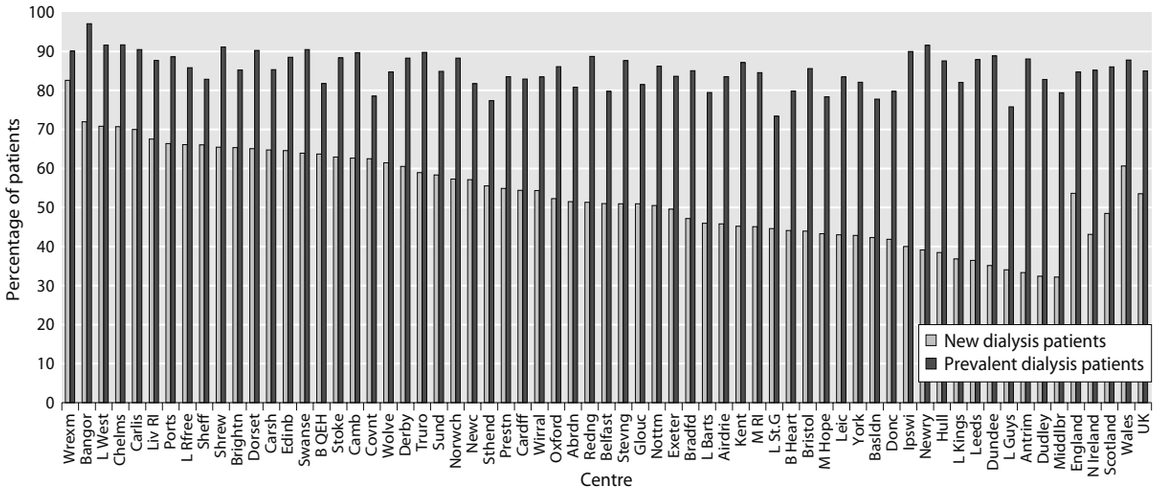

Fig. 8.20. Percentage of new and prevalent dialysis patients with Hb $\geqslant$10 g/dl by centre in 2010

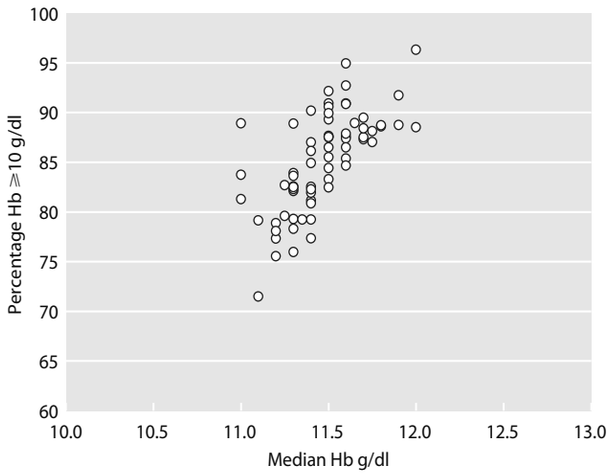

Fig. 8.21. Percentage of HD patients with Hb $\geqslant$10 g/dl plotted against median haemoglobin by centre in 2010

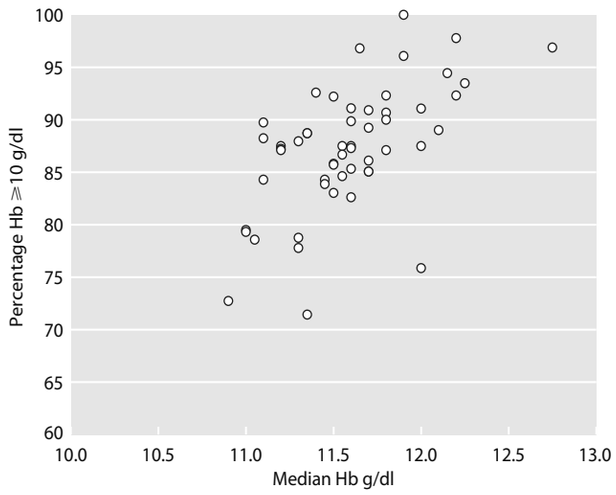

Fig. 8.23. Percentage of PD patients with Hb $\geqslant$10 g/dl plotted against median haemoglobin by centre in 2010

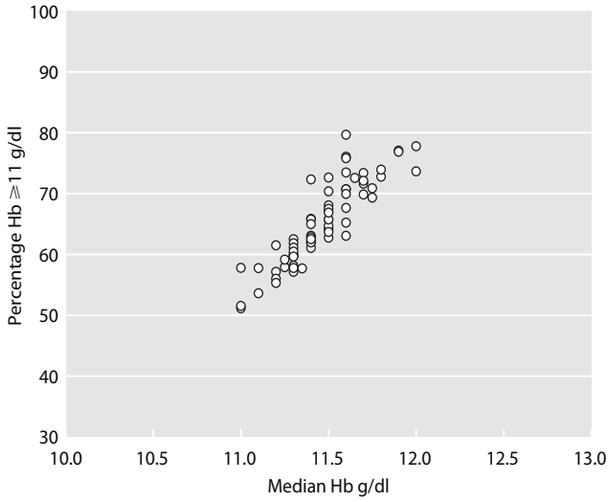

Fig. 8.22. Percentage of HD patients with Hb $\geqslant$11 g/dl plotted against median haemoglobin by centre in 2010

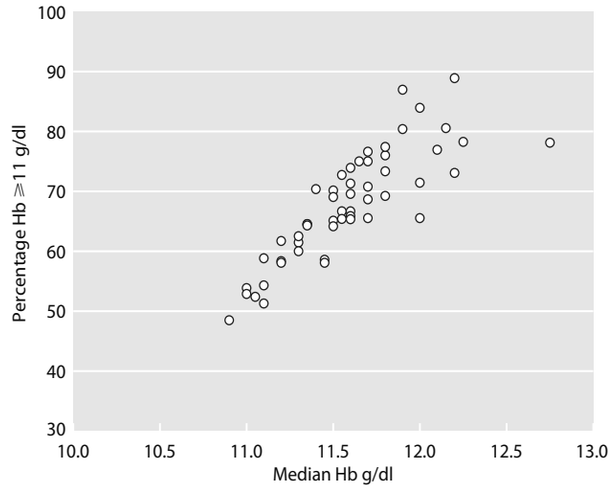

Fig. 8.24. Percentage of PD patients with Hb $\geqslant$11 g/dl plotted against median haemoglobin by centre in 2010

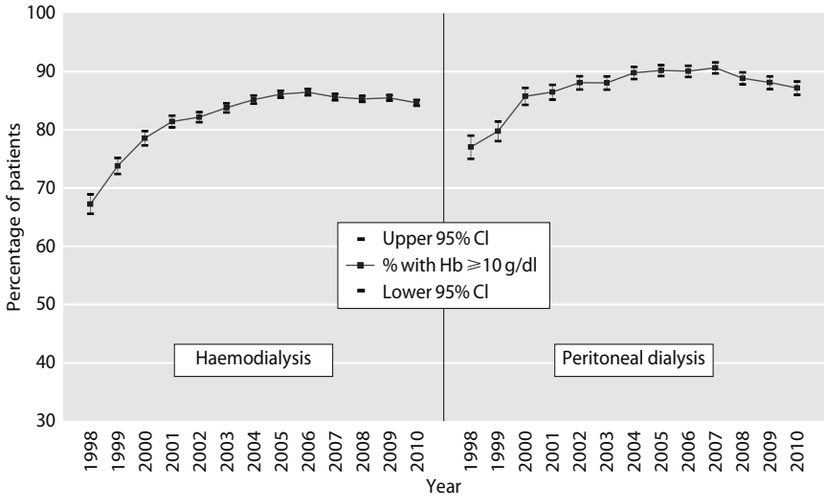

Fig. 8.25. Percentage of prevalent HD and PD patients (1998–2010) with Hb ⩾10 g/dl

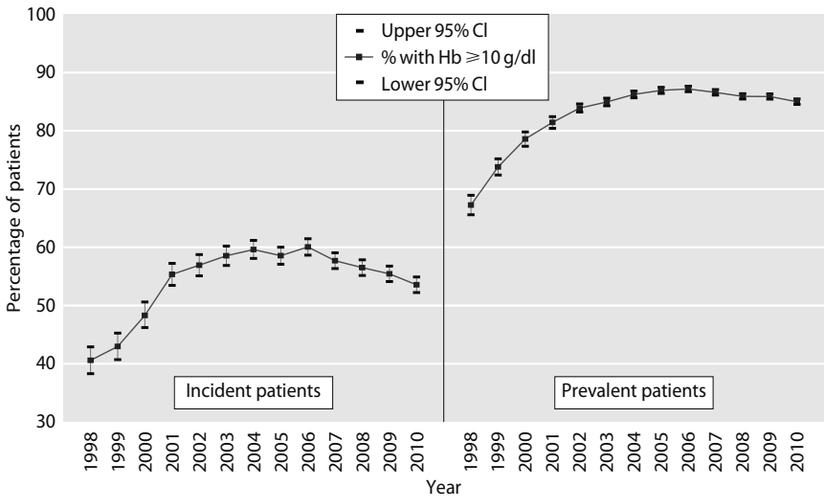

Fig. 8.26. Percentage of incident and prevalent dialysis patients (1998–2010) with Hb ⩾10 g/dl

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 with minimum standards by year (1998 to 2010) is shown in figure 8.25 for prevalent patients (by treatment modality) and in figure 8.26 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 8.27 and 8.28).

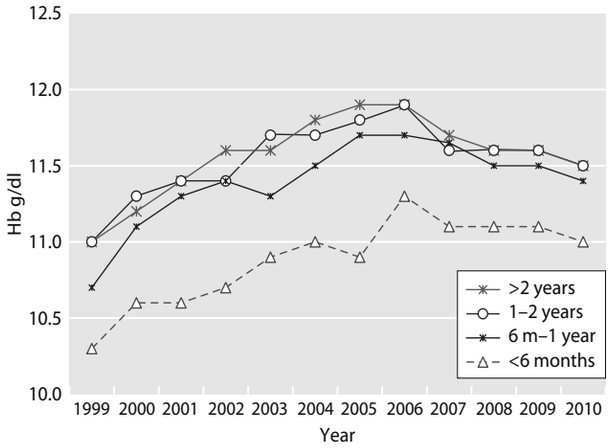

Fig. 8.27. Median haemoglobin plotted by length of time on RRT (HD patients)

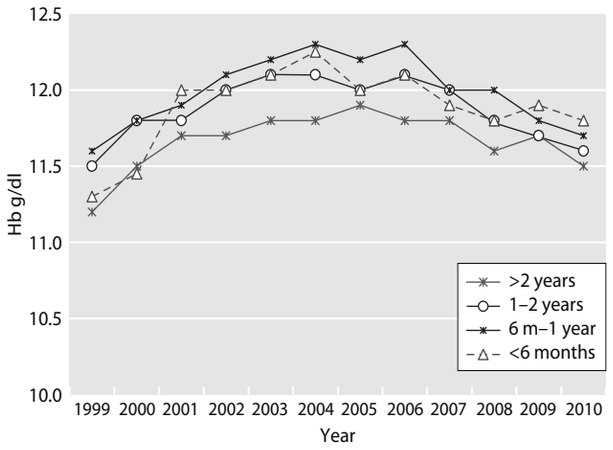

Fig. 8.28. Median haemoglobin plotted by length of time on RRT (PD patients)

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 8.4 and 8.5 for HD and PD patients respectively.

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

All centres achieved greater than 90% compliance with a serum ferritin $\geqslant 100\,\mu g/L$ for HD patients. The PD population had a lower median ferritin value (264 μg/L, IQR 148–426 vs. 444 μg/L, IQR 299–635 for HD). In 2010, 31 centres reported less than 90% of PD patients compliant with serum ferritin $\geqslant 100\,\mu g/L$.

Changes in ferritin 2001–2010

The compliance with guidelines for ferritin in the HD populations has been 95% or above since 2007. In the PD population the compliance has fluctuated over the last few years, and was 85.9% in 2010. The serial values are shown in figure 8.37. 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 8.38.

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 8.39 and 8.40).

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 are relatively expensive and thus approaches to achieving normal haemoglobin levels

Table 8.4. Ferritin in HD patients in 2010

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin $\geqslant 100\,\mu g/L$	% ferritin $\geqslant 800\,\mu g/L$
Antrim	100	123	411	135–982	287–629	98	11
B Heart	95	375	310	65–747	204–446	92	2
B QEH	90	738	378	141–673	303–462	97	2
Bangor	100	82	553	207–961	399–716	98	11
Basldn	97	128	339	103–605	270–405	95	2
Belfast	97	211	534	123–1136	326–795	97	24
Bradfd	96	158	672	254–1260	462–878	99	32
Brightn	93	300	441	171–805	305–586	98	5
Bristol	100	429	604	123–1232	431–801	97	25
Camb	72	230	298	96–703	190–411	95	4
Cardff	99	448	266	87–682	171–386	93	2
Carlis	100	52	498	245–2557	391–724	100	21
Carsh	97	661	350	96–784	257–468	95	5
Chelms	98	110	464	239–823	380–561	100	7

Table 8.4. Continued

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Clwyd	97	59	479	196–1180	311–568	98	8
Colchr	97	96	716	338–1401	585–920	100	35
Covnt	99	329	352	102–775	219–479	96	5
Derby	100	201	356	130–754	233–477	96	4
Derry	100	53	494	38–1656	297–807	91	26
Donc	100	130	467	248–925	356–614	100	12
Dorset	98	221	539	256–998	428–679	98	13
Dudley	97	140	343	39–824	219–463	90	5
Exeter	100	321	284	109–721	206–373	96	4
Glouc	99	175	487	110–1012	306–672	96	14
Hull	97	304	417	202–734	306–541	99	4
Ipswi	71	75	622	115–1176	422–797	96	24
Kent	98	324	377	77–1125	215–604	92	12
L Barts	98	734	481	149–1078	331–671	98	14
L Guys	80	426	578	200–1696	398–846	99	29
L Kings	99	385	604	203–1341	425–835	99	28
L Rfree	85	548	435	82–1348	251–737	93	21
L St.G	98	261	420	150–1041	308–575	97	11
L West	89	1104	525	253–1203	404–680	99	17
Leeds	100	437	511	106–1202	377–687	96	16
Leic	100	730	350	102–732	253–470	95	4
Liv Ain	2	3					
Liv RI	98	361	553	153–1409	338–822	98	27
M Hope	19	65					
M RI	87	382	376	107–816	251–510	96	6
Middlbr	97	255	674	124–1871	341–1068	96	40
Newc	100	246	688	157–1732	433–996	98	41
Newry	99	99	621	90–1058	383–775	95	22
Norwch	97	291	535	83–1275	345–753	94	20
Nottm	100	385	530	227–872	422–621	99	9
Oxford	99	348	301	91–741	195–420	94	4
Plymth	98	122	668	215–1876	465–1125	99	41
Ports	99	441	315	82–733	210–435	93	4
Prestn	99	461	540	89–1423	339–824	94	28
Redng	100	242	517	200–1075	391–684	98	17
Sheff	100	565	480	156–917	350–613	97	10
Shrew	98	183	404	83–952	249–649	95	12
Stevng	99	358	445	156–943	301–610	98	10
Sthend	100	119	322	174–612	263–407	98	3
Stoke	99	276	697	230–1587	491–894	100	34
Sund	99	163	583	202–1935	408–812	99	26
Swanse	100	322	337	65–760	203–497	90	4
Truro	100	140	466	234–1022	355–573	99	8
Tyrone	97	87	829	263–1763	550–1130	99	52
Ulster	100	86	585	279–1055	467–717	100	15
Wirral	66	114	601	266–1167	471–768	99	23
Wolve	100	285	512	145–1082	409–649	97	14
Wrexm	61	44	423	177–869	278–562	100	9
York	94	131	508	99–823	411–607	95	5
England	**93**	**16,058**	**448**	**125–1133**	**305–638**	**97**	**14**
N Ireland	**99**	**659**	**553**	**136–1305**	**350–783**	**97**	**24**
Wales	**96**	**955**	**321**	**85–778**	**203–492**	**93**	**4**
E, W & NI	**93**	**17,672**	**444**	**121–1127**	**299–635**	**96**	**14**

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

Table 8.5. Ferritin in PD patients in 2010

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Antrim	100	11					
B Heart	97	35	210	35–1682	129–395	86	6
B QEH	84	117	158	32–655	78–236	68	3
Bangor	100	23	151	14–459	61–344	61	4
Basldn	100	24	164	50–385	86–282	63	0
Belfast	96	24	261	64–1423	136–381	88	13
Bradfd	97	32	280	31–998	122–453	88	6
Brightn	83	62	371	127–853	234–499	98	6
Bristol	96	54	380	60–1065	213–623	91	7
Camb	100	31	267	34–783	195–464	87	3
Cardff	100	87	119	23–293	68–192	56	2
Carlis	100	12					
Carsh	97	90	195	47–646	130–345	87	3
Chelms	100	32	122	19–481	54–225	63	0
Clwyd	60	3					
Colchr	n/a	n/a					
Covnt	89	64	245	56–658	143–359	84	3
Derby	99	88	323	108–774	207–450	97	3
Derry	100	2					
Donc	96	22	172	63–358	123–285	82	0
Dorset	98	50	259	113–725	169–333	98	2
Dudley	81	47	133	18–509	77–235	64	0
Exeter	100	69	206	33–558	114–280	77	1
Glouc	100	39	230	49–793	136–418	87	3
Hull	94	58	343	99–947	228–445	95	5
Ipswi	94	33	264	35–783	101–349	76	3
Kent	97	65	288	82–763	161–419	88	3
L Barts	93	161	285	93–1038	193–473	94	7
L Guys	95	41	207	70–723	117–306	80	2
L Kings	100	84	240	52–801	120–312	82	6
L Rfree	98	62	355	129–953	220–632	97	16
L St.G	98	53	299	106–1616	230–469	96	6
L West	97	30	280	116–1216	179–421	100	7
Leeds	100	84	363	118–761	244–501	96	5
Leic	99	140	358	83–938	258–475	94	8
Liv Ain	0	0					
Liv RI	97	76	320	68–1272	199–487	92	8
M Hope	2	2					
M RI	97	73	175	41–440	110–230	78	0
Middlbr	94	17					
Newc	100	45	457	92–1322	331–864	93	27
Newry	100	8					
Norwch	98	45	158	43–862	82–408	64	9
Nottm	100	78	283	66–1189	183–410	88	10
Oxford	97	98	205	75–671	136–328	85	3
Plymth	98	42	352	37–970	126–519	79	10
Ports	98	89	260	72–773	169–411	90	3
Prestn	100	60	230	37–915	131–516	80	8
Redng	99	77	404	73–720	269–566	94	3
Sheff	100	60	330	61–871	142–578	83	8
Shrew	94	17					
Stevng	89	25	270	65–955	118–366	80	8
Sthend	100	18					
Stoke	97	63	438	76–1133	288–757	94	21
Sund	97	28	565	32–1753	218–1166	89	32

Table 8.5. Ferritin in PD patients in 2010

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Swanse	100	45	203	58–673	135–300	87	2
Truro	96	25	283	122–742	212–475	96	4
Tyrone	100	7					
Ulster	100	2					
Wirral	46	16					
Wolve	100	62	224	30–721	112–453	79	3
Wrexm	20	4					
York	100	17					
England	**92**	**2,712**	**271**	**54–879**	**157–441**	**87**	**6**
N Ireland	**98**	**54**	**235**	**37–1423**	**121–387**	**83**	**7**
Wales	**90**	**162**	**149**	**24–556**	**77–250**	**67**	**2**
E, W & NI	**92**	**2,928**	**264**	**50–871**	**148–426**	**86**	**6**

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

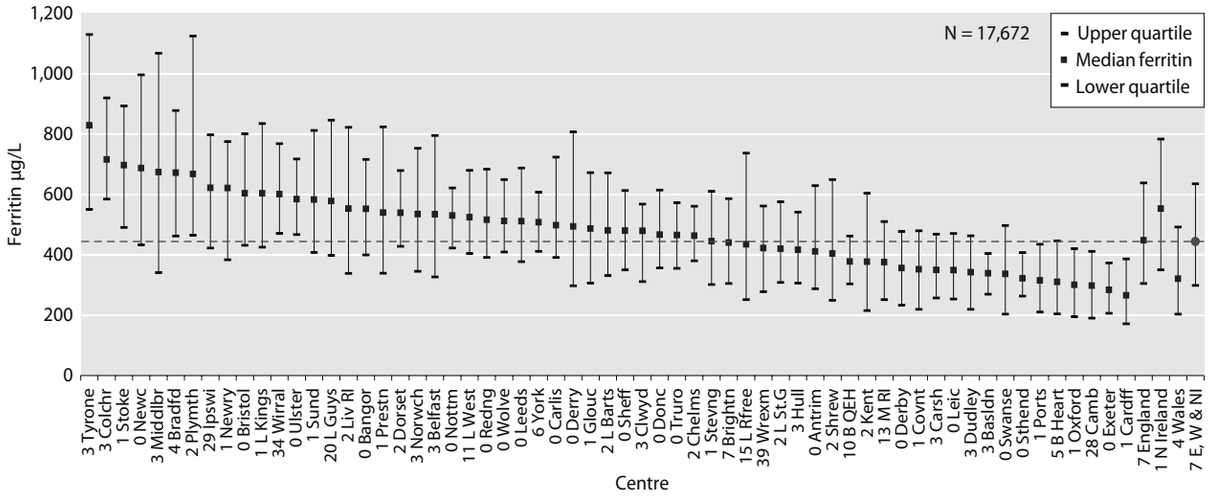

Fig. 8.29. Median ferritin in patients treated with HD by centre in 2010

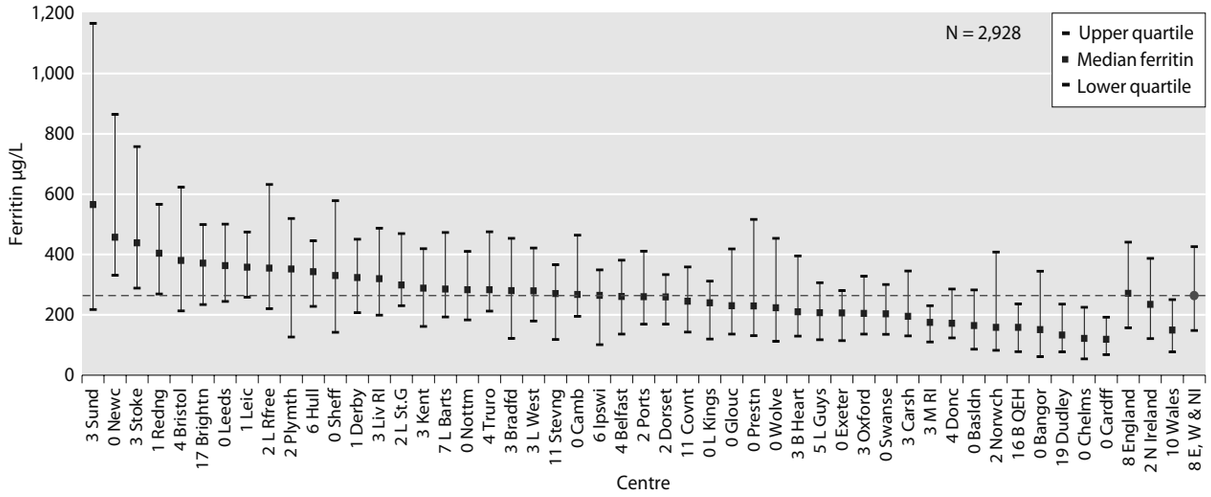

Fig. 8.30. Median ferritin in patients treated with PD by centre in 2010

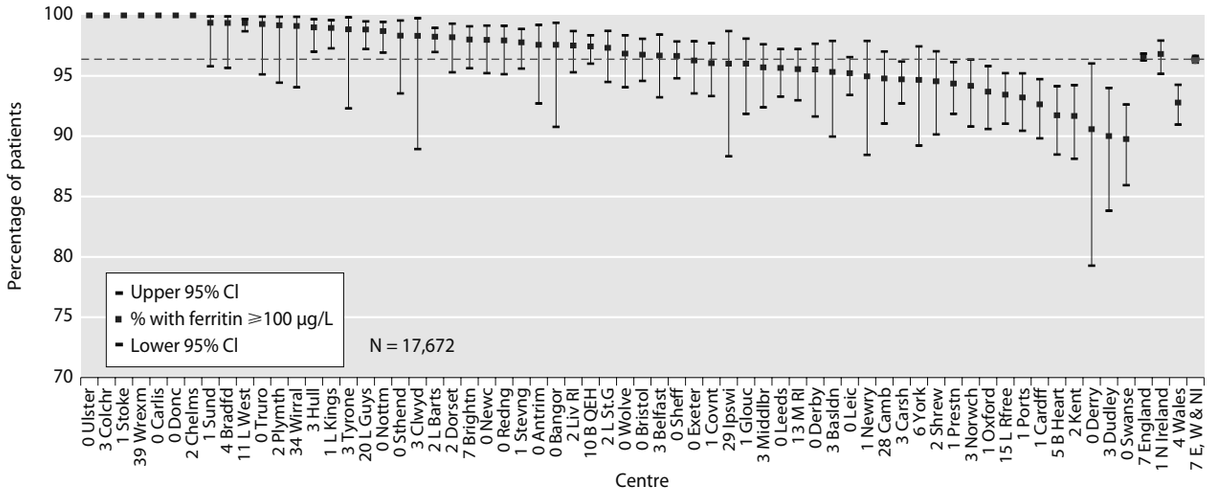

Fig. 8.31. Percentage of HD patients with ferritin ⩾100 µg/L by centre in 2010

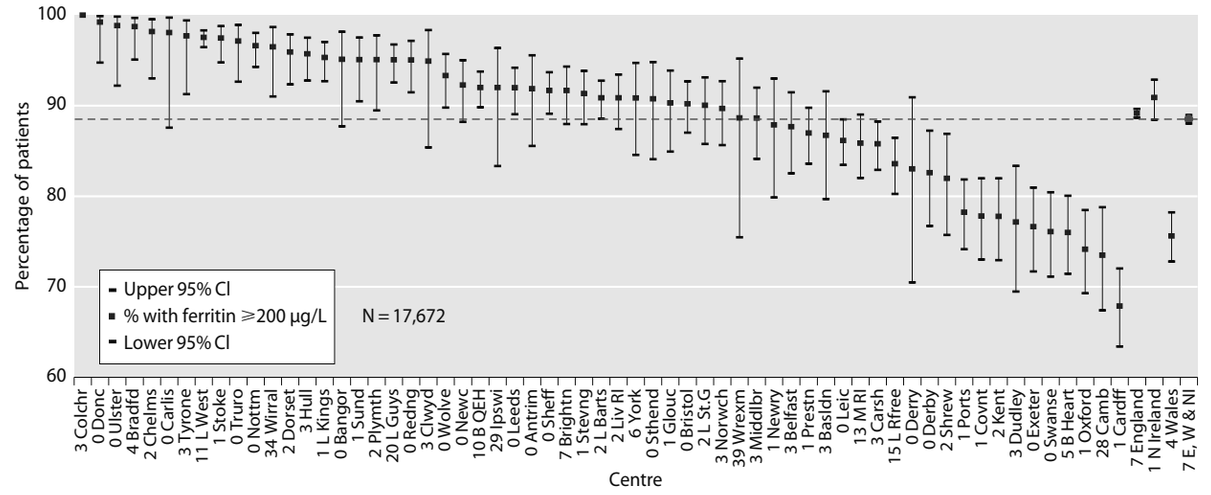

Fig. 8.32. Percentage of HD patients with ferritin ⩾200 µg/L by centre in 2010

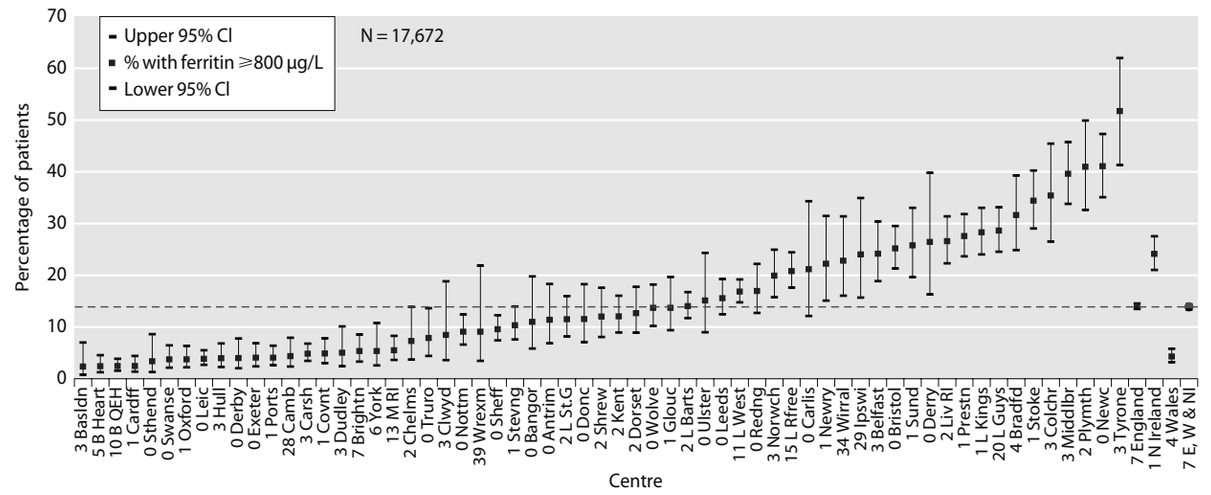

Fig. 8.33. Percentage of HD patients with ferritin ⩾800 µg/L by centre in 2010

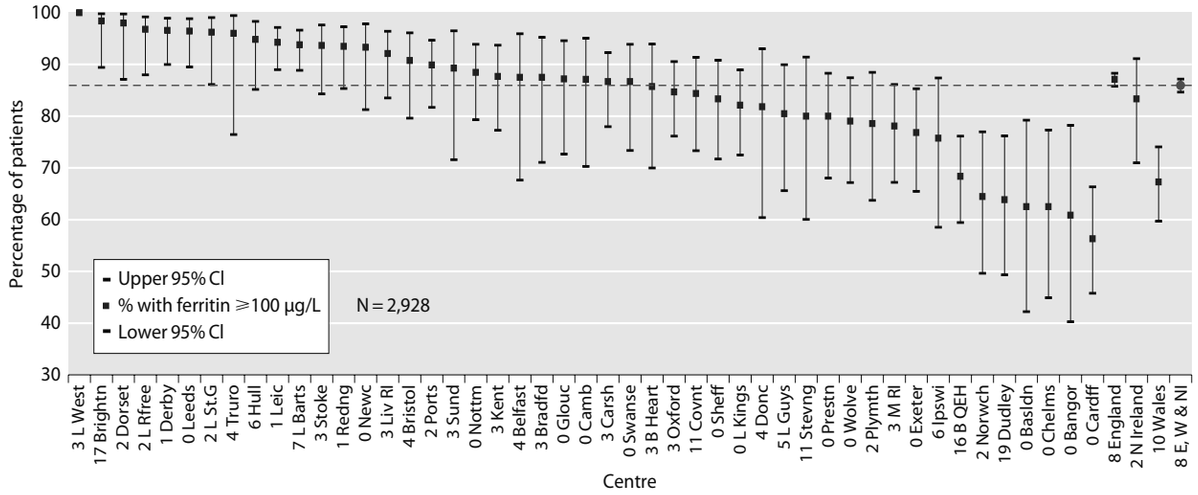

Fig. 8.34. Percentage of PD patients with ferritin ⩾100 µg/L by centre in 2010

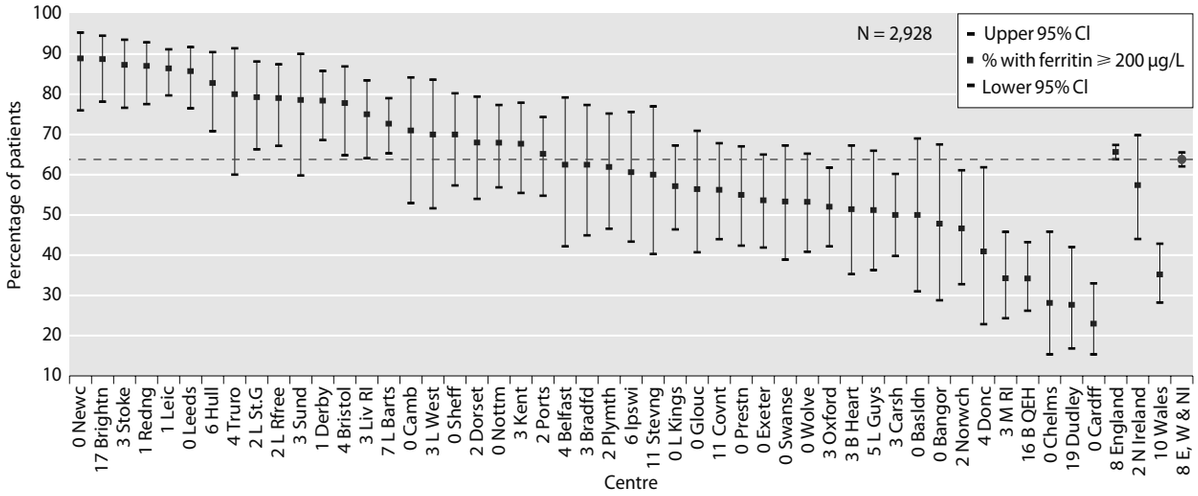

Fig. 8.35. Percentage of PD patients with ferritin ⩾200 µg/L by centre in 2010

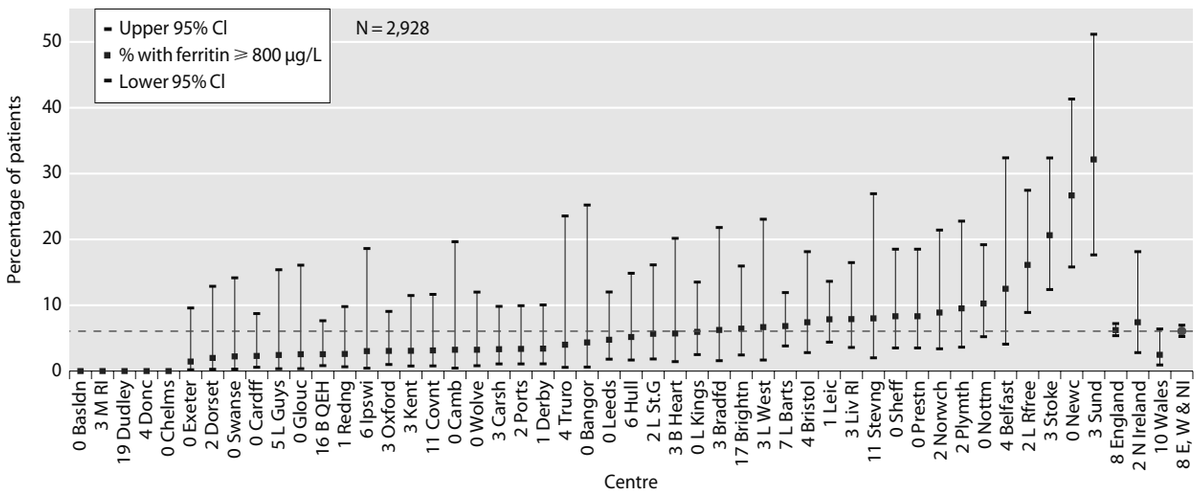

Fig. 8.36. Percentage of PD patients with ferritin ⩾800 µg/L by centre in 2010

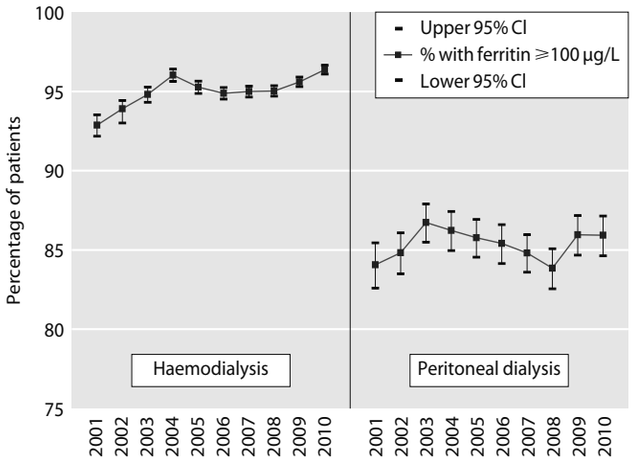

Fig. 8.37. Percentage of patients with ferritin ⩾100 µg/L (2001–2010)

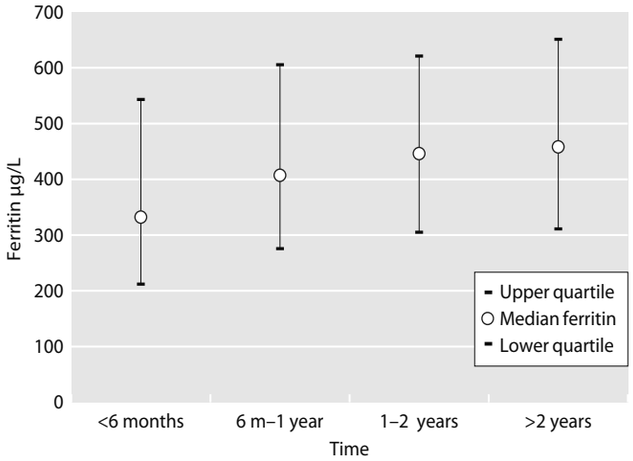

Fig. 8.39. Median ferritin by length of time on RRT in patients treated with HD in 2010

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 [11, 12]. Table 8.6 shows the percentage of patients treated and the dose of ESA given in HD patients. Equivalent data for PD patients are shown in table 8.7. 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 12,000 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 2010 prevalent patients in England, Wales and Northern Ireland were 9,020 IU/week for HD and 6,202 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 (74%) and this difference was present and similar across all age bands (figure 8.41). The percentage of the whole cohort which maintained

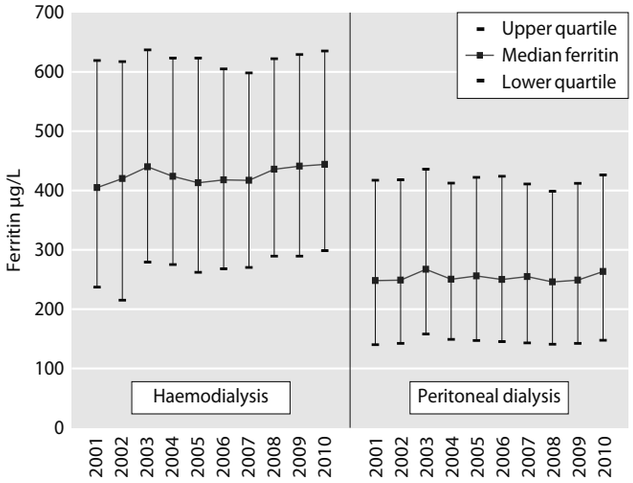

Fig. 8.38. Median ferritin of prevalent patients (2001–2010)

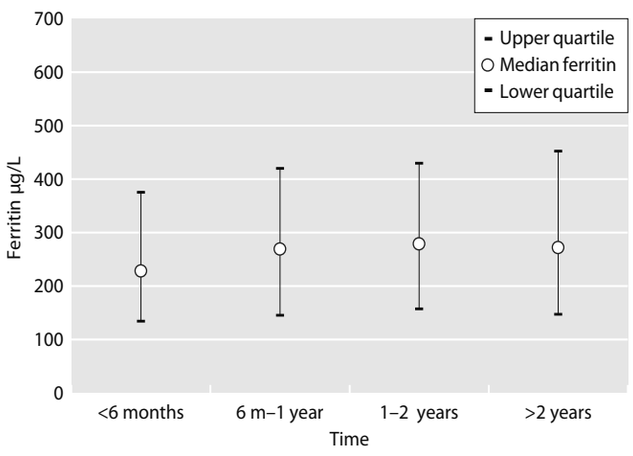

Fig. 8.40. Median ferritin by length of time on RRT in patients treated with PD in 2010

Table 8.6. ESA prescribing in HD patients in 2010

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	123	94	116	100	9,129	8,000	6
B Heart	396	83	330	100	10,297	9,000	15
Basldn	132	91	120	100	8,988	8,000	7
Belfast	217	90	196	100	7,849	6,000	8
Bradfd	165	95	157	99	7,401	6,000	3
Bristol	430	95	407	100	10,062	8,000	5
Chelms	112	100	112	100	12,339	9,000	0
Covnt	332	90	298	100	12,939	12,000	8
Derry	53	92	49	100	10,265	9,000	6
Donc	130	92	120	100	9,475	8,000	7
Exeter	322	96	309	100	8,894	8,000	4
Glouc	173	100	173	0			0
Ipswi	106	89	94	89	8,560	8,000	9
Kent	332	91	301	100	9,616	9,000	8
Leeds	437	92	404	98	5,538	4,000	7
Leic	732	98	719	100	8,054	6,000	2
Liv RI	367	93	340	100	9,156	8,000	6
Middlbr	263	78	206	100	6,461	6,000	17
Newc	247	89	220	100	9,966	7,600	9
Newry	100	95	95	100	6,202	4,000	5
Norwch	299	92	276	100	9,201	8,000	7
Nottm	385	93	358	87	10,806	9,000	6
Oxford	352	90	317	100	11,565	8,000	10
Prestn	467	86	401	9			11
Redng	243	93	226	0			6
Sheff	565	88	495	99	9,408	8,000	12
Shrew	186	91	170	100	8,341	8,000	8
Sthend	119	87	104	100	11,519	10,000	12
Truro	140	100	140	94	7,180	5,538	0
Tyrone	90	93	84	100	9,333	8,000	5
Ulster	86	94	81	100	5,953	6,000	6
Wolve	285	86	246	100	7,407	6,000	13
Wrexm	72	97	70	100	7,557	6,000	1
York	140	78	109	100	6,573	4,000	18
England	**7,857**	**91**	**7,152**	**88**	**9,138**	**8,000**	**8**
N Ireland	**669**	**93**	**621**	**100**	**7,980**	**6,000**	**6**
Wales	**72**	**97**	**70**	**100**	**7,557**	**6,000**	**1**
E, W & NI	**8,598**	**91**	**7,843**	**89**	**9,020**	**8,000**	**8**

Blank cells denote centres excluded from analyses due to missing or very incomplete dosage data

a Hb ⩾10 g/dl without requiring ESA (by age band and modality) is shown in figure 8.42.

Figure 8.43 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 being on treatment, some individuals may have just become anaemic and not yet started therapy, others may have been on ESA treatment but not had it recorded and other patients may have decided not to use ESA because of a history of malignancy.

ESA prescription and gender

Provision of ESA by age and gender for HD and PD patients is shown in figures 8.44 and 8.45. 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 89% of males. In PD patients, 77% of females compared to 72% of males were on ESA treatment.

Table 8.7. ESA prescribing in PD patients in 2010

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	11						
B Heart	36	75	27	100	7,156	4,000	25
Bangor	23	61	14				39
Basldn	24	50	12	100	6,083	5,000	46
Belfast	25	64	16	100	5,500	4,500	33
Bradfd	33	85	28	89	6,400	4,000	15
Bristol	56	75	42	100	5,401	4,000	25
Camb	31	68	21	100	8,210	5,600	29
Carlis	12						
Chelms	32	84	27	100	4,963	4,000	16
Covnt	72	75	54	100	9,622	8,000	23
Derry	2						
Donc	23	83	19	100	5,368	4,000	17
Dorset	51	84	43	100	6,418	4,000	14
Exeter	69	78	54	100	5,172	4,000	19
Glouc	36	100	36	0			0
Ipswi	35	86	30	97	4,977	5,000	9
Leeds	84	88	74	99	4,945	4,000	11
Leic	141	84	118	100	4,638	4,000	16
Liv RI	78	78	61	100	9,997	8,000	21
Middlbr	18						
Norwch	46	57	26	100	3,954	4,000	39
Nottm	78	69	54	0			29
Oxford	101	74	75	100	9,027	8,000	22
Plymth	43	63	27	100	6,148	6,000	33
Prestn	60	57	34	0			37
Redng	78	73	57	0			23
Sheff	60	65	39	100	6,551	4,000	35
Shrew	18						
Sthend	18						
Swanse	45	60	27	0			40
Truro	26	100	26	85	3,902	3,000	
Tyrone	7						
Ulster	2						
Wolve	62	66	41	100	4,817	3,000	31
York	17						
England	**1,438**	**75**	**1,081**	**82**	**6,318**	**4,000**	**23**
N Ireland	**47**	**66**	**31**	**100**	**5,226**	**3,000**	**32**
Wales	**68**	**60**	**41**				**40**
E, W & NI	**1,553**	**74**	**1,153**	**81**	**6,202**	**4,000**	**24**

Blank cells denote centres excluded from analyses due to low patient numbers or very incomplete dosage data

ESAs and time on renal replacement therapy

The percentage of patients on ESA by time on RRT and dialysis modality is shown in figure 8.46. This is a cross-sectional analysis at the final quarter of 2010. Patients who had previously changed RRT modality were still included in this analysis. The proportion of PD patients requiring ESA rises with duration of RRT from 73% after 1 year of PD, to 78% 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.

ESA dose and success with guideline compliance

There is no significant relationship between centres' mean ESA dose and median Hb for HD patients (figure 8.47) or compliance with the EPBG minimum

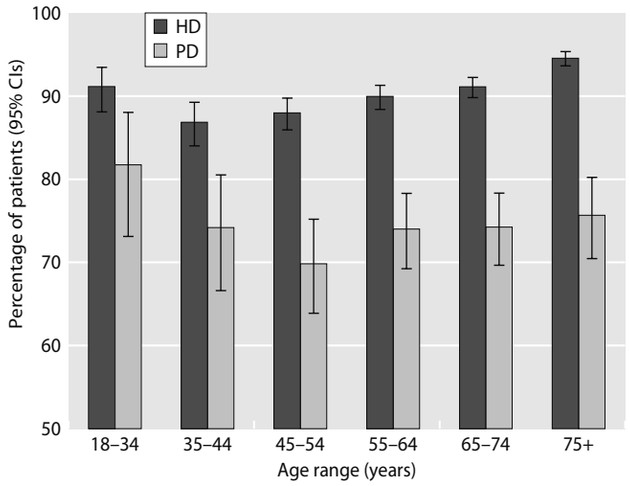

Fig. 8.41. Percentage of dialysis patients on ESA, by age group and treatment modality (2010)

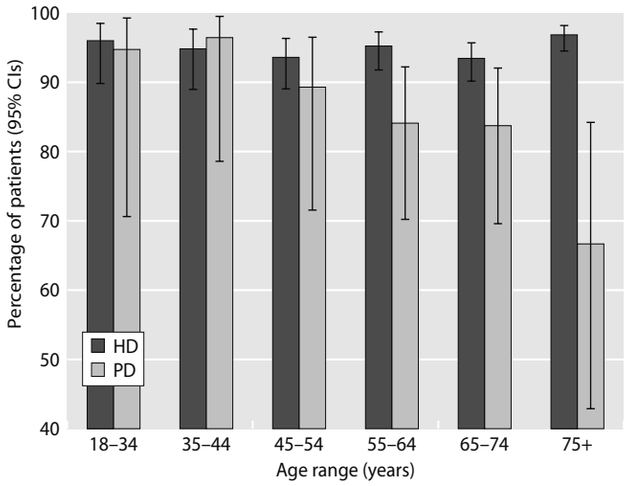

Fig. 8.43. Percentage of patients with Hb <10 g/dl who are on ESA, by age group and treatment modality (2010)

standard for Hb in HD patients (figure 8.48). This is not surprising as the most anaemic patients and those least responsive to ESAs are those given the biggest doses. Figure 8.49 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 12 g/dl (HD) or 12.5g/dl (PD) are receiving ESA. It has been suggested that it may be inappropriate to include those patients not receiving ESA within the group not meeting this RA target. There are 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 [11, 12].

Figures 8.50 and 8.51 show the percentages of HD and PD patients in each centre whose Hb lies above, within or below the RA guidelines of 10–12 g/dl (HD) or 10.5–12.5 g/dl (PD). These charts also show the proportion of patients with a Hb above the upper limit who were receiving, or were not receiving ESAs. These analyses are restricted to the centres with acceptable ESA returns as stipulated above. These figures show that 31.1% of HD patients had a Hb >12 g/dl. Most of these patients (84.8%) were on ESAs. Over a quarter (25.2%) of PD patients had a Hb >12.5 g/dl, but only 52.8% of these were on ESAs.

