Chapter 9
Haemoglobin, Ferritin and Erythropoietin amongst UK Adult Dialysis Patients in 2009: national and centre-specific analyses

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Key Words
Anaemia · Chronic kidney disease · Dialysis · End stage renal disease · Epidemiology · Erythropoietin · Erythropoietin Stimulating Agent · Ferritin · Haemodialysis · Haemoglobin · Quality improvement · Peritoneal dialysis

Summary

- In 2009, the median Hb of patients at the time of starting dialysis in the UK was 10.2 g/dl with 55% of patients having a Hb $\geqslant$10.0 g/dl.
- The median Hb of prevalent patients on HD in the UK was 11.6 g/dl with an IQR of 10.6–12.4 g/dl.
- The median Hb of prevalent patients on PD in the UK was 11.7 g/dl with an IQR of 10.7–12.6 g/dl.
- In 2009, 56% of HD patients had Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl compared to 54% in 2008.
- In 2009, 54% of PD patients had Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl compared to 55% in 2008.
- In England, Wales and Northern Ireland the median ferritin in HD patients was 441 µg/L (IQR 289–629) and 96% of HD patients had a ferritin $\geqslant$100 µg/L. These figures were almost identical to those in 2008 (median ferritin 436 µg/L (IQR 289–622), 95% of patients with median $\geqslant$100 µg/L).
- In England, Wales and Northern Ireland the median ferritin in PD patients was 249 µg/L (IQR 142–412) with 86% of PD patients having a ferritin $\geqslant$100 µg/L.
- In 2009, the mean Erythropoietin Stimulating Agent (ESA) dose was higher for HD than PD patients (9,507 vs. 6,212 IU/week) in England, Wales and Northern Ireland.

Introduction

This chapter describes UK Renal Registry (UKRR) data relating to the management of anaemia in dialysis patients during 2009. The chapter reports outcomes of submitted variables and analyses of these variables in the context of established guidelines and recommendations.

The renal National Service Framework (NSF) part one [1] and the RA minimum standards document 3rd edition [2] state that individuals with chronic kidney disease (CKD) should achieve a haemoglobin (Hb) of at least 10 g/dl within 6 months of being seen by a nephrologist, unless there is a specific reason why it was unachievable. At present the UKRR does not collect Hb measurements specifically from patients 6 months after meeting a nephrologist. However an indication of the attainment of this standard is given by the Hb of the incident patient population (i.e. the Hb at the start of dialysis). The achievement of these standards is mainly through the use of iron therapy (oral and intravenous) and Erythropoietin Stimulating Agents (ESAs).

The European Best Practice Guidelines (EBPG) [3] set a minimum target of 11 g/dl but suggest not to go higher than 12 g/dl in severe cardiovascular disease. The United States Kidney Disease Outcomes Quality Initiative (KDOQI) [4] guidelines set a target Hb range of 11–12 g/dl with a recommendation that the Hb target should not be greater than 13.0 g/dl. The NICE guidelines published in 2006 [5] and the 4th edition of the RA Clinical Practice Guidelines 2006 [6] recommended an outcome Hb of between 10.5 and 12.5 g/dl (with ESA dose changes considered at 11 and 12 g/dl) which allows for the difficulty in consistently narrowing the distribution to between 11 and 12 g/dl. Since 2007, the UKRR Annual Report has reported how the attempt to comply with both the 10.5–12.5 g/dl range and the minimum standard of Hb $\geqslant$ 10.0 g/dl has impacted on performance against a combination of measures. The risks associated with low ($<$10 g/dl) and high ($>$13 g/dl) Hb are not necessarily equivalent.

The national and international recommendations for target iron status in CKD used in this chapter remain unchanged from the 2006 UKRR Annual Report. The 2007 Renal Association (RA) Clinical Practice Guidelines Document, revised European Best Practice Guidelines (EBPGII), Dialysis Outcomes Quality Initiative (DOQI) guidelines and UK NICE anaemia guidelines all recommend a target serum ferritin greater than 100 µg/L and percentage transferrin saturation (TSAT) of more than 20% in patients with CKD. RA guidelines and EBPGII recommend hypochromic red cells (HRC) less than 10%. In addition, EBPGII recommends a target reticulocyte Hb content (CHr) greater than 29 pg/cell. KDOQI recommends a serum ferritin $>$200 µg/L for HD patients. The NICE guidelines suggest that a hypochromic red cell value $>$6% suggests ongoing iron deficiency.