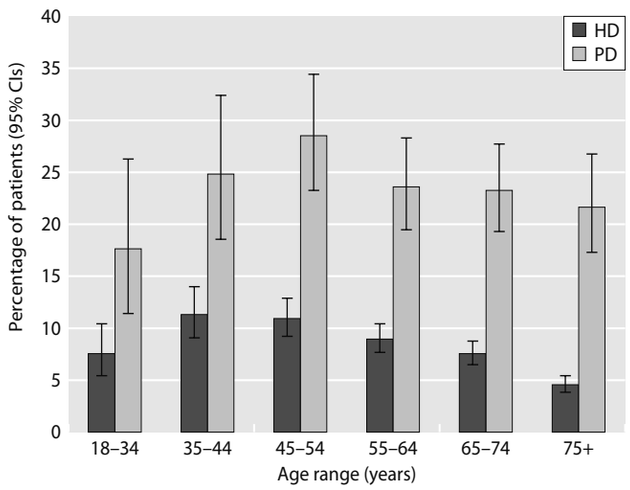

Fig. 8.42. Percentage of whole cohort (2010) who are not on ESA and have Hb ⩾10 g/dl, by age group and treatment modality

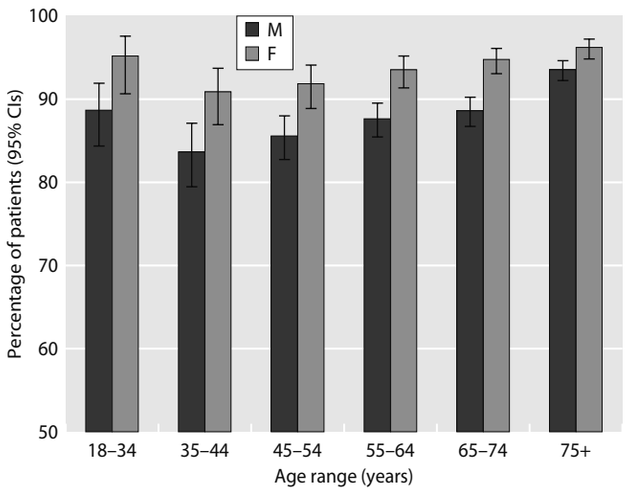

Fig. 8.44. Prescription of ESA by age and gender in patients treated with HD (2010)

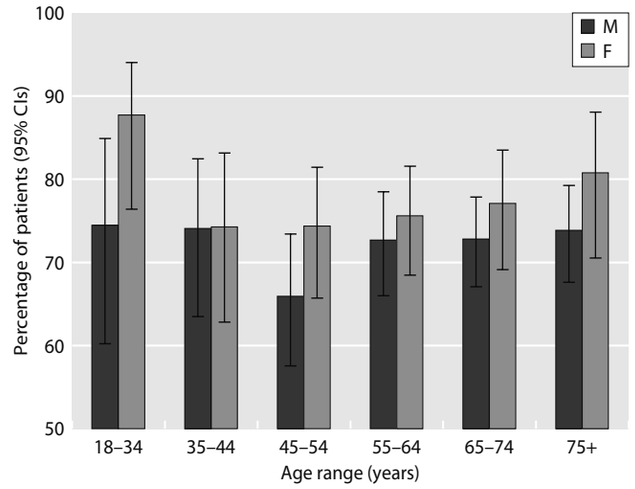

Fig. 8.45. Prescription of ESA by age and gender in patients treated with PD (2010)

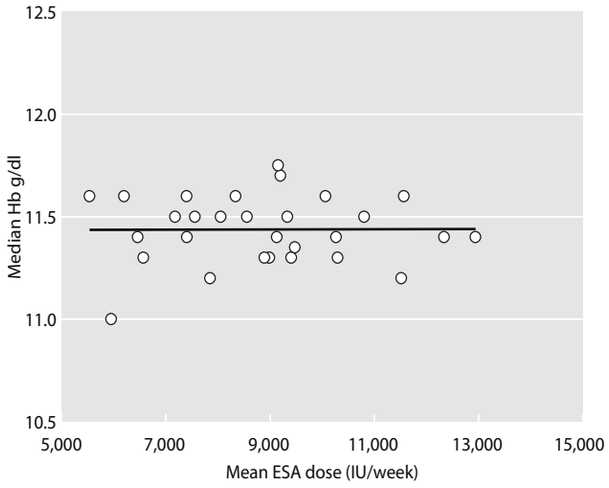

Fig. 8.47. Median Hb versus mean ESA dose in patients treated with HD by centre in 2010

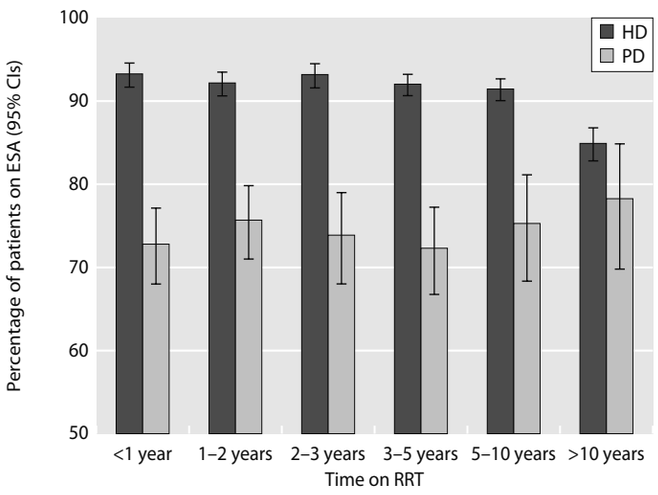

Fig. 8.46. Percentage of patients on ESA by time on RRT (2010)

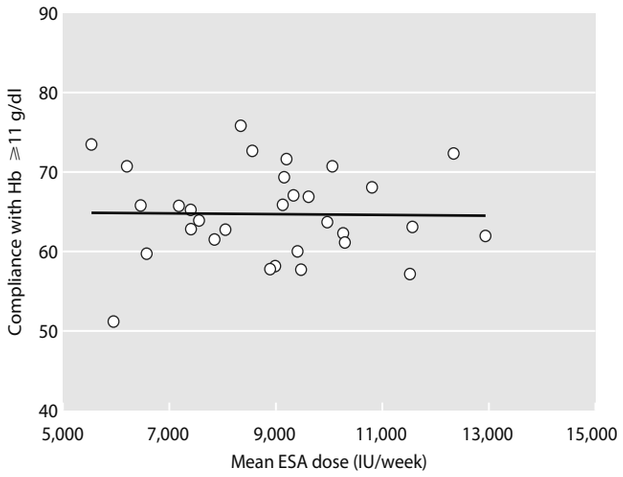

Fig. 8.48. Compliance with European Best Practice Guidelines versus mean ESA dose in patients treated with HD by centre in 2010

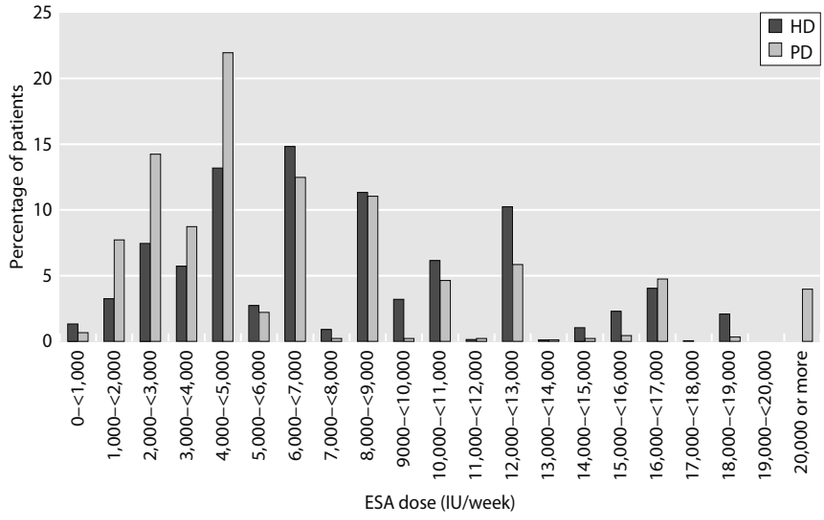

Fig. 8.49. Frequency distribution of weekly ESA dose in 2010

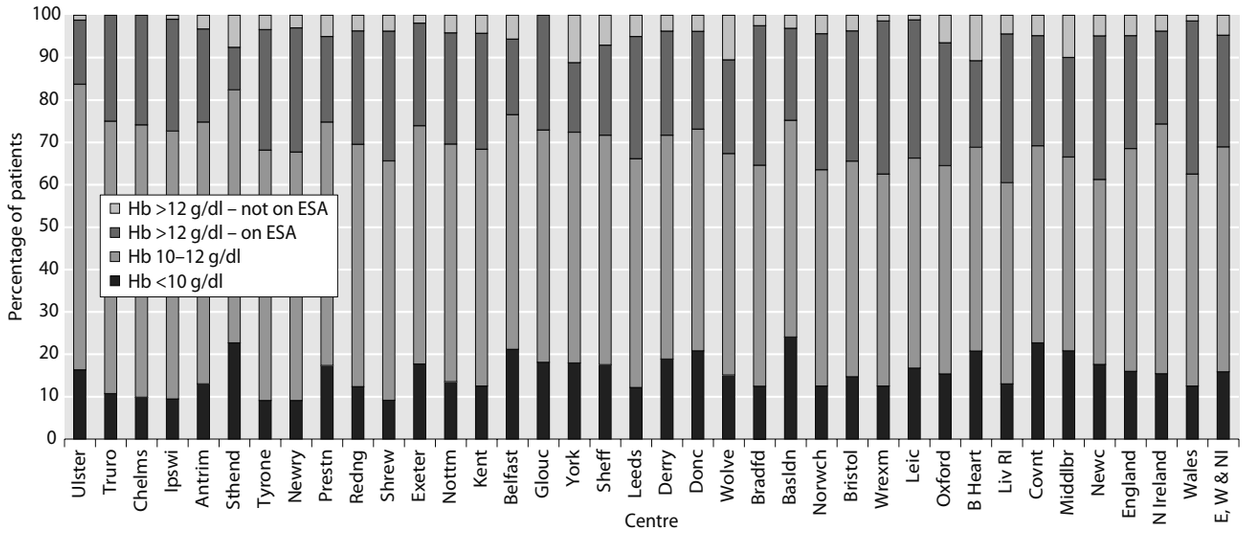

Fig. 8.50. Distribution of haemoglobin in patients treated with HD and the proportion of patients with Hb >12 g/dl receiving ESA by centre in 2010

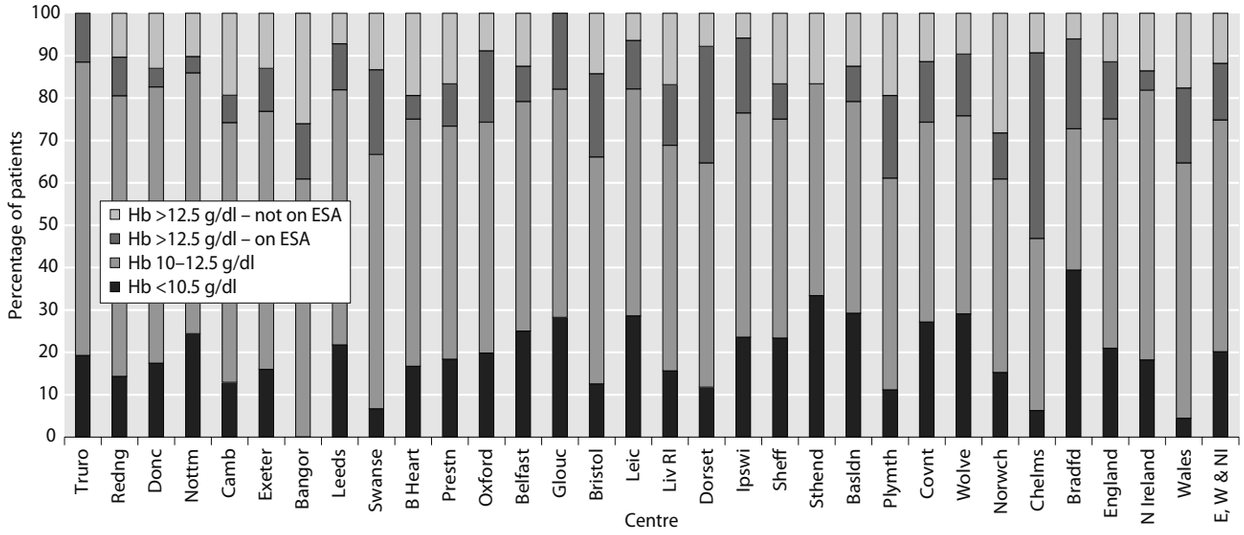

Fig. 8.51. Distribution of haemoglobin in patients treated with PD and the proportion of patients with Hb >12.5 g/dl receiving ESA by centre in 2010

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 (84.6% and 87.2% respectively). As would be anticipated, a greater proportion of prevalent patients (85.0%) than incident patients (53.6%) had a Hb ⩾10.0 g/dl in 2010.

In the UK the median Hb of patients on HD was 11.5 g/dl with an IQR of 10.5–12.3 g/dl, and the median Hb of patients on PD was 11.6 g/dl with an IQR of 10.6–12.5 g/dl. These UK averages are similar to those published in the last few UKRR reports.

Compliance with advice regarding iron stores as reflected by ferritin remained stable in the UK with 96% of HD patients and 86% of PD patients achieving a serum ferritin greater than 100 µg/L.

The analysis of ESA usage was limited by incomplete data returns. From the available data, 91% of HD patients and 74% of PD patients were on

ESA treatment in England, Wales and Northern Ireland.

New guidelines introduced in 2010 [8, 9] mean that from the 15th Annual Report all RRT patients on ESA treatment will be measured against the Hb target of 10–12 g/dl. It will be of interest how this affects median Hb levels and ESA use over the next few years.

Conflicts of interest: none

References

1 Department of Health Renal Team National Service Framework for Renal Services: Part One – Dialysis and transplantation. Department of Health, London. 2004
2 Renal Association. Treatment of adults and children with renal failure: standards and audit measures. 3rd Edition. Royal College of Physicians of London and the Renal Association, London. 2002
3 Revised European Best Practice Guidelines for the Management of Anaemia in Patients with Chronic Renal Failure. Nephrol Dial Transplant 2004;19:ii1–ii47
4 NKF-K/DOQI Clinical Practice Guidelines for Anemia of Chronic Kidney Disease: Update 2000. American journal of kidney diseases 2001;37:S182–S238
5 National Collaborating Centre for Chronic Conditions. Anaemia management in chronic kidney disease: national clinical guideline for management in adults and children. Royal College of Physicians, London. 2006
6 UK Renal Association Clinical Practice Guidelines Committee: Complications of CKD, 4th Edition. 2007. http://www.renal.org/pages/pages/clinical-affairs/guidelines.php
7 Renal Association Clinical Practice Guidelines Committee: Haemodialysis, 5th Edition. 2009. http://www.renal.org/clinical/guidelinessection/haemodialysis.aspx
8 UK Renal Association Clinical Practice Guidelines Committee: Anaemia of CKD, 5th Edition. 2010. http://www.renal.org/clinical/GuidelinesSection/AnaemiaInCKD.aspx
9 National Institute for Health and Clinical Excellence (NICE). Anaemia management in people with chronic kidney disease (CG114), 2011. http://guidance.nice.org.uk/CG114
10 http//:www.kdigo.org
11 Drueke TB, Locatelli F, Clyne N, Eckardt K-U, Macdougall IC, Tsakiris D, Burger H-U, Scherhag A, the CREATE Investigators: Normalization of Hemoglobin Level in Patients with Chronic Kidney Disease and Anemia. N Engl J Med 2006;355:2071–2084
12 Singh AK, Szczech L, Tang KL, Barnhart H, Sapp S, Wolfson M, Reddan D, the CHOIR Investigators: Correction of Anemia with Epoetin Alfa in Chronic Kidney Disease. N Engl J Med 2006;355:2085–2098

UK Renal Registry 14th Annual Report: Chapter 9 Biochemical Variables amongst UK Adult Dialysis patients in 2010: 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

- 56% of HD patients and 69% of PD patients achieved the audit measure for phosphate.
- 30% of HD and 22% of PD patients had a serum phosphate above the audit standard range for their respective RRT modality.
- 75% of HD and 76% of PD patients had adjusted calcium between 2.2–2.5 mmol/L.
- 28% of HD and 31% of PD patients had a serum PTH between 16–32pmol/L.
- 60% of HD and 80% 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 and receives data from Scotland via the Scottish Renal Registry. 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]. Currently the 5th edition of the UK Renal Association clinical practice guidelines is in practice. This edition commenced in a graded manner in 2009 and includes an expanded number of guideline modules compared to previous editions. For the purpose of this report only, guideline modules and their respective audit measures published prior to 2010, such as Haemodialysis [1] (published in December 2009) have been incorporated into this report to reflect performance targets available in 2010.

Audit measures for kidney disease increasingly include tighter specification limits in conjunction with a growing evidence base. Out of range observations (e.g. hyperphosphataemia and hypophosphataemia) need to be interpreted cautiously as they may relate to different clinical problems or population characteristics. These will therefore require different strategies to improve centre performance of clinical audit measures. To supplement these performance analyses, summary statistical data 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 2010. Scotland is also only included in analyses pertaining to phosphate control. The cohort studied were patients prevalent on dialysis treatment on 31st December 2010, 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 2011/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 2010 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. Scottish centres have only been included in analyses relating to phosphate control, with data for their prevalent dialysis cohort being supplied directly by the Scottish Renal Registry. The audit measure used for serum phosphate in the HD cohort was 1.1–1.7 mmol/L [1] as per the updated haemodialysis guidelines and in the PD cohort was 1.1–1.8 mmol/L [7]. 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 depends on a local reference range [1, 7]. 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 in line with the 4th edition of the Renal Association clinical practice guidelines that were current during 2010 [7]. 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 18–24 mmol/L as per the updated haemodialysis guidelines [1] and in the PD cohort was 22–30 mmol/L [7]. A summary of the current Renal Association audit measures and conversion factors to SI units are given in table 9.1.

Quarterly values were extracted from the database for the last two quarters for calcium, phosphate and bicarbonate; the last three quarters for PTH and the entire year for cholesterol. Patients who did not have these data were excluded from the analyses. The completeness of data were analysed at centre and country level. All patients were included in analyses but centres with less than 50%

Table 9.1. Summary of clinical audit measures and conversion factors from SI units

Biochemical variable	Clinical audit measure	Conversion factor from SI units
Phosphate	HD Patients: 1.1–1.7 mmol/L PD Patients: 1.1–1.8 mmol/L	mg/dl = mmol/L × 3.1
Calcium (adjusted)	Normal range (ideally <2.5 mmol/L)	mg/dl = mmol/L × 4
Parathyroid hormone	2–4 times upper limit of normal	ng/L = pmol × 9.5
Bicarbonate	HD Patients: 18–24 mmol/L PD Patients: 22–30 mmol/L	mg/dl = mmol/L × 6.1
Cholesterol	No audit measure	mg/dl = mmol/L × 38.6

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 decimal place. All data has been rounded up in an attempt to make all centres more comparable.

The number preceding the centre name in each figure indicates the percentage of missing data for that centre. Funnel plot analysis was used to identify 'outlying centres' [6]. The percentage achieving each standard was plotted against centre size along with the upper and lower 95% and 99.9% limits. Centres can be identified on these plots by 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 2010 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

In 2010 the following Renal Association clinical practice guidelines regarding phosphate management was applicable:

'We suggest that pre-dialysis (mid-week) serum phosphate, if elevated, should be lowered towards the normal range such as between 1.1 and 1.7 mmol/l. (2C)' (Module: Haemodialysis) [1]

For PD patients, 'Serum phosphate in dialysis patients should be maintained between 1.1 and 1.8 mmol/L' (Module 2: Complications) [7]

The data completeness for serum phosphate across the UK was 96% for both HD patients and PD patients although there was considerable variation between centres (tables 9.2 and 9.4). The individual centre means and standard deviations are shown in tables 9.2 and 9.4. Fifty-six percent (CI 55–57%) of HD patients

Table 9.2. Summary statistics for phosphate in haemodialysis patients in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Abrdn	92.4	169	1.5	0.5	1.4	1.2	1.7
Airdrie	92.6	151	1.6	0.5	1.5	1.3	1.9
Antrim	100.0	123	1.2	0.4	1.1	1.0	1.4
B Heart	98.5	390	1.7	0.5	1.6	1.3	1.9
B QEH	84.9	697	1.6	0.5	1.5	1.2	1.8
Bangor	98.8	81	1.6	0.5	1.5	1.2	1.8
Basldn	97.7	129	1.4	0.5	1.4	1.1	1.7
Belfast	98.2	213	1.6	0.5	1.5	1.2	2.0
Bradfd	97.0	160	1.4	0.5	1.3	1.0	1.7
Brightn	98.1	317	1.6	0.5	1.6	1.2	1.9
Bristol	100.0	430	1.6	0.5	1.6	1.3	1.9
Camb	94.0	300	1.6	0.5	1.5	1.2	1.8
Cardff	98.7	447	1.6	0.5	1.5	1.2	1.9
Carlis	98.1	51	1.5	0.5	1.6	1.1	1.8
Carsh	98.4	673	1.6	0.5	1.5	1.2	1.8
Chelms	100.0	112	1.6	0.4	1.5	1.3	1.8
Clwyd	96.7	59	1.5	0.5	1.5	1.1	1.9
Colchr	97.0	96	1.5	0.4	1.5	1.3	1.6
Covnt	99.1	329	1.5	0.5	1.4	1.2	1.8
D & Gall	95.9	47	1.6	0.4	1.5	1.2	1.9
Derby	99.5	201	1.6	0.5	1.5	1.3	1.9
Derry	100.0	53	1.5	0.5	1.4	1.1	1.6
Donc	100.0	130	1.6	0.5	1.5	1.3	1.9
Dorset	100.0	226	1.5	0.4	1.5	1.2	1.8
Dudley	99.3	143	1.7	0.5	1.6	1.3	2.0

Table 9.2. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Dundee	90.5	142	1.6	0.5	1.5	1.2	1.8
Dunfn	95.7	110	1.6	0.5	1.5	1.2	1.9
Edinb	95.3	243	1.6	0.5	1.6	1.3	2.0
Exeter	100.0	322	1.6	0.5	1.5	1.2	1.8
Glasgw	91.7	522	1.7	0.6	1.6	1.3	2.0
Glouc	100.0	177	1.6	0.5	1.6	1.3	1.9
Hull	99.0	309	1.6	0.5	1.6	1.3	1.9
Inverns	90.6	77	1.7	0.5	1.6	1.4	1.9
Ipswi	99.1	105	1.5	0.5	1.5	1.1	1.8
Kent	98.5	327	1.6	0.5	1.6	1.3	1.9
Klmarnk	89.4	127	1.4	0.5	1.4	1.2	1.7
L Barts	99.1	743	1.6	0.5	1.5	1.2	1.9
L Guys	86.5	460	1.4	0.5	1.4	1.1	1.7
L Kings	100.0	390	1.6	0.5	1.5	1.2	1.9
L Rfree	88.7	571	1.5	0.5	1.5	1.2	1.8
L St.G	98.5	263	1.5	0.5	1.4	1.1	1.7
L West	99.4	1,234	1.4	0.5	1.3	1.1	1.7
Leeds	100.0	437	1.5	0.5	1.5	1.2	1.8
Leic	99.7	730	1.6	0.4	1.5	1.2	1.8
Liv Ain[a]	7.4	10					
Liv RI	98.4	361	1.5	0.5	1.5	1.1	1.8
M Hope	76.3	257	1.5	0.6	1.5	1.1	1.9
M RI	89.5	393	1.6	0.5	1.5	1.2	1.9
Middlbr	98.9	260	1.6	0.5	1.5	1.2	1.8
Newc	99.2	245	1.6	0.5	1.6	1.2	1.9
Newry	99.0	99	1.5	0.5	1.5	1.2	1.8
Norwch	99.3	297	1.6	0.4	1.5	1.3	1.8
Nottm	100.0	385	1.5	0.4	1.4	1.2	1.7
Oxford	100.0	352	1.6	0.5	1.6	1.3	2.0
Plymth	99.2	123	1.5	0.6	1.5	1.2	1.8
Ports	100.0	444	1.7	0.5	1.7	1.3	2.0
Prestn	99.6	465	1.7	0.5	1.6	1.3	1.9
Redng	100.0	243	1.4	0.4	1.3	1.2	1.6
Sheff	100.0	565	1.7	0.5	1.6	1.3	1.9
Shrew	97.3	181	1.5	0.4	1.5	1.2	1.8
Stevng	98.6	356	1.6	0.5	1.6	1.3	1.9
Sthend	100.0	119	1.6	0.4	1.6	1.3	1.9
Stoke	100.0	278	1.5	0.5	1.5	1.2	1.8
Sund	54.6	90	1.6	0.5	1.6	1.2	1.9
Swanse	100.0	323	1.5	0.4	1.5	1.2	1.7
Truro	100.0	140	1.7	0.5	1.6	1.3	2.0
Tyrone	97.8	88	1.6	0.4	1.6	1.3	1.9
Ulster	100.0	86	1.4	0.4	1.4	1.1	1.6
Wirral	94.2	163	1.5	0.5	1.4	1.1	1.8
Wolve	100.0	285	1.4	0.5	1.4	1.1	1.7
Wrexm	100.0	72	1.4	0.6	1.3	1.0	1.7
York	95.0	133	1.5	0.5	1.4	1.1	1.7
England	**95.8**	**16,597**	**1.6**	**0.5**	**1.5**	**1.2**	**1.8**
N Ireland	**99.0**	**662**	**1.5**	**0.5**	**1.4**	**1.1**	**1.8**
Scotland	**92.4**	**1,588**	**1.6**	**0.5**	**1.5**	**1.3**	**1.9**
Wales	**99.1**	**982**	**1.5**	**0.5**	**1.5**	**1.2**	**1.8**
UK	**95.8**	**19,829**	**1.6**	**0.5**	**1.5**	**1.2**	**1.8**

[a]Poor data completeness from L Ain in 2010 due to technical difficulties with data extraction

Table 9.3. Percentage of haemodialysis patients within, below and above the range specified in the RA audit measure for phosphate (1.1–1.7mmol/L) in 2010

							Change from 2009		
Centre	N	% phos 1.1–1.7 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.7 mmol/L	% within range	95% LCL	95% UCL
Abrdn	169	58.6	51.0	65.8	17.8	23.7			
Airdrie	151	55.0	47.0	62.7	11.9	33.1			
Antrim	123	56.9	48.0	65.4	31.7	11.4	3.6	−12.9	20.0
B Heart	390	54.6	49.6	59.5	7.4	38.0	−7.2	−16.3	1.9
B QEH	697	57.3	53.5	60.9	11.3	31.4	−9.1	−15.6	−2.6
Bangor	81	59.3	48.3	69.4	12.4	28.4	−13.7	−33.1	5.7
Basldn	129	55.0	46.4	63.4	20.9	24.0	−8.8	−24.5	6.9
Belfast	213	46.0	39.4	52.7	16.9	37.1	−14.7	−26.9	−2.5
Bradfd	160	51.3	43.5	58.9	27.5	21.3	−9.7	−24.0	4.7
Brightn	317	49.8	44.4	55.3	15.1	35.0	−9.2	−19.7	1.3
Bristol	430	55.6	50.9	60.2	7.9	36.5	−1.0	−9.9	7.9
Camb	300	61.3	55.7	66.7	9.7	29.0	−2.4	−13.4	8.7
Cardff	447	53.9	49.3	58.5	11.4	34.7	−6.1	−14.7	2.5
Carlis	51	52.9	39.4	66.1	21.6	25.5	−15.5	−39.5	8.6
Carsh	673	58.5	54.8	62.2	11.3	30.2	−6.4	−13.4	0.6
Chelms	112	66.1	56.8	74.2	8.0	25.9	5.5	−11.2	22.2
Clwyd	59	49.2	36.7	61.7	20.3	30.5	−7.0	−29.5	15.5
Colchr	96	72.9	63.2	80.9	7.3	19.8	−1.2	−18.0	15.5
Covnt	329	57.5	52.0	62.7	15.8	26.8	0.6	−9.5	10.8
D & Gall	47	55.3	41.1	68.8	10.6	34.0			
Derby	201	61.2	54.3	67.7	9.0	29.9	−5.8	−17.6	6.1
Derry	53	66.0	52.4	77.4	13.2	20.8	−5.6	−28.1	16.9
Donc	130	59.2	50.6	67.3	10.8	30.0	−3.6	−20.1	12.9
Dorset	226	62.0	55.5	68.0	12.4	25.7	−9.3	−20.8	2.3
Dudley	143	50.4	42.2	58.5	10.5	39.2	−6.2	−22.0	9.6
Dundee	142	60.6	52.3	68.3	12.0	27.5			
Dunfn	110	54.6	45.2	63.6	14.6	30.9			
Edinb	243	49.4	43.1	55.7	13.2	37.5			
Exeter	322	59.0	53.6	64.3	10.9	30.1	−4.2	−14.3	5.9
Glasgw	522	49.6	45.3	53.9	8.8	41.6			
Glouc	177	57.1	49.7	64.2	7.9	35.0	−6.5	−20.0	6.9
Hull	309	51.8	46.2	57.3	12.0	36.3	−7.4	−17.8	3.0
Inverns	77	62.3	51.1	72.4	6.5	31.2			
Ipswi	105	57.1	47.5	66.2	15.2	27.6	−5.8	−23.5	12.0
Kent	327	59.0	53.6	64.2	11.0	30.0	−2.9	−12.9	7.1
Klmarnk	127	59.8	51.1	68.0	18.9	21.3			
L Barts	743	52.1	48.5	55.7	16.6	31.4	−5.4	−12.3	1.5
L Guys	460	55.4	50.9	59.9	23.0	21.5	−2.8	−11.0	5.3
L Kings	390	56.7	51.7	61.5	10.8	32.6	−8.1	−17.2	1.0
L Rfree	571	56.9	52.8	60.9	15.9	27.2	0.1	−7.7	7.9
L St.G	263	55.5	49.5	61.4	19.8	24.7	−5.1	−16.4	6.3
L West	1,234	55.6	52.8	58.3	24.6	19.9	−0.7	−6.0	4.5
Leeds	437	54.2	49.5	58.9	16.7	29.1	−6.9	−15.5	1.7
Leic	730	61.4	57.8	64.8	9.9	28.8	−5.2	−11.7	1.3
Liv RI	361	55.1	50.0	60.2	16.6	28.3	−9.1	−18.4	0.3
M Hope	257	47.1	41.1	53.2	21.8	31.1	−10.8	−21.8	0.2
M RI	393	52.2	47.2	57.1	14.8	33.1	−2.8	−13.2	7.7
Middlbr	260	58.9	52.8	64.7	11.2	30.0	−0.4	−11.5	10.7
Newc	245	54.7	48.4	60.8	13.1	32.2	−4.2	−15.5	7.2
Newry	99	60.6	50.7	69.7	12.1	27.3	11.7	−6.7	30.0
Norwch	297	63.3	57.7	68.6	6.4	30.3	−1.2	−11.4	9.1
Nottm	385	63.1	58.2	67.8	14.0	22.9	0.7	−8.3	9.7

Table 9.3. Continued

Centre	N	% phos 1.1–1.7 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.7 mmol/L	Change from 2009		
							% within range	95% LCL	95% UCL
Oxford	352	52.3	47.1	57.5	10.5	37.2	−6.8	−16.6	2.9
Plymth	123	57.7	48.8	66.1	14.6	27.6	0.2	−16.4	16.8
Ports	444	44.1	39.6	48.8	11.0	44.8	−14.7	−23.3	−6.1
Prestn	465	54.6	50.1	59.1	8.6	36.8	−5.8	−14.3	2.6
Redng	243	65.4	59.2	71.2	18.1	16.5	−1.6	−12.6	9.4
Sheff	565	56.1	52.0	60.2	7.1	36.8	−5.5	−13.0	2.1
Shrew	181	59.1	51.8	66.0	13.8	27.1	−5.0	−18.1	8.2
Stevng	356	52.8	47.6	58.0	9.0	38.2	−4.1	−13.8	5.6
Sthend	119	57.1	48.1	65.7	7.6	35.3	−7.6	−23.8	8.7
Stoke	278	60.8	54.9	66.4	13.3	25.9	−4.4	−15.0	6.1
Sund	90	52.2	42.0	62.3	11.1	36.7	−6.3	−23.2	10.6
Swanse	323	65.3	60.0	70.3	11.5	23.2	−4.2	−13.8	5.4
Truro	140	58.6	50.3	66.4	5.0	36.4	1.5	−13.8	16.9
Tyrone	88	61.4	50.8	70.9	6.8	31.8	−4.1	−23.1	14.8
Ulster	86	65.1	54.5	74.4	19.8	15.1	−1.6	−20.1	17.0
Wirral	163	55.8	48.1	63.3	17.8	26.4	−10.0	−23.9	3.8
Wolve	285	54.0	48.2	59.7	21.4	24.6	−8.7	−19.3	1.9
Wrexm	72	52.8	41.3	64.0	26.4	20.8	−8.7	−30.0	12.7
York	133	58.7	50.1	66.7	17.3	24.1	−13.6	−28.9	1.7
England	**16,597**	**56.2**	**55.5**	**57.0**	**13.8**	**30.0**	**−5.1**	**−6.5**	**−3.7**
N Ireland	**662**	**56.3**	**52.5**	**60.1**	**17.7**	**26.0**	**−3.8**	**−10.7**	**3.2**
Scotland	**1,588**	**54.0**	**51.5**	**56.4**	**12.2**	**33.9**			
Wales	**982**	**57.7**	**54.6**	**60.8**	**13.1**	**29.1**	**−6.2**	**−11.8**	**−0.5**
UK	**19,829**	**56.1**	**55.4**	**56.8**	**13.8**	**30.1**	**−5.3***	**−6.6**	**−4.0**

Blank cells denote Scottish centres where calculation of change in target attainment was not feasible, as the UKRR did not have historical data for comparison

Table 9.4. Summary statistics for phosphate in peritoneal dialysis patients in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Abrdn	96.4	27	1.7	0.5	1.7	1.3	2.0
Airdrie	100.0	11					
Antrim	100.0	11					
B Heart	97.2	35	1.5	0.4	1.5	1.3	1.7
B QEH	89.3	125	1.5	0.4	1.4	1.2	1.8
Bangor	100.0	23	1.5	0.3	1.5	1.3	1.8
Basldn	100.0	24	1.5	0.3	1.4	1.3	1.7
Belfast	96.0	24	1.6	0.5	1.5	1.2	2.0
Bradfd	100.0	33	1.7	0.5	1.6	1.4	2.0
Brightn	98.7	74	1.4	0.4	1.3	1.1	1.6
Bristol	100.0	56	1.6	0.4	1.6	1.3	1.9
Camb	100.0	31	1.4	0.4	1.3	1.2	1.7
Cardff	100.0	87	1.6	0.4	1.5	1.2	1.9
Carlis	100.0	12					
Carsh	97.9	91	1.6	0.4	1.6	1.3	1.9
Chelms	100.0	32	1.6	0.4	1.6	1.3	2.0
Clwyd	80.0	4					
Covnt	95.8	69	1.4	0.4	1.4	1.2	1.6
D & Gall	100.0	6					
Derby	98.9	88	1.5	0.4	1.4	1.2	1.7
Derry	100.0	2					

Table 9.4. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Donc	100.0	23	1.6	0.5	1.6	1.3	1.7
Dorset	98.0	50	1.5	0.3	1.4	1.3	1.6
Dudley	98.3	57	1.7	0.6	1.6	1.3	1.8
Dundee	95.0	19					
Dunfn	100.0	26	1.7	0.5	1.7	1.3	2.0
Edinb	97.9	47	1.6	0.4	1.7	1.3	1.9
Exeter	100.0	69	1.5	0.4	1.4	1.2	1.7
Glasgw	93.6	44	1.6	0.3	1.6	1.5	1.8
Glouc	100.0	39	1.8	0.6	1.7	1.3	2.1
Hull	100.0	62	1.7	0.4	1.7	1.3	1.9
Inverns	0.0	0					
Ipswi	100.0	35	1.7	0.4	1.7	1.2	2.0
Kent	100.0	67	1.5	0.3	1.4	1.2	1.6
Klmarnk	75.0	30	1.6	0.5	1.6	1.2	1.9
L Barts	98.3	170	1.5	0.4	1.4	1.1	1.7
L Guys	97.7	42	1.6	0.5	1.5	1.3	1.8
L Kings	100.0	84	1.5	0.4	1.4	1.2	1.7
L Rfree	100.0	63	1.5	0.3	1.4	1.2	1.6
L St.G	98.2	53	1.5	0.5	1.4	1.3	1.6
L West	100.0	31	1.5	0.5	1.5	1.2	1.8
Leeds	98.8	83	1.5	0.4	1.5	1.2	1.7
Leic	99.3	140	1.5	0.4	1.5	1.2	1.7
Liv Ain	0.0	0					
Liv RI	98.7	77	1.5	0.4	1.5	1.2	1.8
M Hope	71.8	79	1.7	0.6	1.7	1.3	2.1
M RI	100.0	75	1.7	0.5	1.6	1.4	2.0
Middlbr	94.4	17					
Newc	100.0	45	1.6	0.5	1.6	1.3	1.9
Newry	100.0	8					
Norwch	95.7	44	1.5	0.4	1.5	1.2	1.7
Nottm	100.0	78	1.6	0.4	1.5	1.4	1.8
Oxford	100.0	101	1.7	0.4	1.7	1.5	2.0
Plymth	97.7	42	1.6	0.4	1.6	1.3	1.9
Ports	100.0	91	1.7	0.5	1.6	1.3	2.0
Prestn	100.0	60	1.7	0.4	1.7	1.4	2.0
Redng	98.7	77	1.5	0.3	1.4	1.3	1.6
Sheff	100.0	60	1.6	0.3	1.6	1.3	1.8
Shrew	94.4	17					
Stevng	96.4	27	1.5	0.4	1.4	1.2	1.6
Sthend	100.0	18					
Stoke	100.0	65	1.5	0.3	1.5	1.3	1.7
Sund	100.0	29	1.5	0.6	1.6	1.2	1.9
Swanse	100.0	45	1.5	0.4	1.6	1.2	1.7
Truro	100.0	26	1.5	0.6	1.4	1.2	1.8
Tyrone	85.7	6					
Ulster	100.0	2					
Wirral	48.6	17					
Wolve	100.0	62	1.5	0.4	1.4	1.2	1.7
Wrexm	95.0	19					
York	100.0	17					
England	**96.8**	**2,862**	**1.6**	**0.4**	**1.5**	**1.3**	**1.8**
N Ireland	**96.4**	**53**	**1.6**	**0.4**	**1.5**	**1.3**	**1.9**
Scotland	**85.0**	**210**	**1.6**	**0.4**	**1.6**	**1.4**	**1.9**
Wales	**98.9**	**178**	**1.6**	**0.4**	**1.5**	**1.3**	**1.8**
UK	**96.0**	**3,303**	**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

(61% in 2009) and 69% (CI 67–71%) of PD patients (70% in 2009) achieved a phosphate level within the target range specified by the RA clinical audit measure (tables 9.3, 9.5). The proportion of HD patients with hyperphosphataemia was 30% compared to 24% in 2009 and the proportion with hypophosphataemia was 14% compared to 2009 when it was 15% (table 9.3, figures 9.1, 9.2). The proportion of PD patients with hyperphosphataemia was 22% compared to 23% in 2009 and the proportion with hypophosphataemia was 9% compared to 8% in 2009 (table 9.5, figures 9.3, 9.4). Compared with 2009, fewer haemodialysis patients achieved the target range due to an increase in the numbers above the upper limit that was lowered from 1.8 mmol/L to 1.7 mmol/L for 2010. Longitudinal analysis using the 2010 ranges showed no evidence of a deterioration in phosphate control for England, Northern Ireland and Wales combined (figure 9.5).

There was significant between centre variation in the proportion of patients below, within and above the range specified by the clinical performance measure (figures 9.1–9.4). For haemodialysis patients, two centres (Colchester and Swansea) performed significantly better than the national average whereas one centre (Portsmouth) was significantly worse (figure 9.2, table 9.3) with a large proportion of patients with phosphate greater than 1.7 mmol/L.

The 5th Renal Association clinical practice guidelines on CKD–Mineral and Bone Disorders was finalised on 6th December 2010 and recommends that phosphate be maintained between 1.1 and 1.7 mmol/L for all dialysis patients and this audit standard will be used in next year's report [8].

Table 9.5. 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 2010

							Change from 2009		
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
Abrdn	27	63.0	43.8	78.8	7.4	29.6	−13.0	−45.6	19.5
B Heart	35	68.6	51.7	81.7	14.3	17.1	3.2	−28.3	34.6
B QEH	125	73.6	65.2	80.6	6.4	20.0	2.8	−12.0	17.5
Bangor	23	91.3	71.1	97.8	4.4	4.4	−1.8	−21.2	17.6
Basldn	24	87.5	67.6	95.9	4.2	8.3	15.5	−13.5	44.5
Belfast	24	58.3	38.3	75.9	12.5	29.2	14.2	−19.8	48.2
Bradfd	33	51.5	34.9	67.8	9.1	39.4	−3.3	−35.5	28.9
Brightn	74	73.0	61.8	81.9	13.5	13.5	15.6	−4.8	36.0
Bristol	56	69.6	56.5	80.2	3.6	26.8	13.8	−8.4	36.0
Camb	31	74.2	56.3	86.5	12.9	12.9	−16.1	−40.6	8.3
Cardff	87	63.2	52.6	72.7	10.3	26.4	−13.1	−30.4	4.3
Carsh	91	63.7	53.4	72.9	8.8	27.5	−4.4	−21.8	12.9
Chelms	32	59.4	41.9	74.7	9.4	31.3	−27.3	−54.8	0.2
Covnt	69	75.4	63.9	84.1	13.0	11.6	−2.6	−21.2	16.1
Derby	88	72.7	62.5	81.0	13.6	13.6	−11.4	−27.5	4.7
Donc	23	73.9	52.8	87.8	4.4	21.7	−8.2	−38.3	21.9
Dorset	50	84.0	71.1	91.8	2.0	14.0	10.9	−9.8	31.7
Dudley	57	71.9	59.0	82.0	3.5	24.6	5.3	−18.1	28.6
Dunfn	26	61.5	42.1	77.9	0.0	38.5	−14.7	−49.0	19.7
Edinb	47	57.5	43.1	70.7	8.5	34.0	−2.2	−27.8	23.4
Exeter	69	78.3	67.0	86.5	5.8	15.9	−0.4	−19.1	18.2
Glasgw	44	79.6	65.2	89.0	4.6	15.9	9.7	−12.9	32.3
Glouc	39	53.9	38.3	68.7	5.1	41.0	−11.0	−39.9	17.9
Hull	62	62.9	50.3	74.0	4.8	32.3	−4.8	−26.9	17.2
Ipswi	35	54.3	37.9	69.8	5.7	40.0	9.1	−20.4	38.5
Kent	67	76.1	64.5	84.8	7.5	16.4	−11.4	−28.5	5.8
Klmarnk	30	56.7	38.8	72.9	6.7	36.7	8.3	−24.6	41.2
L Barts	170	63.5	56.0	70.4	18.8	17.7	0.1	−13.5	13.7
L Guys	42	73.8	58.6	84.9	9.5	16.7	5.6	−19.6	30.8
L Kings	84	69.1	58.4	78.0	14.3	16.7	4.3	−15.5	24.2

Table 9.5. 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 2009		
							% within range	95% LCL	95% UCL
L Rfree	63	79.4	67.6	87.6	11.1	9.5	2.0	−17.0	20.9
L St.G	53	71.7	58.2	82.2	13.2	15.1	−5.1	−26.7	16.5
L West	31	61.3	43.5	76.5	16.1	22.6	−9.7	−40.5	21.2
Leeds	83	67.5	56.7	76.7	14.5	18.1	0.4	−18.3	19.1
Leic	140	70.7	62.7	77.7	10.0	19.3	1.1	−12.9	15.0
Liv RI	77	66.2	55.0	75.9	10.4	23.4	−8.1	−27.0	10.7
M Hope	79	55.7	44.6	66.2	7.6	36.7	2.9	−16.1	21.9
M RI	75	52.0	40.8	63.0	8.0	40.0	−6.6	−26.8	13.6
Newc	45	64.4	49.6	76.9	8.9	26.7	2.4	−23.1	28.0
Norwch	44	77.3	62.7	87.3	9.1	13.6	6.8	−17.3	30.9
Nottm	78	76.9	66.3	85.0	7.7	15.4	12.6	−4.8	30.0
Oxford	101	64.4	54.6	73.1	3.0	32.7	0.9	−16.9	18.7
Plymth	42	66.7	51.3	79.2	4.8	28.6	−9.6	−35.5	16.2
Ports	91	55.0	44.7	64.8	12.1	33.0	−2.2	−22.0	17.6
Prestn	60	65.0	52.2	75.9	6.7	28.3	−2.7	−24.5	19.1
Redng	77	80.5	70.2	87.9	6.5	13.0	1.1	−15.8	17.9
Sheff	60	73.3	60.8	83.0	3.3	23.3	−4.6	−24.2	15.0
Stevng	27	85.2	66.5	94.3	7.4	7.4	25.9	−4.2	56.0
Stoke	65	83.1	72.0	90.4	6.2	10.8	11.0	−7.4	29.5
Sund	29	51.7	34.1	68.9	20.7	27.6	−15.0	−49.4	19.5
Swanse	45	75.6	61.0	85.9	8.9	15.6	1.7	−21.8	25.1
Truro	26	69.2	49.5	83.8	19.2	11.5	7.3	−28.6	43.3
Wolve	62	69.4	56.9	79.5	14.5	16.1	−3.8	−27.2	19.6
England	**2,862**	**69.0**	**67.3**	**70.7**	**9.4**	**21.6**	**0.3**	**−2.9**	**3.4**
N Ireland	**53**	**67.9**	**54.3**	**79.0**	**5.7**	**26.4**	**6.3**	**−15.8**	**28.4**
Scotland	**210**	**66.2**	**59.5**	**72.3**	**5.7**	**28.1**	**1.0**	**−10.8**	**12.8**
Wales	**178**	**70.8**	**63.7**	**77.0**	**8.4**	**20.8**	**−6.6**	**−18.3**	**5.1**
UK	**3,303**	**68.9**	**67.3**	**70.5**	**9.1**	**22.0**	**0.1**	**−2.9**	**3.0**

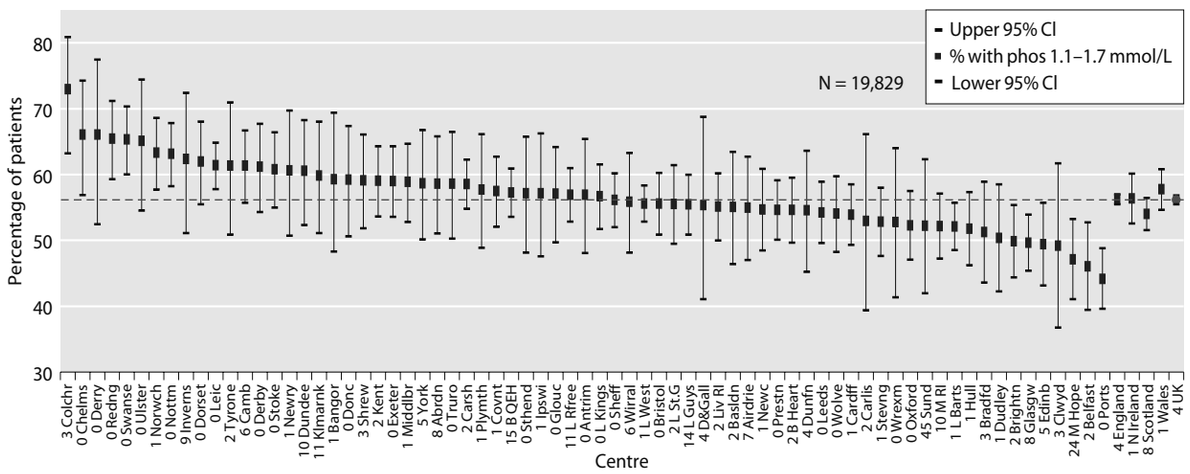

Fig. 9.1. Percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2010

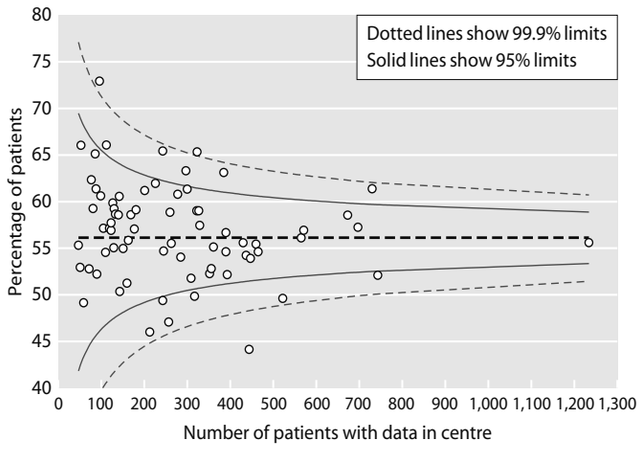

Fig. 9.2. Funnel plot of percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7mmol/L) by centre in 2010

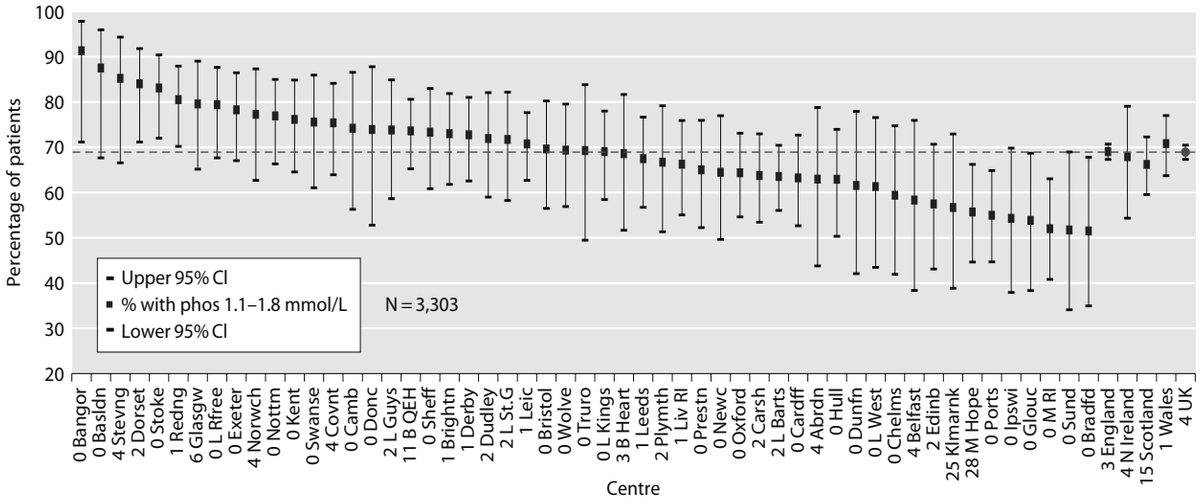

Fig. 9.3. Percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.8 mmol/L) by centre in 2010

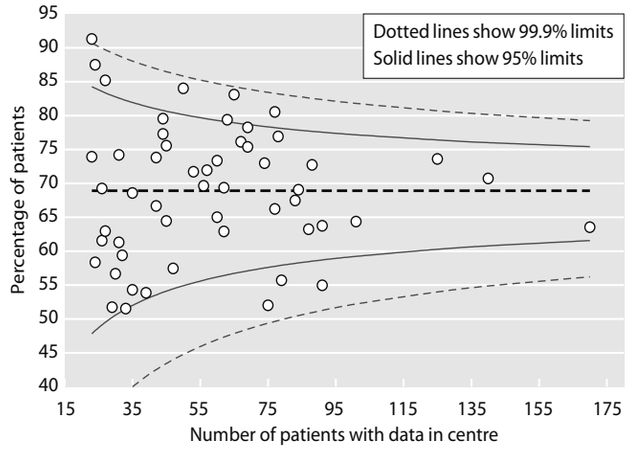

Fig. 9.4. Funnel plot of percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.8 mmol/L) by centre in 2010

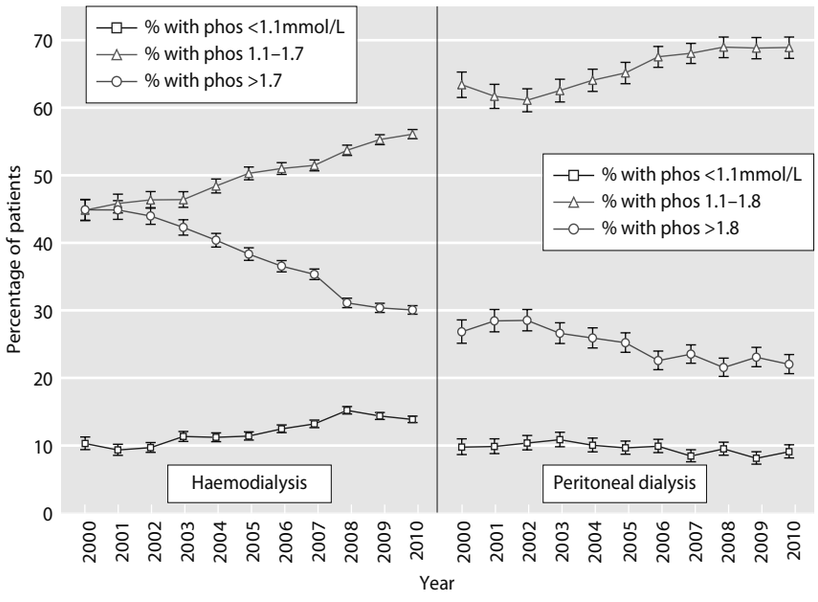

Fig. 9.5. Longitudinal change in percentage of patients with phosphate below, within and above the 2010 RA standards by dialysis modality 2000–2010

Adjusted calcium

In 2010 the following Renal Association clinical practice guideline regarding calcium management was applicable:

'We suggest that pre-dialysis (mid-week) serum calcium, adjusted for serum albumin should be within the normal range (2C)' (Module: Haemodialysis) [1]

For PD patients, 'Serum calcium, adjusted for albumin concentration, should be maintained within the normal reference range for the laboratory used and ideally kept below 2.5 mmol/L. (Module 2: Complications) [7]

The current guidelines are 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 amongst patients with ERF. This topic was discussed in considerable detail last year and most of the shortcomings remain. However the ongoing restructuring of pathology into a smaller number of services together with harmonisation should increase measurement uniformity across laboratories and hence renal units.

Meanwhile, centres must work with their laboratories to ensure that the calcium results are adjusted correctly for the methods in use. These problems must be borne in mind when trying to interpret the following figures that compare serum adjusted calcium achieved in different renal centres. 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 current 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 as per earlier guidance. Previously the UKRR used 2.2–2.5 mmol/L as the audit measure for adjusted calcium and in the absence of any change in guidance has maintained this range in this report to allow consistency. The data for adjusted calcium was 94% complete for HD patients and 96% complete for PD patients overall, although there was between centre variation (tables 9.6, 9.8). Seventy-five percent (CI 75–76%) of HD patients and 76% (CI 74–77%) of PD patients achieved adjusted calcium between 2.2–2.5mmol/L (tables 9.7, 9.9), not significantly different from 2009. The proportion of HD patients with hypercalcaemia was 11% compared to 12% in 2009 and the proportion with hypocalcaemia was 14% compared to 13% in 2009. For peritoneal dialysis patients the proportion of patients with hypercalcaemia was 15% compared to 17% in 2009 and the proportion with hypocalcaemia was 9% compared to 8% in 2009 (tables 9.7, 9.9, figures 9.6 to 9.9). The changes in the percentages above, below and within range for the period 2000 to 2010 for England, Northern Ireland and Wales combined are shown in figure 9.10. The percentage of patients achieving the audit standard

Table 9.6 Summary statistics for adjusted calcium in haemodialysis patients in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	123	2.4	0.15	2.3	2.3	2.4
B Heart	98	390	2.3	0.20	2.3	2.2	2.4
B QEH	65	534	2.3	0.21	2.2	2.1	2.4
Bangor	99	81	2.3	0.16	2.3	2.2	2.4
Basldn	98	129	2.4	0.15	2.4	2.3	2.5
Belfast	98	213	2.3	0.16	2.3	2.2	2.4
Bradfd	97	160	2.4	0.17	2.4	2.3	2.4
Brightn	72	232	2.3	0.19	2.3	2.2	2.4
Bristol	100	430	2.5	0.19	2.5	2.4	2.6
Camb	94	300	2.3	0.18	2.3	2.2	2.4
Cardff*	95	431	2.4	0.18	2.4	2.3	2.5
Carlis	98	51	2.3	0.17	2.3	2.2	2.5
Carsh	98	673	2.3	0.19	2.3	2.2	2.4
Chelms	100	112	2.4	0.14	2.4	2.3	2.5
Clwyd	97	59	2.3	0.23	2.3	2.2	2.4
Colchr	97	96	2.4	0.17	2.4	2.3	2.5
Covnt	100	331	2.3	0.18	2.2	2.1	2.4
Derby	100	202	2.4	0.14	2.4	2.3	2.5
Derry	100	53	2.4	0.17	2.4	2.3	2.5
Donc	100	130	2.4	0.13	2.4	2.3	2.5
Dorset	88	198	2.3	0.16	2.3	2.2	2.4
Dudley	90	129	2.4	0.22	2.4	2.3	2.6
Exeter	100	322	2.3	0.18	2.3	2.2	2.4
Glouc	100	177	2.4	0.13	2.3	2.3	2.4
Hull	99	309	2.4	0.18	2.4	2.3	2.5
Ipswi	100	106	2.3	0.16	2.3	2.2	2.4
Kent	97	323	2.4	0.17	2.4	2.3	2.5
L Barts	99	743	2.3	0.19	2.3	2.2	2.4
L Guys	86	460	2.3	0.19	2.3	2.2	2.4
L Kings	100	390	2.3	0.15	2.3	2.2	2.4
L Rfree	89	573	2.3	0.19	2.3	2.1	2.4
L St.G	99	263	2.3	0.17	2.3	2.2	2.4
L West*	94	1,172	2.4	0.17	2.4	2.3	2.5
Leeds	100	437	2.4	0.16	2.3	2.3	2.5
Leic	100	730	2.4	0.17	2.3	2.2	2.4
Liv Ain	9	12					
Liv RI	93	343	2.4	0.17	2.3	2.2	2.5
M Hope	76	257	2.3	0.19	2.3	2.2	2.4
M RI	90	393	2.2	0.18	2.2	2.1	2.3
Middlbr	99	260	2.3	0.20	2.3	2.2	2.4
Newc	99	245	2.2	0.16	2.2	2.1	2.3
Newry	99	99	2.3	0.19	2.3	2.2	2.4
Norwch	98	294	2.4	0.15	2.4	2.3	2.5
Nottm	100	384	2.4	0.17	2.4	2.3	2.5
Oxford	100	352	2.4	0.15	2.4	2.3	2.5
Plymth	99	123	2.3	0.20	2.3	2.2	2.4
Ports	100	442	2.4	0.18	2.3	2.2	2.5
Prestn	92	428	2.3	0.17	2.3	2.2	2.4
Redng	100	243	2.4	0.15	2.4	2.3	2.5
Sheff	100	565	2.3	0.16	2.3	2.2	2.4
Shrew	97	181	2.4	0.17	2.4	2.3	2.5
Stevng	99	357	2.4	0.15	2.4	2.3	2.5
Sthend	100	119	2.4	0.17	2.4	2.4	2.6
Stoke	96	267	2.4	0.17	2.4	2.3	2.5
Sund	55	90	2.4	0.20	2.4	2.3	2.5
Swanse	100	323	2.3	0.17	2.2	2.1	2.4

Table 9.6 Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Truro	100	140	2.3	0.16	2.3	2.2	2.4
Tyrone	98	88	2.5	0.14	2.5	2.4	2.5
Ulster	100	86	2.5	0.14	2.5	2.4	2.5
Wirral	92	160	2.4	0.17	2.4	2.3	2.5
Wolve	100	285	2.3	0.20	2.3	2.2	2.4
Wrexm	100	72	2.4	0.18	2.4	2.2	2.5
York	85	119	2.4	0.18	2.4	2.3	2.5
England	**93**	**16,161**	**2.3**	**0.19**	**2.3**	**2.2**	**2.4**
N Ireland	**99**	**662**	**2.4**	**0.17**	**2.4**	**2.2**	**2.5**
Wales	**97**	**966**	**2.3**	**0.19**	**2.3**	**2.2**	**2.5**
E, W & NI	**94**	**17,789**	**2.3**	**0.19**	**2.3**	**2.2**	**2.4**

Blank cells denote centres excluded from analyses 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 9.7. Percentage of haemodialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2010

							Change from 2009		
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	123	82.9	75.2	88.6	8.1	8.9	5.4	−7.7	18.6
B Heart	390	66.7	61.8	71.2	24.6	8.7	−5.0	−13.5	3.6
B QEH	534	68.2	64.1	72.0	27.2	4.7	−0.9	−8.2	6.3
Bangor	81	81.5	71.5	88.5	14.8	3.7	−1.0	−16.9	15.0
Basldn	129	79.1	71.2	85.2	3.1	17.8	9.1	−4.8	23.0
Belfast	213	77.5	71.4	82.6	17.4	5.2	0.2	−10.1	10.6
Bradfd	160	82.5	75.8	87.6	6.3	11.3	−6.0	−16.1	4.2
Brightn	232	71.1	65.0	76.6	21.6	7.3	4.6	−7.0	16.3
Bristol	430	65.4	60.7	69.7	5.4	29.3	3.1	−5.5	11.7
Camb	300	73.0	67.7	77.7	17.3	9.7	0.8	−9.4	11.0
Cardff[a]	431	77.5	73.3	81.2	7.7	14.9	3.6	−3.9	11.1
Carlis	51	78.4	65.1	87.6	9.8	11.8	10.0	−11.7	31.8
Carsh	673	67.8	64.1	71.2	23.2	9.1	−5.4	−12.0	1.2
Chelms	112	85.7	78.0	91.1	4.5	9.8	1.3	−11.1	13.7
Clwyd	59	66.1	53.2	77.0	18.6	15.3	−7.9	−28.6	12.8
Colchr	96	71.9	62.1	80.0	4.2	24.0	6.8	−11.0	24.5
Covnt	331	64.7	59.4	69.6	27.8	7.6	−0.1	−9.8	9.7
Derby	202	73.8	67.3	79.4	2.0	24.3	−7.2	−17.5	3.2
Derry	53	77.4	64.2	86.7	7.6	15.1	−6.0	−25.3	13.4
Donc	130	86.2	79.1	91.1	5.4	8.5	8.1	−5.0	21.1
Dorset	198	82.8	76.9	87.5	9.1	8.1	−0.8	−11.2	9.5
Dudley	129	62.0	53.4	70.0	7.8	30.2	0.3	−15.8	16.4
Exeter	322	79.5	74.7	83.6	13.0	7.5	7.3	−1.6	16.1
Glouc	177	88.7	83.1	92.6	6.2	5.1	6.6	−3.1	16.3
Hull	309	78.3	73.4	82.6	9.7	12.0	0.7	−7.9	9.4
Ipswi	106	79.3	70.5	85.9	14.2	6.6	1.7	−13.2	16.6
Kent	323	78.3	73.5	82.5	5.9	15.8	7.8	−1.1	16.8
L Barts	743	69.3	65.9	72.5	23.4	7.3	4.6	−2.0	11.1
L Guys	460	71.7	67.5	75.7	20.9	7.4	3.3	−4.3	10.8
L Kings	390	81.3	77.1	84.9	14.6	4.1	−0.3	−7.6	7.0
L Rfree	573	66.8	62.9	70.6	27.4	5.8	−0.1	−7.5	7.2
L St.G	263	82.5	77.4	86.6	10.3	7.2	4.6	−4.6	13.7
L West[a]	1,172	77.8	75.4	80.1	5.6	16.6	−1.8	−6.2	2.6

Table 9.7. 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 2009		
							% within range	95% LCL	95% UCL
Leeds	437	81.7	77.8	85.1	7.8	10.5	8.0	0.8	15.2
Leic	730	81.9	79.0	84.5	9.5	8.6	2.7	−2.6	8.1
Liv RI	343	80.5	75.9	84.3	8.8	10.8	4.6	−3.5	12.7
M Hope	257	71.2	65.4	76.4	19.1	9.7	3.3	−6.9	13.4
M RI	393	59.5	54.6	64.3	36.9	3.6	−0.7	−11.0	9.6
Middlbr	260	71.9	66.2	77.1	17.3	10.8	0.6	−9.6	10.8
Newc	245	57.1	50.9	63.2	40.8	2.0	−23.6	−33.9	−13.3
Newry	99	78.8	69.6	85.7	16.2	5.1	17.1	0.4	33.8
Norwch	294	82.0	77.2	86.0	7.1	10.9	8.3	−0.6	17.2
Nottm	384	78.9	74.5	82.7	2.9	18.2	4.0	−3.8	11.9
Oxford	352	84.1	79.9	87.6	5.1	10.8	5.0	−2.6	12.6
Plymth	123	75.6	67.3	82.4	12.2	12.2	−0.5	−14.9	13.9
Ports	442	75.8	71.6	79.6	12.0	12.2	−4.9	−12.1	2.3
Prestn	428	77.1	72.9	80.8	19.4	3.5	5.1	−2.7	12.8
Redng	243	84.4	79.2	88.4	7.0	8.6	1.6	−7.0	10.3
Sheff	565	80.5	77.1	83.6	12.4	7.1	0.7	−5.4	6.8
Shrew	181	78.5	71.9	83.8	6.1	15.5	−5.6	−16.2	4.9
Stevng	357	83.5	79.3	87.0	3.9	12.6	8.3	0.4	16.1
Sthend	119	69.8	60.9	77.3	4.2	26.1	−6.7	−21.5	8.1
Stoke	267	73.4	67.8	78.4	10.1	16.5	−4.7	−14.3	4.8
Sund	90	77.8	68.0	85.2	6.7	15.6	2.9	−11.4	17.3
Swanse	323	70.0	64.8	74.7	25.7	4.3	−0.8	−10.1	8.5
Truro	140	76.4	68.7	82.7	15.0	8.6	−8.0	−20.3	4.3
Tyrone	88	79.6	69.9	86.7	0.0	20.5	10.5	−6.6	27.6
Ulster	86	76.7	66.7	84.5	0.0	23.3	−0.3	−16.8	16.3
Wirral	160	83.1	76.5	88.2	8.1	8.8	2.8	−8.3	13.8
Wolve	285	74.4	69.0	79.1	14.0	11.6	4.0	−5.6	13.6
Wrexm	72	77.8	66.8	85.9	12.5	9.7	10.6	−8.6	29.9
York	119	83.2	75.4	88.9	5.9	10.9	−0.8	−13.5	12.0
England	**16,161**	**75.2**	**74.5**	**75.9**	**14.1**	**10.7**	**0.8**	**−0.4**	**2.1**
N Ireland	**662**	**78.9**	**75.6**	**81.8**	**10.1**	**11.0**	**4.3**	**−1.7**	**10.2**
Wales	**966**	**74.6**	**71.8**	**77.3**	**15.3**	**10.0**	**1.6**	**−3.6**	**6.7**
E, W & NI	**17,789**	**75.3**	**74.7**	**75.9**	**14.0**	**10.7**	**1.0**	**−0.2**	**2.2**

[a]These centres supplied uncorrected calcium and were corrected using the formula:
adjusted calcium = unadjusted calcium + [(40 − albumin) × 0.02]

Table 9.8. Summary statistics for adjusted calcium in peritoneal dialysis patients in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	91	10					
B Heart	97	35	2.3	0.17	2.3	2.2	2.4
B QEH	90	126	2.3	0.19	2.3	2.2	2.4
Bangor	100	23	2.4	0.16	2.4	2.3	2.6
Basldn	100	24	2.4	0.16	2.5	2.4	2.5
Belfast	96	24	2.3	0.17	2.4	2.2	2.5
Bradfd	100	33	2.4	0.15	2.4	2.3	2.4
Brightn	99	74	2.4	0.16	2.4	2.3	2.4
Bristol	100	56	2.6	0.14	2.5	2.5	2.6
Camb	100	31	2.3	0.14	2.3	2.2	2.4
Cardff[a]	100	87	2.4	0.16	2.4	2.3	2.4
Carlis	100	12					

Table 9.8. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Carsh	98	91	2.3	0.18	2.3	2.2	2.4
Chelms	100	32	2.4	0.14	2.4	2.3	2.5
Clwyd	80	4					
Covnt	97	70	2.3	0.16	2.3	2.2	2.4
Derby	99	88	2.5	0.16	2.5	2.4	2.6
Derry	100	2					
Donc	100	23	2.4	0.11	2.4	2.4	2.5
Dorset	82	42	2.4	0.14	2.4	2.3	2.5
Dudley	93	54	2.4	0.14	2.4	2.3	2.5
Exeter	100	69	2.3	0.19	2.3	2.2	2.4
Glouc	100	39	2.4	0.18	2.4	2.3	2.6
Hull	100	62	2.5	0.17	2.4	2.4	2.5
Ipswi	100	35	2.4	0.16	2.3	2.2	2.5
Kent	93	62	2.4	0.21	2.4	2.4	2.5
L Barts	98	170	2.4	0.19	2.3	2.2	2.5
L Guys	98	42	2.4	0.15	2.4	2.3	2.5
L Kings	100	84	2.3	0.15	2.3	2.2	2.4
L Rfree	100	63	2.3	0.16	2.2	2.2	2.4
L St.G	98	53	2.4	0.14	2.4	2.4	2.5
L West[a]	100	31	2.5	0.16	2.5	2.4	2.6
Leeds	99	83	2.3	0.16	2.3	2.2	2.4
Leic	99	140	2.4	0.16	2.4	2.3	2.5
Liv Ain	0	0					
Liv RI	94	73	2.3	0.18	2.4	2.2	2.5
M Hope	72	79	2.3	0.20	2.3	2.2	2.4
M RI	100	75	2.3	0.18	2.3	2.2	2.4
Middlbr	94	17					
Newc	100	45	2.3	0.19	2.3	2.2	2.4
Newry	100	8					
Norwch	98	45	2.5	0.12	2.5	2.4	2.5
Nottm	100	78	2.5	0.15	2.5	2.4	2.6
Oxford	100	101	2.4	0.19	2.5	2.3	2.5
Plymth	98	42	2.4	0.16	2.4	2.3	2.5
Ports	100	91	2.4	0.19	2.4	2.3	2.5
Prestn	85	51	2.4	0.19	2.4	2.3	2.5
Redng	99	77	2.4	0.16	2.4	2.4	2.5
Sheff	100	60	2.3	0.12	2.3	2.3	2.4
Shrew	94	17					
Stevng	100	28	2.4	0.13	2.4	2.3	2.5
Sthend	100	18					
Stoke	94	61	2.4	0.15	2.4	2.3	2.5
Sund	100	29	2.5	0.22	2.4	2.4	2.6
Swanse	100	45	2.3	0.13	2.3	2.2	2.4
Truro	100	26	2.4	0.18	2.4	2.3	2.5
Tyrone	86	6					
Ulster	100	2					
Wirral	49	17					
Wolve	100	62	2.4	0.18	2.3	2.2	2.5
Wrexm	95	19					
York	100	17					
England	**96**	**2,833**	**2.4**	**0.18**	**2.4**	**2.3**	**2.5**
N Ireland	**95**	**52**	**2.4**	**0.17**	**2.4**	**2.3**	**2.5**
Wales	**99**	**178**	**2.4**	**0.16**	**2.4**	**2.3**	**2.5**
E, W & NI	**96**	**3,063**	**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
[a]These centres supplied uncorrected calcium and were corrected using the formula:
adjusted calcium = unadjusted calcium + [(40 − albumin) × 0.02]

Table 9.9. Percentage of peritoneal dialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2010

							Change from 2009		
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	35	80.0	63.6	90.2	14.3	5.7	10.8	−18.4	39.9
B QEH	126	71.4	62.9	78.6	18.3	10.3	−6.9	−21.1	7.3
Bangor	23	69.6	48.5	84.8	4.4	26.1	4.1	−29.6	37.7
Basldn	24	70.8	50.2	85.4	8.3	20.8	2.8	−31.1	36.8
Belfast	24	83.3	63.1	93.6	16.7	0.0	−7.9	−31.1	15.4
Bradfd	33	81.8	65.0	91.6	9.1	9.1	−8.5	−30.6	13.6
Brightn	74	83.8	73.6	90.6	8.1	8.1	−4.5	−19.4	10.5
Bristol	56	51.8	38.9	64.5	1.8	46.4	−15.9	−38.5	6.7
Camb	31	87.1	70.3	95.1	9.7	3.2	12.9	−12.6	38.5
Cardff[a]	87	79.3	69.5	86.6	11.5	9.2	6.1	−10.0	22.2
Carsh	91	78.0	68.4	85.4	14.3	7.7	−3.8	−18.5	10.9
Chelms	32	84.4	67.5	93.3	3.1	12.5	17.7	−10.0	45.4
Covnt	70	74.3	62.8	83.2	15.7	10.0	−0.4	−19.3	18.6
Derby	88	67.1	56.6	76.0	2.3	30.7	−20.8	−36.7	−4.8
Donc	23	87.0	66.5	95.7	0.0	13.0	19.1	−10.0	48.2
Dorset	42	85.7	71.7	93.4	2.4	11.9	8.2	−12.6	28.9
Dudley	54	77.8	64.8	86.9	0.0	22.2	−4.0	−25.0	16.9
Exeter	69	73.9	62.3	82.9	14.5	11.6	−1.5	−21.2	18.2
Glouc	39	66.7	50.7	79.6	7.7	25.6	−11.7	−37.9	14.4
Hull	62	74.2	61.9	83.6	1.6	24.2	−3.2	−23.1	16.6
Ipswi	35	82.9	66.7	92.1	5.7	11.4	1.9	−20.8	24.6
Kent	62	67.7	55.2	78.2	8.1	24.2	7.4	−14.7	29.5
L Barts	170	77.1	70.1	82.8	9.4	13.5	1.5	−10.6	13.5
L Guys	42	81.0	66.3	90.2	7.1	11.9	−7.7	−27.6	12.2
L Kings	84	81.0	71.1	88.0	13.1	6.0	3.0	−14.0	20.1
L Rfree	63	69.8	57.5	79.9	23.8	6.4	5.3	−16.3	27.0
L St.G	53	81.1	68.4	89.5	0.0	18.9	7.9	−12.7	28.5
L West[a]	31	64.5	46.6	79.1	0.0	35.5	−16.1	−44.9	12.6
Leeds	83	78.3	68.2	85.9	10.8	10.8	0.7	−15.8	17.2
Leic	140	75.0	67.2	81.5	5.7	19.3	−2.1	−15.1	11.0
Liv RI	73	72.6	61.3	81.6	16.4	11.0	−6.1	−24.2	12.1
M Hope	79	70.9	60.0	79.8	19.0	10.1	−2.3	−19.4	14.9
M RI	75	76.0	65.1	84.3	18.7	5.3	−3.3	−20.3	13.6
Newc	45	71.1	56.4	82.4	22.2	6.7	7.1	−17.6	31.8
Norwch	45	82.2	68.3	90.9	0.0	17.8	0.8	−20.4	22.0
Nottm	78	61.5	50.4	71.6	2.6	35.9	5.1	−14.0	24.2
Oxford	101	71.3	61.7	79.3	4.0	24.8	7.9	−9.5	25.2
Plymth	42	81.0	66.3	90.2	0.0	19.1	12.5	−12.4	37.5
Ports	91	81.3	72.0	88.1	5.5	13.2	10.7	−6.5	27.8
Prestn	51	78.4	65.1	87.6	7.8	13.7	−9.5	−28.0	9.0
Redng	77	81.8	71.6	88.9	5.2	13.0	−7.2	−22.0	7.5
Sheff	60	83.3	71.7	90.8	13.3	3.3	3.9	−13.8	21.6
Stevng	28	82.1	63.6	92.4	0.0	17.9	11.8	−17.6	41.1
Stoke	61	82.0	70.3	89.7	3.3	14.8	10.3	−8.7	29.4
Sund	29	62.1	43.6	77.6	0.0	37.9	3.7	−31.1	38.6
Swanse	45	84.4	70.8	92.4	11.1	4.4	14.9	−7.5	37.2
Truro	26	73.1	53.3	86.6	11.5	15.4	25.5	−10.5	61.4
Wolve	62	75.8	63.7	84.9	8.1	16.1	0.2	−22.1	22.5
England	**2,833**	**75.6**	**74.0**	**77.2**	**8.8**	**15.6**	**0.2**	**−2.7**	**3.2**
N Ireland	**52**	**78.9**	**65.7**	**87.9**	**11.5**	**9.6**	**−7.5**	**−25.4**	**10.5**
Wales	**178**	**79.2**	**72.6**	**84.6**	**9.6**	**11.2**	**7.8**	**−3.5**	**19.2**
E, W & NI	**3,063**	**75.9**	**74.3**	**77.4**	**8.9**	**15.3**	**0.5**	**−2.3**	**3.3**

[a]These centres supplied uncorrected calcium and were corrected using the formula:
adjusted calcium = unadjusted calcium + [(40 − albumin) × 0.02]]

for calcium appears to have plateaued for both HD and PD patients.

Similar to that seen in earlier phosphate analyses, 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 9.6–9.10). 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 adjustment factors between centres. In particular, 81% of haemodialysis patients in Newcastle achieved the target range in 2009 with a mean for the population of 2.4 mmol/L but only 57% in 2010 with a mean for the population of 2.2 mmol/L. Further investigation revealed that this decrease coincided with a change in the laboratory analysers that resulted in a downward shift in calcium and an upward shift in albumin – since the equation for calculating adjusted calcium was not changed this would result in a decrease in adjusted calcium. This serves to emphasise the need for laboratories to use the appropriate equation for albumin-adjustment of calcium.

The 5th Renal Association clinical practice guidelines on CKD–Mineral and Bone Disorders was finalised on 6th December 2010 and recommends that calcium, adjusted for albumin, be maintained within the reference range and ideally between 2.2 and 2.5 mmol/L for all dialysis patients [8] – the audit standard will therefore remain the same in next year's report.

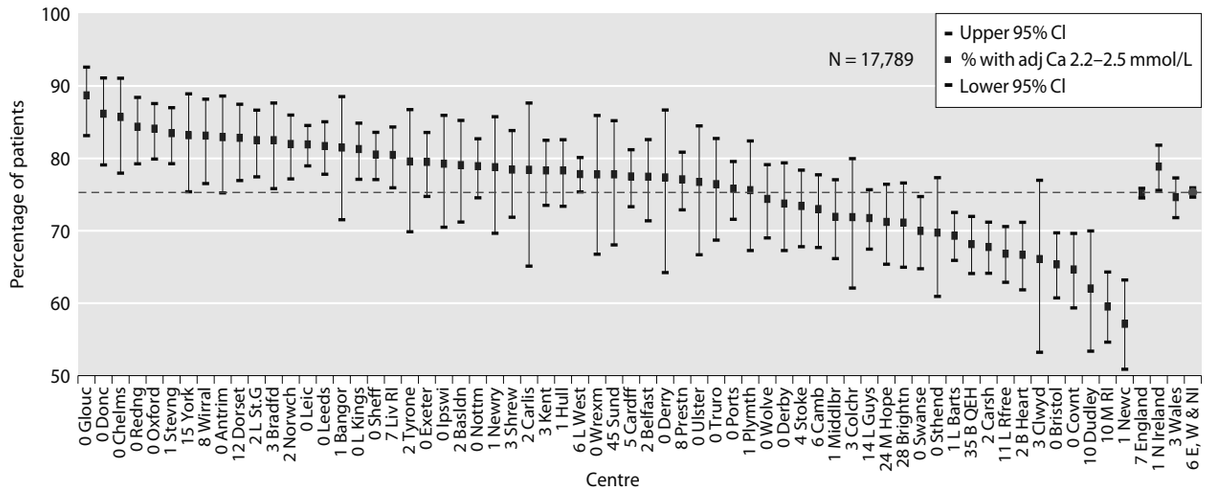

Fig. 9.6. Percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2010

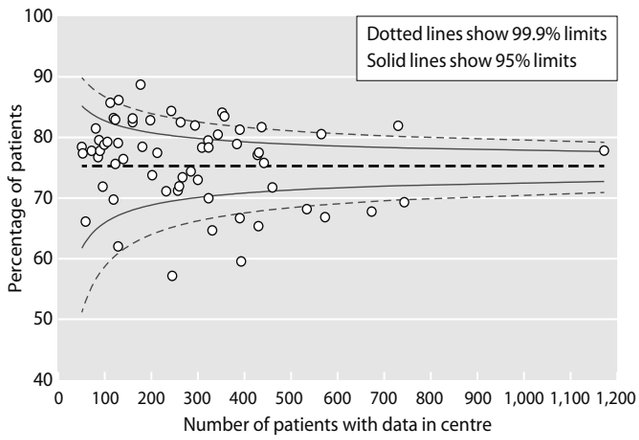

Fig. 9.7. Funnel plot of percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2010

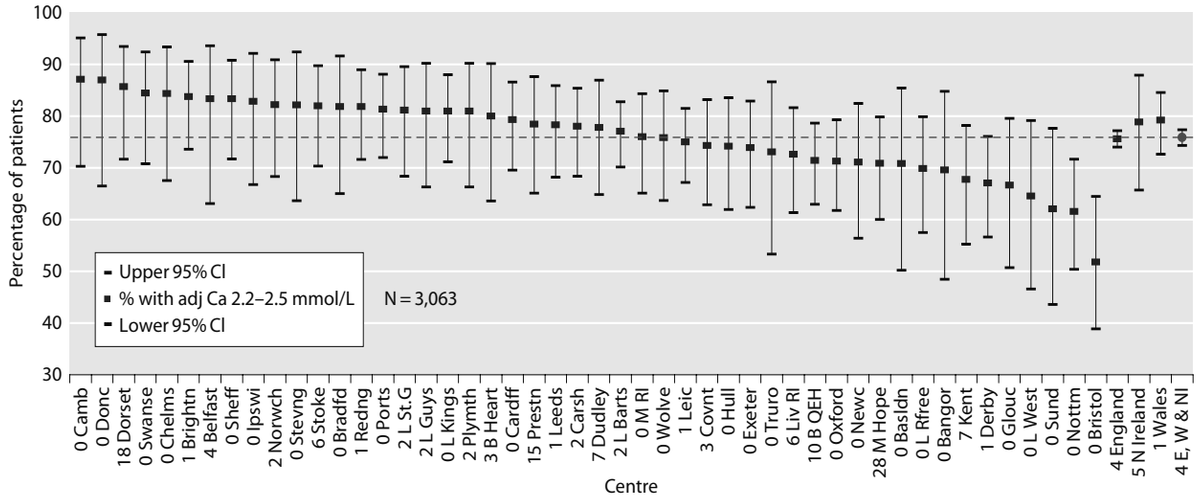

Fig. 9.8. Percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2010

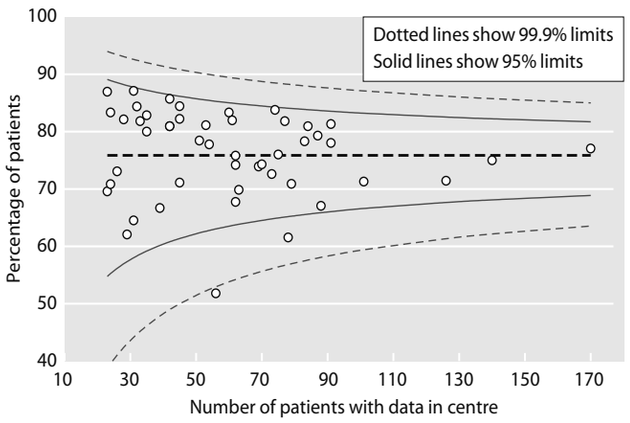

Fig. 9.9. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2010

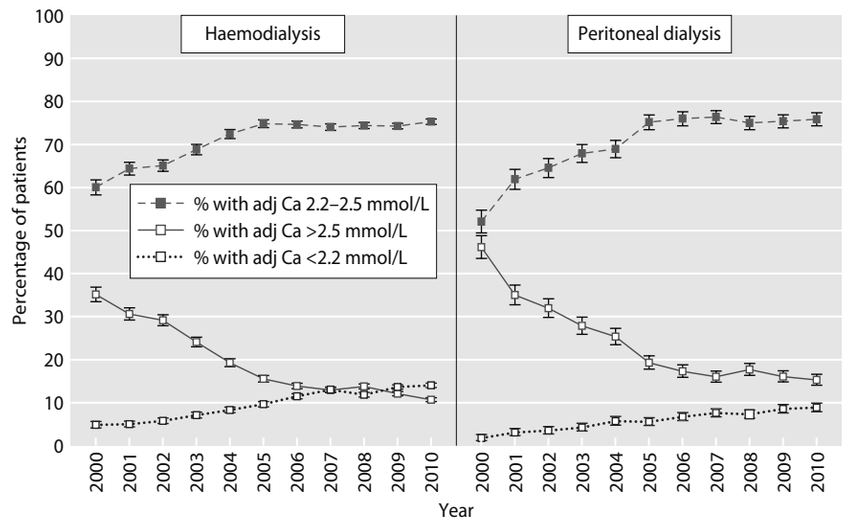

Fig. 9.10. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.5 mmol/L and >2.5 mmol/L by dialysis modality 2000–2010

Parathyroid hormone

At the beginning of 2010 no new guidelines regarding the target range for PTH in dialysis patients had yet been published with clinical practice being dictated by the 4th edition of the Renal Association Clinical Practice Guidelines which stated:

'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) [7]

The data for parathyroid hormone were 87% complete for HD patients and 89% complete for PD patients overall, although there was between centre variation (tables 9.10, 9.12). Twenty-eight percent (CI 27–29%) of HD patients and 31% (29–32%) of PD patients achieved a parathyroid hormone between 16–32 pmol/L (tables 9.11, 9.13). The proportion of HD patients with a parathyroid hormone above the upper limit of the range was 43% and the proportion with parathyroid hormone below the lower limit of the range was 29%. The proportion of PD patients with parathyroid hormone above the upper limit of the range was 40% and the proportion with parathyroid hormone below the lower limit

Table 9.10. Summary statistics for PTH in haemodialysis patients in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	123	26	20	21	11	35
B Heart	93	369	39	43	27	13	51
B QEH	50	412	37	47	25	10	48
Bangor	100	82	27	34	20	13	31
Basldn	97	128	36	32	26	14	48
Belfast	94	205	47	44	32	17	67
Bradfd	95	157	34	39	21	11	41
Brightn	97	312	35	41	23	9	46
Bristol	96	414	37	35	28	15	49
Camb	60	191	34	50	24	11	40
Cardff	96	436	50	44	38	22	61
Carlis	98	51	33	31	24	11	44
Carsh	4	27					
Chelms	100	112	35	25	30	17	43
Clwyd	93	57	35	35	24	10	48
Colchr	97	96	28	25	20	10	35
Covnt	99	329	36	41	23	12	45
Derby	99	199	33	41	24	14	38
Derry	100	53	43	30	32	22	61
Donc	100	130	47	40	34	20	61
Dorset	96	217	28	29	18	8	37
Dudley	94	135	41	47	27	11	52
Exeter	98	317	22	27	14	6	25
Glouc	99	175	30	28	22	11	36
Hull	95	297	46	58	26	10	59
Ipswi	100	106	49	49	33	16	56
Kent	97	322	47	41	36	21	58
L Barts	99	739	50	50	35	17	61
L Guys	74	394	47	49	30	14	61
L Kings	93	364	49	43	36	16	70
L Rfree	84	541	35	35	24	12	46
L St.G	97	258	47	45	32	19	58
L West	89	1103	57	57	39	17	76
Leeds	99	433	32	32	24	12	42
Leic	99	726	43	42	30	14	64
Liv Ain	4	6					
Liv RI	98	359	39	38	27	13	54
M Hope	72	243	39	41	23	12	51
M RI	85	374	48	46	36	19	63

Table 9.10. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Middlbr	93	244	43	39	34	17	57
Newc	83	204	33	26	27	13	46
Newry	99	99	34	42	24	11	38
Norwch	96	286	34	31	27	15	43
Nottm	99	380	35	38	24	11	44
Oxford	96	338	48	45	34	19	64
Plymth	94	116	21	22	15	7	27
Ports	95	420	37	44	22	7	50
Prestn	99	463	38	34	29	14	51
Redng	99	241	31	27	25	16	40
Sheff	97	547	43	41	30	15	56
Shrew	97	181	36	39	19	10	48
Stevng	97	349	56	51	38	29	76
Sthend	94	112	59	52	47	25	75
Stoke	92	256	51	39	41	23	68
Sund	94	155	45	45	32	16	58
Swanse	71	230	44	38	33	18	58
Truro	99	139	27	28	18	9	38
Tyrone	98	88	37	22	32	23	47
Ulster	100	86	21	18	17	8	29
Wirral	61	106	37	35	25	16	47
Wolve	98	280	23	31	14	7	29
Wrexm	97	70	23	22	19	10	29
York	89	125	36	34	28	11	47
England	**86**	**14,978**	**41**	**43**	**28**	**13**	**53**
N Ireland	**98**	**654**	**36**	**35**	**27**	**15**	**44**
Wales	**88**	**875**	**43**	**41**	**31**	**17**	**53**
E, W & NI	**87**	**16,507**	**41**	**43**	**28**	**13**	**53**

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

Table 9.11. Percentage of haemodialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2010

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	Change from 2009		
							% within range	95% LCL	95% UCL
Antrim	123	35.0	27.1	43.8	39.0	26.0	1.6	−14.1	17.3
B Heart	369	28.7	24.3	33.6	29.8	41.5	2.8	−5.7	11.3
B QEH	412	25.2	21.3	29.7	36.4	38.4	−8.6	−16.3	−0.9
Bangor	82	42.7	32.5	53.6	32.9	24.4	4.8	−15.4	25.1
Basldn	128	31.3	23.8	39.8	28.1	40.6	−0.3	−15.2	14.6
Belfast	205	30.2	24.4	36.9	20.0	49.8	4.7	−6.6	15.9
Bradfd	157	28.0	21.6	35.6	37.6	34.4	4.5	−8.3	17.3
Brightn	312	25.3	20.8	30.4	38.5	36.2	−0.7	−10.2	8.7
Bristol	414	32.6	28.3	37.3	26.1	41.3	1.8	−6.6	10.3
Camb	191	30.4	24.3	37.3	35.6	34.0			
Cardff	436	26.4	22.5	30.7	16.5	57.1	−5.6	−13.5	2.4
Carlis	51	23.5	13.9	37.0	37.3	39.2	−4.5	−26.2	17.2
Chelms	112	38.4	29.9	47.7	18.8	42.9	9.0	−7.3	25.4

Table 9.11. Continued

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	Change from 2009		
							% within range	95% LCL	95% UCL
Clwyd	57	26.3	16.5	39.2	38.6	35.1	4.3	−15.6	24.1
Colchr	96	33.3	24.7	43.3	41.7	25.0	−1.5	−19.5	16.5
Covnt	329	28.9	24.2	34.0	32.8	38.3	1.4	−7.8	10.6
Derby	199	41.2	34.6	48.2	28.1	30.7	3.6	−8.6	15.8
Derry	53	39.6	27.5	53.2	11.3	49.1	17.2	−5.2	39.6
Donc	130	32.3	24.8	40.8	16.2	51.5	0.3	−15.6	16.2
Dorset	217	25.4	20.0	31.6	43.3	31.3	−1.0	−11.9	10.0
Dudley	135	24.4	17.9	32.4	34.1	41.5	−0.1	−14.6	14.5
Exeter	317	26.5	21.9	31.6	55.2	18.3	−1.9	−11.2	7.4
Glouc	175	30.9	24.5	38.1	37.1	32.0	3.0	−9.7	15.6
Hull	297	21.6	17.2	26.6	34.7	43.8	1.3	−7.3	10.0
Ipswi	106	27.4	19.7	36.6	22.6	50.0	−7.0	−23.8	9.7
Kent	322	28.3	23.6	33.4	16.5	55.3			
L Barts	739	23.8	20.9	27.0	22.6	53.6	−1.9	−8.0	4.1
L Guys	394	24.4	20.4	28.9	28.7	47.0	1.8	−5.6	9.2
L Kings	364	21.7	17.8	26.2	23.9	54.4	0.0	−7.9	7.9
L Rfree	541	30.7	26.9	34.7	32.4	37.0	−2.5	−10.0	5.0
L St.G	258	31.4	26.0	37.3	19.0	49.6	3.1	−7.5	13.8
L West	1,103	21.6	19.3	24.1	22.5	55.9	−2.5	−7.2	2.1
Leeds	433	34.2	29.9	38.8	31.4	34.4	4.3	−3.9	12.4
Leic	726	24.2	21.3	27.5	28.2	47.5	1.6	−4.2	7.4
Liv RI	359	27.3	22.9	32.1	30.4	42.3	−0.6	−9.2	8.0
M Hope	243	31.7	26.2	37.8	32.9	35.4			
M RI	374	23.5	19.5	28.1	21.1	55.4	0.7	−8.7	10.1
Middlbr	244	25.4	20.3	31.3	23.8	50.8	−2.1	−12.3	8.1
Newc	204	30.4	24.5	37.0	29.9	39.7	1.7	−9.4	12.7
Newry	99	38.4	29.4	48.3	30.3	31.3	1.8	−16.2	19.8
Norwch	286	33.9	28.7	39.6	27.6	38.5	−5.6	−16.0	4.8
Nottm	380	33.7	29.1	38.6	32.4	34.0	3.1	−5.6	11.8
Oxford	338	26.3	21.9	31.3	21.0	52.7	5.7	−2.8	14.1
Plymth	116	31.9	24.1	40.9	51.7	16.4	4.0	−11.7	19.6
Ports	420	21.7	18.0	25.9	41.7	36.7	0.1	−7.4	7.5
Prestn	463	26.8	23.0	31.0	28.9	44.3	−8.0	−16.2	0.2
Redng	241	41.5	35.4	47.8	24.5	34.0	5.4	−6.0	16.7
Sheff	547	26.5	23.0	30.4	26.7	46.8	−1.1	−8.0	5.8
Shrew	181	30.9	24.6	38.0	34.3	34.8	2.4	−10.1	14.9
Stevng	349	25.5	21.2	30.3	13.2	61.3	3.1	−5.3	11.5
Sthend	112	24.1	17.1	32.9	12.5	63.4	−5.9	−21.2	9.5
Stoke	256	23.8	19.0	29.4	13.3	62.9	−7.0	−17.0	3.1
Sund	155	25.8	19.5	33.3	24.5	49.7	−0.3	−13.1	12.5
Swanse	230	29.6	24.0	35.8	20.0	50.4	−0.5	−11.6	10.5
Truro	139	25.9	19.3	33.8	43.9	30.2	−3.2	−17.1	10.7
Tyrone	88	40.9	31.2	51.4	10.2	48.9	2.8	−16.4	22.0
Ulster	86	33.7	24.6	44.3	46.5	19.8	−4.2	−23.0	14.6
Wirral	106	41.5	32.5	51.1	24.5	34.0	6.0	−11.2	23.2
Wolve	280	26.1	21.3	31.5	53.9	20.0	1.3	−8.2	10.8
Wrexm	70	32.9	22.9	44.6	42.9	24.3	−0.5	−21.1	20.1
York	125	24.8	18.0	33.1	31.2	44.0	−5.8	−20.9	9.2
England	**14,978**	**27.4**	**26.7**	**28.1**	**29.3**	**43.3**	**−0.2**	**−1.6**	**1.1**
N Ireland	**654**	**35.0**	**31.5**	**38.8**	**26.6**	**38.4**	**3.5**	**−3.2**	**10.2**
Wales	**875**	**29.3**	**26.3**	**32.4**	**22.5**	**48.2**	**−2.0**	**−7.7**	**3.6**
E, W & NI	**16,507**	**27.8**	**27.1**	**28.5**	**28.8**	**43.4**	**−0.2**	**−1.5**	**1.1**

Blank cells denote a centre with low patient numbers last year precluding calculation of the change in target attainment

Table 9.12. Summary statistics for PTH in peritoneal dialysis patients in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	11					
B Heart	86	31	28	18	23	15	39
B QEH	85	119	23	23	15	7	30
Bangor	100	23	24	16	24	7	32
Basldn	100	24	38	32	34	16	50
Belfast	96	24	50	48	33	16	63
Bradfd	94	31	59	54	47	16	93
Brightn	95	71	36	30	30	17	48
Bristol	91	51	37	37	28	11	45
Camb	100	31	31	18	29	17	43
Cardff	98	85	43	34	35	21	59
Carlis	100	12					
Carsh	3	3					
Chelms	100	32	40	38	29	15	50
Clwyd	80	4					
Covnt	93	67	31	31	20	11	44
Derby	98	87	25	25	19	14	30
Derry	100	2					
Donc	96	22	46	35	38	21	66
Dorset	86	44	24	25	15	8	28
Dudley	90	52	31	30	20	13	39
Exeter	99	68	24	23	21	10	32
Glouc	95	37	39	42	29	13	49
Hull	92	57	27	26	18	9	31
Ipswi	100	35	49	34	41	28	64
Kent	99	66	39	25	32	23	57
L Barts	95	165	32	33	24	12	45
L Guys	98	42	34	25	26	18	49
L Kings	96	81	48	32	41	22	65
L Rfree	98	62	31	26	24	12	38
L St.G	98	53	40	32	28	15	51
L West	87	27	56	35	58	31	79
Leeds	100	84	34	23	33	17	52
Leic	94	132	39	38	27	14	64
Liv Ain	0	0					
Liv RI	97	76	28	25	20	12	35
M Hope	71	78	35	36	23	14	46
M RI	99	74	44	37	31	18	59
Middlbr	72	13					
Newc	53	24	24	19	18	10	36
Newry	100	8					
Norwch	72	33	25	23	18	12	26
Nottm	97	76	30	22	30	9	48
Oxford	90	91	50	40	45	19	62
Plymth	98	42	23	16	23	9	33
Ports	82	75	37	34	25	14	47
Prestn	100	60	34	28	27	18	45
Redng	99	77	33	30	26	14	41
Sheff	90	54	42	35	34	21	53
Shrew	89	16					
Stevng	96	27	45	57	29	19	57
Sthend	89	16					
Stoke	92	60	56	40	46	27	76
Sund	97	28	26	25	17	7	38
Swanse	96	43	36	25	31	21	47
Truro	92	24	36	25	28	17	60

Table 9.12. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Tyrone	100	7					
Ulster	100	2					
Wirral	40	14					
Wolve	95	59	18	13	15	9	28
Wrexm	90	18					
York	100	17					
England	**89**	**2,620**	**35**	**32**	**26**	**13**	**47**
N Ireland	**98**	**54**	**42**	**39**	**29**	**19**	**49**
Wales	**96**	**173**	**36**	**29**	**30**	**19**	**47**
E, W & NI	**89**	**2,847**	**35**	**32**	**27**	**14**	**47**

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

Table 9.13. Percentage of peritoneal dialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2010

							Change from 2009		
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	31	41.9	26.1	59.6	25.8	32.3	−3.5	−39.2	32.2
B QEH	119	25.2	18.2	33.8	50.4	24.4	−10.7	−26.7	5.2
Bangor	23	47.8	28.8	67.5	30.4	21.7	20.2	−14.1	54.6
Basldn	24	25.0	11.7	45.6	25.0	50.0	−7.0	−40.2	26.2
Belfast	24	25.0	11.7	45.6	25.0	50.0	−11.4	−42.8	20.1
Bradfd	31	19.4	9.0	36.9	22.6	58.1	0.8	−25.8	27.4
Brightn	71	33.8	23.8	45.5	21.1	45.1	2.0	−18.7	22.7
Bristol	51	27.5	17.0	41.2	31.4	41.2	0.0	−21.7	21.8
Camb	31	41.9	26.1	59.6	19.4	38.7	9.7	−21.8	41.2
Cardff	85	28.2	19.7	38.7	17.7	54.1	−0.9	−18.3	16.4
Chelms	32	25.0	13.0	42.6	28.1	46.9	−1.7	−30.4	27.0
Covnt	67	23.9	15.2	35.5	41.8	34.3	−3.8	−23.4	15.8
Derby	87	49.4	39.1	59.8	33.3	17.2	−3.0	−22.9	16.8
Donc	22	31.8	16.0	53.4	13.6	54.6	7.7	−25.1	40.5
Dorset	44	20.5	11.0	34.9	59.1	20.5	−4.6	−27.6	18.5
Dudley	52	28.9	18.2	42.5	38.5	32.7	17.0	−3.8	37.7
Exeter	68	32.4	22.4	44.3	44.1	23.5	−5.4	−27.0	16.3
Glouc	37	27.0	15.2	43.4	32.4	40.5	1.2	−26.5	28.9
Hull	57	33.3	22.4	46.4	42.1	24.6	5.0	−17.6	27.7
Ipswi	35	31.4	18.3	48.3	8.6	60.0	−9.1	−37.2	19.1
Kent	66	37.9	27.1	50.1	16.7	45.5			
L Barts	165	30.9	24.3	38.4	33.3	35.8	0.2	−12.9	13.4
L Guys	42	38.1	24.8	53.4	19.1	42.9	2.4	−24.8	29.5
L Kings	81	17.3	10.5	27.1	17.3	65.4	−3.3	−20.0	13.3
L Rfree	62	32.3	21.9	44.8	32.3	35.5	6.5	−14.5	27.4
L St.G	53	30.2	19.4	43.7	26.4	43.4	−1.3	−24.3	21.7
L West	27	18.5	7.9	37.5	7.4	74.1	−0.8	−27.4	25.8
Leeds	84	26.2	17.9	36.6	23.8	50.0	−12.6	−31.0	5.8
Leic	132	30.3	23.1	38.7	28.8	40.9	0.2	−14.3	14.6
Liv RI	76	32.9	23.3	44.2	39.5	27.6	−1.3	−21.1	18.4
M Hope	78	37.2	27.2	48.4	30.8	32.1			
M RI	74	33.8	24.0	45.2	18.9	47.3	2.8	−16.4	21.9
Newc	24	16.7	6.4	36.9	41.7	41.7	−5.8	−30.7	19.2
Norwch	33	33.3	19.5	50.8	45.5	21.2	1.8	−27.0	30.5
Nottm	76	17.1	10.2	27.3	34.2	48.7	−6.7	−22.3	9.0

Table 9.13. Continued

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >32 pmol/L	Change from 2009 % within range	Change from 2009 95% LCL	Change from 2009 95% UCL
Oxford	91	22.0	14.6	31.6	18.7	59.3	−2.2	−18.5	14.1
Plymth	42	33.3	20.8	48.7	38.1	28.6	−7.2	−35.2	20.8
Ports	75	37.3	27.2	48.8	28.0	34.7	11.9	−8.3	32.1
Prestn	60	38.3	27.0	51.1	21.7	40.0	−11.7	−34.5	11.2
Redng	77	32.5	23.0	43.7	31.2	36.4	8.9	−10.0	27.7
Sheff	54	29.6	19.0	43.0	16.7	53.7	−12.7	−35.8	10.3
Stevng	27	37.0	21.2	56.2	18.5	44.4	7.9	−26.0	41.8
Stoke	60	23.3	14.3	35.6	8.3	68.3	−7.2	−28.1	13.7
Sund	28	17.9	7.6	36.4	50.0	32.1	−15.5	−47.9	17.0
Swanse	43	32.6	20.3	47.7	20.9	46.5	0.0	−26.1	26.1
Truro	24	37.5	20.8	57.8	20.8	41.7			
Wolve	59	37.3	26.0	50.2	50.9	11.9	5.6	−19.2	30.4
England	**2,620**	**30.3**	**28.5**	**32.1**	**30.1**	**39.7**	**−0.6**	**−3.9**	**2.8**
N Ireland	**54**	**38.9**	**26.9**	**52.4**	**18.5**	**42.6**	**0.5**	**−22.0**	**23.1**
Wales	**173**	**34.1**	**27.4**	**41.5**	**21.4**	**44.5**	**2.1**	**−10.6**	**14.8**
E, W & NI	**2,847**	**30.7**	**29.0**	**32.4**	**29.3**	**40.0**	**−0.4**	**−3.6**	**2.7**

Blank cells denote a centre with low patient numbers last year precluding calculation of the change in target attainment

of the range was 29% (tables 9.11, 9.13, figures 9.11 to 9.14). 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 although individual centre performance was little changed from last year.