To achieve adequate iron status across a patient population, RA guidelines and EBPGII advocate population target medians for ferritin of 200–500 µg/L, for TSAT of 30–40%, for hypochromic red cells of $<$2.5% and CHr of 35 pg/cell. EBPGII comments that a serum ferritin target for the treatment population of 200–500 µg/L ensures that 85–90% of patients attain a serum ferritin of 100 µg/L.

All guidelines advise that serum ferritin levels should not exceed 800 µg/L since the potential risk of toxicity increases without conferring additional benefit. The KDOQI and NICE guidelines advise against intravenous iron administration to patients with a ferritin $>$500 µg/L.

Serum ferritin has some disadvantages as an index of iron status. It measures storage iron rather than available iron, behaves as an acute phase reactant and is therefore increased in inflammatory states, malignancy and liver disease and may not accurately reflect iron stores if measured within a week of the administration of intravenous iron. Of the alternative measures of iron status available, HRC and CHr are generally considered superior to TSAT. Both however require specialised analysers to which few UK renal centres have easy access. Since TSAT is measured infrequently in many centres and most UK centres continue to use serum ferritin for routine iron management, ferritin remains the chosen index of iron status for this report.

The 5th edition of the UK Renal Association's Anaemia in CKD guideline [7] was published at the end of 2010 and attempted to unify targets with those published in the 2010 update NICE guideline on anaemia management in CKD [8]. In future reports the analyses will need to analyse performance against these new standards, but as this chapter examines 2009 data it remains appropriate to report against the old guidelines which were in use at the time. The KDIGO website [9] is a useful resource for comparison of international anaemia guidelines.

Methods

The incident and prevalent RRT cohorts for 2009 were analysed. The UKRR extracted quarterly data electronically from

renal centres in England, Wales and Northern Ireland; data from Scotland were provided by the Scottish Renal Registry. Patients receiving dialysis on 31st December 2009 were included in the prevalent analysis if they had been on the same modality of dialysis in the same centre for 3 months. The last available measurement of Hb from each patient from the last two quarters of 2009 was used for analysis. Patients were analysed as a complete cohort and also divided by modality into groups.

For the incident patient analyses, data from the first quarter after starting dialysis were used. Patients commencing RRT on PD or HD were included. Those receiving a pre-emptive transplant were excluded.

The last available ferritin measurement was taken from the last three quarters of the year and analysed for prevalent patients. Scotland is excluded from the analysis as data regarding ferritin is not included in its return.

The completeness of data items was analysed at both centre and country level. As in previous years all patients were included in analyses but centres with less than 50% completeness were excluded from the caterpillar and funnel plots showing centre performance. Centres providing relevant data from less than 20 patients were also excluded from the plots. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

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

The percentage achieving RA and other standards was calculated for Hb. The percentage of patients achieving serum ferritin $\geqslant 100\,\mu g/L$, $\geqslant 200\,\mu g/L$ and $\geqslant 800\,\mu g/L$ were also calculated. These are represented as caterpillar plots with 95% confidence intervals (CIs) shown.

Longitudinal analysis was performed to calculate overall changes in achievement of standards from 1998 to 2009.

The UK RA Clinical Practice [2, 6] and NICE [5] guidelines in operation at the time these data were collected were as follows:

Patients with CKD should achieve a Hb of at least 10 g/dl within 6 months of being seen by a nephrologist, unless there is a specific reason why it could not be achieved.

Patients with CKD treated with RRT should have a Hb of between 10.5 and 12.5 g/dl.

Patients with CKD should have a serum ferritin greater than 100 μg/L and percentage transferrin saturation (TSAT) of more than 20%.

Serum ferritin levels in patients with CKD should not exceed 800 μg/L.