A significant contributor to centre variation will be the assay used to measure PTH. This has been demonstrated by a study undertaken by the Scottish Clinical Biochemistry Managed Diagnostic Network in association with the Scottish Renal Registry. Analysis of samples from 106 haemodialysis patients by six different PTH immunoassays in common use showed a 1.2- to 2.7-fold variation in results in spite of similar reference ranges for each method [9]. Since current guidelines refer to multiples of the upper reference limit, 53% of patients were classified differently by different methods with implications for treatment eg with Cinacalcet. In an excellent accompanying editorial, Garrett and Goldsmith [10] also highlighted the high biological variability of PTH and its poor ability to predict skeletal or patient outcomes. Whether more accurate and specific assays

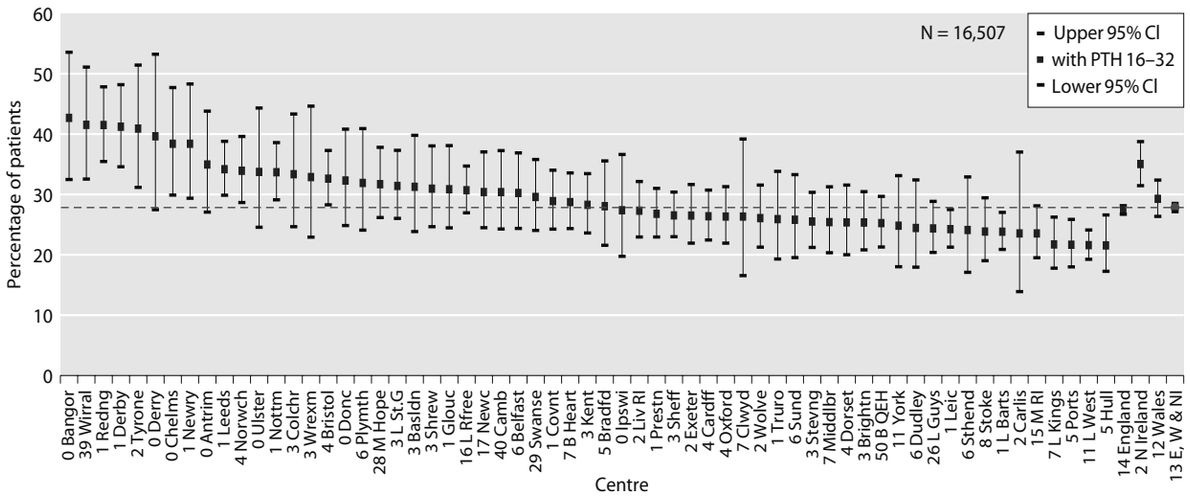

Fig. 9.11. Percentage of haemodialysis patients with PTH within range (16–32 pmol/L) by centre in 2010

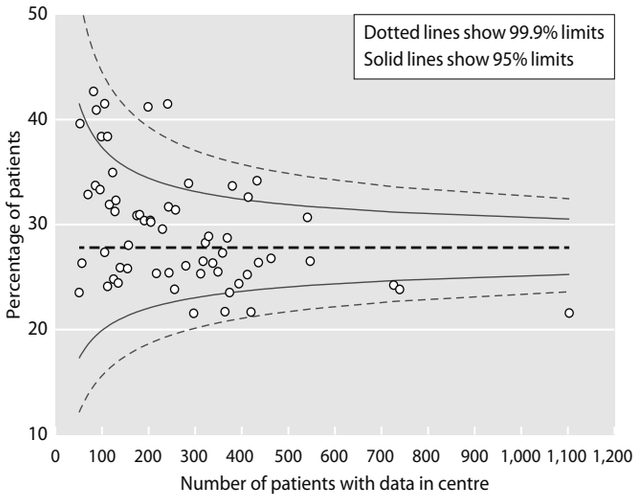

Fig. 9.12. Funnel plot of percentage of haemodialysis patients with PTH within range (16–32 pmol/L) by centre in 2010

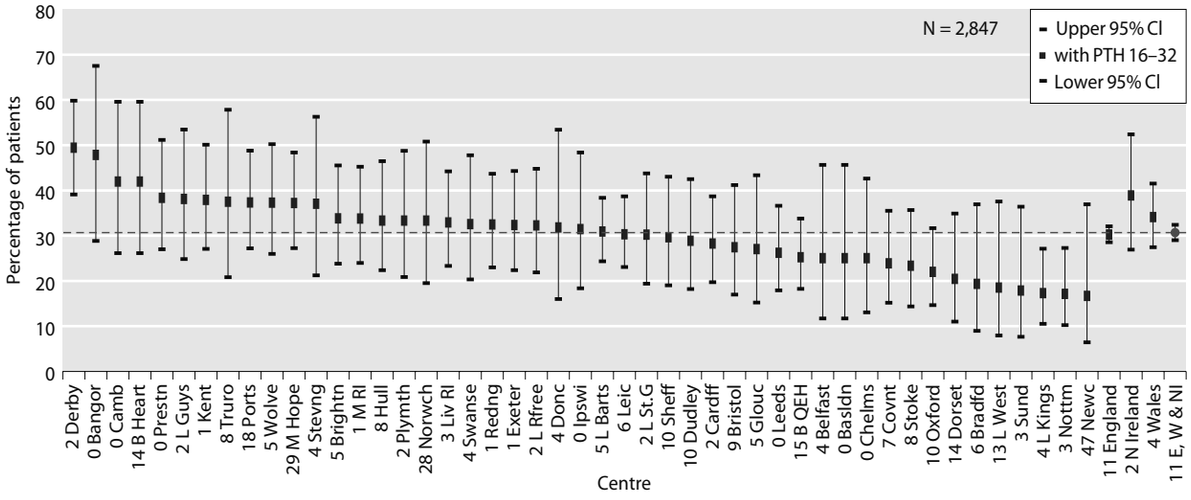

Fig. 9.13. Percentage of peritoneal dialysis patients with PTH within range (16–32 pmol/L) by centre in 2010

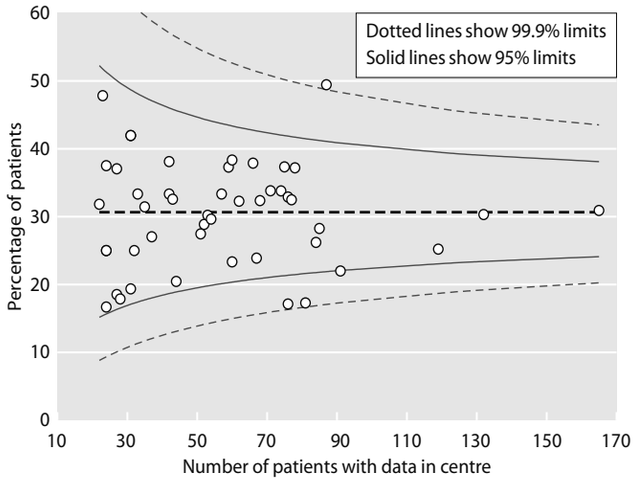

Fig. 9.14. Funnel plot of percentage of peritoneal dialysis patients with PTH within range (16–32 pmol/L) by centre in 2010

would improve this or whether PTH will be supplanted by other markers such as bone specific alkaline phosphatase that also have greater pre-analytical stability remains to be determined [11].

Improvement of PTH assays to achieve consensus results within CKD patients requires manufacturers to consider two principal factors: adoption of a common reference preparation for standardisation, such as the WHO international standard 95/646, and selection of pairs of antibodies that do not detect PTH fragments such as 7–84 that accumulate in CKD. Meanwhile Almond et al. [9] and a recent editorial review [12] urge adoption of assay-specific action limits for PTH in CKD patients. However this approach raises a number of difficult governance issues. There is already evidence that the manufacturers of the major diagnostic platforms used throughout the world have started to respond. The Roche assay used by Almond et al. [9] was PTH (intact) that was not standardised and cross-reacted with PTH 7–84. Roche have recently launched the more expensive PTH (1–84) that is standardised against the WHO international standard 95/646 and has $\leqslant 0.1\%$ cross-reactivity with both PTH (1–34) and PTH (7–84) (information supplied by Roche Diagnostics).

Mineral and bone variables

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 [13–17]. A recent cohort study has demonstrated that simultaneous achievement of all three audit measures does appear to be associated with better outcomes [18].

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 as discussed above. However, detecting these centre level differences is an important step in understanding the factors associated with exceptional 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 already some evidence of changing practice in this regard with a rise in the percentage of HD patients with a PTH > 32 pmol/L over the last five years.

Bicarbonate

In 2010 the following Renal Association clinical practice guidelines regarding bicarbonate management was applicable:

'We suggest that pre-dialysis (mid-week) serum bicarbonate concentrations measured with minimum delay after venepuncture should be between 18 and 24 mmol/l. (2C)' (Module: Haemodialysis) [1]

'For PD patients, Plasma bicarbonate should be maintained within the normal range.' (Module 3b: Peritoneal dialysis) [7]

Citing evidence for reduced risk of adverse events, the Haemodialysis module of the 5th edition of the Renal Association clinical practice guidelines published in December 2009 [1] recommended a target range for serum bicarbonate of 18–24 mmol/L, a reduction from the previous guideline range of 20–26 mmol/L.

Bicarbonate data were 90% complete for HD patients and 89% complete for PD patients (tables 9.14, 9.16). With the introduction of a lower bicarbonate target range in haemodialysis patients for 2010, the proportion of patients achieving the audit measure has fallen in this group from 72% in 2009 to 60% in 2010 (CI 59–60%) although the mean bicarbonate decreased slightly from 24 mmol/L in 2009 to 23 mmol/L in 2010, (table 9.14). The proportion achieving the standard in PD patients comparatively shows little change at 80% (CI 79–82%). Collectively there was significant inter-centre variation for both HD and PD (tables 9.15, 9.17, figures 9.15, 9.16). 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 9.15, 9.17). The UKRR has previously conducted a limited survey into the possible underlying causes of this variation. The study predominantly looked at measures of sample 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 [19].

Total cholesterol

There is no audit standard for total cholesterol in the Renal Association clinical practice guidelines. Current

Table 9.14. Summary statistics for serum bicarbonate in haemodialysis patients by centre in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	123	25	2	25	24	26
B Heart	77	305	24	3	24	22	26
B QEH	81	667	25	3	25	23	27
Bangor	99	81	24	3	25	22	26
Basldn	97	128	23	3	23	21	25
Belfast	98	213	22	3	23	21	24
Bradfd	97	160	23	3	22	21	25
Brightn	94	302	23	3	23	21	25
Bristol	100	430	23	3	23	21	25
Camb	92	295	23	2	23	22	25
Cardff	98	442	22	3	22	20	24
Carlis	98	51	22	3	22	19	23
Carsh	98	669	25	3	25	23	27
Chelms	100	112	25	2	25	24	26
Clwyd	97	59	22	3	23	20	24
Colchr	97	96	27	2	27	25	28
Covnt	98	325	25	3	25	23	27
Derby	100	201	24	3	24	22	25
Derry	100	53	21	2	20	19	22
Donc	100	130	23	3	23	21	25
Dorset	100	225	23	3	23	22	25
Dudley	98	141	24	3	24	22	26
Exeter	100	322	23	3	23	21	25
Glouc	100	177	24	3	24	22	26
Hull	99	308	21	2	21	20	23
Ipswi	100	106	23	3	22	21	24
Kent	98	327	20	3	20	18	22
L Barts	99	742	23	3	23	21	24
L Guys	63	336	23	3	23	21	25
L Kings	99	388	25	2	25	24	27
L Rfree	88	568	22	3	22	21	24
L St.G	99	263	26	3	26	24	29
L West	75	927	20	3	20	18	22
Leeds	100	436	22	3	21	20	23
Leic	100	729	25	3.2	25	23	27
Liv Ain	10	13					
Liv RI	98	361	23	3.4	22	21	24
M Hope	8	26					
M RI	89	392	24	3.2	23	21	25
Middlbr	98	257	26	3.4	26	24	28
Newc	0	0					
Newry	98	98	23	2.3	23	22	25
Norwch	98	292	22	2.9	22	20	23
Nottm	81	311	25	3.4	25	24	27
Oxford	100	352	25	3.7	25	22	27
Plymth	99	123	22	2.6	22	20	23
Ports	100	444	23	3.0	23	22	25
Prestn	99	463	23	3.3	23	21	26
Redng	100	243	27	2.8	26	25	28
Sheff	100	565	25	2.7	25	23	27
Shrew	99	185	25	3.3	26	24	27
Stevng	98	352	24	2.8	24	22	26
Sthend	100	119	23	3.1	24	21	25
Stoke	94	260	26	3.9	26	23	29
Sund	98	162	22	3.0	22	20	24
Swanse	100	323	26	3.1	25	23	28

Table 9.14. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Truro	100	140	22	2.3	21	20	23
Tyrone	98	88	23	2.7	23	21	25
Ulster	100	86	22	2.3	22	21	23
Wirral	92	160	25	3.5	25	23	28
Wolve	100	285	23	3.0	22	21	24
Wrexm	100	72	25	3.0	26	23	27
York	95	133	24	2.9	24	22	26
England	**89**	**15,504**	**24**	**3.4**	**23**	**21**	**26**
N Ireland	**99**	**661**	**23**	**2.8**	**23**	**21**	**25**
Wales	**99**	**977**	**24**	**3.4**	**23**	**21**	**26**
E, W & NI	**90**	**17,142**	**23**	**3.4**	**23**	**21**	**26**

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

Table 9.15. Percentage of haemodialysis patients within, below and above the range for bicarbonate (18–24 mmol/L) by centre in 2010

							Change from 2009		
Centre	N	% bicarb 18–24 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <18 mmol/L	% bicarb >24 mmol/L	% within range	95% LCL	95% UCL
Antrim	123	38.2	30.1	47.1	0.0	61.8	−41.8	−56.5	−27.1
B Heart	305	57.7	52.1	63.1	1.3	41.0	−17.1	−26.6	−7.6
B QEH	667	45.4	41.7	49.2	1.8	52.8	−30.6	−36.9	−24.2
Bangor	81	49.4	38.7	60.1	0.0	50.6	−20.9	−40.7	−1.1
Basldn	128	65.6	57.0	73.3	6.3	28.1	−12.1	−26.4	2.3
Belfast	213	76.1	69.9	81.3	4.2	19.7	−9.2	−18.9	0.5
Bradfd	160	68.8	61.2	75.5	5.6	25.6	−2.4	−15.7	10.9
Brightn	302	66.6	61.0	71.7	5.0	28.5	−13.1	−22.6	−3.7
Bristol	430	67.9	63.3	72.2	4.0	28.1	−13.5	−21.1	−5.8
Camb	295	68.8	63.3	73.8	1.0	30.2	−4.1	−14.6	6.4
Cardff	442	75.6	71.3	79.4	7.2	17.2	5.3	−2.7	13.3
Carlis	51	74.5	60.9	84.6	3.9	21.6	−9.7	−29.8	10.4
Carsh	669	45.7	42.0	49.5	1.1	53.2	−26.7	−33.6	−19.8
Chelms	112	40.2	31.5	49.5	0.9	58.9	−19.5	−36.5	−2.4
Clwyd	59	79.7	67.5	88.1	3.4	17.0	12.5	−7.1	32.1
Colchr	96	17.7	11.3	26.7	0.0	82.3	−44.1	−60.8	−27.4
Covnt	325	44.0	38.7	49.5	1.2	54.8	−20.4	−30.5	−10.3
Derby	201	62.7	55.8	69.1	2.5	34.8	−8.9	−20.5	2.7
Derry	53	90.6	79.3	96.0	3.8	5.7	15.6	−2.2	33.3
Donc	130	73.1	64.8	80.0	1.5	25.4	−9.8	−23.6	4.0
Dorset	225	71.1	64.9	76.7	0.9	28.0	−14.3	−24.3	−4.3
Dudley	141	53.9	45.6	62.0	0.7	45.4	−15.2	−30.9	0.5
Exeter	322	69.9	64.6	74.6	2.8	27.3	−15.0	−23.5	−6.5
Glouc	177	52.5	45.2	59.8	1.1	46.3	−9.9	−23.5	3.7
Hull	308	89.0	85.0	92.0	4.9	6.2	6.5	−0.9	13.8
Ipswi	106	75.5	66.4	82.7	0.9	23.6	10.5	−6.0	27.0
Kent	327	77.7	72.8	81.9	15.9	6.4	9.3	0.3	18.3
L Barts	742	72.1	68.8	75.2	3.4	24.5	−3.2	−9.3	2.9
L Guys	336	70.5	65.4	75.2	2.4	27.1	−7.7	−15.9	0.4
L Kings	388	34.8	30.2	39.7	0.3	65.0	−27.0	−36.0	−18.0
L Rfree	568	75.7	72.0	79.1	4.1	20.3	4.7	−2.3	11.7
L St.G	263	32.7	27.3	38.6	0.4	66.9	1.3	−9.4	12.0
L West	927	75.9	73.1	78.6	17.8	6.3			
Leeds	436	78.9	74.8	82.5	6.9	14.2	7.7	0.2	15.1
Leic	729	46.6	43.0	50.3	1.0	52.4	−24.4	−30.9	−17.9

Table 9.15. Continued

Centre	N	% bicarb 18–24 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <18 mmol/L	% bicarb >24 mmol/L	Change from 2009		
							% within range	95% LCL	95% UCL
Liv RI	361	71.8	66.9	76.2	4.2	24.1	4.5	−4.3	13.3
M RI	392	63.5	58.6	68.1	2.3	34.2	−5.2	−15.2	4.7
Middlbr	257	31.1	25.8	37.1	1.6	67.3	−21.3	−32.2	−10.4
Newry	98	71.4	61.7	79.5	1.0	27.6	−13.7	−28.8	1.4
Norwch	292	78.1	73.0	82.5	8.6	13.4	1.1	−7.9	10.0
Nottm	311	37.0	31.8	42.5	1.3	61.7	−38.2	−47.6	−28.7
Oxford	352	43.2	38.1	48.4	1.4	55.4	−16.1	−25.8	−6.4
Plymth	123	82.1	74.3	87.9	7.3	10.6	7.6	−6.2	21.3
Ports	444	67.6	63.1	71.8	2.5	30.0	−13.1	−20.6	−5.6
Prestn	463	57.9	53.3	62.3	6.1	36.1	−16.7	−25.0	−8.4
Redng	243	22.6	17.8	28.3	0.0	77.4	−40.4	−50.9	−29.9
Sheff	565	44.1	40.0	48.2	0.5	55.4	−21.9	−29.3	−14.5
Shrew	185	32.4	26.1	39.5	2.7	64.9	−46.7	−58.5	−34.9
Stevng	352	60.5	55.3	65.5	2.3	37.2	−23.1	−31.5	−14.6
Sthend	119	59.7	50.6	68.1	4.2	36.1	−12.6	−28.3	3.1
Stoke	260	31.9	26.5	37.8	0.4	67.7			
Sund	162	74.7	67.4	80.8	6.8	18.5	−6.8	−18.6	5.0
Swanse	323	37.5	32.4	42.9	0.6	61.9	−23.5	−33.4	−13.6
Truro	140	87.9	81.3	92.3	4.3	7.9	1.9	−8.6	12.4
Tyrone	88	67.1	56.6	76.0	1.1	31.8	−6.8	−24.7	11.1
Ulster	86	88.4	79.7	93.6	0.0	11.6	38.9	22.5	55.4
Wirral	160	40.0	32.7	47.8	2.5	57.5	−35.3	−48.5	−22.1
Wolve	285	73.3	67.9	78.2	2.1	24.6	15.1	5.0	25.2
Wrexm	72	33.3	23.5	44.9	2.8	63.9	−41.0	−60.6	−21.3
York	133	55.6	47.1	63.8	0.8	43.6	−19.6	−34.7	−4.4
England	**15,504**	**59.4**	**58.6**	**60.1**	**3.8**	**36.8**	**−12.3**	**−13.8**	**−10.9**
N Ireland	**661**	**69.9**	**66.3**	**73.3**	**2.0**	**28.1**	**−7.4**	**−13.6**	**−1.2**
Wales	**977**	**57.9**	**54.8**	**61.0**	**3.9**	**38.2**	**−9.2**	**−14.9**	**−3.5**
E, W & NI	**17,142**	**59.7**	**59.0**	**60.4**	**3.8**	**36.5**	**−12.0**	**−13.3**	**−10.6**

Blank cells denote a centre with low patient numbers last year precluding calculation of the change in target attainment

Table 9.16. Summary statistics for serum bicarbonate in peritoneal dialysis patients by centre in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	36	4					
B Heart	94	34	24	3	25	23	27
B QEH	81	113	25	4	25	22	27
Bangor	91	21	27	3	27	25	30
Basldn	100	24	26	3	26	24	28
Belfast	96	24	25	2	25	23	27
Bradfd	100	33	26	3	25	24	28
Brightn	87	65	24	3	24	23	26
Bristol	100	56	24	3	25	23	26
Camb	100	31	27	3	27	25	29
Cardff	99	86	22	4	23	19	25
Carlis	100	12					
Carsh	88	82	28	4	28	26	31
Chelms	100	32	26	2	26	25	27
Clwyd	80	4					

Table 9.16. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Covnt	92	66	26	3	26	24	28
Derby	99	88	27	4	27	24	29
Derry	100	2					
Donc	91	21	26	3	25	24	29
Dorset	98	50	24	3	24	22	26
Dudley	98	57	26	4	26	24	28
Exeter	100	69	25	4	25	23	27
Glouc	100	39	26	3	26	24	28
Hull	100	62	26	3	26	24	28
Ipswi	100	35	25	3	26	23	27
Kent	100	67	22	3	22	20	24
L Barts	98	170	25	3	25	23	26
L Guys	98	42	24	3	25	22	27
L Kings	99	83	26	2	26	24	28
L Rfree	100	63	25	3	25	22	27
L St.G	98	53	29	3	29	28	31
L West	100	31	23	3	23	21	26
Leeds	99	83	25	3	26	23	27
Leic	95	134	27	4	28	25	30
Liv Ain	0	0					
Liv RI	99	77	24	3	24	22	26
M Hope	8	9					
M RI	99	74	25	3	25	23	27
Middlbr	94	17					
Newc	0	0					
Newry	50	4					
Norwch	96	44	22	2	21	20	23
Nottm	76	59	26	4	26	23	28
Oxford	74	75	26	3	26	24	28
Plymth	98	42	24	3	24	22	25
Ports	93	85	26	3	27	25	29
Prestn	80	48	25	3	25	23	28
Redng	99	77	28	3	28	26	30
Sheff	100	60	26	3	26	24	28
Shrew	89	16					
Stevng	96	27	25	2	24	23	26
Sthend	100	18					
Stoke	95	62	27	4	28	24	30
Sund	100	29	25	3	25	23	27
Swanse	100	45	27	4	27	25	30
Truro	100	26	26	3	26	23	28
Tyrone	86	6					
Ulster	100	2					
Wirral	54	19					
Wolve	100	62	26	3	26	24	28
Wrexm	95	19					
York	100	17					
England	**89**	**2,638**	**26**	**4**	**26**	**23**	**28**
N Ireland	**76**	**42**	**25**	**2**	**25**	**23**	**27**
Wales	**97**	**175**	**25**	**4**	**25**	**22**	**27**
E, W & NI	**89**	**2,855**	**26**	**4**	**26**	**23**	**28**

Blank cells denote low patient numbers or poor data completeness

Table 9.17. Percentage of peritoneal dialysis patients within, below and above the range for bicarbonate (22–30 mmol/L) by centre in 2010

							Change from 2009		
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	34	88.2	72.5	95.5	11.8	0.0	−7.8	−25.2	9.7
B QEH	113	75.2	66.5	82.3	19.5	5.3	−5.2	−19.6	9.3
Bangor	21	81.0	58.9	92.7	4.8	14.3	1.6	−27.8	31.1
Basldn	24	83.3	63.1	93.6	12.5	4.2	−16.7	−36.3	3.0
Belfast	24	95.8	75.7	99.4	4.2	0.0	7.6	−10.1	25.3
Bradfd	33	84.9	68.4	93.6	6.1	9.1	−15.2	−31.3	1.0
Brightn	65	75.4	63.5	84.3	21.5	3.1	9.2	−11.2	29.7
Bristol	56	89.3	78.1	95.1	10.7	0.0	10.2	−6.5	26.9
Camb	31	93.6	77.6	98.4	0.0	6.5	6.5	−12.8	25.7
Cardff	86	60.5	49.8	70.2	39.5	0.0	−4.1	−22.6	14.4
Carsh	82	68.3	57.5	77.4	2.4	29.3	−14.1	−30.5	2.4
Chelms	32	90.6	74.7	96.9	6.3	3.1	0.6	−18.8	20.0
Covnt	66	89.4	79.4	94.9	7.6	3.0	2.8	−11.7	17.4
Derby	88	84.1	74.9	90.4	5.7	10.2	−1.3	−15.5	13.0
Donc	21	90.5	68.9	97.6	0.0	9.5	2.5	−21.1	26.0
Dorset	50	80.0	66.7	88.9	18.0	2.0	5.0	−16.3	26.3
Dudley	57	82.5	70.4	90.3	8.8	8.8	1.6	−18.1	21.3
Exeter	69	78.3	67.0	86.5	14.5	7.3	−5.3	−23.1	12.4
Glouc	39	82.1	66.9	91.2	10.3	7.7	−9.8	−29.5	9.8
Hull	62	82.3	70.7	89.9	11.3	6.5	−8.1	−23.9	7.8
Ipswi	35	88.6	73.2	95.6	8.6	2.9	5.2	−15.1	25.6
Kent	67	50.8	39.0	62.5	47.8	1.5	−10.2	−32.5	12.1
L Barts	170	86.5	80.5	90.8	10.6	2.9	1.3	−8.6	11.2
L Guys	42	85.7	71.7	93.4	14.3	0.0	10.7	−11.1	32.6
L Kings	83	100.0	0.0	100.0	0.0	0.0	10.3	0.8	19.8
L Rfree	63	81.0	69.4	88.9	14.3	4.8	0.3	−17.9	18.5
L St.G	53	69.8	56.3	80.6	1.9	28.3	−7.0	−28.8	14.8
L West	31	71.0	53.0	84.2	25.8	3.2			
Leeds	83	86.8	77.6	92.5	9.6	3.6	−5.0	−17.3	7.3
Leic	134	74.6	66.6	81.3	6.0	19.4	−9.4	−21.9	3.1
Liv RI	77	77.9	67.3	85.8	22.1	0.0	−4.1	−20.7	12.4
M RI	74	83.8	73.6	90.6	10.8	5.4	−3.7	−18.0	10.6
Norwch	44	47.7	33.6	62.3	52.3	0.0	−25.0	−51.0	1.0
Nottm	59	79.7	67.5	88.1	8.5	11.9			
Oxford	75	80.0	69.4	87.6	8.0	12.0	0.6	−17.1	18.4
Plymth	42	76.2	61.1	86.7	23.8	0.0	−8.0	−30.8	14.8
Ports	85	90.6	82.3	95.2	5.9	3.5	0.9	−11.7	13.4
Prestn	48	81.3	67.7	90.0	16.7	2.1	−1.5	−20.9	17.9
Redng	77	76.6	65.9	84.8	0.0	23.4	−8.3	−24.8	8.2
Sheff	60	93.3	83.5	97.5	3.3	3.3	6.6	−6.9	20.0
Stevng	27	92.6	74.8	98.1	7.4	0.0	8.6	−14.4	31.5
Stoke	62	67.7	55.2	78.2	11.3	21.0			
Sund	29	86.2	68.5	94.7	13.8	0.0	2.9	−22.8	28.5
Swanse	45	77.8	63.4	87.6	6.7	15.6	−11.4	−31.2	8.5
Truro	26	80.8	61.3	91.8	11.5	7.7	−4.2	−32.9	24.4
Wolve	62	83.9	72.6	91.1	4.8	11.3	−3.9	−21.8	13.9
England	**2,638**	**80.7**	**79.2**	**82.2**	**11.6**	**7.7**	**−2.9**	**−5.6**	**−0.2**
N Ireland	**42**	**90.5**	**77.2**	**96.4**	**7.1**	**2.4**	**6.0**	**−10.1**	**22.1**
Wales	**175**	**72.0**	**64.9**	**78.2**	**22.3**	**5.7**	**−3.8**	**−15.5**	**8.0**
E, W & NI	**2,855**	**80.3**	**78.8**	**81.7**	**12.2**	**7.5**	**−2.8**	**−5.4**	**−0.1**

Blank cells denote low patient numbers last year precluding calculation of change in target attainment

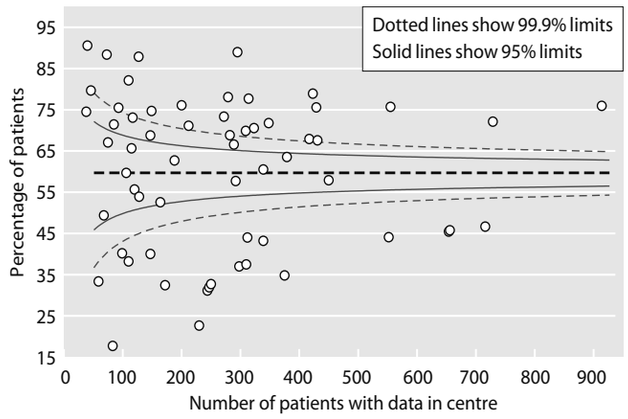

Fig. 9.15. Funnel plot for percentage of haemodialysis patients within the range for bicarbonate (18–24 mmol/L) by centre in 2010

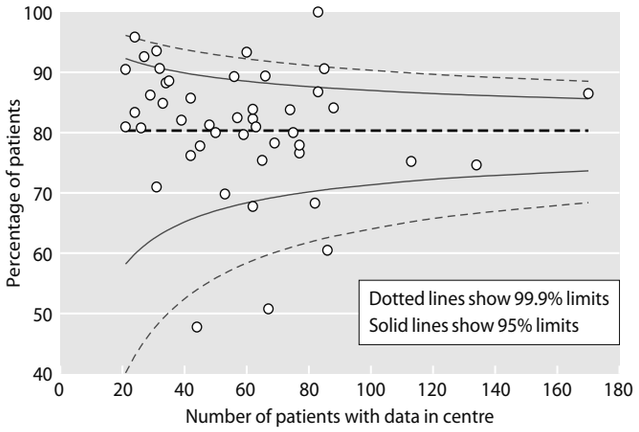

Fig. 9.16. Funnel plot for percentage of peritoneal dialysis patients within the range for bicarbonate (22–30 mmol/L) by centre in 2010

guidance on lipid management states:

'Three hydroxy-3 methylglutaryl-Co-enzyme A reductase inhibitors (statins) should be considered for primary prevention in all CKD including dialysis patients with a 10-year risk of cardiovascular disease, calculated as >20% according to the Joint British Societies' Guidelines (JBS 2), despite the fact that these calculations have not been validated in patients with renal disease. The target total cholesterol should be <4 mmol/l or a 25% reduction from baseline, and a fasting low density lipoprotein (LDL)-cholesterol of <2 mmol/l or a 30% reduction from baseline, should be achieved, whichever is the greatest reduction in all patients (Evidence in CKD 1–3, Good Practice in CKD 4–5 and dialysis patients). Statins should not be withdrawn from patients in whom they were previously indicated and should continue to be prescribed when such patients start renal replacement therapy (RRT) or change modality. (Good Practice).' (Module 2: Complications) [7]

Total cholesterol data were 83% complete for HD patients and 79% complete for PD patients. As there are no specific audit measures for total cholesterol, summary data are presented for each dialysis centre (tables 9.18, 9.19, figures 9.17, 9.18). There are a

Table 9.18. Summary statistics for total cholesterol in haemodialysis patients by centre in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	98	120	3.7	0.9	3.6	3.0	4.2
B Heart	97	384	4.2	1.1	4.1	3.4	4.9
B QEH	67	553	3.9	1.0	3.8	3.2	4.5
Bangor	90	74	4.3	1.0	4.1	3.6	4.9
Basldn	97	128	3.5	1.1	3.4	2.8	4.0
Belfast	90	195	3.9	1.2	3.8	3.1	4.7
Bradfd	88	145	3.8	1.0	3.7	3.1	4.2
Brightn	29	95					
Bristol	90	387	4.1	1.3	3.9	3.2	4.8
Camb	66	212	3.8	1.0	3.7	3.1	4.5
Cardff	94	425	3.9	1.1	3.8	3.2	4.5
Carlis	98	51	4.1	1.2	3.8	3.2	5.0
Carsh	88	604	4.2	1.2	4.0	3.4	4.8
Chelms	94	105	3.6	1.0	3.4	2.9	4.0
Clwyd	92	56	4.0	0.9	4.0	3.3	4.5
Colchr	84	83	3.8	1.1	3.8	3.1	4.3

Table 9.18. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Covnt	0	1					
Derby	88	177	3.8	1.0	3.6	3.1	4.3
Derry	100	53	3.7	0.9	3.5	3.1	4.2
Donc	88	114	3.9	1.1	3.8	3.1	4.5
Dorset	96	217	4.1	1.0	4.0	3.4	4.6
Dudley	89	128	3.7	1.0	3.7	3.0	4.3
Exeter	96	309	4.0	1.1	3.9	3.2	4.6
Glouc	93	165	3.9	1.0	3.8	3.1	4.5
Hull	59	183	4.1	1.1	4.0	3.3	4.7
Ipswi	91	96	3.9	1.1	3.8	3.3	4.6
Kent	93	310	4.1	1.1	4.0	3.3	4.7
L Barts	98	737	4.1	1.1	3.9	3.3	4.7
L Guys	79	418	4.1	1.1	4.0	3.3	4.7
L Kings	91	354	4.1	1.0	3.9	3.4	4.6
L Rfree	86	552	4.1	1.1	4.0	3.3	4.7
L St.G	95	253	3.8	1.1	3.7	3.0	4.4
L West	98	1,220	3.6	0.9	3.5	3.0	4.1
Leeds	99	432	3.9	0.9	3.8	3.3	4.4
Leic	91	665	3.8	1.0	3.7	3.2	4.4
Liv Ain	3	4					
Liv RI	2	7					
M Hope	71	238	3.7	1.0	3.7	3.0	4.3
M RI	86	377	3.8	1.1	3.7	3.0	4.5
Middlbr	97	256	4.2	1.2	4.1	3.3	5.0
Newc	99	245	3.8	1.0	3.7	3.1	4.5
Newry	99	99	3.5	1.0	3.3	2.8	4.3
Norwch	99	296	4.0	1.0	3.9	3.2	4.6
Nottm	99	380	3.9	1.0	3.7	3.2	4.4
Oxford	84	297	3.8	1.0	3.8	3.0	4.4
Plymth	90	112	3.9	1.0	3.7	3.2	4.6
Ports	64	282	4.0	1.2	3.9	3.2	4.8
Prestn	98	457	3.9	1.0	3.8	3.3	4.5
Redng	99	240	3.9	0.9	3.8	3.3	4.4
Sheff	93	526	4.0	1.1	3.9	3.2	4.7
Shrew	93	173	4.1	1.1	4.0	3.4	4.7
Stevng	17	61					
Sthend	92	110	4.0	1.0	4.0	3.3	4.5
Stoke	96	268	3.9	0.9	3.9	3.2	4.6
Sund	98	161	4.3	1.3	4.1	3.4	4.9
Swanse	99	321	4.0	1.1	3.8	3.2	4.6
Truro	99	138	4.0	1.1	3.9	3.4	4.5
Tyrone	98	88	3.7	0.8	3.6	3.2	4.2
Ulster	100	86	3.5	0.9	3.5	2.9	4.1
Wirral	61	106	3.8	1.0	3.7	3.1	4.3
Wolve	96	275	4.3	1.1	4.3	3.6	5.0
Wrexm	74	53	4.0	1.0	4.0	3.3	4.4
York	94	131	4.4	1.1	4.3	3.6	5.2
England	**82**	**14,218**	**3.9**	**1.1**	**3.8**	**3.2**	**4.6**
N Ireland	**96**	**641**	**3.7**	**1.0**	**3.6**	**3.0**	**4.3**
Wales	**94**	**929**	**4.0**	**1.1**	**3.9**	**3.2**	**4.6**
E, W & NI	**83**	**15,788**	**3.9**	**1.1**	**3.8**	**3.2**	**4.6**

Blank cells denote low patient numbers or poor data completeness

Table 9.19. Summary statistics for total cholesterol in peritoneal dialysis patients by centre in 2010

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	100	11					
B Heart	100	36	5.3	1.6	5.3	4.1	6.1
B QEH	87	122	4.4	1.2	4.3	3.7	4.8
Bangor	96	22	5.0	1.1	4.8	4.4	5.2
Basldn	100	24	4.3	1.2	4.0	3.7	5.1
Belfast	100	25	4.5	1.0	4.5	4.1	5.0
Bradfd	91	30	4.3	1.0	4.1	3.4	5.1
Brightn	40	30					
Bristol	77	43	4.6	1.3	4.6	3.7	5.5
Camb	100	31	4.1	1.1	4.1	3.2	4.8
Cardff	99	86	4.6	1.2	4.7	3.6	5.4
Carlis	92	11					
Carsh	22	20					
Chelms	84	27	4.0	1.1	3.8	3.2	4.3
Clwyd	60	3					
Covnt	0	0					
Derby	69	61	4.5	1.2	4.5	3.5	5.3
Derry	100	2					
Donc	48	11					
Dorset	92	47	4.5	1.2	4.3	3.6	5.1
Dudley	57	33	4.1	1.2	3.9	3.2	5.0
Exeter	99	68	4.8	1.1	4.6	4.2	5.3
Glouc	100	39	4.6	1.3	4.6	3.6	5.5
Hull	42	26					
Ipswi	100	35	4.4	1.0	4.4	3.6	5.3
Kent	94	63	4.7	1.0	4.7	4.1	5.4
L Barts	97	168	4.4	1.0	4.3	3.7	4.9
L Guys	93	40	4.7	1.1	4.6	3.9	5.3
L Kings	98	82	4.6	1.3	4.4	3.7	5.1
L Rfree	100	63	4.7	1.5	4.5	3.7	5.3
L St.G	98	53	4.6	1.2	4.5	3.6	5.6
L West	100	31	4.4	1.1	4.1	3.4	5.0
Leeds	99	83	4.2	0.8	4.0	3.6	4.8
Leic	95	134	4.3	1.2	4.2	3.5	5.0
Liv Ain	0	0					
Liv RI	1	1					
M Hope	58	64	4.4	1.3	4.3	3.5	5.1
M RI	99	74	4.6	1.1	4.6	3.7	5.3
Middlbr	39	7					
Newc	100	45	4.3	1.1	4.3	3.4	5.0
Newry	100	8					
Norwch	98	45	4.6	1.0	4.6	4.0	5.4
Nottm	90	70	4.5	1.2	4.6	3.6	5.2
Oxford	90	91	4.5	1.2	4.2	3.6	5.0
Plymth	95	41	4.4	1.2	4.1	3.8	5.2
Ports	81	74	4.5	1.3	4.2	3.6	5.2
Prestn	87	52	4.8	1.2	4.6	4.2	5.2
Redng	85	66	4.6	1.4	4.4	3.7	5.2
Sheff	45	27					
Shrew	50	9					
Stevng	75	21	4.9	1.3	4.7	3.8	5.7
Sthend	83	15					
Stoke	98	64	4.1	1.4	4.0	3.2	5.2
Sund	93	27	4.5	0.8	4.4	3.9	5.2
Swanse	78	35	4.6	1.3	4.4	3.7	5.8

Table 9.19. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Truro	85	22	4.9	1.3	5.0	3.9	6.0
Tyrone	100	7					
Ulster	100	2					
Wirral	40	14					
Wolve	82	51	5.0	1.8	4.9	3.7	6.5
Wrexm	75	15					
York	88	15					
England	**78**	**2,306**	**4.5**	**1.2**	**4.4**	**3.6**	**5.2**
N Ireland	**100**	**55**	**4.5**	**1.1**	**4.5**	**3.6**	**5.3**
Wales	**89**	**161**	**4.7**	**1.3**	**4.6**	**3.7**	**5.4**
E, W & NI	**79**	**2,522**	**4.5**	**1.2**	**4.4**	**3.6**	**5.2**

Blank cells denote low patient numbers or poor data completeness

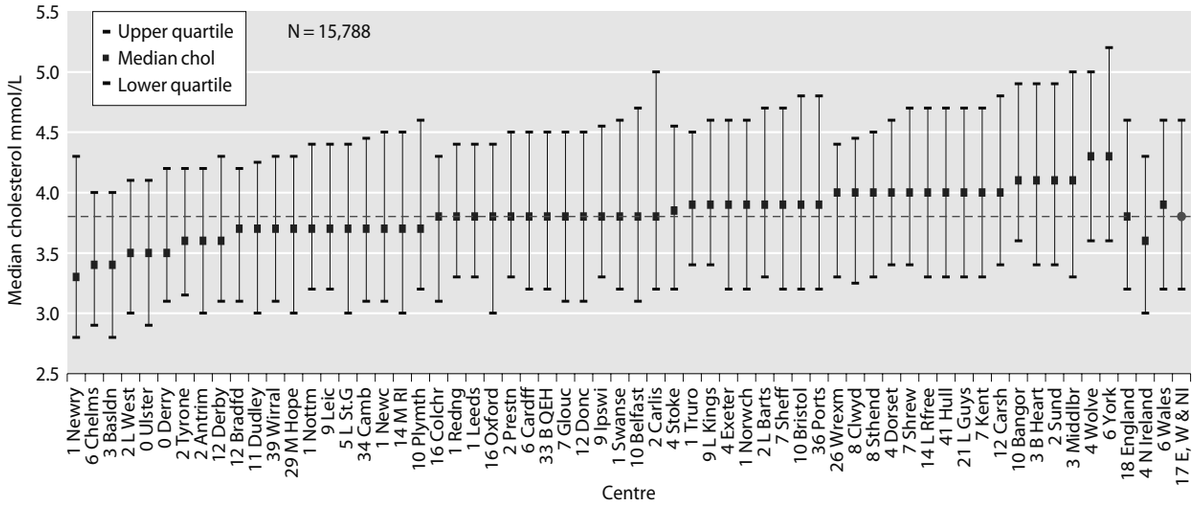

Fig. 9.17. Median total cholesterol in haemodialysis patients by centre in 2010

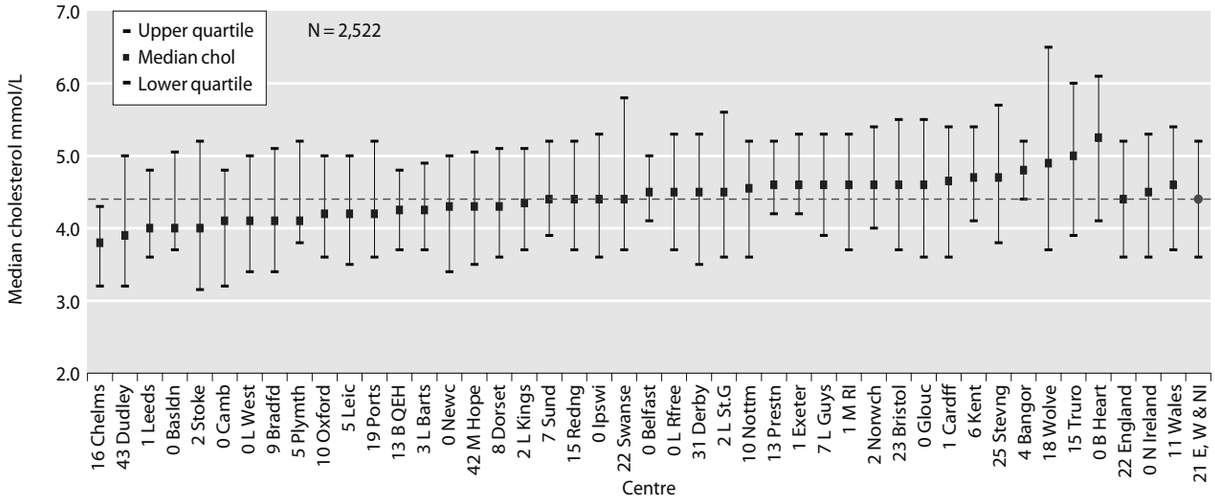

Fig. 9.18. Median total cholesterol in peritoneal dialysis patients by centre in 2010

number of case-mix factors (comorbidity, inflammation, malnutrition) which may account for any inter-centre variation in addition to differences in prescription of lipid lowering medication and other therapies known to influence serum lipid concentration e.g. steroids, sevelamer etc.

Conflicts of interest: none

References

1 Renal association. Clinical practice guidelines. 5th edition. Haemodialysis. http://www.renal.org/Clinical/GuidelinesSection/Haemodialysis.aspx

2 Ansell D, Feehally J, Feest T, Tomson C, Williams AJ, Warwick G: U.K. Renal registry report 2007. Chapter 9. Management of biochemical variables. UK Renal Registry, Bristol, UK 2007

3 Ansell D, Tomson CRV: Chapter 15 uk renal registry annual report: U.K. Renal registry, ukrr database, validation and methodology. Nephron Clin Pract 2009;111(suppl 1):c277–85.Epub 2009 Mar 26

4 Morton AR, Garland JS, Holden RM: Is the calcium correct? Measuring serum calcium in dialysis patients. Semin Dial;23:283–289

5 KDOQI: Clinical practice guidelines for bone metabolism and disease in chronic kidney disease http://www.kidney.org/professionals/KDOQI/guidelines_bone/index.htm

6 Spiegelhalter DJ: Funnel plots for comparing institutional performance. Statistics in Medicine 2005;24:1185–1202

7 Renal association. Clinical practice guidelines. 4th edition. Module 2 complications http://www.Renal.Org/clinical/oldguidelines.Aspx

8 Renal association. Clinical practice guidelines. 5th edition CKD mineral and Bone disorders http://www.renal.org/Clinical/GuidelinesSection/CKD–MBD.aspx

9 Almond A, Ellis AR, Walker SW: Current parathyroid hormone immunoassays do not adequately meet the needs of patients with chronic kidney disease. Ann Clin Biochem 2011;49:63–67

10 Garrett G, Goldsmith DJA: Parathyroid hormone measurements, guidelines statements and clinical treatments: a real world cautionary tale. Ann Clin Biochem 2011;49:4–6

11 Gardham C, Stevens PE, Delaney MP, LeRoux M, Coleman A, Lamb EJ: Variability of parathyroid hormone and other markers of bone mineral metabolism in patients receiving haemodialysis. Clin J Am Soc Nephrol 2010;5:1261–1267

12 Sturgeon CM, Sprague SM, Metcalfe W: Variation in parathyroid hormone immunoassay results – a critical governance issue in the management of chronic kidney disease. Nephrol Dial Transplant 2011;26:3440–3445

13 Kalantar-Zadeh K, Kuwae N, Regidor DL, Kovesdy CP, Kilpatrick RD, Shinaberger CS, McAllister CJ, Budoff MJ, Salusky IB, Kopple JD: Survival predictability of time-varying indicators of bone disease in maintenance hemodialysis patients. Kidney Int 2006;70:771–780

14 Melamed ML, Eustace JA, Plantinga L, Jaar BG, Fink NE, Coresh J, Klag MJ, Powe NR: Changes in serum calcium, phosphate, and pth and the risk of death in incident dialysis patients: A longitudinal study. Kidney Int 2006;70:351–357

15 Noordzij M, Korevaar JC, Boeschoten EW, Dekker FW, Bos WJ, Krediet RT: The kidney disease outcomes quality initiative (k/doqi) guideline for bone metabolism and disease in ckd: Association with mortality in dialysis patients. Am J Kidney Dis 2005;46:925–932

16 Stevens LA, Djurdjev O, Cardew S, Cameron EC, Levin A: Calcium, phosphate, and parathyroid hormone levels in combination and as a function of dialysis duration predict mortality: Evidence for the complexity of the association between mineral metabolism and outcomes. J Am Soc Nephrol 2004;15:770–779

17 Block GA, Klassen PS, Lazarus JM, Ofsthun N, Lowrie EG, Chertow GM: Mineral metabolism, mortality, and morbidity in maintenance hemodialysis. J Am Soc Nephrol 2004;15:2208–2218

18 Danese MD, Belozeroff V, Smirnakis K, Rothman KJ: Consistent control of mineral and bone disorder in incident hemodialysis patients. Clin J Am Soc Nephrol 2008;2:2

19 Ansell DF, T.G. (eds): Renal registry 7th annual report. In chapter 6: Adequacy of haemodialysis and serum bicarbonate, 2004, pp 59–86

UK Renal Registry 14th Annual Report: Chapter 10 Blood Pressure Profile of Prevalent Patients receiving Renal Replacement Therapy in England, Wales and Northern Ireland in 2010: 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 (64% for pre-HD measurements) than for PD patients (44%) or transplant recipients (36%).
- In 2010, the median pre- and post-HD SBP were 140 mmHg and 128 mmHg respectively. The median SBP of patients on PD was 138 mmHg. Transplant recipients had a median SBP of 134 mmHg. Median DBP were 71 mmHg (pre-HD), 67 mmHg (post-HD), 80 mmHg (PD) and 79 mmHg (transplant).
- In England, Wales and Northern Ireland, only 25.6% of PD patients achieved the Renal Association guideline of SBP <130 mmHg **and** DBP <80 mmHg.
- In England, Wales and Northern Ireland, only 27.7% of transplant patients achieved the Renal Association guideline of SBP <130 mmHg **and** DBP <80 mmHg.

Introduction

For patients on dialysis, low blood pressure (BP) appears paradoxically to be associated with lower survival – reverse epidemiology – or the relationship is at least non-linear [1]. Original descriptions at the individual patient level were confounded by unmeasured case-mix, with comorbidity associated with both lower BP and lower survival, but similar patterns have now been reported at the centre level [2]. There are reports however, that raise the possibility that the association can be overcome by long dialysis and careful attention to dry-weight [3]. Further, BP in dialysis patients varies as much within individuals as it does between individuals [4]. The extent of this variability appears to be as important as the absolute value in predicting cardiovascular mortality in haemodialysis patients [5]. The optimal measure of BP therefore remains the subject of considerable controversy, with ambulatory BP predicting mortality better than pre- or post-dialysis BP [6].

The Renal Association does not currently 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 [7] 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 [1, 8].

This chapter reports UK Renal Registry (UKRR) data completeness for BP for adult renal centres in England, Northern Ireland and Wales and presents centre-level average blood pressure attainment for patients on haemodialysis (HD), peritoneal dialysis (PD) and with a functioning kidney transplant at the end of December 2010.

Methods

All adult patients in England, Wales and Northern Ireland receiving RRT (HD, PD and transplant recipients) on 31st December 2010 were considered for inclusion in the analyses.

The method of data extraction employed is described in chapter 15 of the 11th UKRR Annual Report [9]. 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 to the Scottish Renal Registry. However, BP measurements were not collected from the Scottish Registry 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 2010 were included. This included incident patients starting RRT during 2010 who were still alive on 31st December 2010. 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 systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse pressure (PP). The data were analysed to produce summary statistics (mean, median, maximum, minimum). Standard deviation and quartile ranges were also calculated. Median BP and inter-quartile ranges (IQRs) are presented for each analysis 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.

Chi-squared tests were used in the analyses of the 2010 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. Data completeness is summarised in table 10.1. Overall, completeness is very similar to that in the previous UKRR report.

BP on each modality

Figure 10.1 gives the median and IQR for SBP, DBP and PP in prevalent HD patients (pre- and post-dialysis), PD and transplant patients.

In 2010, the median pre- and post-HD SBP were 140 mmHg and 128 mmHg respectively. The median SBP of patients on PD was 138 mmHg. Transplant recipients had a median SBP of 134 mmHg. Median DBP were 71 mmHg (pre-HD), 67 mmHg (post-HD), 80 mmHg (PD) and 79 mmHg (Transplant).

Relationship between the centre mean and the proportion above a threshold BP in that centre

As the distribution of BP in each centre approximates a normal distribution (data not shown), the population mean of each BP variable should predict the number of individuals above (or below) a predefined threshold or standard (Rose and Day 1990). As these assumptions were confirmed in the 13th UKRR Annual Report [10] only mean (or median) BP data by centre are presented below.

Table 10.1. Percentage of patients in each renal centre for whom BP readings were extracted by the UKRR, by modality

	% completed data					% completed data			
Centre	Pre-HD	Post-HD	PD	Transplant	Centre	Pre-HD	Post-HD	PD	Transplant
Antrim	98	84	91	87	Leic	99	98	70	41
B Heart	92	92	0	0	Liv Ain	66	65	0	n/a
B QEH	0	0	0	2	Liv RI	89	89	12	61
Bangor	96	96	100	n/a	M Hope	78	78	0	0
Basldn	98	73	92	48	M RI	22	33	0	0
Belfast	94	69	12	64	Middlbr	98	96	39	52
Bradfd	1	1	100	77	Newc	96	95	0	1
Brightn	0	0	0	0	Newry	97	76	75	93
Bristol	100	100	95	71	Norwch	96	74	2	55
Camb	99	99	97	97	Nottm	100	100	99	92
Cardff	8	25	60	97	Oxford	97	97	47	12
Carlis	98	98	0	0	Plymth	0	0	0	0
Carsh	78	78	2	0	Ports	100	100	65	12
Chelms	100	71	81	81	Prestn	19	0	0	0
Clwyd	92	92	60	80	Redng	98	0	99	95
Colchr	96	96	n/a	n/a	Sheff	100	97	98	97
Covnt	100	98	93	77	Shrew	97	96	0	0
Derby	100	97	99	98	Stevng	98	96	4	0
Derry	98	87	100	89	Sthend	97	97	28	55
Donc	100	80	78	98	Stoke	96	96	2	0
Dorset	99	79	82	75	Sund	98	97	7	94
Dudley	78	60	57	16	Swanse	100	100	100	99
Exeter	100	100	100	81	Truro	100	100	65	98
Glouc	100	100	100	100	Tyrone	97	72	86	88
Hull	96	97	95	0	Ulster	98	78	50	94
Ipswi	99	99	100	87	Wirral	80	28	11	n/a
Kent	96	95	0	0	Wolve	100	99	100	95
L Barts	0	0	0	0	Wrexm	99	96	0	0
L Guys	0	0	0	0	York	91	89	100	48
L Kings	0	0	0	0					
L Rfree	0	0	0	0	**England**	**63**	**59**	**42**	**32**
L St.G	48	48	0	0	**N Ireland**	**96**	**76**	**51**	**73**
L West	0	0	0	0	**Wales**	**57**	**64**	**68**	**87**
Leeds	100	100	99	94	**E, W & NI**	**64**	**60**	**44**	**36**

Centre-specific analyses of BP in haemodialysis patients

Figures 10.2 and 10.3 illustrate the median and IQR pre-dialysis SBP and DBP in each centre supplying data on >50% of patients. Figures 10.4 and 10.5 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.

There remained marked centre variation: the difference between the centres with the lowest and highest median SBP was >25 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.

Centre-specific analyses of BP in peritoneal dialysis patients

Figures 10.6 and 10.7 illustrate the median and IQR SBP and DBP in each centre supplying data on >50% of eligible patients. Figure 10.8 gives the proportion of patients meeting the audit standard of BP <130/80 mmHg.

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 the high rates of completeness of return, which were documented in the centres included in this analysis, would have been achieved if this were the case.

Centre-specific analysis of BP in transplant patients

Figures 10.9 and 10.10 illustrate the median and IQR SBP and DBP in each centre supplying data on >50% of eligible patients and figure 10.11 illustrates the proportion of patients meeting the audit standard of BP <130/80 mmHg.

As with PD patients, the possibility of information bias in these analyses cannot be excluded.

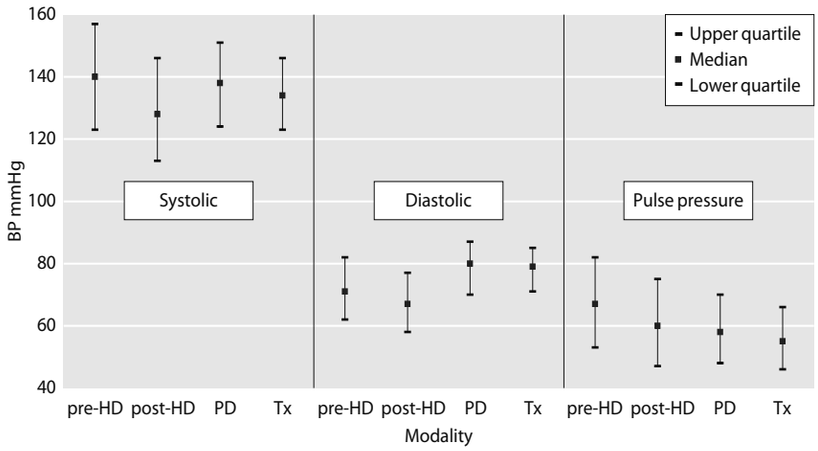

Fig. 10.1. Summary of BP achievements

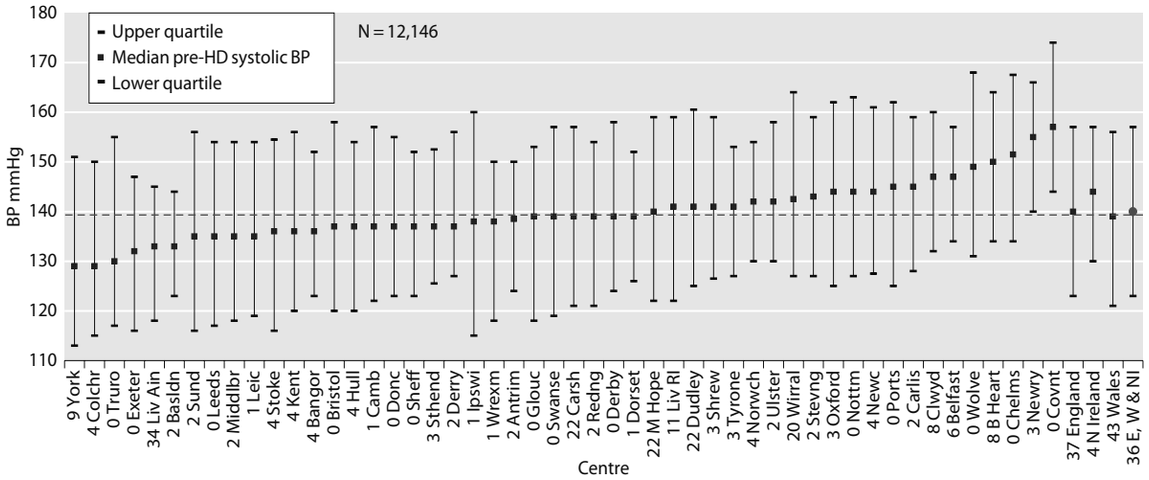

Fig. 10.2. Median systolic BP: pre-HD

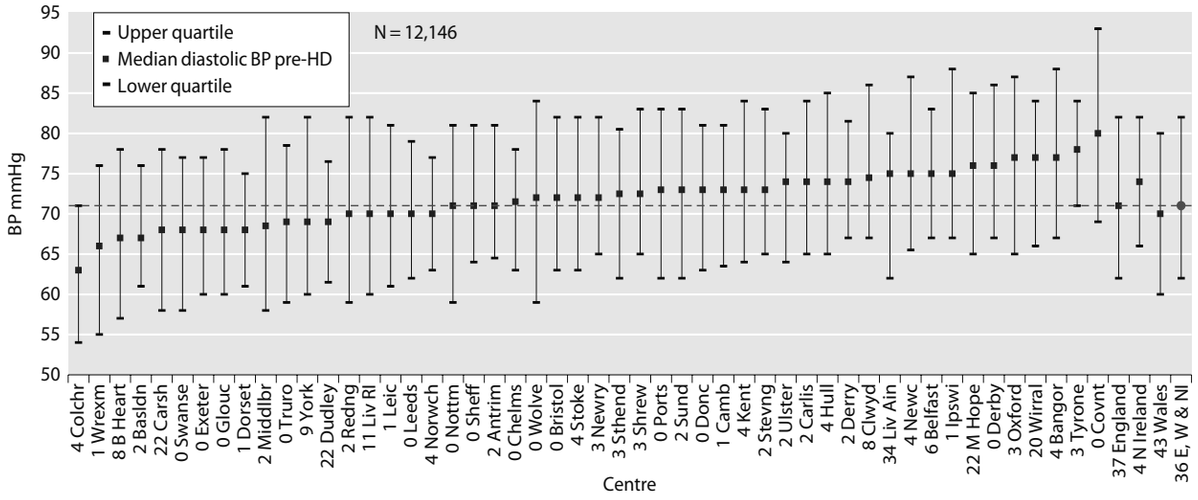

Fig. 10.3. Median diastolic BP: pre-HD

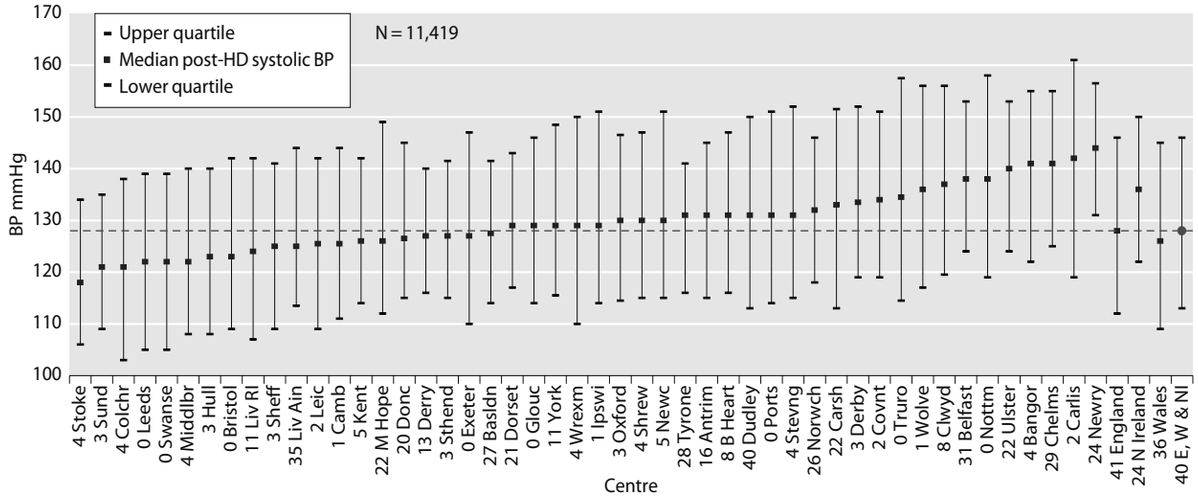

Fig. 10.4. Median systolic BP: post-HD

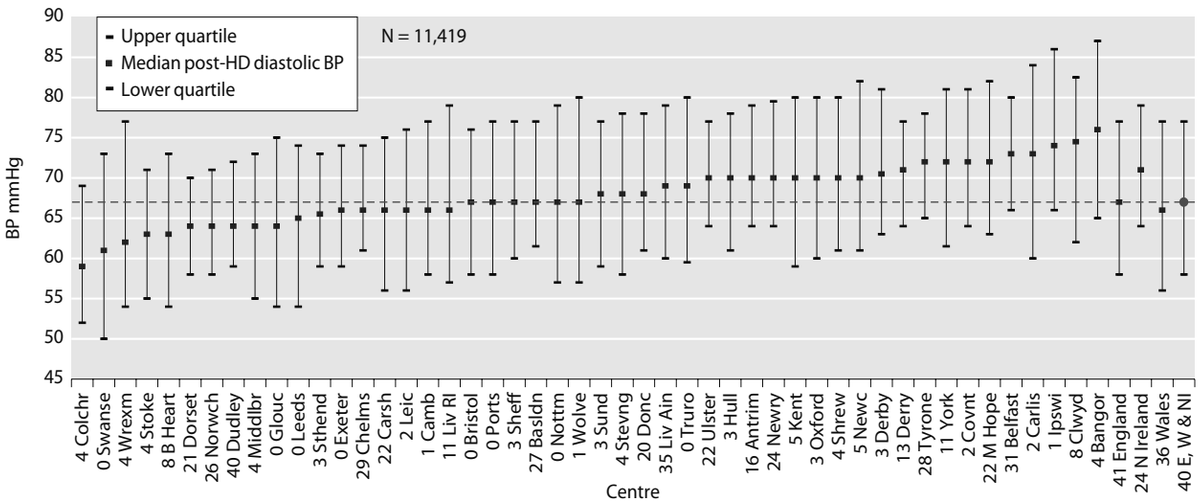

Fig. 10.5. Median diastolic BP: post-HD

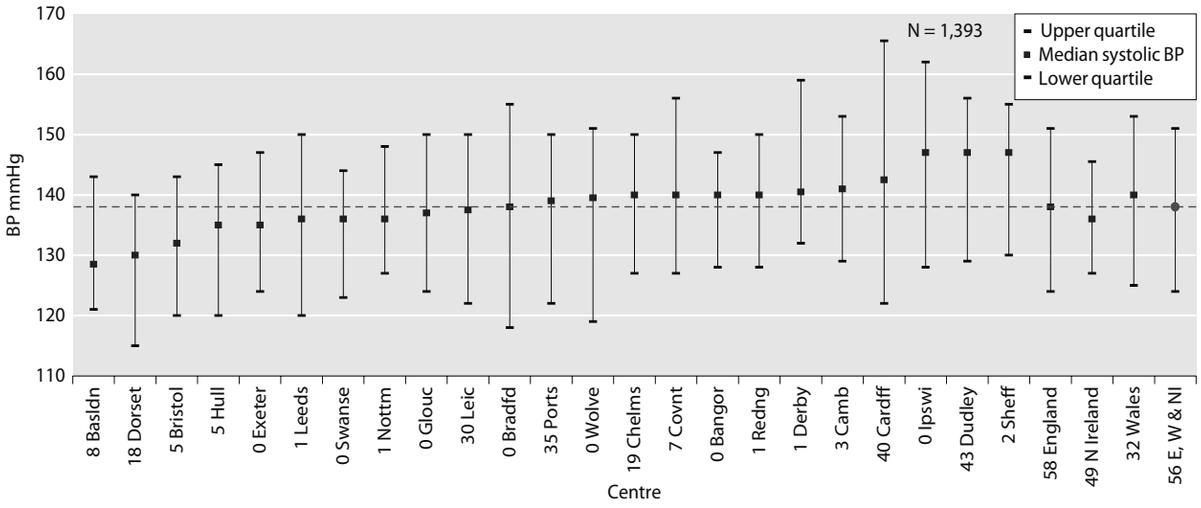

Fig. 10.6. Median systolic BP: PD

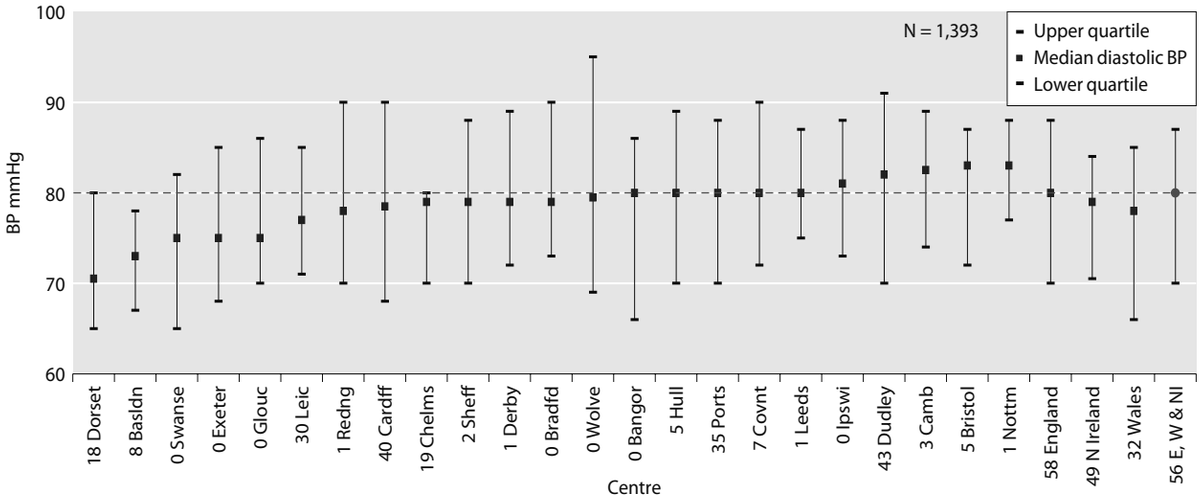

Fig. 10.7. Median diastolic BP: PD

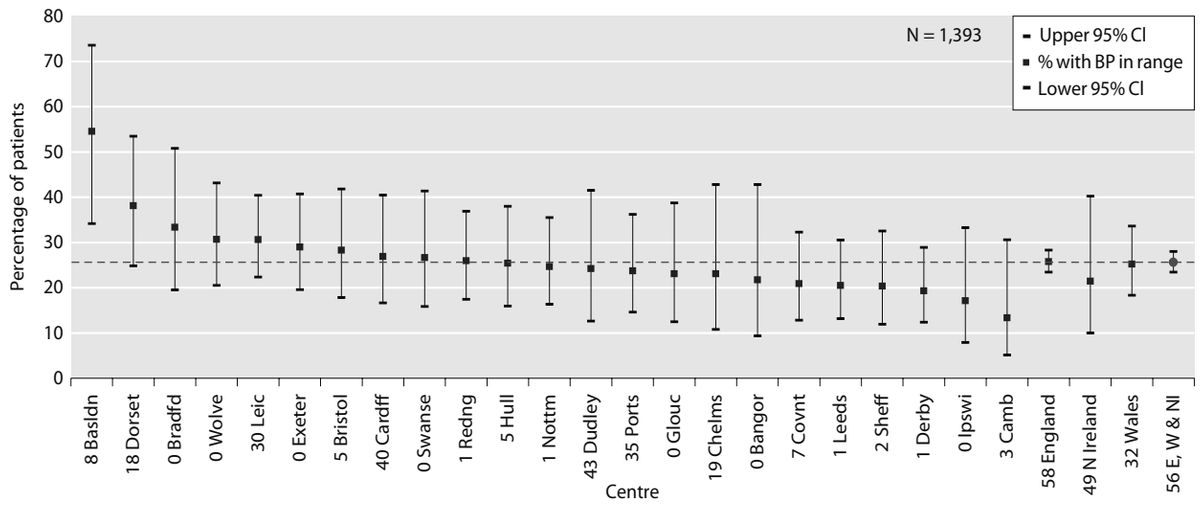

Fig. 10.8. Percentage of patients with BP <130 mmHg systolic and <80 mmHg diastolic: PD

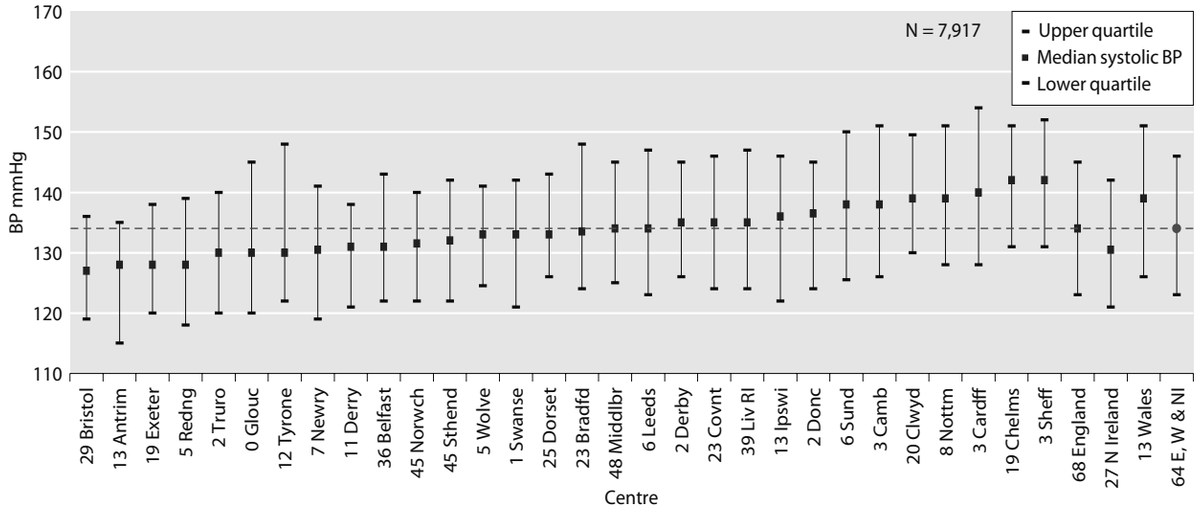

Fig. 10.9. Median systolic BP: Transplant

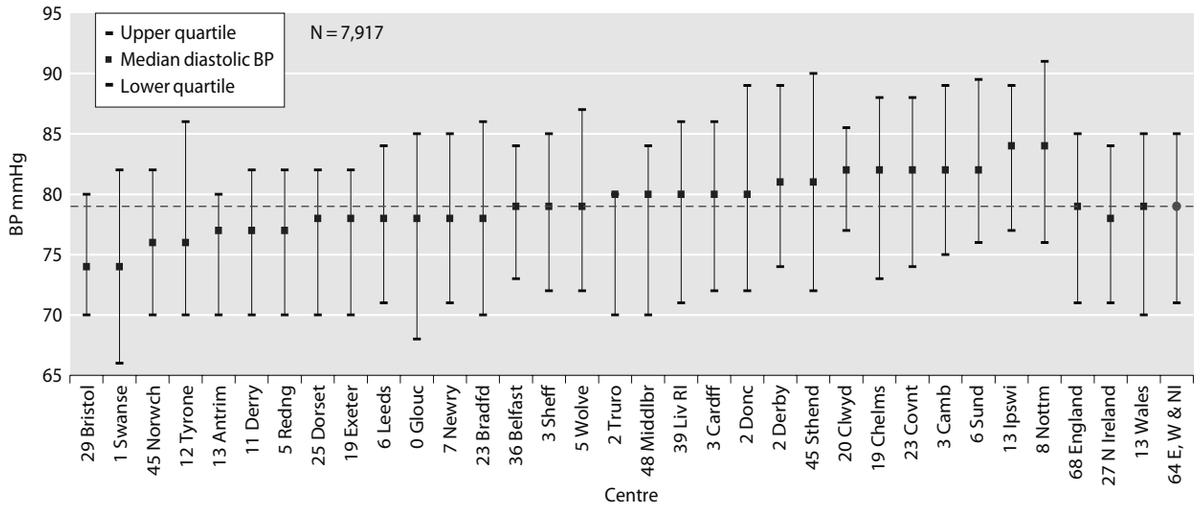

Fig. 10.10. Median diastolic BP: Transplant

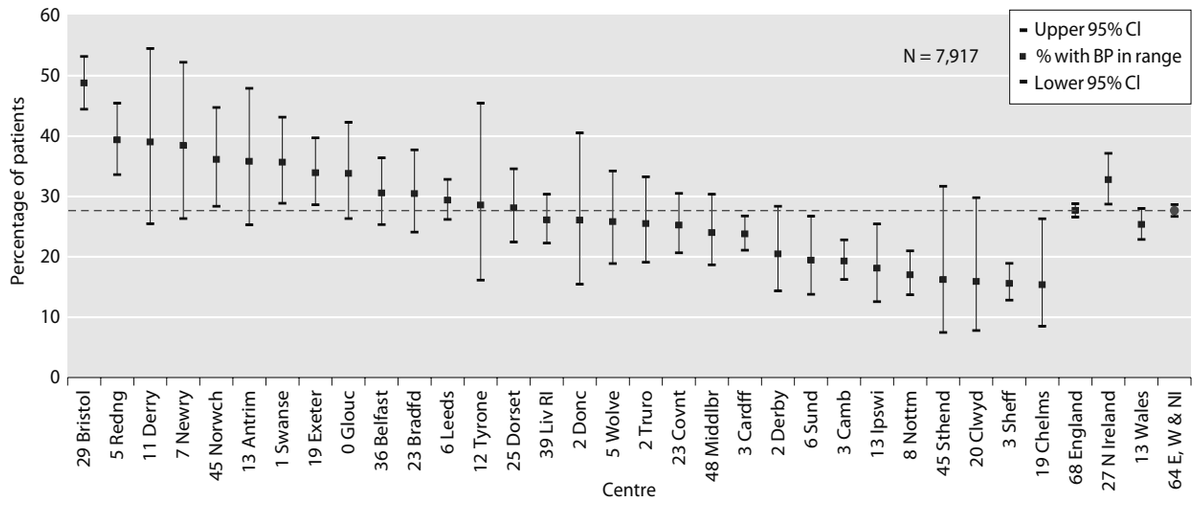

Fig. 10.11. Percentage of patients with BP <130 mmHg systolic and <80 mmHg diastolic: Transplant

Discussion

The utility of UKRR data to inform practice in the area blood pressure control 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).

Bearing in mind these limitations, blood pressure control in 2010 amongst RRT patients in England, Northern Ireland and Wales remained poor. In patients on HD, this can be explained partly by uncertainty relating to the optimum blood pressure target for patients [11]. However, for those on PD and those with functioning kidney transplants, there remains evidence of marked variation between centres in attainment of nationally agreed blood pressure standards.

Conflicts of interest: none

References

1 Levin NW, Kotanko P, Eckardt KU, Kasiske BL, Chazot C, Cheung AK, Redon J, Wheeler DC, Zoccali C, London GM: Blood pressure in chronic kidney disease stage 5D-report from a Kidney Disease: Improving Global Outcomes controversies conference. Kidney Int. 2010;77: 273–228

2 Robinson BM, Tong L, Zhang J, Wolfe RA, Goodkin DA, Greenwood RN, Kerr PG, Morgenstern H, Li Y, Pisoni RL, Saran R, Tentori F, Akizawa T, Fukuhara S, Port FK: Blood pressure levels and mortality risk among hemodialysis patients in the Dialysis Outcomes and Practice Patterns Study. Kidney Int. 2012. doi: 10.1038/ki.2012.136. [Epub ahead of print]

3 Chazot C, Vo-Van C, Deleaval P, Lorriaux C, Hurot JM, Mayor B, Jean G: Predialysis systolic blood pressure evolution in incident hemodialysis patients: effects of the dry weight method and prognostic value. Blood Purif. 2012;33:275–283

4 Rohrscheib MR, Myers OB, Servilla KS, Adams CD, Miskulin D, Bedrick EJ, Hunt WC, Lindsey DE, Gabaldon D, Zager PG: Age-related blood pressure patterns and blood pressure variability among hemodialysis patients. Clin J Am Soc Nephrol 2008;3:1407–1414

5 Di Iorio B, Di Micco L, Torraca S, Sirico ML, Guastaferro P, Chiuchiolo L, Nigro F, De Blasio A, Romano P, Pota A, Rubino R, Morrone L, Lopez T, Casino FG: Variability of blood pressure in dialysis patients: a new marker of cardiovascular risk. J Nephrol. 2012. doi: 10.5301/jn.5000108. [Epub ahead of print]

6 Agarwal R: Blood pressure and mortality among hemodialysis patients. Hypertension 2010;55:762–768

7 Cassidy M, Richardson D, Jones C: UK Renal Association Clinical Practice Guidelines Committee: 2007 RA Guidelines – Module 2: Complications of CKD, 4th Edition. 2007. http://www.renal.org/Clinical/GuidelinesSection/ComplicationsofCKD.aspx

8 KDIGO clinical practice guideline for the care of kidney transplant recipients. Am J Transplant 2009;9(suppl 3):S1–S155

9 Ansell D, Tomson CR: UK Renal Registry 11th Annual Report (December 2008): Chapter 15 The UK Renal Registry, UKRR database, validation and methodology. Nephron Clin Pract 2009;111(suppl 1): c277–c285

10 Webb L, Tomson CRV, Casula A, Farrington K: Registry 13th Annual Report (December 2010): 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. Nephron Clin Pract 2011;119(suppl. 2):c215–c224

11 Agarwal R: The Controversies of Diagnosing and Treating Hypertension among Hemodialysis Patients. Seminars in dialysis 2012;25:370–376

UK Renal Registry 14th Annual Report: Chapter 11 Clinical, Haematological and Biochemical Parameters in Patients receiving Renal Replacement Therapy in Paediatric Centres in the UK in 2010: 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 −0.96 whereas children with a functioning transplant had normal weights (median z-score 0).
- Median height z-score for children on dialysis was −1.80 and for children with a functioning transplant −1.26.
- 79% of transplant patients, 71% of haemodialysis patients and 74% of peritoneal dialysis patients had a systolic blood pressure within the 90th percentile standard.
- 51% of transplant patients, 40% of HD patients and 51% of PD patients had a haemoglobin within the age appropriate standard.
- 51% of HD patients and 74% 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. Progress has been made towards a merger of the adult and paediatric registries with increasing electronic 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 report focuses on the following variables for the prevalent paediatric dialysis and transplantation cohort on 31st December 2010:

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. Overview of anaemia control in children with ERF
5. Key biochemical findings in this population

Analyses of prevalent paediatric patients receiving renal replacement therapy for the year 2010 and for the period 2000 to 2010 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, ten 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 11.1 and appendix K. This year a significant amount of effort has been put into improving the overall accuracy of the entire paediatric dataset by clinical teams, data managers and statisticians (see chapter 5 Demography of the UK Paediatric RRT population).

Data collection

The data presented in this report relate to the annual census date of 31st December 2010.

Table 11.1. Paediatric renal centres, their abbreviations and IT systems

Paediatric centre	Abbreviation	Renal IT system
Belfast	Blfst_P	Mediqal[a]
Birmingham	Bham_P	Proton
Bristol	Brstl_P	Proton
Cardiff	Cardf_P	Proton
Glasgow	Glasg_P	Filemaker
Leeds	Leeds_P	Proton
Liverpool	Livpl_P	None
London Evelina	L Eve_P	Proton[b]
London Great Ormond Street	L GOSH_P	Proton[b]
Manchester	Manch_P	None
Newcastle	Newc_P	Clinical Vision[a]
Nottingham	Nottm_P	Proton
Southampton	Soton_P	Bespoke[c]

[a]Installed, although paper data submissions received in 2010
[b]GOSH and London Evelina have a link to the PROTON system in Bristol but with no lab links
[c]Recent implementation of a bespoke renal IT system has enabled transmission of a limited dataset from Southampton this year

Those paediatric centres with access to renal IT systems submitted encrypted electronic data directly to the UKRR. Those centres without access sent paper or electronic returns in the original BAPN database format which were then entered into the original BAPN database as in previous years. 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]. 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 11.2. Data analysis is presented for each centre individually and at a national level for each variable.

Table 11.2 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
Haemoglobin (g/dl) (NICE guidelines for dialysis patients only)	<10.0 for <2yr 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
Ferritin (g/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
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 renal centre			
Parathyroid hormone (individual centre units)	Within twice the normal range Levels may be maintained within normal range if growing appropriately			

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. If a patient had missing data, they were excluded from the relevant analyses.

Longitudinal analyses of attainment of standards over time were also performed. This was based on a single data point per ERF patient per year collected as described previously. Changing audit standards over time and variable data return for previous years encourages cautious interpretation of these analyses. All analyses were done using SAS 9.2.

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 11.3 to 11.6 show the completeness of data returns for transplant and dialysis patients for 2010 and the 2000–2010 period. Each patient was assessed with regard to the completeness of data for each year between 2000 and 2010. Thus the total does not represent the number of patients treated but the number of patient treatment years assessed for each modality.

In 2010, overall completeness was good, with GOSH showing a significant improvement in data returns for height, weight and blood pressure compared to the 2009 report. Data completeness for bicarbonate was low in dialysis patients (59.3%) in 2010 partly as a result of data extraction difficulties which are being addressed.

In 2010, Southampton, Newcastle and Manchester were only able to provide a limited dataset due to a combination of technical difficulties and limited resources resulting in their respective low completion percentages. The original BAPN dataset did not include details about bone metabolism for transplanted patients. This explains the poor returns in this area for centres without automatic electronic download of these items from their laboratories into a renal data system.

Height, weight and BMI

Figures 11.1 and 11.4 show that children receiving renal replacement therapy were short for their age, the height deficit being greater in children on dialysis than in those who had a functioning kidney transplant. The overall median z-score was −1.26 in the transplanted group and −1.80 in the dialysis group.

Children with a functioning kidney transplant had a normal weight (median z-score of −0.02), (figure 11.2), whilst those on dialysis had a weight below that of healthy children with a median z-score of −0.96 (figure 11.5).

Body mass index in children with a functioning transplant in 2010 showed inter-centre variation with a median z-score of 0.85 (figure 11.3). The median BMI z-score in those on dialysis was lower at 0.30 (figure 11.6). This data indicates that in the group as a whole, children on dialysis have an appropriate weight for height with a BMI z-score close to zero.

Figure 11.7 shows that the UK average median z-score for height in children on renal replacement therapy and the percentage of children receiving growth hormone each year did not change between 2000 and 2010. Amongst those patients with a height z-score of <2SD between 2000 and 2010, 27% were noted to be receiving growth hormone if they were on dialysis, compared to only 10% if they had a functioning transplant. More detailed analysis including primary diagnosis and comorbidity will be required to establish the factors contributing to this.

Blood pressure

Analyses of blood pressure management have shown that blood pressure is higher in children receiving renal

Table 11.3. Percentage data completeness for transplant patients by centre for each variable and total number of patients per centre in 2010

Centre	Transplant patients N	Height	Weight	BMI	Systolic BP	Hb	Creat	Ferr	EPO	IV iron	Chol	HCO_3	eGFR	Ca	Phos
Blfst_P	22	90.9	90.9	90.9	90.9	90.9	90.9	18.2	77.3	72.7	63.6	81.8	90.9	0.0	0.0
Bham_P	55	98.2	98.2	98.2	98.2	98.2	98.2	54.5	98.2	98.2	69.1	98.2	98.2	98.2	98.2
Brstl_P	36	91.7	94.4	91.7	91.7	94.4	94.4	52.8	94.4	94.4	72.2	91.7	91.7	88.9	91.7
Cardf_P	13	100.0	100.0	100.0	100.0	100.0	100.0	76.9	23.1	7.7	53.8	100.0	100.0	100.0	100.0
Glasg_P	32	81.3	81.3	81.3	81.3	78.1	81.3	68.8	78.1	78.1	43.8	81.3	81.3		
L Eve_P	64	95.3	98.4	95.3	96.9	98.4	98.4	95.3	98.4	98.4	79.7		95.3	98.4	98.4
L GOSH_P	106	89.6	94.3	89.6	93.4	96.2	85.8	86.8	94.3	91.5		84.9	77.4	94.3	94.3
Leeds_P	50	98.0	98.0	98.0	98.0	98.0	98.0	26.0	98.0	98.0	92.0	96.0	98.0	98.0	96.0
Livpl_P	26	57.7	50.0	50.0	57.7	57.7	57.7	57.7	53.8	42.3	42.3	57.7	57.7	0.0	0.0
Manch_P	30	33.3	33.3	33.3	33.3	33.3	33.3	10.0	33.3	33.3	33.3	33.3	33.3	33.3	33.3
Newc_P	22	22.7	22.7	22.7	22.7	22.7	22.7	18.2	22.7	22.7	18.2	18.2	22.7	0.0	0.0
Nottm_P	55	89.1	92.7	89.1	94.5	92.7	94.5	80.0	94.5	94.5	36.4	94.5	89.1	89.1	87.3
Soton_P	8	87.5	100.0	87.5	62.5	25.0	87.5	12.5	25.0	25.0	0.0	0.0	75.0	25.0	12.5
UK	**519**	**84.2**	**85.9**	**83.8**	**85.4**	**85.4**	**84.6**	**61.3**	**82.5**	**80.7**	**46.4**	**80.0**	**81.5**	**71.7**	**71.1**

Blank cells represent data items that could not be sent by centres due to technical reasons

Table 11.4. Percentage data completeness for dialysis patients by centre for each variable and total number of patients per centre in 2010

Centre	Transplant patients N	Height	Weight	BMI	Systolic BP	Hb	Ferr	EPO	IV iron	Chol	HCO_3	PTH	Ca	Phos
Blfst_P	7	71.4	85.7	71.4	85.7	85.7	42.9	71.4	57.1	42.9	42.9	85.7	85.7	85.7
Bham_P	16	100.0	100.0	100.0	93.8	100.0	93.8	100.0	100.0	56.3	87.5	100.0	100.0	100.0
Brstl_P	12	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7
Cardf_P	3	100.0	100.0	100.0	100.0	100.0	100.0	66.7	0.0	66.7	100.0	100.0	100.0	100.0
Glasg_P	10	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	20.0	60.0	50.0	60.0	60.0
L Eve_P	15	53.3	86.7	53.3	93.3	93.3	86.7	93.3	93.3	0.0		93.3	93.3	93.3
L GOSH_P	27	81.5	85.2	81.5	81.5	81.5	81.5	81.5	81.5	0.0	59.3	81.5	81.5	81.5
Leeds_P	11	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	63.6	100.0	90.9	100.0	100.0
Manch_P	24	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	0.0	8.3	8.3	8.3	8.3
Newc_P	7	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6
Nottm_P	21	85.7	90.5	85.7	61.9	90.5	90.5	90.5	90.5	38.1	100.0	90.5	90.5	90.5
Soton_P	12	58.3	58.3	58.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UK	**165**	**67.3**	**72.1**	**67.3**	**64.8**	**67.9**	**64.8**	**66.7**	**64.8**	**26.7**	**59.3**	**66.7**	**67.9**	**67.9**

Blank cells represent data items that could not be sent by centres due to technical reasons
Liverpool is not shown in this table as they did not have any patients under 16 years on dialysis in 2010

Table 11.5. Percentage data completeness for each variable for each transplant patient per year from 2000–2010

Centre	Transplant patient years	Height	Weight	Systolic BP	Hb	eGFR	Creatinine	Ferritin
Blfst_P	102	94.1	94.1	95.1	100.0	94.1	100.0	35.3
Bham_P	278	98.6	98.9	98.9	98.6	97.8	98.6	19.8
Brstl_P	286	96.5	98.3	95.1	96.2	93.7	96.5	24.8
Cardf_P	145	89.7	92.4	92.4	98.6	89.7	99.3	60.7
Glasg_P	319	95.6	97.2	96.9	98.4	95.6	99.7	51.7
L Eve_P	593	85.5	87.7	87.4	94.3	84.8	93.8	59.0
L GOSH_P	787	80.8	83.6	81.4	96.3	78.1	94.8	63.8
Leeds_P	274	93.8	94.9	94.5	94.9	92.7	97.1	15.7
Livpl_P	230	96.1	97.8	98.7	98.7	95.7	98.7	59.1
Manch_P	457	97.2	98.9	98.0	98.7	96.9	98.9	3.5
Newc_P	170	97.1	98.2	97.6	97.6	97.1	100.0	41.2
Nottm_P	456	89.9	91.7	91.0	96.5	89.0	98.5	38.8
Soton_P	63	81.0	85.7	82.5	79.4	79.4	88.9	14.3
UK	**4,160**	**90.7**	**92.5**	**91.7**	**96.6**	**89.6**	**97.0**	**41.3**

Table 11.6. Percentage data completeness for each variable for dialysis patients per centre per year from 2000–2010

Centre	Dialysis patient N	Height	Weight	Systolic BP	Hb	PTH	Ca	Phos	Ferritin
Blfst_P	62	91.9	98.4	98.4	100.0	87.1	91.9	91.9	66.1
Bham_P	138	97.1	97.8	96.4	100.0	92.8	100.0	100.0	48.6
Brstl_P	123	93.5	97.6	97.6	97.6	91.9	96.7	96.7	69.1
Cardf_P	29	89.7	96.6	96.6	100.0	82.8	100.0	100.0	93.1
Glasg_P	94	86.2	96.8	95.7	98.9	85.1	95.7	97.9	87.2
L Eve_P	118	60.2	74.6	67.8	80.5	73.7	73.7	82.2	67.8
L GOSH_P	260	76.9	84.6	82.3	96.2	80.8	96.5	86.5	83.5
Leeds_P	124	88.7	91.1	88.7	93.5	86.3	91.9	93.5	87.1
Livpl_P	63	85.7	100.0	98.4	100.0	82.5	96.8	95.2	88.9
Manch_P	182	92.3	94.0	90.1	98.4	87.9	98.4	98.4	79.7
Newc_P	57	91.2	94.7	94.7	96.5	86.0	98.2	98.2	89.5
Nottm_P	176	67.0	76.7	61.4	97.2	83.0	98.9	98.9	74.4
Soton_P	26	88.5	96.2	76.9	73.1	69.2	73.1	73.1	57.7
UK	**1,452**	**83.3**	**89.8**	**85.7**	**95.7**	**84.6**	**94.6**	**93.7**	**76.1**

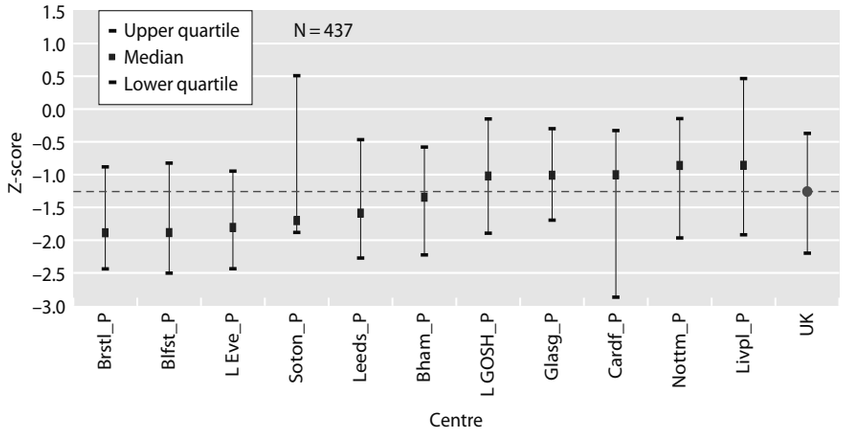

Fig. 11.1. Median height z-scores for transplant patients in 2010
Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

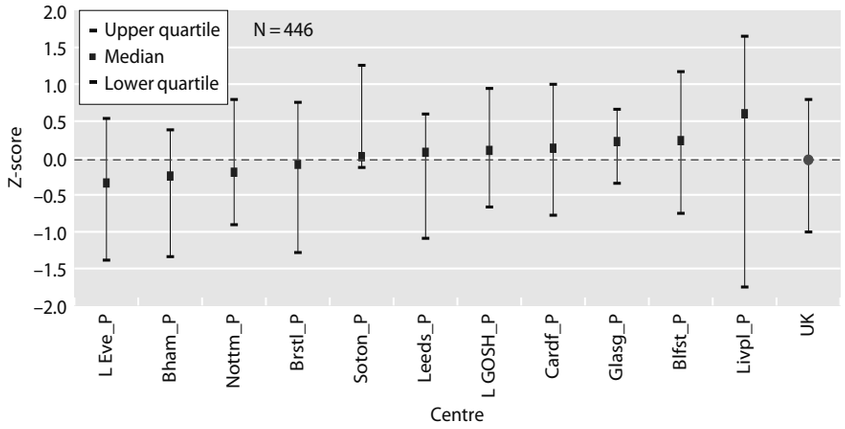

Fig. 11.2. Median weight z-scores for transplant patients in 2010
Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

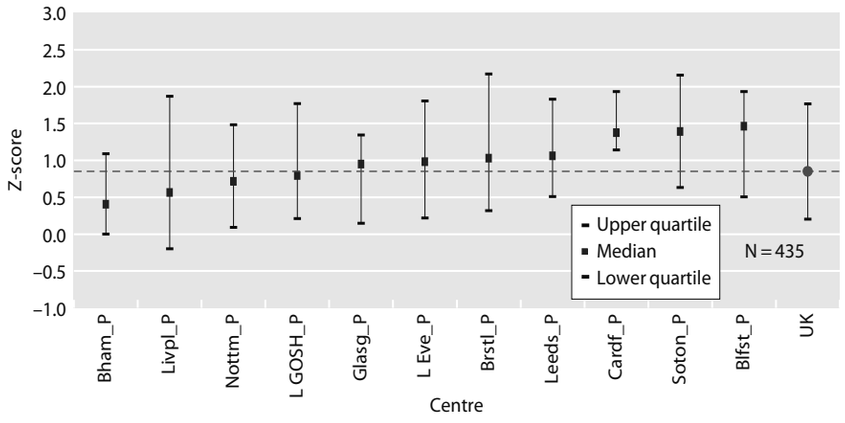

Fig. 11.3. Median BMI z-scores for transplant patients in 2010
Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

replacement therapy than in healthy children (figures 11.8, 11.9). There was wide inter-centre variation in systolic blood pressure, particularly in dialysis patients in 2010 with a UK median z-score of 0.23 for dialysis patients and 0.38 for transplant patients.