Data regarding ESAs were collected from all renal centres. Erythropoietin data from the last quarter of 2009 were used. Scotland was excluded from the analysis as data regarding ESA was not included in its return. Centres were excluded if there was <90% completeness of ESA data. Centres reporting fewer than 70% of HD patients or fewer than 50% of PD patients treated with ESAs were considered to have incomplete data and were also excluded from further analysis. It is recognised that these exclusion criteria are relatively arbitrary but are in part based upon the frequency distribution graph of centres' ESA use. The percentage of patients on ESAs is calculated from these data and incomplete data returns risk seriously impacting on any conclusions drawn.

Data are presented as weekly erythropoietin dose. Doses of darbepoietin were harmonised with erythropoietin data by multiplying by 200 and correcting for frequency of administration less than weekly. No adjustments were made with respect to route of administration.

The ESA data were collected electronically from renal IT systems but in contrast to laboratory linked variables the ESA dose required manual data entry. The reliability depended upon who entered the data, whether the entry was linked to the prescription or whether the prescriptions were provided by the primary care physician. In the latter case, doses may not be as reliably updated as the link between data entry and prescription is indirect.

Results

Haemoglobin

Haemoglobin in incident dialysis patients

The Hb at the time of starting RRT gives the only indication of concordance with current anaemia management recommendations in the pre-dialysis (CKD 5 – not yet on dialysis) group.

Patients for conservative care of established renal failure were by definition excluded from the dataset. Patients were similarly excluded if they received a pre-emptive transplant. In the future the UKRR hopes to collect and report CKD 5 data from patients who subsequently commence RRT and for those managed conservatively.

The percentage of data returned and outcome Hb are listed in table 9.1. Nine of the ten renal centres excluded from this analysis are relatively small centres which had submitted data on fewer than 20 patients, only one was excluded because data completeness was less than 50% (Plymouth).

The median Hb of patients at the time of starting dialysis in the UK was 10.2 g/dl with 55% of patients having a Hb $\geqslant 10.0$ g/dl (vs. 10.2 g/dl and 57% for 2009 report). The variation between centres remained high (31–90%).

The median starting Hb by centre is shown in figure 9.1 and the percentage starting with a Hb $\geqslant 10.0$ g/dl by centre is given in figure 9.2. The distribution of Hb in incident dialysis patients during 2009 is shown in figure 9.3.

Incident dialysis patients from 2008 were followed for one year and the median haemoglobin (and percentage with a Hb $\geqslant 10.0$ g/dl) of survivors at the end of each