Although children receiving dialysis had a slightly lower median SBP z-score compared to transplant patients, a higher proportion of dialysis patients had SBP above the 90th percentile (table 11.7). For children with a functioning kidney transplant, 78.6% had a

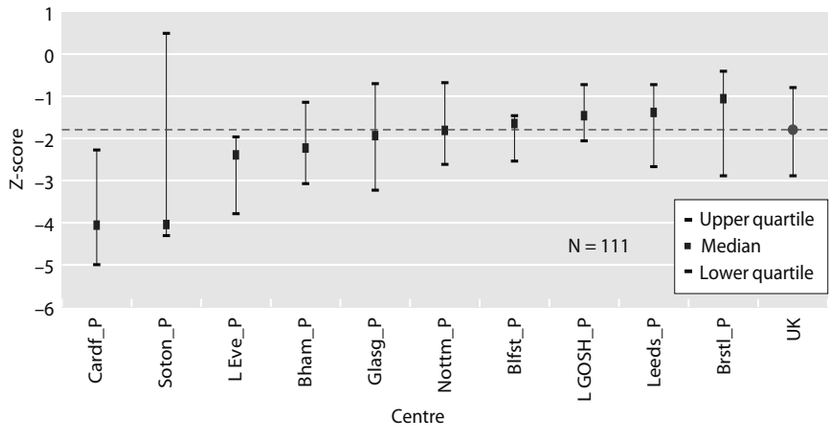

Fig. 11.4. Median height z-scores for dialysis patients in 2010
Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

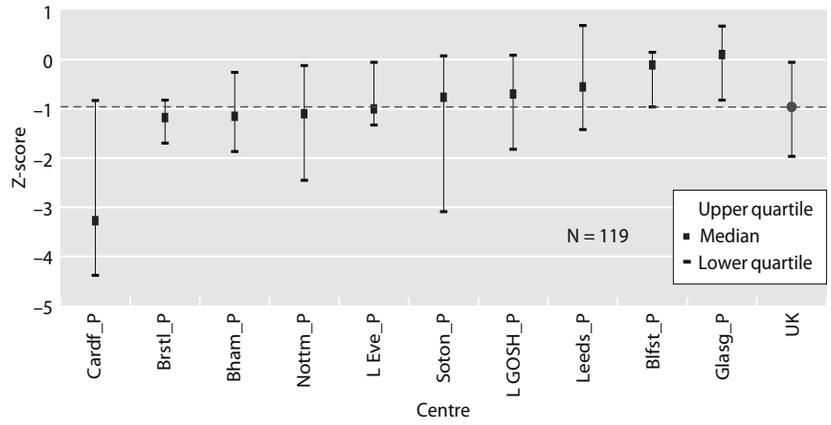

Fig. 11.5. Median weight z-scores for dialysis patients in 2010
Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

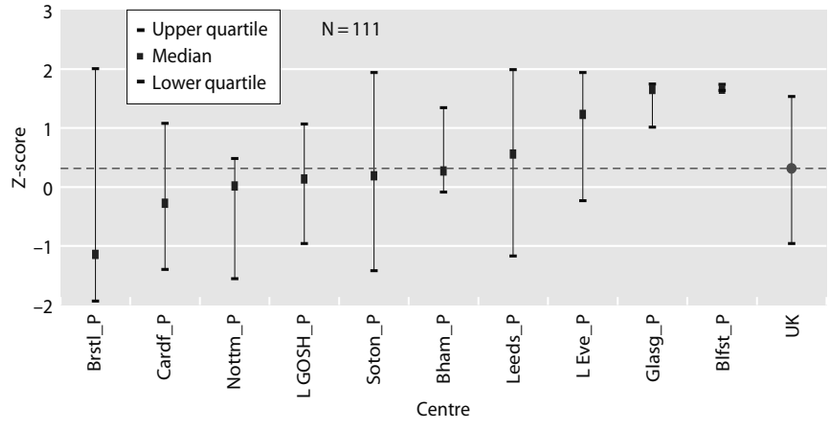

Fig. 11.6. Median BMI z-scores for dialysis patients in 2010
Centres with less than 50% data completeness were excluded from the centre specific analysis but were included in the UK totals

systolic BP <90th percentile which was slightly better than last year when 73.2% of such children achieved the target (table 11.7). In comparison, 71.1% of children on haemodialysis had a systolic BP <90th percentile whilst 74.2% of children receiving peritoneal dialysis achieved this (table 11.7). The results for peritoneal dialysis are substantially better than those achieved in the previous year (51.7%). When analysing data by age, blood pressure control was slightly worse in the 5–11.99 year age group irrespective of RRT modality.

Haemoglobin

The analyses in this report continue to show that many children receiving renal replacement therapy are anaemic. Fifty one percent (centre range 35–77%) of children with a functioning transplant achieved the

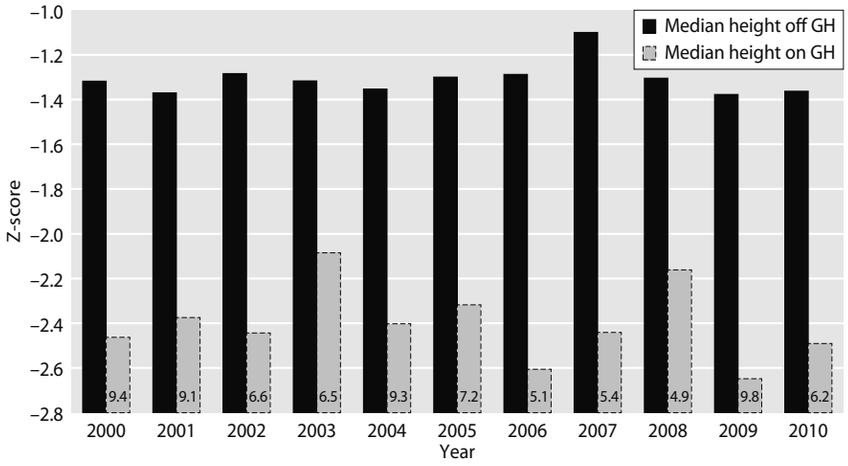

Fig. 11.7. Median height z-scores in paediatric patients receiving RRT from 2000 to 2010, with the percentage of children using growth hormone each year

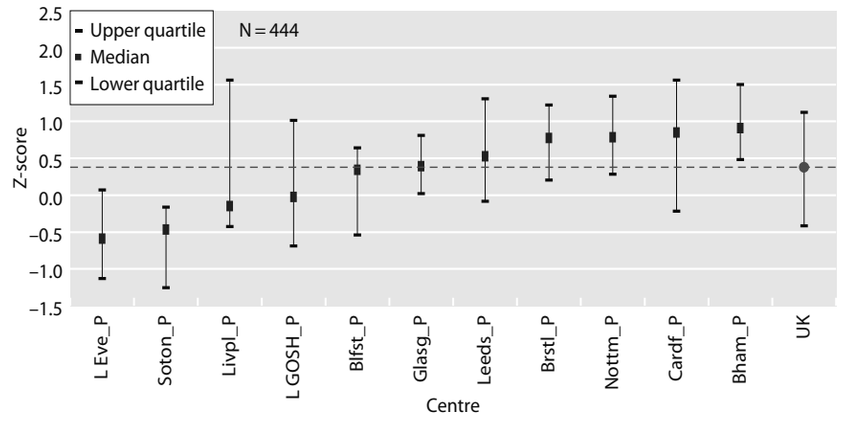

Fig. 11.8. Median systolic blood pressure z-scores for transplant patients in 2010
Centres with less than 50% data completeness were excluded from the centres specific analysis but were included in the UK totals

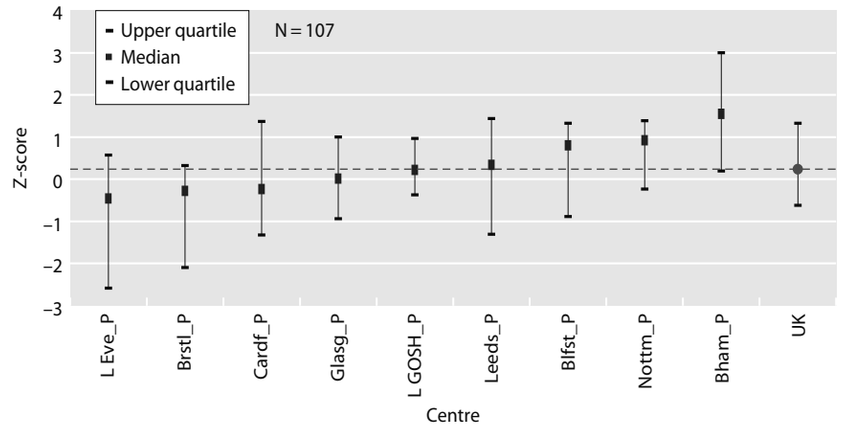

Fig. 11.9. Median systolic blood pressure z-scores for dialysis patients in 2010
Centres with less than 50% data completeness were excluded from the centres specific analysis but were included in the UK totals

haemoglobin standard (table 11.8). This was despite the analysis methodology adjusting the target haemoglobin for children with poor graft function (CKD 3bT or lower) and using the NICE standard for management of anaemia in chronic kidney disease for these patients.

Forty seven percent of haemodialysis patients and 28% of peritoneal dialysis patients had haemoglobin

Table 11.7. Percentage of patients achieving the standards for systolic blood pressure in 2010

	Transplant patients		Haemodialysis patients		Peritoneal dialysis 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	20	85.0	2	50.0	4	75.0
Bham_P	54	64.8	7	28.6	8	62.5
Brstl_P	33	78.8	6	100.0	5	80.0
Cardf_P	13	61.5	1	100.0	2	50.0
Glasg_P	26	84.6			6	83.3
L Eve_P	62	95.2	6	83.3	8	75.0
L GOSH_P	100	84.0	9	66.7	13	92.3
Leeds_P	49	73.5	6	66.7	5	60.0
Livpl_P[a]	15	73.3	n/a	n/a	n/a	n/a
Nottm_P	52	69.2	6	83.3	7	42.9
Soton_P	5	100.0				
UK[b]	**444**	**78.6**	**45**	**71.1**	**62**	**74.2**
Age (years)						
0–4.99	38	76.3	14	78.6	25	84.0
5–11.99	186	75.3	16	62.5	25	64.0
12–15.99	220	81.8	15	73.3	12	75.0

[a]Liverpool did not have any dialysis patients under 16 years in 2010
[b]As Newcastle and Manchester had <50% completeness for all groups they have been excluded from centre specific analysis, though included in the UK totals
Blank cells denote categories where data completion is <50% complete, and thus not displayed

Table 11.8. Percentage of patients achieving the haemoglobin standard in 2010

	Transplant patients				Haemodialysis patients				Peritoneal dialysis patients			
Centre	Patients with data N	% achieving standard	% below standard	% above standard	Patients with data N	% achieving standard	% below standard	% above standard	Patients with data N	% achieving standard	% below standard	% above standard
Blfst_P	20	35.0	65.0	0.0	2	0.0	100.0	0.0	4	50.0	25.0	25.0
Bham_P	54	50.0	46.3	3.7	8	25.0	62.5	12.5	8	75.0	12.5	12.5
Brstl_P	34	41.2	58.8	0.0	6	0.0	66.7	33.3	5	40.0	60.0	0.0
Cardf_P	13	76.9	15.4	7.7	1	0.0	100.0	0.0	2	0.0	50.0	50.0
Glasg_P	25	68.0	28.0	4.0					6	50.0	16.7	33.3
L Eve_P	63	57.1	36.5	6.3	6	100.0	0.0	0.0	8	62.5	25.0	12.5
L GOSH_P	102	53.9	41.2	4.9	9	44.4	44.4	11.1	13	53.8	15.4	30.8
Leeds_P	49	53.1	44.9	2.0	6	66.7	33.3	0.0	5	80.0	20.0	0.0
Livpl_P[a]	15	60.0	33.3	6.7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nottm_P	51	37.3	60.8	2.0	7	42.9	28.6	28.6	12	33.3	50.0	16.7
UK[b]	**443**	**51.2**	**45.1**	**3.6**	**47**	**40.4**	**46.8**	**12.8**	**65**	**50.8**	**27.7**	**21.5**
Age (years)												
0–4.99	40	30.0	67.5	2.5	15	33.3	60.0	6.7	29	51.7	34.5	13.8
5–11.99	186	62.9	33.3	3.8	16	43.8	43.8	12.5	24	50.0	29.2	20.8
12–15.99	217	45.2	51.2	3.7	16	43.8	37.5	18.8	12	50.0	8.3	41.7

[a]Liverpool did not have any dialysis patients under 16 years in 2010
[b]As Newcastle, Manchester and Southampton had <50% completeness for all groups they have been excluded from centre specific analysis, though included in the UK totals
Blank cells denote categories where data completion is <50% complete, and thus not displayed

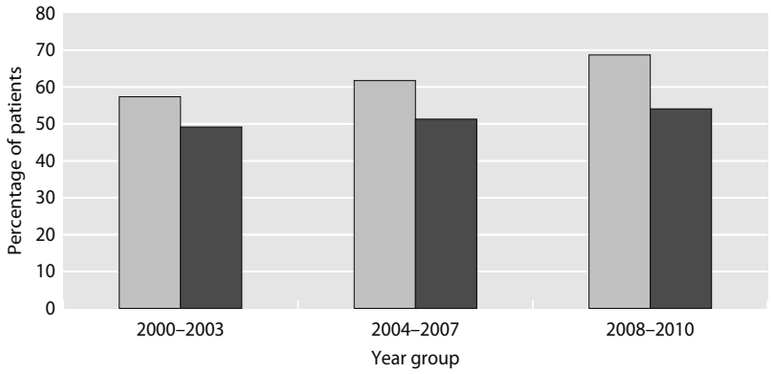

Fig. 11.10. The percentage of paediatric dialysis patients achieving the treatment standards for haemoglobin from 2000–2010

levels below the standard. A significant percentage of children also had haemoglobin concentrations above the recommended standard (13% for HD and 28% for PD). The importance of this in the paediatric population, with a very different spectrum of comorbidity from adults, is not known. Analysis by age showed that the proportion of children with a haemoglobin below the standard was greatest for the under 5 years age group irrespective of RRT modality. As for the proportion of children achieving above the recommended haemoglobin standard this appears to increase with age in children on haemodialysis and peritoneal dialysis (table 11.8).

Figure 11.10 shows that the percentage of patients achieving the treatment standards for haemoglobin has gradually increased over the last decade, more noticeably in dialysis patients. In the dialysis group the percentage of patients achieving treatment standards for ferritin has also increased with time with a similar rise noted in those with a functioning transplant. For those with a Hb below the recommended range, the percentage of patients achieving a ferritin within the target range has also increased over the last decade.

The attainment of the haemoglobin standard in transplant patients was assessed for different levels of graft function (figure 11.11) and with the use of MMF as immunosuppressant therapy (figure 11.12). Figure 11.11 demonstrates that haemoglobin standard attainment was marginally worse for patients with transplant dysfunction (17% of patients with Hb below the standard also had an eGFR <45 whilst only 14.5% of patients with a Hb within the standard had an eGFR <45). As for the impact of MMF, figure 11.12 shows that patients using MMF as immunosuppressant therapy were more likely to have haemoglobin concentrations below the standard, which was statistically significant $p < 0.0001$.

Regarding the use of Erythropoietin and IV iron, figure 11.13 shows that there has been a reduction in the use of both agents in the last 2 years. More patients are on EPO than IV iron in both the transplant and dialysis groups.

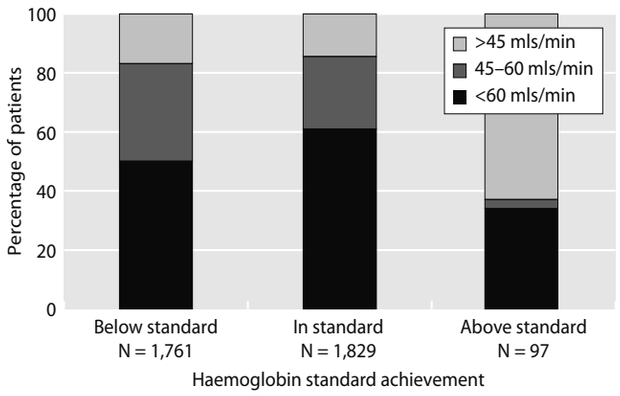

Fig. 11.11. The achievement of haemoglobin treatment standards in paediatric transplant patients, by the level of graft function
This figures combines all data from 2000–2010

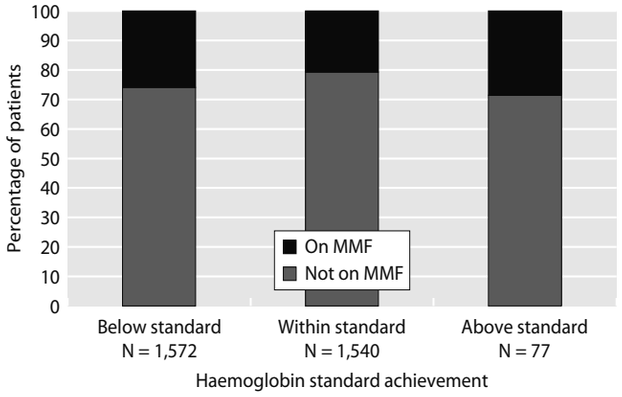

Fig. 11.12. The achievement of haemoglobin treatment standards in paediatric transplant patients, by use of MMF
This figure combines all data from 2000–2010

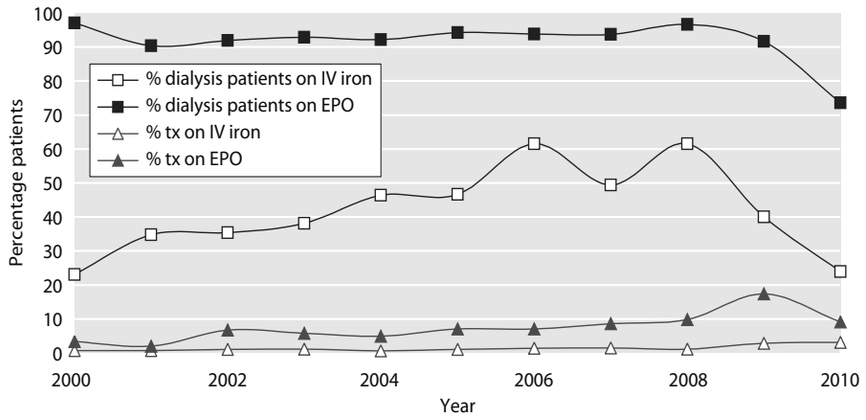

Fig. 11.13. The use of erythropoietin and IV iron in paediatric patients between 2000 and 2010 by treatment modality

Phosphate, calcium and PTH

In 2010 in the UK as a whole, 51% of haemodialysis patients and 74% of peritoneal dialysis patients had a phosphate within the target range (table 11.9). The achievement of the standard for calcium was better with 72% of children on haemodialysis and 82% of children on peritoneal dialysis having a calcium level within the target range (table 11.10). As for PTH, 31% of children on HD and 48% on PD had a PTH within the target range with wide inter-centre variation (table 11.11). In comparison, 77% of patients with a functioning transplant achieved a PTH within the target range. Caution should be exercised in the interpretation of 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. There were no significant age related differences seen.

Discussion

Whilst the move to electronic reporting with multiple data submissions per annum remains incomplete,

Table 11.9. Achievement of the phosphate standard in dialysis patients in 2010

	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	2	50.0	0.0	50.0	4	75.0	25.0	0.0
Bham_P	8	62.5	0.0	37.5	8	75.0	12.5	12.5
Brstl_P	6	66.7	0.0	33.3	5	60.0	0.0	40.0
Cardf_P	1	0.0	0.0	100.0	2	100.0	0.0	0.0
Glasg_P					6	83.3	0.0	16.7
L Eve_P	6	16.7	33.3	50.0	8	75.0	12.5	12.5
L GOSH_P	9	66.7	0.0	33.3	13	92.3	0.0	7.7
Leeds_P	6	50.0	0.0	50.0	5	40.0	20.0	40.0
Nottm_P	7	42.9	0.0	57.1	12	66.7	0.0	33.3
UK[a]	47	51.1	4.3	44.7	65	73.8	7.7	18.5
Age (years)								
0–4.99	15	73.3	6.7	20.0	29	75.9	3.4	20.7
5–11.99	16	43.8	6.3	50.0	24	70.8	12.5	16.7
12–15.99	16	37.5	0.0	62.5	12	75.0	8.3	16.7

[a]As Newcastle, Manchester and Southampton had <50% completeness for all groups they have been excluded from centre specific analysis, though included in the UK totals

Liverpool did not have any dialysis patients under 16 years in 2010

Blank cells denote categories where data completion is <50% complete, and thus not displayed

Table 11.10. Achievement of the adjusted calcium standard in dialysis patients in 2010

	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	2	100.0	0.0	0.0	4	50.0	0.0	50.0
Bham_P	8	87.5	0.0	12.5	8	75.0	0.0	25.0
Brstl_P	6	50.0	16.7	33.3	5	80.0	20.0	0.0
Cardf_P	1	0.0	0.0	100.0	2	50.0	0.0	50.0
Glasg_P					6	50.0	0.0	50.0
L Eve_P	6	83.3	16.7	0.0	8	100.0	0.0	0.0
L GOSH_P	9	66.7	22.2	11.1	13	84.6	0.0	15.4
Leeds_P	6	83.3	16.7	0.0	5	100.0	0.0	0.0
Nottm_P	7	71.4	0.0	28.6	12	91.7	0.0	8.3
UK[a]	**47**	**72.3**	**10.6**	**17.0**	**65**	**81.5**	**1.5**	**16.9**
Age (years)								
0–4.99	15	80	20	0	29	75.9	3.4	20.7
5–11.99	16	62.5	12.5	25	24	91.7	0.0	8.3
12–15.99	16	75	0	25	12	75.0	0.0	25.0

[a]As Newcastle, Manchester and Southampton had <50% completeness for all groups they have been excluded from centre specific analysis, though included in the UK totals
Liverpool did not have any dialysis patients under 16 years in 2010
Blank cells denote categories where data completion is <50% complete, and thus not displayed

interpretation of annual census data with regard to haematological, biochemical and blood pressure parameters, needs to be made with caution. Technical difficulties and lack of resources has meant that the proportion of patients from whom anthropometric and laboratory data were available for analysis was smaller this year than in previous reports. The most significant contribution to this difficulty related to the move of the

Table 11.11. Percentage of patients achieving the PTH standard 2010

	Haemodialysis patients			Peritoneal dialysis patients			Transplant patients		
Centre	Patients with data N	% achieving standard	% above standard	Patients with data N	% achieving standard	% above standard	Patients with data N	% achieving standard	% above standard
Blfst_P	2	0.0	100.0	4	50.0	50.0			
Bham_P	8	12.5	87.5	8	25.0	75.0	54	44.4	55.6
Brstl_P	6	50.0	50.0	5	0.0	100.0	26	76.9	23.1
Cardf_P	1	0.0	100.0	2	0.0	100.0			
Glasg_P				5	80.0	20.0			
L Eve_P	6	33.3	66.7	8	37.5	62.5	63	93.7	6.3
L GOSH_P	9	44.4	55.6	13	69.2	30.8	95	85.3	14.7
Leeds_P	6	16.7	83.3	4	50.0	50.0			
Livpl_P[b]	n/a	n/a	n/a	n/a	n/a	n/a			
Nottm_P	7	42.9	57.1	12	50.0	50.0	44	81.8	18.2
UK[a]	**45**	**31.1**	**68.9**	**63**	**47.6**	**52.4**	**307**	**76.9**	**23.1**
Age (years)									
0–4.99	14	35.7	64.3	28	39.3	60.7	33	60.6	39.4
5–11.99	15	33.3	66.7	21	66.7	33.3	126	78.6	21.4
12–15.99	15	26.7	73.3	12	41.7	58.3	144	79.9	20.1

[a]As Newcastle, Manchester and Southampton had <50% completeness for all groups they have been excluded from centre specific analysis, though included in the UK totals
[b]Liverpool did not have any dialysis patients under 16 years in 2010
Blank cells denote categories where data completion is <50% complete, and thus not displayed

Manchester paediatric nephrology service to a new centre with reduced administrative support and access to a Renal IT system that is only now becoming live. 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 again this year.

Anthropometry

As in previous reports the paediatric RRT population was shorter than the UK average, with children on dialysis having a greater height deficit than those who have a transplant. The data shown this year indicate that amongst children on renal replacement therapy, with a height two standard deviations below the mean, approximately one quarter are treated with growth hormone, with the percentage treated amongst transplanted children being even lower at 10%. Chromosomal anomalies and syndromic diagnoses may cause growth restriction which is not amenable to treatment with growth hormone but it is unlikely that this accounts for this low percentage as the numbers of children reported to have chromosomal anomalies and syndromic diagnoses are small (see chapter 5 Demography of the UK Paediatric RRT Population). The indication for the licence for growth hormone treatment in renal disease is chronic kidney disease including dialysis. Initial studies in transplant patients suggested that growth hormone treatment might be associated with an increased risk of rejection [6] and although this has never been shown conclusively, it may explain the pattern of use of growth hormone in this patient group. An increasing number of patients are on steroid free immunosuppression regimens and it would be useful in future analyses to look at this sub-group to see if this is beneficial for growth.

In 2010, children with a transplant had a normal weight for age, but as they were short their BMI was above the UK average with a median z-score of 0.80. The dialysis patients had lower weights and heights than an age-related population, with height being more affected than weight, their median BMI z-score was 0.30. More detailed analysis of growth and nutritional state by age group may be informative although without details of pubertal development the data will need to be interpreted with caution.

Blood pressure

Achieving targets for blood pressure remained challenging, although overall there has been an improvement in the number of patients achieving the BP audit standard. There is inter-centre variation with some centres achieving excellent results. As these data represent one reading per year, they need to be interpreted with caution and there are, of course, many influences on the recorded blood pressure. Differences in measurement technique may be an important factor. For children with a functioning kidney transplant, 78.6% had a systolic BP $<$90th percentile which was slightly better than last year when 73.2% of such children achieved the target (table 11.7). There was no improvement in the number meeting the standard in the haemodialysis population, 71.1% this year versus 75.6% last year, however an improvement was seen in the peritoneal dialysis population from 51.7 % last year to 74.2% this year. This year the data have been analysed by age. For all treatment modalities, results in the 5–11.99 year age group were lower than younger or older children. This was unexpected and needs further analysis to understand why this should be.

There is increasing literature that suggests that a BP closer to the 50th centile may be beneficial [7] and although currently the evidence is limited to pre-dialysis CKD patients the standard for future years may change. Data on the use of hypertensives are collected and may be analysed in future reports. The use of lower target blood pressure and/or the use of particular subclasses of antihypertensives such as ACE/ARBs together with the presence or absence of LVH would be an appropriate topic for future audit and research.

Anaemia

As with previous reports the management of anaemia remained imperfect. However in 2010, more dialysis patients were achieving a Hb within the recommended range as well as a ferritin within the target range, although there is still scope for improvement. To get further information as to why many patients were not achieving standards, analyses focussing on the use of IV iron and ESA as well as treatment modality in anaemic patients would be helpful, but improved reporting of ferritin would be needed to enable this. It is noticeable that very young children are less likely to reach the standard and this may be due to a reluctance to use ESAs subcutaneously in this group. With all treatment modalities a small percentage of patients had a Hb above the recommended level, although this has reduced when compared with the 2008 and 2009 data. Trials in adults, 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 were sought [8, 9]. The significance of this in the paediatric population is not known.

More patients in both the dialysis and transplant groups were on ESAs than IV iron. It could be argued that more patients should be treated with IV iron before commencing ESAs. The data for the dialysis patients show that many were not achieving ferritin levels within the audit standards. The trends over time showed a recent reduction in the use of both IV iron and ESAs. These changes may reflect the publication in 2006 of NICE guidance for the management of anaemia in CKD which for the first time gave an upper limit for the Hb target followed by the publication of the 2008 Registry report which showed achievement of these audit standards indicating that there were a significant number of dialysis patients with Hb above targets [1].

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 analyses of the achievement of audit standards by modality and age group shows that achievement of calcium and phosphate targets for children on haemodialysis was highest amongst the youngest patients. This probably reflects the reliance of this age group on adults for the provision of their dietary intake and medications. The same trend is not apparent amongst PD patients. The reasons for this are not clear but may relate to the level of residual renal function, further analysis would be needed to confirm this. The achievement of a PTH less than twice the normal range for age was universally poor but the optimal level for PTH in this patient population remains a matter of controversy [10]. The advent of calcimimetics to help control hyperparathyroidism may have a major impact upon the management of renal osteodystrophy in children and future reports will hopefully be able to show whether this is the case.

Summary

In summary the 2010 report shows that children and young people on renal replacement therapy remained short compared to their peers. Further analyses planned for next year's report may provide more detail but a separate audit project on this important area will be needed to suggest potential interventions. Achievement of recommended targets for blood pressure control and management of anaemia are improving and allow some optimism for continued improvement. Furthermore as more centres move toward electronic reporting, quarterly downloads of data will become possible. This will provide a better picture of what is happening for individual children and allow more robust interpretation of data. This will be particularly helpful for analyses of blood pressure and biochemistry and has the potential to provide very useful feedback to centres on the management of children with RRT, some of whom can be very challenging patients to look after.

Conflicts of interest: none

References

1 UK Renal Registry 12th Annual Report (December 2009): Chapter 12 Clinical, Haematological and Biochemical Parameters in Patients receiving Renal Replacement Therapy in Paediatric Centres in the UK in 2008: national and centre-specific analyses.

2 Hussain F, Castledine C, Schalkwyk DV, Sinha MD, Lewis MA, Inward C. Nephron Clin Pract 2010;115(suppl 1):c289–c308

3 Freeman JV CT, Chinn S et al. Cross sectional stature and weight reference curves for the UK, 1990. Arch Dis Child 1995;73:17–24

4 National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. Pediatrics 2004;114(2):555–576

5 BAPN clinical standards http://www.bapn.org/clinical_standards.html

6 NICE clinical guideline 39. Anaemia management in people with chronic kidney disease. London: National Institute for Health and Clinical Excellence, 2008

7 Tyden G, Berg U, Reinholt F. Acute renal graft rejection after treatment with human growth hormone. *Lancet* 1990;336:1455–1456

8 Strict blood-pressure control and progression of renal failure in children, ESCAPE Trial Group, N Engl J Med. 2009 Oct 22;361(17): 1639–1650

9 Besarab A, Bolton WK, Browne JK et al. The effects of normal as compared with low hematocrit values in patients with cardiac disease who are receiving hemodialysis and epoetin. New Engl J Med 1998; 339:584–590

10 Singh AK, Szczech L, Tang KL et al. Correction of anemia with epoetin alfa in chronic kidney disease. N Engl J Med 2006;355:2085–2098

UK Renal Registry 14th Annual Report: Chapter 12 Epidemiology of Staphylococcus Aureus Bacteraemia Amongst Patients Receiving Dialysis for Established Renal Failure in England in 2009 to 2011: a joint report from the Health Protection Agency and the UK Renal Registry

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Key Words
Bacteraemia · Dialysis · Established renal failure · Health Protection Agency · Staphylococcus · Vascular access

Summary

- From April 2009–2010 there were 77 confirmed episodes of MRSA bacteraemia at a median rate of 0.25 per 100 prevalent dialysis patients.
- This number decreased to 61 episodes between April 2010–2011 at a median rate of 0 per 100 prevalent dialysis patients.
- Overall there has been an 82% reduction in absolute episodes since the first year of mandatory reporting in 2007.
- The incidence of bacteraemia in patients with a central venous catheter was approximately six fold higher than in those with an AV fistula.
- From January 1st to 30th June 2011 there were 160 episodes of MSSA bacteraemia with a rate of 1.06 episodes per 100 dialysis patients.
- The incidence of MSSA in patients with a central venous catheter was again six fold higher than in those with an AV fistula.
- Overall rates of MRSA bacteraemia in dialysis patients continued to fall although there remained variation between centres.
- Initial data from the early days of MSSA reporting suggested high rates of infection and an even greater variation between centres.

Introduction

Infection remains the second leading cause of death in patients with established renal failure (ERF) receiving renal replacement therapy (RRT) [1, 2, 3]. High rates of systemic infection amongst haemodialysis patients are related to a decreased level of immunity, a high frequency of invasive treatment and the type of vascular access in use. Venous catheters have a higher reported rate of bacteraemia in comparison to arteriovenous fistulas (AVF) [4, 5].

In the 2009 Renal Registry Report, the UK Renal Registry and the Health Protection Agency reported the epidemiology of Methicillin Resistant Staphylococcus Aureus (MRSA) bacteraemia in dialysis patients based on data collected between 1st April 2008 and 31st March 2009. These data were supplied by clinical staff and captured using a secure web-based system, the Healthcare Associated Infection Data Collection System (HCAI-DCS). A final round of data validation was also undertaken which involved emailing the clinical or infection control leads at each renal centre in order for them to check the details and accept the record. The dataset included dialysis modality, type of dialysis access and use of non-tunnelled venous catheters within the preceding 28 days. The analysis confirmed that dialysis patients continue to be at increased risk of MRSA bacteraemia with a total of 153 episodes in this period. However continuing a trend of reduced bacteraemia rates reported in 2007 [6], there had been a decline of 22% from the previous year. The presence of a central venous catheter was associated with an almost seven fold higher risk of developing a bacteraemia. There remained considerable variation between renal centres in term of infection rates [7].

This report contains analysis relating to the third and fourth years of this surveillance system. In 2011 mandatory surveillance of Methicillin Sensitive Staphylococcus Aureus (MSSA) bacteraemia was also introduced and this report describes the first 6 months of this surveillance, from 1st January 2011 to 30th June 2011.

Methods

MRSA bacteraemia data are presented from between the 1st April 2009 and the 31st March 2011. MSSA bacteraemia data are presented from 1st January 2011 to the 30th June 2011. The methods used have been described in previous registry reports [6, 7]. Briefly, four stages of data collection and validation were undertaken:

1 Identification of Staphylococcal bacteraemias potentially associated with dialysis patients. Records of patients reported by the laboratory to have staphylococcal bacteraemia were reviewed locally to identify those in ERF.
2 This record was then 'shared' with the parent renal centre. This required the laboratory staff to select the renal centre responsible for the dialysis of the patient which in turn triggered an email alert to be sent to the identified contact within the parent renal centre.
3 The renal centre then completed the additional renal data on the case via the HCAI-DCS website.
4 An additional validation and data capture step has been introduced to follow up records that were not shared or completed. This involved emailing clinical or infection control leads with details of the cases. This allowed case completion, and the parent renal centre to accept that episodes were related to patients in ERF requiring dialysis or reject them if the patient was not in ERF. Each individual renal centre was asked to complete and accept the record.

This data reporting mechanism applies only to renal centres in England and is not utilised in Wales, Scotland or Northern Ireland.

Results

Organisational results: 2009–2010

Between 1st April 2009 and 31st March 2010 a total of 87 records submitted to the Health Protection Agency via the HCAI-DCS were identified as being possibly associated with ERF requiring dialysis (table 12.1). Table 12.1 details the numbers of records shared and completed by each renal centre via HCAI-DCS. Of these, 72 records were shared with the identified contact within the renal centre by laboratory staff, clinical details for the remainder were identified by direct contact with the clinical director of the renal centre concerned. Of the shared records 10 were completed via the web portal system giving a completion rate of 14% (10/72). For the remaining records clinical details were obtained again by direct contact with the clinical lead for the individual renal centre.

In total there were 77 accepted episodes of MRSA bacteraemia in patients in ERF during this time period. Of the remaining ten episodes, two were duplicate records, three were excluded as they were paediatric patients, one was a transplant patient and four were excluded as they were not patients with end-stage renal failure; these patients were rejected by their centres at the final stage of validation. Five centres were unable to

Table 12.1. Number of MRSA bacteraemia and the proportion of records shared with and completed by the renal centre in patients with established renal failure reported to the MRSA Healthcare Associated Infection Data Capture System

		MRSA bacteraemia 1/04/2009 to 31/03/2010			MRSA bacteraemia 1/04/2010 to 31/03/2011		
Records		Number	%	Total number	Number	%	Total number
Rejected	Shared & completed	0	0.0	10	0	0.0	4
	Shared, not completed	10	11.5		2	3.1	
	Not shared	0	0.0		2	3.1	
Accepted	Shared & completed	10	11.5	77	16	24.6	61
	Shared, not completed	52	59.8		29	44.6	
	Not shared	15	17.2		16	24.6	
Total		**87**			**65**		

provide validation within the necessary time frame (London Royal Free, Brighton, Portsmouth, Dudley, Shrewsbury). In these instances all episodes of MRSA bacteraemia attributed to these centres were included.

Access and modality data

Figure 12.1 and table 12.2 provide breakdowns by modality and access. There were two patients reported to be on peritoneal dialysis at the time of the MRSA episode although one of these patients had a temporary venous catheter in-situ. The remainder were all haemodialysis patients. There were 15 patients where modality and access type were not recorded either because they were not available or because the data was not validated by the renal centre in time.

In total 37 patients had a tunnelled venous catheter in-situ at the time of bacteraemia while 19 were dialysing via an arteriovenous fistula, four via an arteriovenous graft, two were end-stage renal failure patients dialysing via a temporary venous catheter and one patient had a peritoneal dialysis catheter in-situ (table 12.2).

If it is assumed a 25% usage of venous catheters for the prevalent dialysis population [2, 3] the relative risk of MRSA bacteraemia can be estimated to be approximately six fold higher in patients with a venous catheter compared with those dialysing via an AVF.

Individual episodes

In total 68 patients had an MRSA bacteraemia. Fifty-nine had a single episode whilst nine patients had two

Table 12.2. Type of renal access in patients with established renal failure where record shared and completed, 1st April 2009 to 31st March 2010

		MRSA bacteraemia 1/04/2009 to 31/03/2010			MRSA bacteraemia 1/04/2010 to 31/03/2011		
Renal access type		Number	%	Access class	Number	%	Access class
Unknown		0			0		
Haemodialysis	Other	1			0		
	AVF	19	30.6	37.1	11	32.3	35.5
	AVG	4	6.5		1	3.2	
	NTC	2	3.2	62.9	1	3.2	64.5
	TC	37	59.7		22	61.3	
	Unknown	14			26		
Total		**77**			**61**		
Total known access		**62**			**31**		

AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non-tunnelled catheter
TC = tunnelled catheter

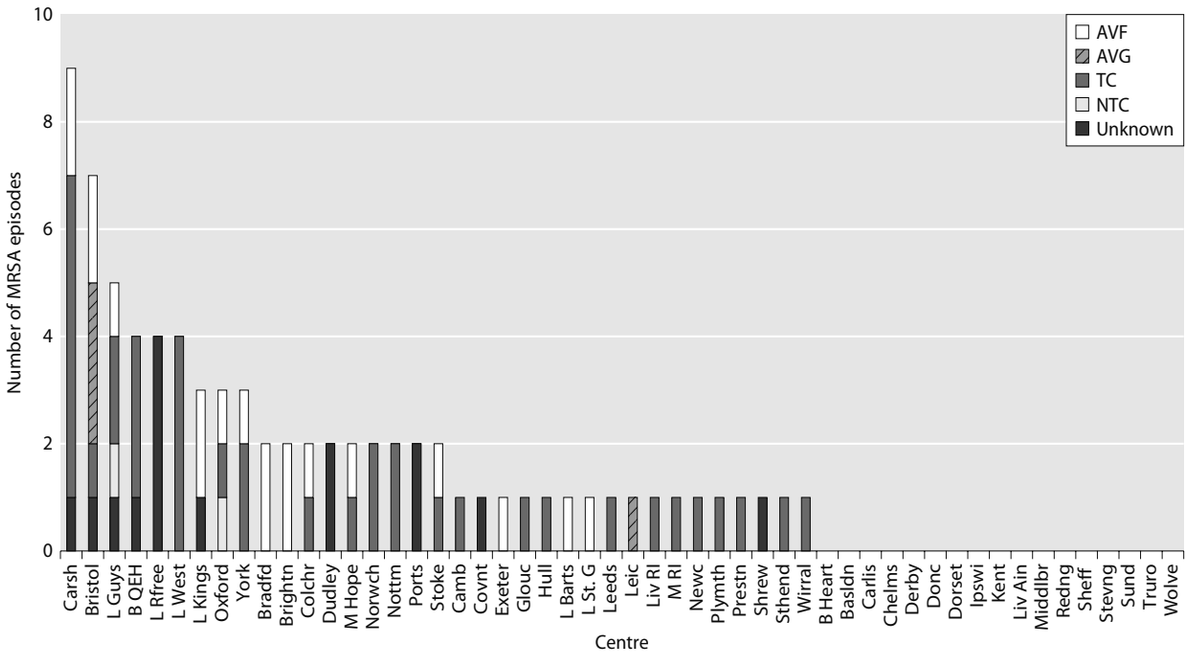

Fig. 12.1. Number of MRSA bacteraemia episodes by access type and renal centre: 1/04/2009 to 31/03/2010
Stacked bars, coded by access type for each English renal centre
AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non-tunnelled catheter
TC = tunnelled catheter

separate bacteraemias accounting for the remaining 18 episodes (table 12.3).

Centre level data

The absolute number of MRSA episodes per centre are detailed in figure 12.1. The median absolute number of episodes per centre was one (range 0 to 9). Seventeen centres recorded no episodes of MRSA bacteraemia. The highest number of episodes in an individual centre was nine at St. Helier (Carshalton). Figure 12.1 also provides data on the type of access in use at the time of each episode of MRSA by renal centre.

The normalised centre-specific rates are based on the number of prevalent patients receiving dialysis in each renal centre at the end of 2009 as reported to the UKRR. Using the number of prevalent haemodialysis patients as the denominator the median rate was 0.30 with a range of 0 to 1.72 per 100 prevalent haemodialysis patients per year (table 12.4). Using the total number of prevalent dialysis patients as the denominator, the median rate was 0.25 with a range of 0 to 1.72 per 100 prevalent dialysis patients per year.

Figure 12.2 illustrates the MRSA rates per 100 prevalent HD patients for each renal centre. Finally in

Table 12.3. Episodes by recurrence

	1/04/2009 to 31/03/2010		1/04/2010 to 31/03/2011	
Episodes per patient	Number	Total	Number	Total
1	59	59	57	57
2	9	18	2	4
3	0	0	0	0
4	0	0	0	0
Total	**68**	**77**	**59**	**61**

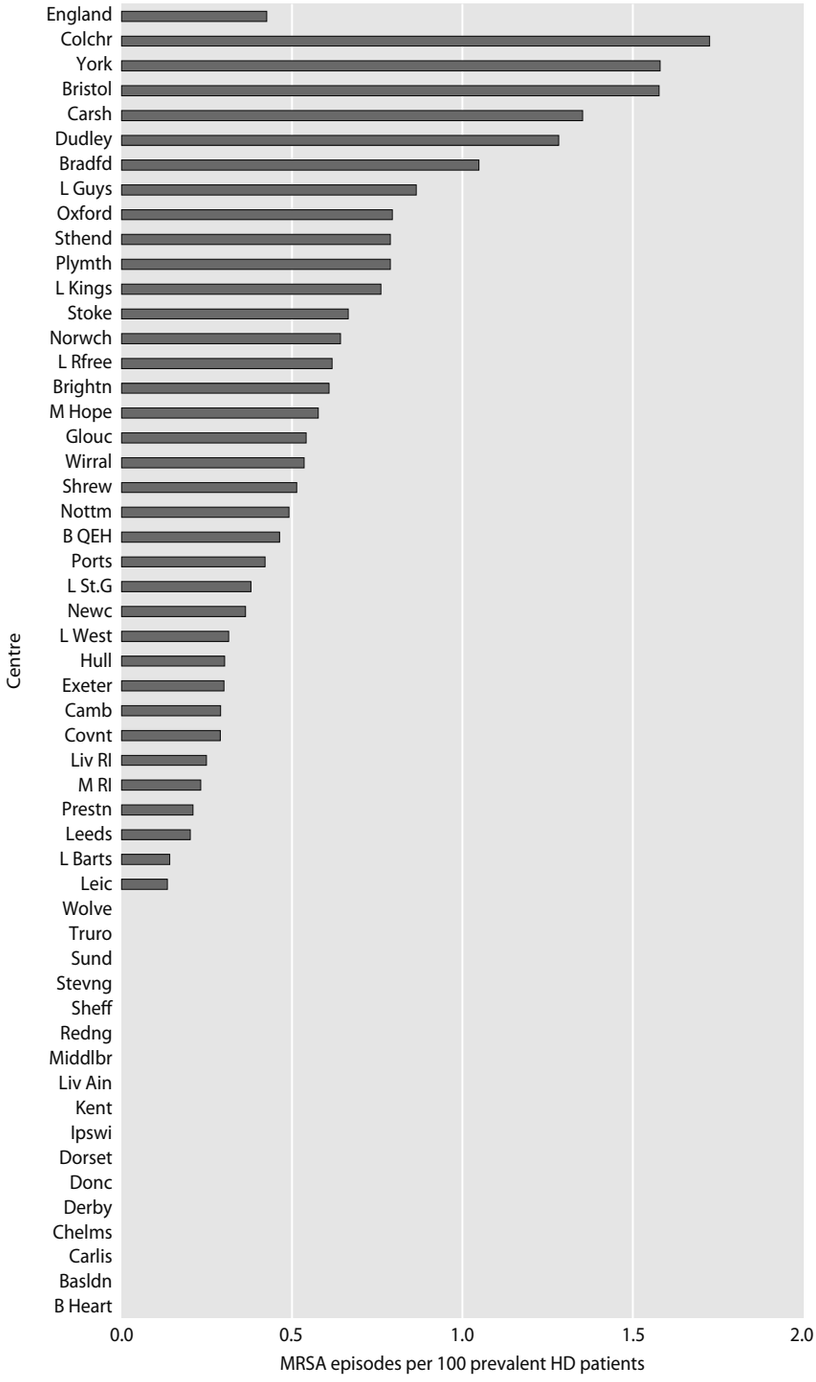

Fig. 12.2. MRSA bacteraemia rate per 100 prevalent HD patients by renal centre: 1/4/2009 to 31/3/2010
For each centre the rate per 100 prevalent HD patients as reported 31/12/2009 is provided. The overall rate for England is provided at the top of the graph

order to adjust for variation in precision of estimated rate, the rate of bacteraemia per 100 prevalent haemodialysis patients for each centre has been plotted against the centre size in a funnel plot (figure 12.3). No centre had a rate in excess of 2 per 100 prevalent haemodialysis patients per year and no centre exceeded the upper 99% confidence line in the funnel plot (figure 12.3).

Organisational results: 2010–2011

Between 1st April 2010 and 31st March 2011 a total of 65 episodes of MRSA bacteraemia were identified as possibly being associated with ERF requiring dialysis (table 12.1) Forty-seven records were shared and of these 16 were completed via the portal system giving a completion rate of 34%. Of these episodes, two were

Table 12.4. Centre specific data for episodes of MRSA bacteraemia by access type, 1/04/2009 to 31/03/2010

	Prevalent patients on 31/12/2009					MRSA bacteraemia episodes (1/04/2009 to 31/03/2010)						Rates	
Centre	HD	PD	Dialysis	Tx	All	Total	AVF	AVG	NTC	TC	UK[a]	HD	Dialysis
B Heart	432	33	465	157	622	0	0	0	0	0	0	0.00	0.00
B QEH	865	159	1,024	797	1,821	4	0	0	0	3	1	0.46	0.39
Basldn	143	28	171	43	214	0	0	0	0	0	0	0.07	0.06
Bradfd	191	34	225	197	422	2	2	0	0	0	0	1.05	0.89
Brightn	329	86	415	322	737	2	2	0	0	0	0	0.61	0.48
Bristol	444	75	519	704	1,223	7	2	3	0	1	1	1.58	1.35
Camb	345	39	384	556	940	1	0	0	0	1	0	0.29	0.26
Carlis	66	15	81	122	203	0	0	0	0	0	0	0.00	0.00
Carsh	666	123	789	513	1,302	9	2	0	0	6	1	1.35	1.14
Chelms	118	37	155	70	225	0	0	0	0	0	0	0.00	0.00
Colchr	116		116		116	2	1	0	0	1	0	1.72	1.72
Covnt	347	82	429	365	794	1	0	0	0	0	1	0.29	0.23
Derby	247	87	334	85	419	0	0	0	0	0	0	0.00	0.00
Donc	121	33	154	42	196	0	0	0	0	0	0	0.00	0.00
Dorset	228	58	286	266	552	0	0	0	0	0	0	0.00	0.00
Dudley	156	56	212	80	292	2	0	0	0	0	2	1.28	0.94
Exeter	334	70	404	327	731	1	1	0	0	0	0	0.30	0.25
Glouc	185	43	228	138	366	1	0	0	0	1	0	0.54	0.44
Hull	332	74	406	319	725	1	0	0	0	1	0	0.30	0.25
Ipswi	110	43	153	155	308	0	0	0	0	0	0	0.00	0.00
Kent	337	69	406	338	744	0	0	0	0	0	0	0.00	0.00
L Barts	712	188	900	738	1,638	1	1	0	0	0	0	0.14	0.11
L Guys	579	50	629	882	1,511	5	1	0	1	2	1	0.86	0.79
L Kings	395	85	480	306	786	3	2	0	0	0	1	0.76	0.63
L Rfree	649	70	719	827	1,546	4	0	0	0	0	4	0.62	0.56
L St. G	264	63	327	334	661	1	1	0	0	0	0	0.38	0.31
L West	1,277	36	1,313	1,412	2,725	4	0	0	0	4	0	0.31	0.30
Leeds	499	106	605	743	1,348	1	0	0	0	1	0	0.20	0.17
Leic	751	166	917	818	1,735	1	0	1	0	0	0	0.13	0.11
Liv Ain	139	7	146		146	0	0	0	0	0	0	0.00	0.00
Liv RI	403	89	492	731	1,223	1	0	0	0	1	0	0.25	0.20
M Hope	347	119	466	318	784	2	1	0	0	1	0	0.58	0.43
M RI	433	103	536	900	1,436	1	0	0	0	1	0	0.23	0.19
Middlbr	295	20	315	392	707	0	0	0	0	0	0	0.00	0.00
Newc	276	54	330	567	897	1	0	0	0	1	0	0.36	0.30
Norwch	312	58	370	221	591	2	0	0	0	2	0	0.64	0.54
Nottm	408	111	519	437	956	2	0	0	0	2	0	0.49	0.39
Oxford	378	104	482	838	1,320	3	1	0	1	1	0	0.79	0.62
Plymth	127	42	169	285	454	1	0	0	0	1	0	0.79	0.59
Ports	476	95	571	730	1,301	2	0	0	0	0	2	0.42	0.35
Prestn	480	78	558	381	939	1	0	0	0	1	0	0.21	0.18
Redng	269	85	354	264	618	0	0	0	0	0	0	0.04	0.03
Sheff	600	72	672	544	1,216	0	0	0	0	0	0	0.00	0.00
Shrew	195	29	224	113	337	1	0	0	0	0	1	0.51	0.45
Stevng	379	29	408	172	580	0	0	0	0	0	0	0.00	0.00
Sthend	127	20	147	60	207	1	0	0	0	1	0	0.79	0.68
Stoke	301	72	373	267	640	2	1	0	0	1	0	0.66	0.54
Sund	178	28	206	162	368	0	0	0	0	0	0	0.00	0.00
Truro	153	28	181	139	320	0	0	0	0	0	0	0.00	0.00
Wirral	187	35	222		222	1	0	0	0	1	0	0.53	0.45
Wolve	300	51	351	126	477	0	0	0	0	0	0	0.03	0.03
York	190	16	206	115	321	3	1	0	0	2	0	1.58	1.46
England	**18,191**	**3,353**	**21,544**	**19,418**	**40,962**	**77**	**19**	**4**	**2**	**37**	**15**	**0.42**	**0.36**

[a]UK – unknown

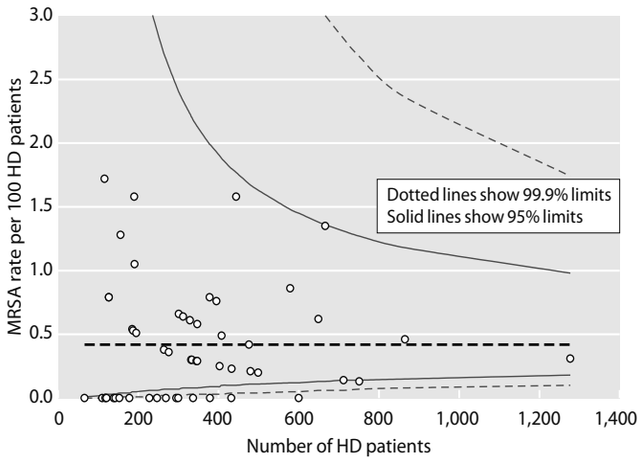

Fig. 12.3. Funnel plot of the MRSA rate per 100 HD patients by centre: 1/4/2009 to 31/3/2010

excluded as the patient was not in end stage renal failure, one was a duplicate record and one patient was not known to the centre they were attributed to. In total there were 61 episodes of MRSA bacteraemia in this time period.

There were only two instances of the same patient with two separate episodes of MRSA bacteraemia, one at University Hospital Birmingham and another at Southport and Ormskirk hospital (table 12.3).

Access and modality data

All patients whose data were validated were receiving haemodialysis for ERF. There were 30 patients where it was not possible to verify the mode of access (table 12.2). Of the remaining 31, 22 dialysed via a tunnelled venous catheter, 11 via an arteriovenous fistula, one via an arteriovenous graft and one via a non-tunnelled catheter. Overall, the rate of bacteraemia was 5.75 times higher in patients with a venous catheter compared to those with an AVF (table 12.2).

Centre level data

Figure 12.4 shows the number of MRSA episodes by centre. Twenty-nine centres reported no episodes of MRSA within the time period.

Figure 12.5 and table 12.5 detail the normalised centre specific rates and are based on the number of patients receiving RRT at the end of 2010. Using the number of prevalent haemodialysis patients as the denominator the median rate was 0.0 with a range of 0 to 2.15 per 100 prevalent haemodialysis patients. Using the total number of

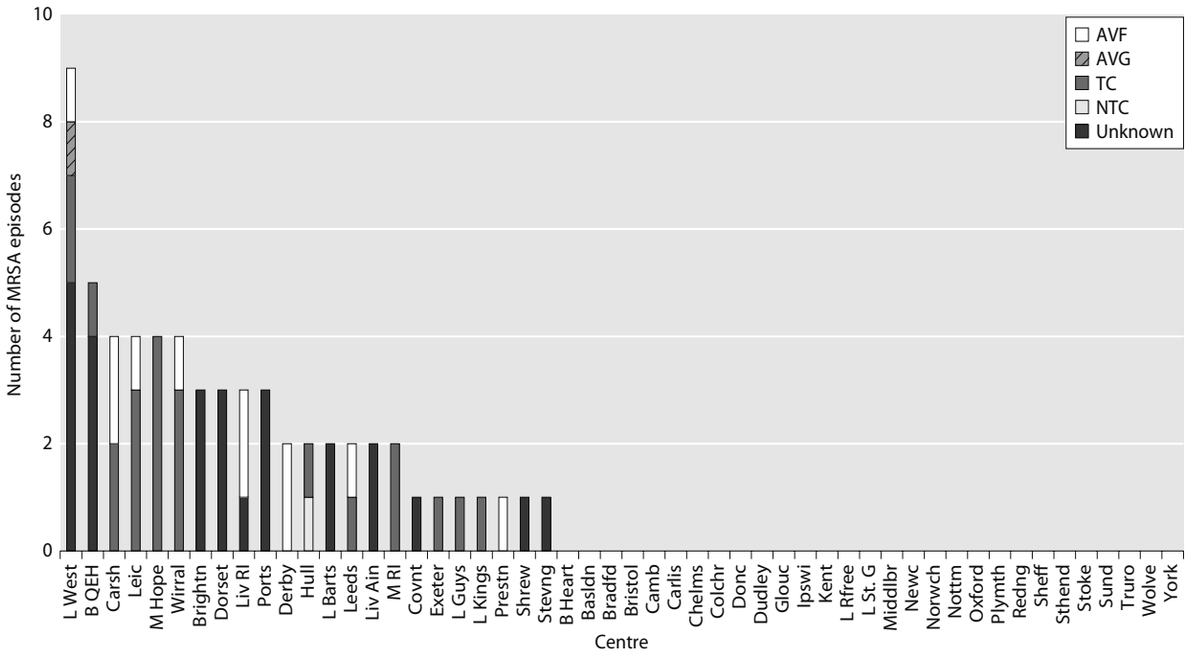

Fig. 12.4. Number of MRSA bacteraemia episodes by access and renal centre: 1/04/2010 to 31/3/2011
Stacked bars, coded by access type for each English renal centre
AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non-tunnelled catheter
TC = tunnelled catheter

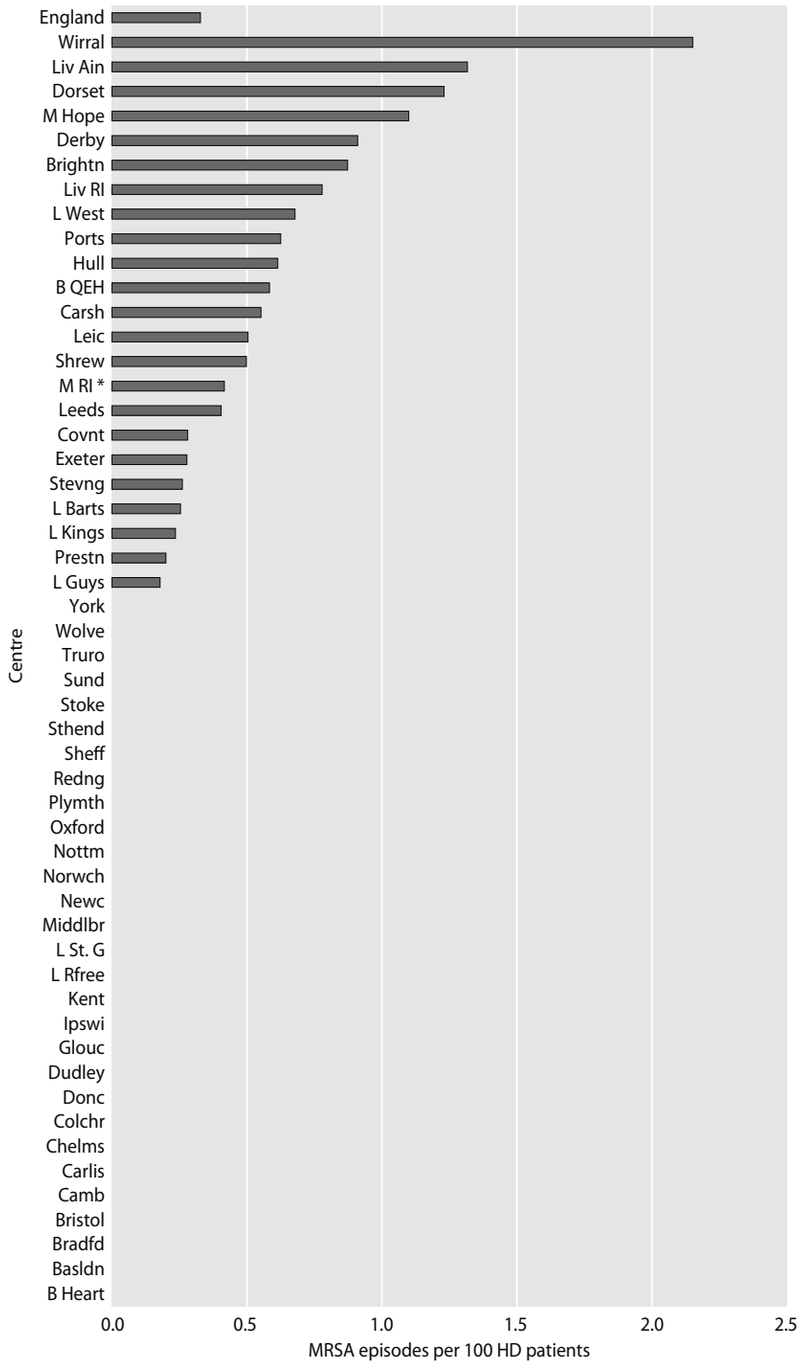

Fig. 12.5. MRSA bacteraemia rate per 100 prevalent HD patients by renal centre: 1/4/2010 to 31/3/2011
For each centre the rate per 100 prevalent HD patients as reported 31/12/2010 is provided
The overall rate for England is provided at the top of the graph

prevalent dialysis patients as the denominator, the median rate was 0.0 with a range of 0 to 1.79 per 100 prevalent dialysis patients per year. Only Arrowe Park hospital (Wirral) had a rate greater than 2 per 100 prevalent haemodialysis patients. No renal centre exceeded the 99% upper confidence limit from the funnel plot (figure 12.6) and only Sheffield plotted above the 95% upper confidence limit, but it would be expected by chance that three centres would fall outside the 95% limits.

Comparison with previous reports

Between 2008/2009 and 2009/2010 there was a 52% drop in the absolute number of MRSA episodes and then a further drop of 24% between 2009/2010 and 2010/2011. Overall since the first year of reporting (2007) there has been an 82% reduction in absolute episodes (figure 12.7). The median centre specific rate declined from 0.64 episodes per 100 prevalent haemodialysis

Table 12.5. Centre specific data for episodes of MRSA bacteraemia by access type, 1/04/2010 to 31/03/2011

	Prevalent patients on 31/12/2010					MRSA bacteraemia episodes (1/04/2010 to 31/03/2011)						Rates	
Centre	HD	PD	Dialysis	Tx	All	Total	AVF	AVG	NTC	TC	UK[a]	HD	Dialysis
B Heart	426	43	469	163	632	0	0	0	0	0	0	0.00	0.00
B QEH	858	153	1,011	833	1,844	5	0	0	0	1	4	0.58	0.49
Basldn	138	25	163	51	214	0	0	0	0	0	0	0.00	0.00
Bradfd	185	37	222	233	455	0	0	0	0	0	0	0.00	0.00
Brightn	344	87	431	339	770	3	0	0	0	0	3	0.87	0.70
Bristol	460	62	522	728	1,250	0	0	0	0	0	0	0.00	0.00
Camb	349	35	384	604	988	0	0	0	0	0	0	0.00	0.00
Carlis	60	13	73	130	203	0	0	0	0	0	0	0.00	0.00
Carsh	726	103	829	548	1,377	4	2	0	0	2	0	0.55	0.48
Chelms	123	35	158	80	238	0	0	0	0	0	0	0.00	0.00
Colchr	120		120		120	0	0	0	0	0	0	0.00	0.00
Covnt	358	84	442	402	844	1	0	0	0	0	1	0.28	0.23
Derby	220	101	321	138	459	2	2	0	0	0	0	0.91	0.62
Donc	147	24	171	51	222	0	0	0	0	0	0	0.00	0.00
Dorset	244	55	299	286	585	3	0	0	0	0	3	1.23	1.00
Dudley	158	62	220	83	303	0	0	0	0	0	0	0.00	0.00
Exeter	361	77	438	347	785	1	0	0	0	1	0	0.28	0.23
Glouc	191	41	232	145	377	0	0	0	0	0	0	0.00	0.00
Hull	326	67	393	332	725	2	0	0	1	1	0	0.61	0.51
Ipswi	116	35	151	165	316	0	0	0	0	0	0	0.00	0.00
Kent	360	71	431	362	793	0	0	0	0	0	0	0.00	0.00
L Barts	791	190	981	797	1,778	2	0	0	0	0	2	0.25	0.20
L Guys	565	47	612	1,006	1,618	1	0	0	0	1	0	0.18	0.16
L Kings	427	94	521	316	837	1	0	0	0	1	0	0.23	0.19
L Rfree	677	71	748	891	1,639	0	0	0	0	0	0	0.00	0.00
L St. G	283	56	339	339	678	0	0	0	0	0	0	0.00	0.00
L West	1,329	37	1,366	1,496	2,862	9	1	1	0	2	5	0.68	0.66
Leeds	496	98	594	789	1,383	2	1	0	0	1	0	0.40	0.34
Leic	795	169	964	844	1,808	4	1	0	0	3	0	0.50	0.41
Liv Ain	152	7	159		159	2	0	0	0	0	2	1.32	1.26
Liv RI	386	85	471	767	1,238	3	2	0	0	0	1	0.78	0.64
M Hope	364	124	488	349	837	4	0	0	0	4	0	1.10	0.82
M RI	481	88	569	983	1,552	2	0	0	0	2	0	0.42	0.35
Middlbr	286	22	308	403	711	0	0	0	0	0	0	0.00	0.00
Newc	270	54	324	564	888	0	0	0	0	0	0	0.00	0.00
Norwch	319	54	373	242	615	0	0	0	0	0	0	0.00	0.00
Nottm	416	88	504	468	972	0	0	0	0	0	0	0.00	0.00
Oxford	381	110	491	872	1,363	0	0	0	0	0	0	0.00	0.00
Plymth	134	46	180	279	459	0	0	0	0	0	0	0.00	0.00
Ports	481	102	583	750	1,333	3	0	0	0	0	3	0.62	0.51
Prestn	504	63	567	401	968	1	1	0	0	0	0	0.20	0.18
Redng	260	86	346	290	636	0	0	0	0	0	0	0.00	0.00
Sheff	611	66	677	577	1,254	0	0	0	0	0	0	0.00	0.00
Shrew	201	22	223	114	337	1	0	0	0	0	1	0.50	0.45
Stevng	385	36	421	185	606	1	0	0	0	0	1	0.26	0.24
Sthend	126	18	144	68	212	0	0	0	0	0	0	0.00	0.00
Stoke	295	73	368	267	635	0	0	0	0	0	0	0.00	0.00
Sund	176	33	209	160	369	0	0	0	0	0	0	0.00	0.00
Truro	153	29	182	153	335	0	0	0	0	0	0	0.00	0.00
Wirral	186	37	223		223	4	1	0	0	3	0	2.15	1.79
Wolve	315	72	387	131	518	0	0	0	0	0	0	0.00	0.00
York	152	24	176	161	337	0	0	0	0	0	0	0.00	0.00
England	**18,667**	**3,311**	**21,978**	**20,682**	**42,660**	**61**	**11**	**1**	**1**	**22**	**26**	**0.33**	**0.28**

[a]UK – unknown

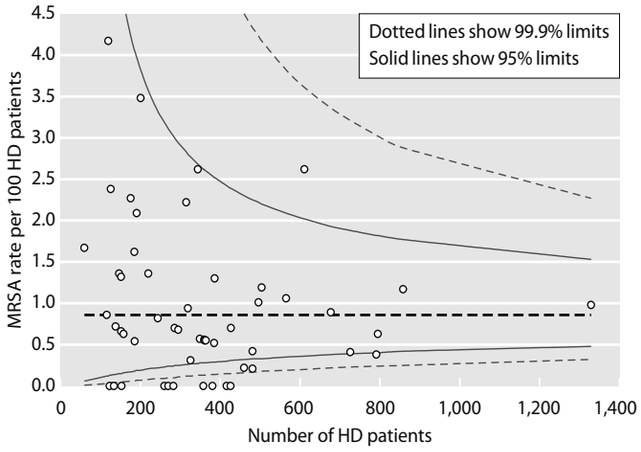

Fig. 12.6. Funnel plot of the MRSA rate per 100 HD patients by renal centre: 1/04/2010 to 31/03/2011

patients in 2008/2009 to 0.30 per 100 prevalent haemodialysis patients in 2009/2010 and again to 0.0 in 2010/2011. The median rate per 100 prevalent dialysis patients declined from 0.55 to 0.25 to 0.0 over the same period.

Methicillin Sensitive Staphylococcus Aureus

The time period between 1st January 2011 and 30th June 2011 represented the first six months of mandatory reporting of Methicillin Sensitive Staphylococcus Aureus (MSSA) bacteraemia. Data were collected using the same process of sharing and validation described above. These data are likely to be an incomplete data set given the transition to mandatory MSSA reporting is still ongoing.

In total 170 episodes of MSSA bacteraemia were identified as being associated with patients in ERF (table 12.6). Ninety were shared and a further 80 were allocated by direct contact with the clinical lead for the each renal centre. Twenty-four were completed via the web portal

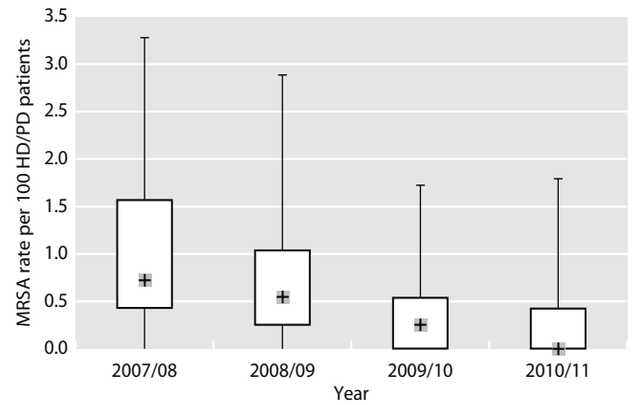

Fig. 12.7. Box and whisker plot of MRSA rates by renal centre per 100 prevalent HD/PD patients by reporting year

Table 12.6. Number of MSSA bacteraemia and the proportion of records shared with and completed by the renal centre in patients with established renal failure reported to the MRSA Healthcare Associated Infection Data Capture System, 1/01/2011 to 30/06/2011

		MSSA bacteraemia (1/01/2011 to 30/06/2011)		
Records		Number	%	Total number
Rejected	Shared & completed	0	0.0	9
	Shared, not completed	2	1.2	
	Not shared	7	4.1	
Accepted	Shared & completed	24	14.1	161
	Shared, not completed	64	37.6	
	Not shared	73	42.9	
Total		**170**		

system giving a completion rate of 27% (24/90) among shared records. Following validation from the individual renal centres, a further nine episodes were excluded giving a total number of 161 MSSA bacteraemia episodes in this six month period. Of the excluded patients, four were not in ERF, three were not known to the renal centre they were allocated to, one was excluded as a paediatric patient and one excluded as the centre they were allocated to was not a renal centre.

Access and modality data

It was possible to obtain access data on 92 of these episodes (table 12.7). In total there were 60 episodes where the patient was dialysing through a tunnelled venous catheter, 28 where the patient was dialysing via an arteriovenous fistula, two episodes involving an AV graft and two associated with a temporary line. In the remaining patients it was not possible to verify their mode of access within the timeframe of this report. Episodes by renal centre, coded for access are demonstrated in figure 12.8.

The risk of an MSSA bacteraemia was 6.1 fold higher in patients dialysing via a venous catheter.

Centre level data

The normalised centre specific rates based on the dialysis population at the end of 2010 demonstrate considerable variation (figure 12.9). Overall the median number of episodes per 100 prevalent haemodialysis patients was 1.27 with a rate of 1.06 per 100 prevalent dialysis patients per year. The range across centres was

Table 12.7. Type of renal access in patients in established renal failure where record shared and completed for the MSSA bacteraemia, 1/01/2011 to 30/06/2011

	MSSA bacteraemia (1/01/2011 to 30/06/2011)		
Renal access type	Number	%	Total number
Unknown	0		
Haemodialysis			
Other	0		
AVF	28	30.4	32.6
AVG	2	2.2	
NTC	2	2.2	67.4
TC	60	65.2	
Unknown	68		
Total	**160**		
Total known access	**92**		

AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non-tunnelled catheter
TC = tunnelled catheter

0.0 to 7.7. Ten centres did not report any episodes of MSSA bacteraemia, although this may be because dialysis details for MSSA episodes were not being reported to the mandatory system by that laboratory. Sixteen centres reported an incidence in excess of 2 per 100 prevalent dialysis patients.

Discussion

Infection remained a leading cause of death in dialysis patients and was exceeded only by cardiovascular disease. Type of access can itself be a major factor either by acting as a portal of entry and becoming the primary source of a bacteraemia or by the catheter becoming colonised as a result of another infective episode (i.e. skin and soft tissue, pneumonia). Dialysis patients continue to be at increased risk of MRSA bacteraemia.

This is the third and fourth years of the full working of reporting via the Health Protection Agency of MRSA bacteraemias, also presented here are the first six months of reporting of MSSA.

As shown in figure 12.7, the reported figures represent a significant decline in MRSA rates in patients with ERF on dialysis compared with previous years. The decline has continued year on year with an overall reduction of 82% since 2008. Similar declines have been reported in other hospital patients. The cause of this decline has

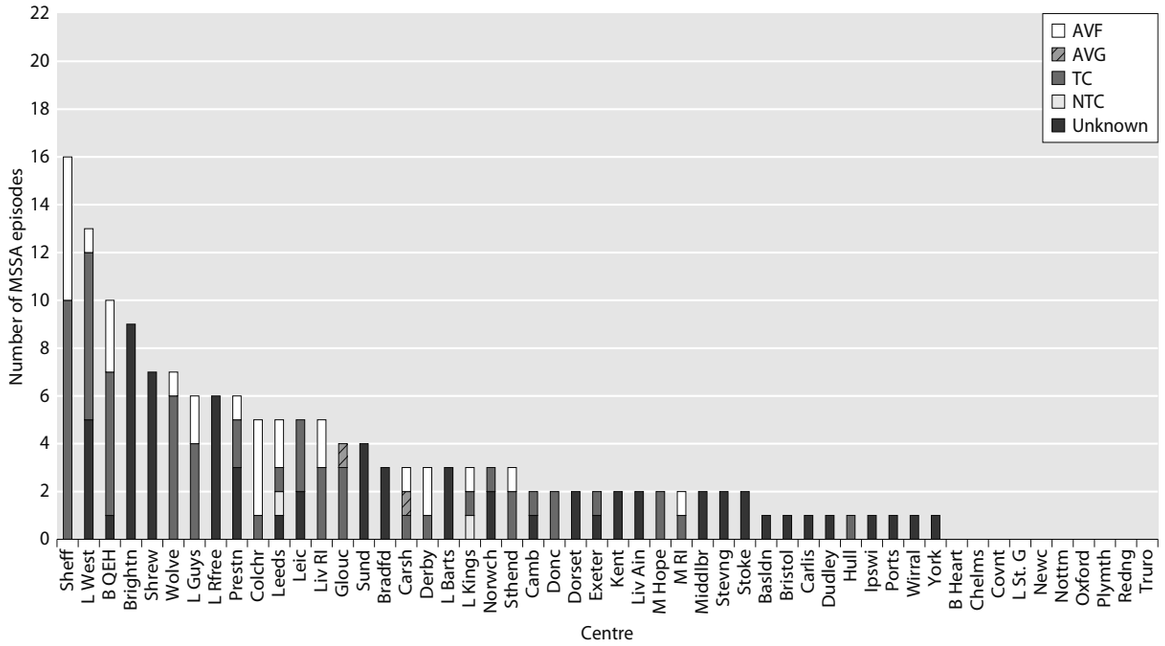

Fig. 12.8. Number of MSSA bacteraemia episodes by access and renal centre: 1/01/2011 to 30/06/2011
Stacked bars, coded by access type for each English renal centre
AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non-tunnelled catheter
TC = tunnelled catheter

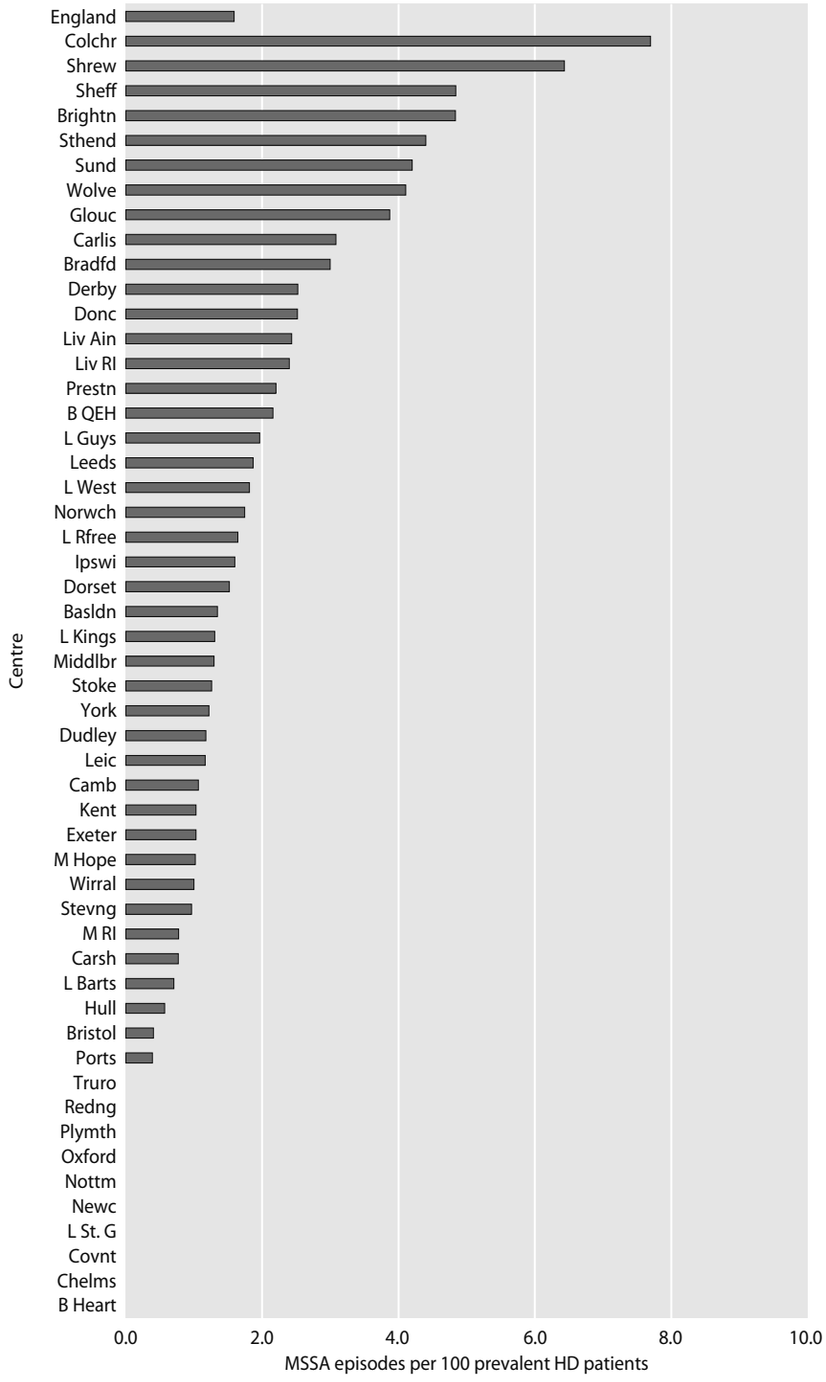

Fig. 12.9. MSSA bacteraemia rate per 100 prevalent HD patients by renal centre: 1/01/2011 to 30/06/2011

For each centre the rate per 100 prevalent HD patients as reported 31/12/2010 is provided

The overall rate for England is provided at the top of the graph

not been analysed in this study but is likely to be multi-factorial. The adoption of national screening and surveillance programmes, reduction in the use of venous catheters and increasing usage of antimicrobial locks all may have contributed.

The data on MSSA bacteraemia represent the first efforts at surveillance and therefore there is no comparable data available to give an idea of rates. In addition, only the first six months of 2011 are given but if the data are extrapolated this would indicate 320 cases of MSSA per year. There is a noticeably higher incidence of MSSA infection when compared with recently reported MRSA rates suggesting that MSSA bacteraemia continues to be a significant problem amongst ERF patients.

The reasons for the discrepancy are not analysed in this report. Whilst one would expect a higher rate of MSSA it

would be reasonable to extrapolate from the first six months of the year that there were nearly 320 MSSA infections among dialysis patients in 2011. As this is the first year of the surveillance system there may be an element of reporting bias. *Staphylococcus aureus* is recognised as a major cause of vascular device-associated infection and the success of MRSA screening and eradication programmes may have favoured the elimination of MRSA strains but left patients still vulnerable to infection by MSSA. It is also noticeable that some centres with little or no MRSA may have a high incidence of MSSA bacteraemia. Further work is needed to demonstrate the overall trend of MSSA bacteraemia amongst dialysis patients.

Conclusion

The third and fourth years of mandatory reporting of MRSA have continued to show a decline in infection rates in renal centres in England with an overall drop of over 80% since 2008. The first six months of mandatory MSSA reporting show a higher rate of infection and more data are required to understand the risks and trends amongst ERF patients.

Infection remains a considerable cause of morbidity and mortality amongst ERF patients and the presence of a tunnelled venous catheter continues to be a considerable risk factor for developing bacteraemia.

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Conflicts of interest: none

References

1 Ansell D, Roderick P, Hodsman A, Ford D, Steenkamp R, Tomson C. UK Renal Registry 11th Annual Report (December 2008): Chapter 7 Survival and causes of death of UK adult patients on renal replacement therapy in 2007: national and centre-specific analyses. Nephron Clin Pract. 2009; 111(suppl 1):c113–c139

2 UK Renal Registry. The National Dialysis Access Survey: preliminary results. Chapter 6, UK Renal Registry 8th Annual Report. Bristol: UK Renal Registry, 2005

3 UK Renal Registry. The UK Vascular Access Survey – Follow-up Data & Repeat Survey. Chapter 5, UK Renal Registry 8th Annual Report. Bristol: UK Renal Registry, 2006

4 Moist LM, Trpeski L, Na Y, Lok CE. Increased hemodialyis catheter use in Canada and associated mortality risk: Data from the Canadian Organ Replacement Registry 2001–2004 Clin J Am Soc Nephrol. 2008 Nov;3(6):1726–1732. Epub 2008 Oct 15

5 Inrig JK, Reed SD, Szczech LA, Engemann JJ, Friedman JY, Corey GR, et al. Relationship between clinical outcomes and vascular access type among hemodialysis patients with Staphylococcus aureus bacteremia. Clin J Am Soc Nephrol 2006;1(3):518–524

6 Fluck R, Wilson J, Davies J, Blackburn R, O'Donoghue D, Tomson CR. UK Renal Registry 11th Annual Report (December 2008): Chapter 12 Epidemiology of Methicillin Resistant Staphylococcus aureus bacteraemia amongst patients receiving Renal Replacement Therapy in England in 2007. Nephron Clin Pract. 2009;111(suppl 1):c247–c256

7 Fluck R, Wilson J, Thomson CR UK Renal Registry 12th Annual Report: Chapter 12 Epidemiology of Methicillin Resistant Staphylococcus Aureus bacteraemia amongst patients receiving Renal Replacement Therapy in England in 2008: A Joint Report for the UK Renal Registry and the Health Protection Agency

UK Renal Registry 14th Annual Report: Chapter 13 The Linkage of Incident Renal Replacement Therapy Patients in England (2002–2006) to Hospital Episodes and National Mortality Data: improved demography and hospitalisation data in patients undergoing renal replacement therapy

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Key Words
Routine data · Hospitalisation · Comorbidity · Coding

Summary

- Analysis of UK Renal Registry (UKRR) data is often hampered by missing demographical and clinical data including ethnicity, time of referral and co-existing medical conditions (comorbidity). Currently the UKRR has no method of collecting morbidity data once the patient has started renal replacement therapy (RRT).
- By linking UKRR data to Hospital Episode Statistics and Office of National Statistics data, information on demography and hospitalisation could be robustly explored in 98.3% of the 21,633 patients starting RRT between 2002 and 2006.
- For individual centres, there was variation in the mean number of diagnoses coded per admission (3.92–7.22) and the proportion of admissions with discharges the same day (range 6.6–42.8%).
- Linkage allowed successful determination of ethnicity, deprivation score and comorbid conditions in over 96% of patients suitable for analysis, whereas 39% of patients had these three data items complete from the UKRR dataset alone. However using admissions in the six months pre and post start of RRT only determined primary renal disease in an additional 6.5% of patients. Where data was available from both sources, concordance between UKRR and HES for comorbid conditions was 93%.
- Approximately 50% of incident RRT patients died during follow up and in these 65.0% of patients died in hospital with acute services, with an additional 14.2% of patients having been discharged from an acute provider in the preceding 30 days and the remaining 20.8% dying with no hospitalisation in the preceding 30 days.

Introduction

Since 1998 the UK Renal Registry (UKRR) has reported on the demography of incident renal replacement therapy (RRT) patients using data provided by renal centres. The quality of this data has varied between centres making it impossible for more extensive adjustment for important measures such as incident survival. The UKRR dataset has evolved over more than thirteen years to allow the collection of data that the nephrology community recognises as important; however completion rates for these items remain variable [1], and morbidity data after initiating RRT remain uncollected.

Morbidity, more specifically the development of a new condition is often associated with hospitalisation. The burden of hospitalisation in incident RRT patients has been highlighted in other renal disease registries using linkage to hospitalisation records [2, 3]. In the United States rates of admission in transplant and peritoneal dialysis patients have gradually decreased in the last five years but admissions associated with infection remain high in haemodialysis patients [2]. Hospitalisation data, in conjunction with information supplied for payment when a patient starts RRT, is used to enhance comorbidity information [4] and perform additional analyses such as cost evaluations by the United States Renal Data Service (USRDS).

The linkage of registry data to hospitalisation data will allow the reporting of new measures of centre performance, better adjustment of existing measures and allow the study of practice patterns associated with admissions to hospital. In England, hospitalisation is captured by the Hospital Episode Statistics (HES) dataset [5]. Designed to capture all admitted care and more recently outpatient care delivered in English hospitals, data are routinely available from 1998. HES is a rich source of information on inpatient delivered care, detailing demographical information on age, sex, ethnicity and postcode/geographical data including deprivation. Admission information includes the date, type and origin of admission, primary reason for admission, secondary diagnoses (other conditions/comorbidity). Operations and procedures performed whilst an inpatient are recorded along with the location of care, specialty and clinician providing care and in addition to location and length of stay. This chapter describes the linkage of incident patients starting RRT between 2002 and 2006 to the HES and Office of National Statistics datasets, and how this linked dataset can be used to enhance existing variables and derive new measures for renal centres in England.

Methods

Datasets, linkage and cohort

Due to the strict information governance surrounding HES data, this study utilised the Research Capability Programme (RCP), formed to allow researchers access to a wide range of healthcare data. They function in an honest broker role, accessing non-anonymised data sources, linking them using sensitive items and then stripping the dataset of these items. The RCP was functioning in pilot form, having agreed to link data for 12 studies, of which four were finally delivered. They had already taken receipt of the HES dataset from April 1996 to February 2011 and the Office of National Statistics death registrations over a similar period.

Incident patients in English centres starting renal replacement therapy between 1st January 2002 and 31st December 2006 were identified from the UKRR dataset. Demographic, treatment and laboratory data from the start of RRT until the end of 2009 were extracted, encrypted and transferred to the RCP. Data sources were linked by validating NHS numbers where possible using the NHS Personal Demographics Service (PDS) then linked on NHS number and date of birth. In situations where the NHS number existed in the datasets but could not be traced additional checks against patient details were performed. The combined dataset was anonymised, encrypted and returned to the UKRR and the University of Sheffield for analysis.

HES reflect care delivered by a particular consultant, and therefore activity is captured per consulting episode. An admission to one hospital (often referred to as a spell) may contain several episodes and if the patient is transferred a continuous inpatient admission may contain several spells. These records were collapsed for various measures where appropriate using existing data processing guidance [6], factoring patient movement for elective haemodialysis where possible. Elective haemodialysis sessions and admissions for assisted peritoneal dialysis were excluded from frequency analyses. In addition, from April 2003 HES began recording outpatient attendances and these episodes were also supplied. Outpatient HES identifies provider speciality and location but healthcare providers are yet to embrace diagnosis and procedural coding available in this dataset.

For the purposes of modelling frequency of admission and comorbidity, patients who had no linked HES data or who at any point had postcode data suggesting residence outside of England were excluded from analysis.

Variables

Comorbidity prior to starting renal replacement therapy was determined from comorbid conditions as coded by International Classification of Disease version 10 (ICD10) from hospitalisations prior to starting RRT. If the date of first RRT provided by the UKRR was during an admission, the primary reason for admission was excluded from comorbidity as this was technically morbidity. The established UKRR comorbid conditions were translated into ICD10 codes by reviewing codes using the Charlson comorbidity index [7] and the Elixhauser measure [8] taken from existing literature [9]. Conditions collected by the UKRR that did not exist in the Charlson or Elixhauser schemes were converted to ICD10 codes using the NHS Information Centre HRG grouping document which includes all ICD10 and Office of Population Censuses & Surveys (OPCS) procedural codes currently employed.

The ethnicity scheme employed by the UKRR was mapped into that used by HES when collection began in 1996 and further simplified for reporting. As ethnicity in HES is patient reported, this source was used as the primary source with the UKRR dataset queried in situations when ethnicity was coded 'missing'.

Socioeconomic status was determined using the index of multiple deprivation (IMD) version 2004 which is provided for every HES admission and was computed for UKRR postcode data using Lower Super Output Area and existing lookup tables [10]. Admissions or UKRR postcodes returned in the six months pre and post the date of first RRT were used to determine the patient's lower super output area of residence. These geographical areas were ranked according to deprivation by the office of national statistics in 2004, with those ranked 1 the most deprived and 32,482 the least deprived. Summary results were converted to a score out of 100 where 100 was the most deprived for ease of interpretation.

ICD10 diagnoses associated with primary renal disease (PRD) were determined from admissions in the six months pre and post start date of RRT in patients with PRD completed in the UKRR dataset. Non-specific codes such as those spanning several PRD groups were excluded. In patients surviving over 90 days with PRD coded as missing or unknown, a HES-derived PRD was assigned if an appropriate ICD10 code was identified over the same period.

In patients starting RRT in an era when the HES outpatient dataset had been collected for at least six months, HES inpatient and outpatient episodes were examined for nephrology speciality codes (code 361) in the treatment or main speciality fields. If these were earlier than the *date first seen by a nephrologist* reported by UKRR this new data would replace the existing value. The admitting speciality from the first episode was used to determine the speciality delivering care per admission for the first 12 months of RRT in patients who survived beyond 90 days.

Location of death was assigned by comparing the date of death from the ONS and NHS-tracing provided by the UKRR to hospitalisations in NHS trusts that are recognised acute providers in performance measures produced by the NHS information centre [11]. If a patient died whilst in hospital or within 30 days from discharge from an acute provider they were included in the 30 day mortality measure, with deaths outside this period reported separately.

Statistical Analyses

Patients who survived beyond 90 days from the start of RRT were included in analyses of comorbidity, speciality of care, late referral and location of death. Modality was determined at 90 days from the UKRR timeline for modality specific analyses. Funnel plots where used to identify outliers in outcomes measured as proportions with control lines derived from the binomial distribution. Proportions of patients with individual comorbid conditions determined by HES in those patients with and without UKRR comorbidity completed were compared with the Chi-squared test. A Cox proportional hazards model was used to determine the hazard ratio for death for the presence of a comorbidity compared to the absence of that comorbidity, modelled to three years follow-up. Cases were not censored for transplantation to ensure fair comparison between centres as per previous registry reports.

For calculating an overall comorbid score, weights for the presence of individual conditions were determined from a Cox regression model factoring age, sex and the presence or absence of comorbidities from the UKRR scheme, predicting death to three years. Following previously reported methods [12], multivariate hazard ratios for the presence of conditions were converted into scores to create an overall score using the following bandings: a score of 1 for hazard ratio of $\geqslant 1.2$ and <1.5, a score of 2 for hazard ratio of $\geqslant 1.5$ and <2.

Results

Linkage

Figure 13.1 details the data returned from the RCP, including the number of records from each data source

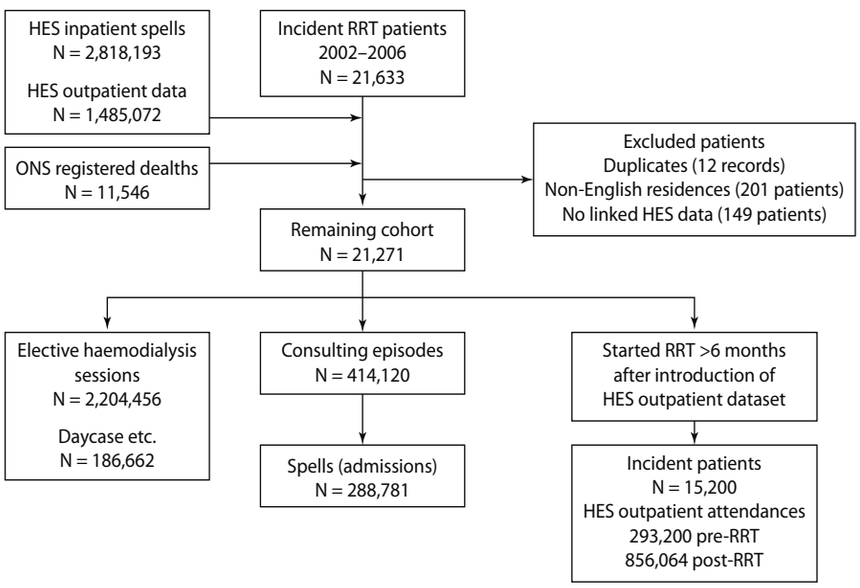

Fig. 13.1. Consort diagram detailing incident RRT patients 2002–2006, HES admissions and ONS records included in the analysis

and patients excluded from subsequent analysis. 98.3% of patients were suitable for continued analysis, with a total of 362 patients excluded. Ninety-seven percent of incident patients were supplied by the UKRR with NHS number. Linkage reports provided by the RCP identified 504 patients that could not have their NHS number traced by the PDS, some of whom would have had NHS numbers provided by the UKRR.

Table 13.1. Number of admissions, coding depth and proportion of admissions being discharged on the same day per centre

Centre	Admission frequency, N	Diagnosis code depth Mean number of codes (95% CI)	Procedure code depth Mean number of codes (95%CI)	Zero length of stays Frequency zero length admission, % (95% CI)
Basildon	2,073	3.9 (3.8–4.0)	0.8 (0.8–0.9)	14.4 (12.9–15.9)
B Heartlands	5,812	4.5 (3.8–4.0)	1.1 (1.0–1.1)	14.0 (13.1–14.9)
B QEH	7,138	4.8 (4.8–4.9)	1.3 (1.3–1.3)	10.9 (10.2–11.7)
Bradford	3,676	4.3 (4.2–4.3)	1.1 (1.0–1.1)	8.3 (7.4–9.2)
Brighton	4,794	5.1 (5.0–5.1)	1.4 (1.4–1.5)	13.0 (12.0–13.9)
Bristol	9,381	6.4 (6.3–6.4)	2.2 (2.1–2.3)	11.3 (10.6–11.9)
Cambridge	5,689	4.7 (4.7–4.8)	1.6 (1.5–1.6)	10.4 (9.6–11.1)
Carlisle	2,543	3.9 (3.8–4.0)	1.2 (1.1–1.2)	33.4 (31.6–35.3)
Carshalton	12,418	4.4 (4.3–4.4)	1.4 (1.4–1.5)	15.7 (15.1–16.4)
Chelmsford	1,398	5.1 (4.9–5.2)	1.5 (1.4–1.6)	9.5 (8.0–11.1)
Coventry	4,697	3.6 (3.5–3.6)	0.9 (0.9–1.0)	11.1 (10.2–12)
Derby	3,302	4.8 (4.7–4.8)	1.5 (1.4–1.5)	14.4 (13.2–15.6)
Dorchester	2,889	4.3 (4.2–4.4)	1.0 (1.0–1.1)	11.0 (9.9–12.1)
Dudley	2,074	4.7 (4.6–4.8)	2.0 (1.9–2.1)	7.8 (6.6–8.9)
Exeter	6,641	7.2 (7.1–7.3)	1.4 (1.3–1.4)	9.6 (8.9–10.3)
Gloucester	3,850	4.3 (4.2–4.3)	1.1 (1.0–1.1)	12.1 (11.0–13.1)
Hull	6,941	4.5 (4.4–4.5)	1.2 (1.1–1.2)	8.8 (8.2–9.5)
Ipswich	3,468	5.1 (5.0–5.2)	1.1 (1.1–1.2)	6.6 (5.7–7.4)
Leeds	11,132	4.2 (4.1–4.2)	1.5 (1.4–1.5)	9.2 (8.7–9.8)
Leicester	11,674	5.1 (5.0–5.1)	1.3 (1.2–1.3)	10.0 (9.5–10.5)
Liverpool – Aintree	1,282	4.7 (4.5–4.8)	1.2 (1.1–1.3)	14.4 (12.5–16.4)
Liverpool – RI	9,146	4.5 (4.5–4.6)	1.4 (1.3–1.4)	9.1 (8.5–9.7)
London – Barts	7,128	4.8 (4.7–4.9)	1.2 (1.1–1.3)	10.4 (9.7–11.1)
London – Guys	8,488	4.2 (4.1–4.2)	1.1 (1.0–1.1)	11.9 (11.2–12.6)
London – Kings	7,665	5.4 (5.3–5.5)	1.8 (1.8–1.9)	11.8 (11.1–12.5)
London – RFree	5,910	4.1 (4.0–4.1)	1.3 (1.3–1.4)	42.8 (41.5–44.1)
London – West	18,043	5.4 (5.4–5.4)	1.5 (1.4–1.5)	13.5 (13.0–14.0)
Middlesbrough	6,922	4.6 (4.6–4.7)	1.1 (1.0–1.1)	12.3 (11.5–13.0)
Newcastle-upon-Tyne	7,561	6.0 (6.0–6.1)	1.6 (1.6–1.7)	10.9 (10.2–11.6)
Norwich	4,394	4.6 (4.5–4.7)	1.0 (0.9–1.0)	13.2 (12.2–14.2)
Nottingham	8,304	6.8 (6.7–6.8)	1.7 (1.6–1.7)	15.3 (14.5–16.1)
Oxford	11,890	4.1 (4.0–4.1)	1.2 (1.2–1.2)	18.6 (17.9–19.3)
Plymouth	4,014	5.4 (5.3–5.4)	1.3 (1.3–1.4)	7.1 (6.3–7.9)
Portsmouth	11,280	4.3 (4.3–4.4)	1.2 (1.2–1.2)	28.3 (27.5–29.2)
Preston	9,304	5.3 (5.2–5.3)	1.3 (1.3–1.3)	16.7 (15.9–17.4)
Reading	4,423	4.1 (4.0–4.2)	1.3 (1.3–1.4)	13.8 (12.8–14.8)
Salford	10,002	4.6 (4.5–4.7)	1.2 (1.2–1.3)	32.4 (31.5–33.4)
Sheffield	10,991	4.5 (4.5–4.5)	1.2 (1.2–1.3)	10.6 (10.1–11.2)
Shrewsbury	1,243	4.6 (4.5–4.8)	1.5 (1.4–1.6)	10.0 (8.3–11.6)
Southend-on-Sea	2,131	5.5 (5.4–5.6)	1.7 (1.6–1.7)	11.0 (9.7–12.3)
Stevenage	5,757	4.0 (3.9–4.1)	1.0 (0.9–1.0)	12.3 (11.4–13.1)
Sunderland	3,821	4.8 (4.7–4.8)	1.7 (1.7–1.8)	12.6 (11.6–13.7)
Truro	3,817	5.1 (5.0–5.2)	1.0 (0.9–1.0)	22.5 (21.2–23.8)
Wirral	4,280	3.6 (3.5–3.6)	1.0 (0.9–1.0)	17.2 (16.1–18.4)
Wolverhampton	6,312	4.0 (4.0–4.1)	0.9 (0.8–0.9)	13.0 (12.2–13.9)
York	3,083	5.0 (4.9–5.1)	1.1 (1.1–1.2)	10.4 (9.3–11.5)
Total	**288,781**	**4.8 (4.8–4.8)**	**1.3 (1.3–1.3)**	**14.5 (14.3–14.6)**

Coding

The coding depth (how many diagnosis codes were utilised to code the first episode of a spell) varied between centres and over time. Table 13.1 details the number of admissions, coding depth for both diagnoses and procedures, and the frequency with which patients were discharged on the same day (zero length of stay admissions). Some centres had a high proportion of zero length of stay admissions (range 6.6%–42.8%), suggesting mis-coding of haemodialysis attendances. Excluding these admissions increased coding depth from 4.81 (95% CI 4.79–4.83) codes per admission to 4.99 (95% CI 4.97–5.01) codes per admission.

Coding depth increased over time at a rate of approximately 0.25 codes per year, as highlighted in figure 13.2.

Enhancement of Existing Variables

Enhanced variables for centres contributing to the cohort are summarised in table 13.2. Sufficient information was available for 20,968 patients (98.6% of analysis cohort) to derive IMD data from the six months pre and post the start of RRT, with 72% provided by the UKRR and a further 26.6% provided by HES. In the 15,165 patients where both sources could provide an IMD rank, ranks differed in 1,061 patients (7%), with an average difference of 6,054 or 19% of the range of IMD scores. When IMD was grouped into fifths across the combined dataset, concordance between sources for those with data for both was 95.5%.

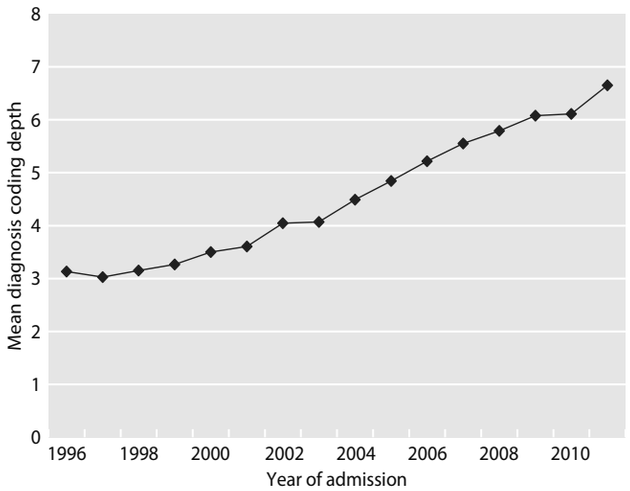

Fig. 13.2. Mean diagnosis coding depth according to date of admission

An additional 23.4% of patients had ethnicity derived bringing the total to 21,027 patients (98.9%). Disagreements in classification between sources were predominantly between Indian, Pakistani or Bangladeshi groups or Black Caribbean, Black African or Black Other groups (1,830 patients, 8.5%). Further re-grouping reduced the disagreement to 246 patients (1.2%). As expected there was a large variation in ethnicity across centres as demonstrated by the funnel plot in figure 13.3.

In patients with suitable HES outpatient data (N = 15,200) the number of patients with no documented contact with a nephrologist before starting RRT decreased from 8,330 to 2,216. New dates were derived in place of UKRR supplied data for 8,920 patients, including 608 patients with UKRR reported date first seen previously matching the date of first dialysis. However, 206 patients were documented as having no contact with renal services and 1,540 patients had still had no contact at 30 days from starting RRT.

For eight centres, the proportion of inpatient and outpatient care for RRT patients delivered by nephrology changed significantly during the follow-up period, suggesting changes in coding practices within the hospitals providing HES data. These centres are excluded from late referral analyses. As previously described in more select cohorts [13] the proportion of patients being seen as a late presentation has decreased over time, with the sharpest decline in the first 12 months of this analysis as demonstrated in figure 13.4, however residual variation between centres regarding timely referral persisted beyond this time, as detailed in table 13.3.

Primary renal disease was coded missing or uncertain in the UKRR dataset for 26.0% (4,978/19,525) of patients surviving over 90 days. Seventy one ICD10 codes that were routinely employed in HES to describe primary renal disease were identified from 67,210 admissions in the 12 month HES observation window and computed primary renal disease in 451 additional patients. Allowing the presence of diabetes to infer primary renal disease yielded 798 additional primary diagnoses, however after this process 3,729 patients (19.5%) were still without a primary renal disease (table 13.5).

Comorbidity

In patients who had UKRR comorbidity completed (53.7%), correlation between HES and UKRR datasets was reasonable, with an overall concordance between individual comorbidities of 93% excluding diabetes, amputation for peripheral vascular disease and

Table 13.2. Patient demography enhanced by HES in 21,271 patients

Centre	Incident patients N	Suitable for analysis %	Ethnicity			Deprivation centile	
			White %	Black %	S Asian %	Mean	95% CI
Basildon	176	98.9	93.7	*	*	48	44–52
Birmingham – Heartlands	512	98.8	70.8	7.1	17.4	66	63–69
Birmingham – QEH	571	97.9	69.6	8.9	14.5	64	62–66
Bradford	313	98.7	59.5	1.9	27.5	71	68–74
Brighton	361	99.4	85.0	1.4	1.4	45	42–48
Bristol	792	98.5	93.5	2.7	1.5	42	40–44
Cambridge	535	97.2	89.6	*	2.1	35	33–37
Carlisle	142	95.8	99.3	*	*	59	55–63
Carshalton	902	98.8	72.1	8.9	5.8	31	29–33
Chelmsford	139	100.0	93.5	*	*	33	30–37
Coventry	436	97.5	80.7	3.1	12.2	48	45–51
Derby	265	99.2	84.0	3.8	5.3	51	48–55
Dorchester	231	100.0	84.4	*	*	39	36–42
Dudley	203	99.0	91.5	3.5	4.5	58	55–62
Exeter	501	99.6	98.4	*	*	49	47–51
Gloucester	296	98.6	96.2	1.7	*	38	35–41
Hull	525	99.4	94.4	*	*	59	57–61
Ipswich	225	96.9	91.3	3.2	*	42	39–45
Leeds	871	99.2	81.0	2.2	9.3	61	60–63
Leicester	943	99.6	82.4	2.8	10.9	48	46–50
Liverpool – Aintree	67	100.0	94.0	*	*	69	63–76
Liverpool – RI	653	92.8	94.1	1	*	71	69–73
London – Barts	560	99.6	41.8	21.5	21.9	69	67–71
London – Guys	669	95.5	66.7	21.9	2.2	55	53–57
London – Kings	581	99.1	55.2	24.7	5.2	59	57–61
London – RFree	326	99.7	46.8	21.5	9.5	63	60–66
London – West	1,411	98.1	43.1	15.8	14.3	56	54–57
Middlesbrough	509	98.8	95.8	*	1.6	66	63–68
Newcastle-upon-Tyne	513	98.8	94.1	*	2.8	65	62–67
Norwich	324	99.7	97.8	*	*	44	42–47
Nottingham	579	99.5	90.5	3.5	2.4	60	58–62
Oxford	831	98.9	87.8	2.8	3.5	31	29–32
Plymouth	348	99.7	95.7	*	*	56	54–59
Portsmouth	718	98.5	94.2	0.8	1.1	38	36–40
Preston	536	99.3	83.1	2.6	10.0	59	57–62
Reading	361	99.4	76.9	7.2	10.3	34	32–37
Salford	497	99.8	81.7	*	9.7	68	66–70
Sheffield	801	99.4	91.5	1.8	3.6	65	63–67
Shrewsbury	151	84.8	89.8	3.9	*	52	49–56
Southend-on-Sea	202	97.5	84.3	2.5	3.0	44	40–47
Stevenage	517	96.5	74.7	10.4	9.6	39	37–41
Sunderland	279	97.8	98.5	*	*	71	68–74
Truro	263	97.7	94.6	*	*	61	60–63
Wirral	271	92.3	91.2	*	*	58	54–62
Wolverhampton	464	98.7	80.3	5.7	10.5	65	62–67
York	261	99.2	92.3	*	*	35	32–38
Total	**21,631**	**98.3**	**80.4**	**5.6**	**6.4**	**53**	

* Counts of less than five patients censored as per ONS recommendations
Note: two patients from a non-English centre excluded from total cohort

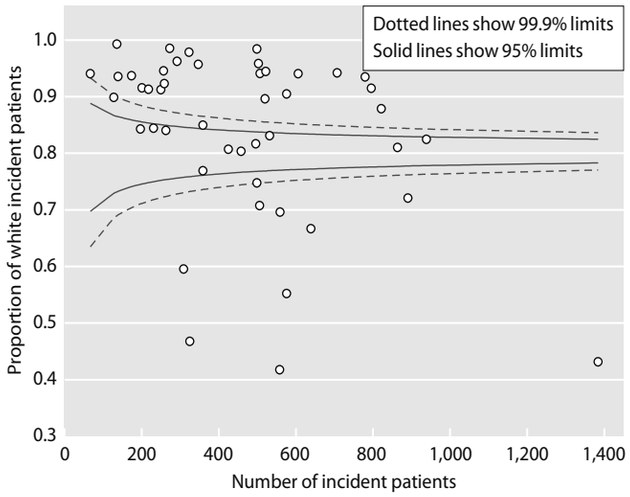

Fig. 13.3. Funnel plot detailing the proportion of white incident patients in England by centre

congestive cardiac failure (figure 13.5). Congestive cardiac failure as a comorbidity was introduced into the UKRR dataset in 2003, but centres do not appear to have used it during the recruitment period. Amputation is coded in HES as a procedure, but the reason for amputation is not part of this procedure code. Hazard ratios for survival censored at three years for the UKRR comorbidities derived from HES in 19,119 patients surviving beyond 90 days with admissions prior to starting RRT are detailed in table 13.6, including race stratified effect estimates for patients coded White and South Asian and comorbidity scores assigned to the presence of these conditions. There was no statistically significant difference in the incidence of individual comorbid conditions as derived by HES, between those with or without a UKRR comorbidity score.

Converting the multivariate hazard ratios into weighted scores, some conditions had statistically significant associated hazard for mortality but insufficient effect size to assign a score (table 13.6). The overall mean comorbid score per patient was 0.88 (95% CI 0.86–0.89) with haemodialysis patients scoring higher when compared to peritoneal dialysis patients (0.96, 95% CI 0.95–0.98 vs. 0.65, 95% CI 0.63–0.68). 48.3% of patients had a combined comorbid score based on UKRR conditions of zero. Comorbidity score increased linearly with age but reduced over the age of seventy (figure 13.6). The comorbid score did progressively increase over the years incident patients were sampled from (figure 13.7), with statistically significant differences between years (ANOVA $p < 0.001$) although the differences between scores were small.

Centre-based comorbidity scores for UKRR conditions were surprisingly uniform overall as detailed in figure 13.8a, however there were differences in the distribution of comorbidity per modality in peritoneal dialysis and haemodialysis for centres (figure 13.8b). Correlation of per centre mean comorbid scores for haemodialysis and peritoneal dialysis per centre was 0.223 ($p = 0.141$). Centres with deeper coding generally had higher comorbidity scores (Spearman's correlation 0.313, $p = 0.034$).

Location of Death

Table 13.4 highlights that there were differences between centres when comparing outcomes by the

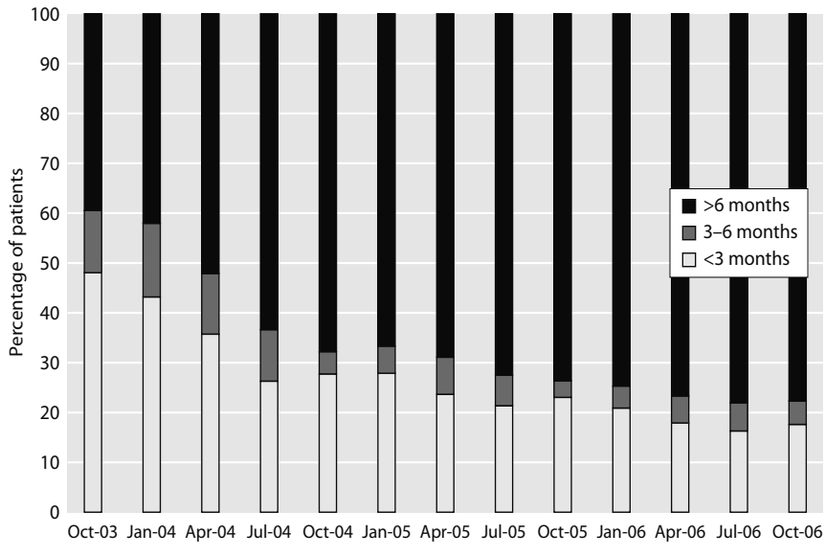

Fig. 13.4. Late presentation over time determined from HES speciality coding for 38 centres with consistent HES coding between October 2003 and October 2006

Table 13.3. Admissions under nephrology and presentation time

Centre	Admissions under nephrology in first 12 months		Incident patients Oct 2003–Dec 2006 (N)	Time from first seen by a nephrologist to starting RRT		
	Total admissions (N)	Proportion under nephrology (%)		Seen <90 days (%)	90 days–6 months (%)	>6 months (%)
Basildon	326	3.7	132	22.7	5.3	72.0
Birmingham – Heartlands	1,029	56.0	365	32.3	12.3	55.3
Birmingham – QEH	1,290	45.7	559	32.6	8.1	59.4
Bradford	663	38.9	188	19.1	5.3	75.5
Brighton	893	69.4	359	26.7	12.8	60.4
Bristol	1,931	77.4	545	21.1	4.0	74.9
Cambridge	922	31.7	377	35.5	9.5	54.9
Carlisle	645	64.5	85	27.1	9.4	63.5
Carshalton	2,239	60.6	574	31.9	8.5	59.6
Chelmsford						
Coventry	817	54.0	276	25.4	8.3	66.3
Derby	524	57.6	221	21.7	10.4	67.9
Dorchester	565	42.5	179	13.4	7.3	79.3
Dudley						
Exeter						
Gloucester	744	69.9	195	22.6	8.7	68.7
Hull	1,314	52.1	352	33.8	7.1	59.1
Ipswich	633	52.6	150	28.0	7.3	64.7
Leeds	1,929	64.0	578	24.6	5.7	69.7
Leicester	2,261	41.1	662	18.3	5.7	76.0
Liverpool – Aintree	211	65.4	67	20.9	9.0	70.1
Liverpool – RI	2,017	72.6	395	28.9	8.4	62.8
London – Barts	1,145	71.3	558	30.8	7.7	61.5
London – Guys	1,447	76.9	425	34.1	6.1	59.8
London – Kings	1,315	76.1	385	33.0	8.3	58.7
London – RFree	677	49.2	325	22.8	5.2	72.0
London – West	2,700	67.2	952	33.8	6.9	59.2
Middlesbrough	1,377	68.1	307	16.0	5.9	78.2
Newcastle-upon-Tyne	1,619	60.7	348	23.0	5.5	71.6
Norwich	937	51.2	323	24.5	4.3	71.2
Nottingham	1,345	60.7	407	21.6	5.7	72.7
Oxford	2,269	61.9	524	21.6	6.9	71.6
Plymouth	752	64.5	234	30.8	11.1	58.1
Portsmouth	2,279	71.8	462	16.9	8.2	74.9
Preston	2,422	62.4	195	22.6	8.7	68.7
Reading						
Salford	3,129	81.3	389	22.6	8.5	68.9
Sheffield	2,080	77.1	524	17.2	5.7	77.1
Shrewsbury						
Southend-on-Sea						
Stevenage	931	63.6	317	16.1	3.8	80.1
Sunderland	896	56.9	181	28.7	7.7	63.5
Truro	653	47.0	157	19.7	10.2	70.1
Wirral	551	34.5	170	37.1	4.7	58.2
Wolverhampton						
York						
Total	**49,477**	**62.6**	**13,598**	**26.2**	**7.2**	**66.6**

Centres with no statistics: variation in HES speciality coding over the follow-up period

Table 13.4. Location of death in patients surviving over 90 days

Centre	Patients surviving over 90 days N	Deaths in hospital %	Deaths in hospital and 30 days post-discharge %	Deaths with no contact within 30 days %
Basildon	159	66.2	77.5	22.5
Birmingham – Heartlds	450	64.1	76.2	23.8
Birmingham – QEH	521	65.8	80.9	19.1
Bradford	281	68.2	77.5	22.5
Brighton	333	*50.3**	*65.6**	**34.4****
Bristol	695	66.5	79.9	20.1
Cambridge	473	59.5	73.6	26.4
Carlisle	128	66.3	78.3	21.7
Carshalton	820	66.4	80.4	19.6
Chelmsford	121	72.4	85.5	14.5
Coventry	382	66.7	76.6	23.4
Derby	239	64.1	76.9	23.1
Dorchester	214	58.3	75.7	24.3
Dudley	176	78.6	84.7	15.3
Exeter	450	59.9	78.7	21.3
Gloucester	274	67.5	76.8	23.2
Hull	466	64.1	81.3	18.7
Ipswich	197	64.4	78.8	21.2
Leeds	778	66.8	83.4	16.6
Leicester	871	69.7	81.7	18.3
Liverpool – Aintree	62	75.9	86.2	13.8
Liverpool – RI	542	64.7	86.0	14.0
London – Barts	535	62.5	77.6	22.4
London – Guys	619	60.7	74.8	25.2
London – Kings	550	*46.8**	*64.4**	35.6**
London – RFree	314	64.3	78.6	21.4
London – West	1,325	64.9	76.1	23.9
Middlesbrough	444	70.9	84.1	*15.9**
Newcastle-upon-Tyne	459	75.5**	86.5	13.5
Norwich	278	60.8	74.5	25.5
Nottingham	520	71.6	83.8	16.2
Oxford	764	60.5	76.0	24.0
Plymouth	288	64.7	82.7	17.3
Portsmouth	642	63.6	80.4	19.6
Preston	506	61.2	77.2	22.8
Reading	334	63.4	72.7	27.3
Salford	468	67.4	82.4	*17.6**
Sheffield	739	70.4	84.3	15.7
Shrewsbury	114	49.1	75.4	24.6
Southend-on-Sea	172	72.9	81.2	18.8
Stevenage	459	62.2	76.8	23.2
Sunderland	254	71.4	84.4	*15.6**
Truro	239	71.2	88.5	11.5
Wirral	230	71.4	85.7	14.3
Wolverhampton	407	64.8	77.2	22.8
York	233	62.4	80.1	19.9
Total	**19,525**	**65.0**	**79.2**	**20.8**

* italics, lower than expected
** bold, higher than expected

Table 13.5. Primary renal disease before and after augmentation with 12 months HES data around the start of RRT

Primary renal disease	Before HES enhancement %	After HES enhancement, excluding diabetes %	After HES enhancement, including diabetes %
Missing	3.4	2.8	1.9
Diabetes	20.8	20.8	25.0
GN	10.9	11.0	11.0
Hypertension	5.9	5.9	5.9
PKD	6.9	7.7	7.7
Pyelonephritis	7.7	8.1	8.1
Reno-Vascular Disease	6.8	6.9	6.9
Other	15.1	16.0	16.0
Uncertain	22.6	20.9	17.6

GN – glomerulonephritis; PKD – polycystic kidney disease

location of death. Overall, 65.0% of patients died in a hospital classed as an acute provider (range 46.8–78.0%), with an additional 14.2% of patients having been discharged from an acute provider in the preceding 30 days (range 6.1–26.3 %) and the remaining 20.8% dying with no hospitalisation with an acute provider in the preceding 30 days (range 11.5–35.6%). Two centres were outliers for the proportion of deaths occurring outside hospital with no inpatient contact in the last 30 days, however no outliers were identified comparing in-hospital and 30-day mortality. Location of death per centre is summarised in table 13.4 with outliers highlighted.

Discussion

An essential function of any chronic disease registry is to accurately compare across provider centres the hard outcomes such as survival and hospitalisation. Patients maintained on renal replacement therapy have high morbidity and mortality and the outcomes mentioned need adequate adjustment particularly for comorbid diseases, ethnicity and socioeconomic factors. In response to the problem of missing data and the absence of morbidity and hospitalisation data within the UK Renal Registry dataset, it was possible to link 21,633 UKRR incident patients to HES data. Subsequent

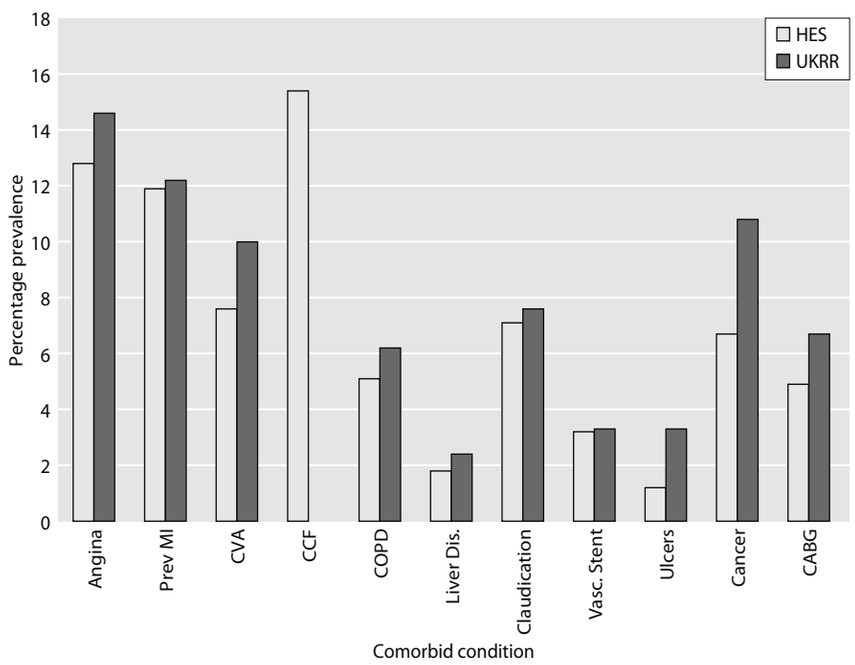

Fig. 13.5. Prevalence of comorbid conditions at the time of starting RRT derived from UKRR and HES in 10,276 patients with data from both sources
Prev MI – previous myocardial infarction
CVA – cerebrovascular accident
CCF – congestive cardiac failure
CABG – coronary artery bypass graft

Table 13.6. Hazard ratios for UKRR comorbidities with greater than 2% prevalence adjusted for age in patients surviving 90 days from starting renal replacement therapy

Condition	Univariate HR (95%CI)	Multivariate HR (95%CI)	Score	Caucasian (95%CI)	South Asian (95%CI)
Angina	1.75 (1.64–1.87)*	1.05 (0.98–1.14)	0	1.04 (0.96–1.13)	1.25 (0.90–1.75)
Myocardial Infarction	1.94 (1.81–2.07)*	1.20 (1.11–1.3)*	1	1.18 (1.08–1.28)*	1.57 (1.09–2.26)**
Heart Failure	2.24 (2.11–2.37)*	1.41 (1.32–1.51)*	1	1.46 (1.36–1.57)*	1.04 (0.75–1.43)
Stroke	1.77 (1.63–1.92)*	1.28 (1.18–1.39)*	1	1.25 (1.14–1.36)*	1.71 (1.21–2.43)*
Diabetes	1.44 (1.37–1.52)*	1.28 (1.21–1.35)*	1	1.38 (1.3–1.47)*	1.69 (1.28–2.24)*
COPD	2.22 (2.03–2.43)*	1.45 (1.32–1.58)*	1	1.45 (1.32–1.59)*	0.54 (0.26–1.11)
Claudication	2.04 (1.88–2.21)*	1.21 (1.11–1.33)*	1	1.24 (1.13–1.36)*	1.02 (0.57–1.82)
Cancer	2.00 (1.84–2.17)*	1.43 (1.32–1.55)*	1	1.33 (1.22–1.46)*	1.16 (0.57–2.37)
CABG	1.21 (1.08–1.35)*	0.76 (0.67–0.86)*	0	0.80 (0.7–0.92)*	0.44 (0.26–0.74)*
Vascular Stent	2.10 (1.88–2.34)*	1.18 (1.05–1.33)*	0	1.17 (1.04–1.32)*	1.16 (0.43–3.13)

* $p < 0.01$
** $p < 0.05$
COPD – chronic obstructive pulmonary disease
CABG – coronary artery bypass graft
Note: diabetes can also reflect primary renal disease in addition to comorbidity

analysis was possible in 98.3% of patients, with ethnicity, socioeconomic data and comorbidity derived for more than 98% of this cohort, representing the most complete description of a UKRR incident cohort to date.

Dataset linkage represents a growth industry in medical research, and the UKRR were fortunate to be included in the panel of datasets included in the RCP pilot. This study has demonstrated that linkage with HES is possible and there are benefits. It allows reporting and research analysis on a greater proportion of patients recorded by the registry and allows more robust comparison between centres. It highlights that information routinely collected but found missing by the UKRR is recorded elsewhere within the health system to a level sufficient to derive information on the majority of patients.

These early findings do allow comparisons to other international registries. Previously reported hazard ratios for death for the presence of atherosclerotic heart disease, congestive cardiac failure, cerebrovascular disease, peripheral vascular disease, COPD, cancer and diabetes are similar to incident USRDS patients in 2000 [4]. To circumvent poor Medicare coverage of

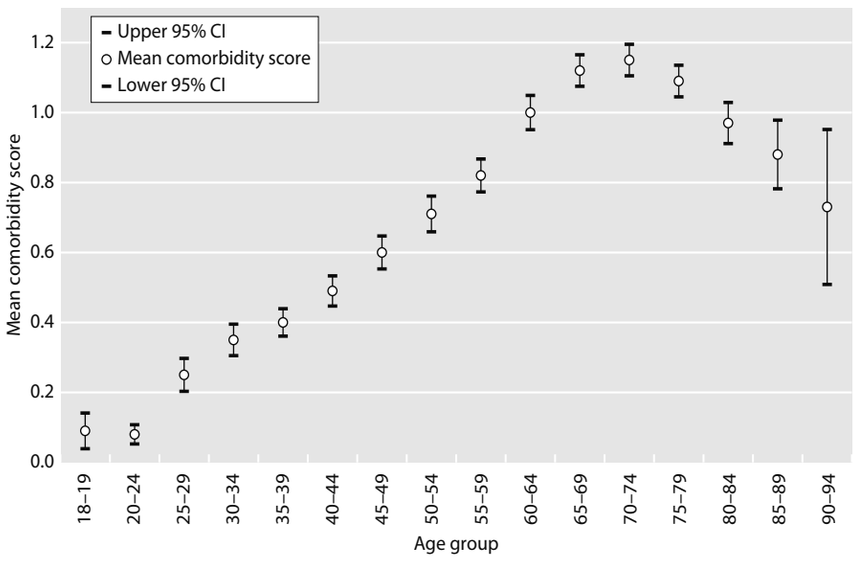

Fig. 13.6. Mean comorbidity score by age group

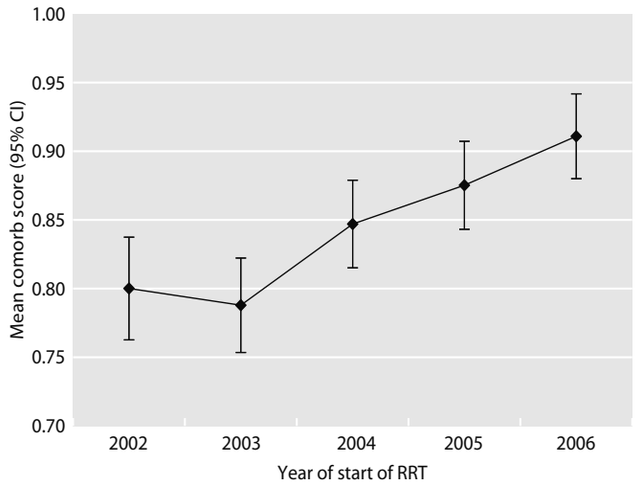

Fig. 13.7. Mean comorbid score derived from HES according to year of start of RRT

admissions prior to start of RRT, in addition to the Medical Evidence Report form admissions from the first nine months of RRT inform the comorbidity scoring performed by the USRDS. The prevalence of individual conditions in a 2001–2005 US white incident cohort is generally twice that reported here [2], and early accrued morbidity may explain some of this increase.

The difference in hazard ratios for different ethnic groups should not be over-interpreted as the confidence intervals for the comorbid conditions in South Asian patients are wide due to their smaller numbers. If scored separately South Asian patients would score higher for myocardial infarction and stroke but less for the remaining conditions. Comorbidity-adjusted centre survival may need to factor the ethnicity-specific impact of comorbid conditions.

The similar prevalence of comorbid conditions in those patients with and without UKRR comorbidity completed implies that missing UKRR comorbidity data may be random, or that comorbidity is similar between centres as demonstrated in figure 13.7. Previous registry reports in fact give us the answer, that in general, poor comorbidity returns are often a characteristic of a centre. The HES and UKRR comorbidity correlation is reasonable at 93%, but it may not be reasonable to assume the same in those patients who have missing comorbidity or that their comorbidity burden is similar to those with it completed. Previous UKRR research highlighted worse survival in patients who had no comorbidity coded [14], and an excess burden of unmeasured comorbid disease, or centre specific effects associated with poor data collection may explain this.

This study demonstrates a high rate of linkage, with only 149 patients (0.07%) resident in England having no linked HES data. There are theoretical reasons why an English RRT patient may have no HES data, but the employed linkage method is strongest when the NHS

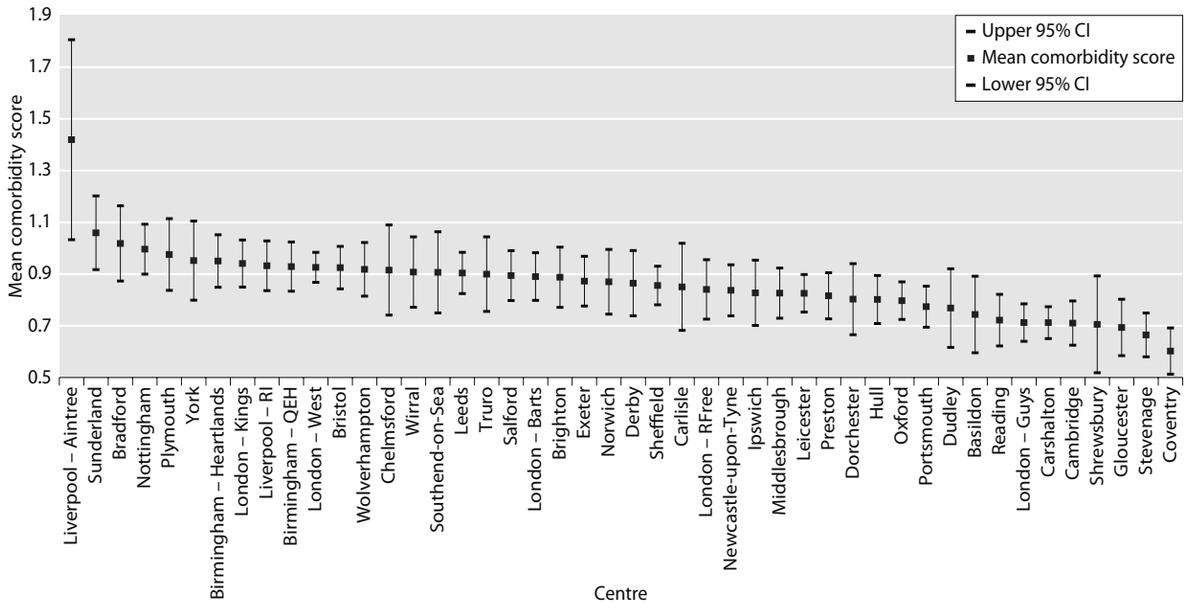

Fig. 13.8a. Mean comorbidity score per centre for patients surviving beyond 90 days, determined from UKRR comorbid conditions identified from admissions prior to starting RRT

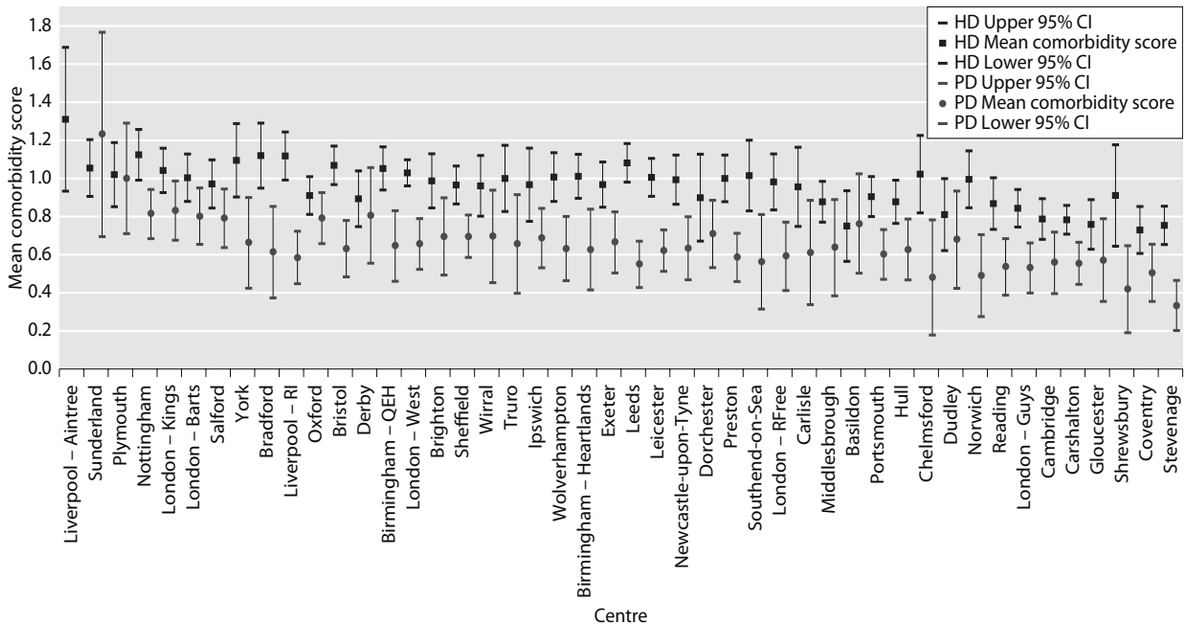

Fig. 13.8b. Mean comorbidity score per centre for patients surviving beyond 90 days stratified by RRT modality at 90 days, determined from UKRR comorbid conditions identified from admissions prior to starting RRT

number is complete and ensuring this would facilitate future linkages. Beyond the linkage validity, routine data has limitations. Issues relating to incorrect data may persist and even be masked by the use of HES data. Morbid or comorbid conditions cannot be classed as missing in the HES dataset, but simply that there are no comorbid conditions, unlike the UKRR dataset. Differences in how NHS trusts code admissions may hamper cause specific admission reporting. Since these data were collected, guidance has been issued on how activity in renal centres should be captured with HES [15]. Standardisation and consensus are needed to allow the greatest utility from a HES-UKRR combined dataset.

Coding practice has been shown elsewhere to have improved over the period in question at a similar rate [16]. Coding depth is around two codes greater for RRT patients than the national average and it is no surprise that there are centres who code deeper than others. The finding that comorbid scores for centres that code deeper are higher is logical, but the clinical significance of this when evaluating centre specific outcomes should be explored. Centres that code well may be doing other processes well leading to better outcomes, and this may dilute the impact comorbidity might have on performance measures.

HES data allows a more detailed and novel analysis than that previously hampered by missing data. Centre and modality specific admission rates and length of stay can be determined, reflecting varying practice patterns and patient experience. Cause specific admissions and related morbidity can be analysed, along with comprehensively adjusted centre-specific incident survival. Hospital standardised mortality rates allows a more direct measure of in-hospital care, both at centre and trust level. Combined with ONS data to determine 30-day mortality following discharge they allow a more complete reporting of hospital associated death [11]. A range of centre-specific performance measures based around hospitalisation and comorbidity will be delivered as part of this project in the coming years.

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Conflicts of interest: none

References

1 Webb L, Gilg J, Feest T, Fogarty D: UK Renal Registry 13th Annual Report (December 2010): Chapter 4: Comorbidities and current smoking status amongst patients starting renal replacement therapy in England, Wales and Northern Ireland from 2008 to 2009. Nephron Clin Pract. 2011;119(suppl 2):c85–96

2 United States Renal Data System:. USRDS 2011 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. In: National Institutes of Health NIoDaDaKD, editor. Bethesda, MD2011

3 Quinn MP, Cardwell CR, Rainey A, McNamee PT, Kee F, Maxwell AP, et al.: The impact of admissions for the management of end-stage renal disease on hospital bed occupancy. Nephron Clin Pract. 2009; 113(4):c315–20

4 Liu J, Huang Z, Gilbertson DT, Foley RN, Collins AJ: An improved comorbidity index for outcome analyses among dialysis patients. Kidney Int. 2009;77(2):141–51

5 What is HES? – NHS Hospital Episodes Statistics Website. 2009; Available from: http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID = 1937&categoryID = 456

6 The NHS Information Centre: How do you spell that?

7 Charlson ME, Pompei P, Ales KL, MacKenzie CR: A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40(5):373–83

8 Elixhauser A, Steiner C, Harris DR, Coffey RM: Comorbidity measures for use with administrative data. Med Care. 1998 Jan;36(1):8–27

9 Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al.: Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care. 2005 Nov;43(11):1130–9

10 Indices of deprivation 2004. 2007 [cited 2012 1/5/2012]; Lookup tables for LSOA to IMD. Available from: http://webarchive.nationalarchives.gov.uk/+/http://www.communities.gov.uk/archived/general-content/communities/indicesofdeprivation/216309/.

11 Campbell MJ, Jacques RM, Fotheringham J, Maheswaran R, Nicholl J: Developing a summary hospital mortality index: retrospective analysis in English hospitals over five years. BMJ. 2012 2012-03-01 00:00:00;344

12 Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al.: Updating and Validating the Charlson Comorbidity Index and Score for Risk Adjustment in Hospital Discharge Abstracts Using Data From 6 Countries. American Journal of Epidemiology. 2011 March 15, 2011; 173(6):676–82

13 Gilg J, Castledine C, Fogarty D, Feest T: Chapter 1: UK RRT Incidence in 2009: National and Centre-Specific Analyses. Nephron Clin Pract. 2011; 119(suppl 2):c1–c25

14 Collier T, Steenkamp R, Tomson C, Caskey F, Ansell D, Roderick P, et al.: Patterns and effects of missing comorbidity data for patients starting renal replacement therapy in England, Wales and Northern Ireland. Nephrology Dialysis Transplantation. 2011 November 1, 2011;26(11): 3651–8

15 NHS Kidney Care: A guide to recording activity within renal units for national reporting. 2011

16 Robinson P: Hospital standardised mortality ratios and their use as a measure of quality, CHKS Technical Document, 2010

UK Renal Registry 14th Annual Report: Chapter 14 Comparative Audit of Peritoneal Dialysis Catheter Placement in England, Northern Ireland and Wales in 2011: a summary of progress to July 2012

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Key Words
Adequacy · Haemodialysis · Urea reduction ratio

Summary

- The first PD access audit covering England, Northern Ireland and Wales was conducted during April to June 2012 looking at incident dialysis patients in 2011.
- Forty three data collection spreadsheets were returned from a total of 63 centres describing 863 PD catheter placements of which 225 had a missing date of insertion.
- A comparative PD catheter audit has the potential to provide valuable information on an important patient related outcome measure and lead to an improvement in patient experience.
- Results will be published on the UK Renal Registry website as soon as they are available.

Introduction

The central paradigm of effective peritoneal dialysis (PD) is an appropriate standard of PD catheter function. Catheter function defines clinical value and ultimately influences the modality experience of the patient. The obvious question therefore arises – what represents an 'appropriate standard' of PD catheter function? Unfortunately, until relatively recently, PD catheter access outcomes have been neglected, although a UK access survey did report that most catheters were placed using the open surgical technique [1]. To date, only the French speaking registry collects and reports comparative data on the PD access procedure and catheter survival (92% at 2 years post insertion) [2]. In an attempt to address this deficit, a 2009 Renal Association working party recommended that the UK Renal Registry should collect centre specific information on various PD access outcome measures including catheter functionality and post-insertion complications [3]. Until now, there has been no provision for this in the UK, however, guidelines for the placement of peritoneal dialysis access including audit standards were published in conjunction with the International Society of Peritoneal Dialysis in 2010 [4].

In 2010, multisite audit conducted across Yorkshire and the Humber (Y & H) demonstrated both significant centre variation in one year catheter function as well as ambiguities in audit standard interpretation. One example being the definition of 'significant haemorrhage' as applied to complications post PD catheter insertion [5]. Together this highlights a need for robust national PD access data to support a responsive access service with a high quality patient experience.

Methods

During 2011 a successful application was made on behalf of the Y & H Renal Network to the Healthcare Quality Improvement Partnership (HQIP) to support a larger multisite (more than 10 sites) audit of PD access in collaboration with the UK Renal Registry. The ultimate aim of the project was to develop an effective national PD access audit with governance arrangements relating to data protection and patient confidentiality held within the UK Renal Registry. The brief permitted a spreadsheet based data collection process for the first year, with subsequent data collection through the Renal Registry's electronic processes. Patient and public partnership were engaged at several levels: during guideline development; at discussions of the Y & H Home Therapies and Self Care strategy; the UK Renal Registry committee and as part of the access audit steering group. Opportunity has arisen to combine the collection of these with a vascular access audit providing valuable data on both PD and haemodialysis access.

During the development of the audit several competing objectives have had to be balanced. It was realised that there was a need to minimise the data to strengthen data completeness including clinically relevant data and objective reproducible measures. The principal data fields (table 14.1) have been refined following a pilot audit of six centres in Y & H and discussed extensively through the Y & H PD audit group and the Dialysis Study Group of the UK Renal Registry. However an existing UK Renal Registry list of causes of access complications had to be used in the interests of expedience with the consequence that it was not piloted and included a number of anomalies (for example there was no option for the possibility that the cause of impaired drainage was unknown (table 14.2) and drainage pain is not listed as a possible cause).

Table 14.1. Data fields for peritoneal dialysis access audit

Data field
Access in use at first ever dialysis (during 2011)
Date of first ever dialysis
Date first seen by renal physician
Access in use at 3 months
Assessed by surgeon for an AVF[a], AVG[b] or peritoneal dialysis catheter at least 3 months before dialysis
Date PD catheter first used
PD catheter Insertion technique
Date of PD catheter failure
PD catheter insertion technique
Detail of surveillance/complication intervention type
Reason for catheter failure
Primary renal diagnosis
BMI
Diabetes – had diabetes at time of catheter insertion (types 1 and 2)
Peritonitis episode within 2/52 of insertion

[a]Arteriovenous fistula
[b]Arteriovenous graft

Results

The first PD access audit covering England, Northern Ireland and Wales was conducted during April to June 2012 looking at incident dialysis patients in 2011. Forty three data collection spreadsheets were returned from a total of 63 centres describing 863 PD catheter placements of which 225 had a missing date of insertion.

Although a report is not currently (August 2012) available, electronic information will be made available as soon as possible via the UK Renal Registry website.

Table 14.2. Access complications

UKRR code	Description	Essential
80	Subcutaneous haematoma	
81	Tunnel infection	Y
82	Peritonitis	
83	Subcutaneous leak	
84	Peritoneal leak	
85	Peritoneo-pleural leak	
86	Inadequate inflow – malposition	
87	Inadequate inflow – fibrin	
88	Inadequate inflow – omental wrap	
	Drainage problem – leak, inadequate flow[a]	*Y*
89	Inadequate outflow – malposition	
90	Inadequate outflow – fibrin	
91	Inadequate outflow – omental wrap	
92	Hernia	
93	Catheter fell out	Y
94	Externalisation of the cuff	
95	EPS encapsulating peritoneal sclerosis	
96	Bowel Perforation	
97	PD catheter exit site infection	Y

[a]Not collected for this audit phase

It is intended to publish centre specific primary PD catheter access success as well as peritonitis rates at less than two weeks post PD catheter insertion. Centres that are identified as outliers through this process will need to conduct a local review of procedures in order to optimise outcome.

Discussion

There is clearly much to be learned as the project is progressed, including minimising data ambiguities and trying to maximise data completeness (for example it is possible that a patient with a catheter that never worked and never had PD may be overlooked in this audit). However, a comparative PD catheter audit has the potential to provide valuable information on an important patient related outcome measure and lead to an improvement in patient experience.

Acknowledgement

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Conflicts of interest: none

References

1 Wilkie M, Wild J. Peritoneal Dialysis Access – Results from a UK Survey. Perit Dial Int. 2009 May–Jun;29(3):355–357
2 Verger C, Ryckelynck JP, Duman M, Veniez G, Lobbedez T, Boulanger E, et al. French peritoneal dialysis registry (RDPLF): outline and main results. Kidney Int Suppl. 2006 Nov(103):S12–S20
3 Renal Association. Report of the Renal Association Working Party on Peritoneal Access, Renal Association UK. 2009
4 Figueiredo A, Goh BL, Jenkins S, Johnson DW, Mactier R, Ramalakshmi S, et al. Clinical practice guidelines for peritoneal access. Perit Dial Int. 2010 Jul–Aug;30(4):424–429
5 Briggs V, Davies S, Jenkins S, Wilkie M. Getting more out of clinical practice guidelines. Perit Dial Int. 2011 Nov–Dec;31(6):631–635

Appendix A: The UK Renal Registry Statement of Purpose

This appendix is available on the web only and can be found at www.renalreg.org

Appendix B: Definitions and Analysis Criteria

This appendix is available on the web only and can be found at www.renalreg.org

Appendix C: Renal Services Described for Non-physicians

This appendix is available on the web only and can be found at www.renalreg.org

Appendix D: Methodology used for Analyses of PCT/HB Incidence and Prevalence and of Standardised Ratios

This appendix is available on the web only and can be found at www.renalreg.org

Appendix E: Methodology for Estimating Catchment Populations of Renal Centres in England for Dialysis Patients

This appendix is available on the web only and can be found at www.renalreg.org

Appendix F: Additional Data Tables for 2010 Incident and Prevalent Patients

This appendix is available on the web only and can be found at www.renalreg.org

Appendix G: UK Renal Registry Dataset Specification

This appendix is available on the web only and can be found at www.renalreg.org

Appendix H: Coding: Ethnicity, EDTA Primary Renal Diagnoses, EDTA Causes of Death

This appendix is available on the web only and can be found at www.renalreg.org

UK Renal Registry 14th Annual Report: 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

EDTA	European Dialysis and Transplant Association
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
Kt/V	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)
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	Number
NI	Northern Ireland
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
NMO	Non-mixed origin
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
US	United States
USA	United States of America
USRDS	United States Renal Data System

UK Renal Registry 14th Annual Report: Appendix J Laboratory conversion factors

	Conversion factors from SI units
Albumin	g/dl = g/L × 0.1
Aluminium	μg/L = μmol/L × 27.3
Bicarbonate	mg/dl = mmol/L × 6.1
Calcium	mg/dl = mmol/L × 4
Calcium × phosphate	$mg^2/dl^2 = mmol^2/L^2 \times 12.4$
Cholesterol	mg/dl = mmol/L × 38.6
Creatinine	mg/dl = μmol/L × 0.011
Glucose	mg/dl = mmol/L × 18
Haemoglobin	Hct = g/dl × 3.11 (*NB this factor is variable*)
Phosphate	mg/dl = mmol/L × 3.1
PTH	ng/L = pmol/L × 9.5
Urea	mg/dl = mmol/L × 6.0
Urea nitrogen	mg/dl = mmol/L × 2.8

UK Renal Registry 14th Annual Report: 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 Infirmary	Newc	England

City	Hospital	Abbreviation	Country
Norwich	Norfolk and Norwich University Hospital	Norwch	England
Nottingham	Nottingham City Hospital	Nottm	England
Oxford	Oxford Radcliffe Hospital	Oxford	England
Plymouth	Derriford Hospital	Plymth	England
Portsmouth	Queen Alexandra Hospital	Ports	England
Preston	Royal Preston Hospital	Prestn	England
Reading	Royal Berkshire Hospital	Redng	England
Sheffield	Northern General Hospital	Sheff	England
Shrewsbury	Royal Shrewsbury Hospital	Shrew	England
Southend	Southend Hospital	Sthend	England
Stevenage	Lister Hospital	Stevng	England
Stoke	University Hospital of North Staffordshire	Stoke	England
Sunderland	Sunderland Royal Hospital	Sund	England
Truro	Royal Cornwall Hospital	Truro	England
Wirral	Arrowe Park Hospital	Wirral	England
Wolverhampton	New Cross Hospital	Wolve	England
York	York District General Hospital	York	England
Bangor	Ysbyty Gwynedd	Bangor	Wales
Cardiff	University Hospital of Wales	Cardff	Wales
Clwyd	Ysbyty Glan Clwyd	Clwyd	Wales
Swansea	Morriston Hospital	Swanse	Wales
Wrexham	Wrexham Maelor Hospital	Wrexm	Wales
Aberdeen	Aberdeen Royal Infirmary	Abrdn	Scotland
Airdrie	Monklands Hospital	Airdrie	Scotland
Dumfries	Dumfries & Galloway Royal Infirmary	D & Gall	Scotland
Dundee	Ninewells Hospital	Dundee	Scotland
Dunfermline	Queen Margaret Hospital	Dunfn	Scotland
Edinburgh	Edinburgh Royal Infirmary	Edinb	Scotland
Glasgow	Glasgow Western Infirmary, Royal Infirmary and Stobhill Hospital	Glasgw	Scotland
Inverness	Raigmore Hospital	Inverns	Scotland
Kilmarnock	Crosshouse Hospital	Klmarnk	Scotland
Antrim	Antrim Hospital	Antrim	Northern Ireland
Belfast	Belfast City Hospital	Belfast	Northern Ireland
Derry	Altnagelvin Hospital	Derry	Northern Ireland
Newry	Daisy Hill Hospital	Newry	Northern Ireland
Tyrone	Tyrone County Hospital	Tyrone	Northern Ireland
Ulster	Ulster Hospital	Ulster	Northern Ireland

Paediatric Centres

City	Hospital	Abbreviation	Country
Belfast	Royal Belfast Hospital for Children	Blfst_P	Northern Ireland
Birmingham	Birmingham Children's Hospital	Bham_P	England
Bristol	Bristol Royal Hospital for Children	Brstl_P	England
Cardiff	Kruf Children's Kidney Centre	Cardf_P	Wales
Glasgow	Royal Hospital for Sick Children	Glasg_P	Scotland
Leeds	St James's University Hospital – Paediatric	Leeds_P	England
Liverpool	Royal Liverpool Children's Hospital	Livpl_P	England
London	Guy's Hospital – Paediatric	L Eve_P	England
London	Great Ormond Street Hospital for Children	LGOSH_P	England
Manchester	Royal Manchester Children's Hospital	Manch_P	England
Newcastle	Royal Victoria Infirmary – Paediatric	Newc_P	England
Nottingham	Nottingham City Hospital – Paediatric	Nottm_P	England
Southampton	Southampton General Hospital – Paediatric	Soton_P	England