Table 9.1. Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis during 2009

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Abrdn	100	49	9.8	8.1–12.6	8.8–10.5	39
Airdrie	91	41	9.7	7.7–12.9	8.5–10.7	49
Antrim	91	20	9.9	7.3–11.7	9.0–10.8	40
B Heart	99	91	9.7	7.2–12.7	9.0–11.2	44
B QEH	76	173	9.9	7.2–13.1	8.8–11.0	49
Bangor	97	28	11.5	8.8–13.0	10.6–12.3	82
Basldn	100	23	9.6	8.0–11.8	9.0–10.4	39
Belfast	91	41	9.3	7.2–12.2	8.6–10.2	41
Bradfd	96	49	10.0	7.8–12.7	9.1–11.2	51
Brightn	100	42	10.9	8.1–13.4	9.1–11.8	69
Bristol	100	132	9.9	8.1–12.5	9.2–10.6	49
Camb	93	101	9.9	8.1–12.6	9.1–11.2	45
Cardff	100	153	10.3	8.2–13.2	9.4–11.5	59
Carlis	100	21	11.0	8.8–14.2	10.1–12.1	81
Carsh	96	184	10.4	8.6–12.5	9.7–11.2	66
Chelms	94	32	11.3	7.6–15.3	10.3–12.6	81
Clwyd	100	15				
Colchr	71	10				
Covnt	90	94	10.3	8.1–12.3	9.4–11.0	61
D & Gall	94	16				
Derby	93	67	10.0	7.7–11.7	9.3–10.9	51
Derry	100	13				
Donc	97	38	10.2	7.3–12.6	9.0–11.1	55
Dorset	98	63	10.2	8.9–13.1	9.7–11.5	73
Dudley	98	57	9.5	7.0–12.1	8.7–10.4	33
Dundee	89	56	9.7	7.6–12.3	8.8–11.1	46
Dunfn	100	29	11.7	9.1–15.3	11.3–12.4	90
Edinb	100	78	10.9	8.0–13.7	9.9–12.2	74
Exeter	100	125	9.9	8.1–12.2	9.0–10.7	49
Glasgw	93	149	10.0	7.5–13.7	8.9–11.2	52
Glouc	100	73	9.8	7.7–12.3	9.0–11.0	47
Hull	96	92	10.3	7.8–12.9	9.2–11.3	60
Inverns	79	15				
Ipswi	94	34	9.9	7.2–12.3	8.5–10.4	44
Kent	96	104	10.2	7.9–12.8	9.2–11.1	56
Klmarnk	69	24	10.2	8.7–11.7	9.5–11.1	67
L Barts	100	219	9.8	7.4–12.7	8.8–11.2	47
L Guys	61	87	9.8	7.9–12.1	8.6–10.6	44
L Kings	100	116	9.9	8.5–12.5	9.1–10.8	48
L Rfree	67	72	10.2	7.8–13.5	9.3–11.5	57
L St.G	93	79	10.4	7.7–13.0	9.2–11.5	63
L West	84	249	10.7	8.6–13.6	9.8–12.0	71
Leeds	100	134	10.0	7.8–12.6	9.0–10.9	54
Leic	99	188	10.1	7.9–12.7	9.3–11.1	56
Liv Ain	79	27	9.8	7.9–13.3	8.5–10.8	37
Liv RI	95	96	10.5	8.0–13.5	9.1–11.5	63
M Hope	83	84	9.8	7.2–13.1	8.6–10.8	43
M RI	98	114	10.1	7.6–12.9	9.0–11.3	54
Middlbr	99	87	9.4	6.3–11.9	8.1–10.3	31
Newc	92	79	10.2	6.3–13.8	8.7–11.4	53
Newry	100	19				
Norwch	87	41	10.3	7.6–12.9	9.4–11.3	61
Nottm	100	114	9.8	7.8–12.5	8.6–11.1	46
Oxford	99	140	10.3	8.1–13.2	9.3–11.7	60
Plymth	46	22				
Ports	100	86	10.2	7.4–13.9	9.2–11.2	56
Prestn	95	115	10.2	8.1–12.8	9.2–11.1	55
Redng	100	91	10.1	7.8–12.9	9.0–11.3	56
Sheff	100	132	10.2	8.1–13.1	9.3–11.2	59
Shrew	98	41	10.7	8.7–14.3	9.2–11.9	66
Stevng	100	87	10.2	7.8–12.6	9.1–11.0	55

Table 9.1. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Sthend	100	22	10.2	6.8–13.7	9.1–11.0	59
Stoke	100	99	10.5	8.1–13.0	9.3–11.5	62
Sund	100	61	10.4	7.8–13.6	9.2–11.6	64
Swanse	98	101	10.3	8.0–13.1	9.3–11.4	61
Truro	98	48	10.5	8.3–13.3	9.5–11.9	63
Tyrone	95	19				
Ulster	100	13				
Wirral	81	46	10.3	8.1–13.2	9.3–11.4	61
Wolve	100	63	10.0	8.1–12.8	9.0–11.3	52
Wrexm	94	16				
York	98	41	9.8	8.3–12.5	9.1–10.6	41
England	**93**	**4,485**	**10.1**	**7.8–12.9**	**9.1–11.2**	**55**
N Ireland	**95**	**125**	**9.9**	**7.5–12.5**	**8.8–10.8**	**50**
Scotland	**92**	**457**	**10.2**	**7.7–13.2**	**9.0–11.4**	**57**
Wales	**99**	**313**	**10.5**	**8.0–13.1**	**9.4–11.5**	**62**
UK	**93**	**5,380**	**10.2**	**7.8–13.0**	**9.1–11.2**	**55**

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

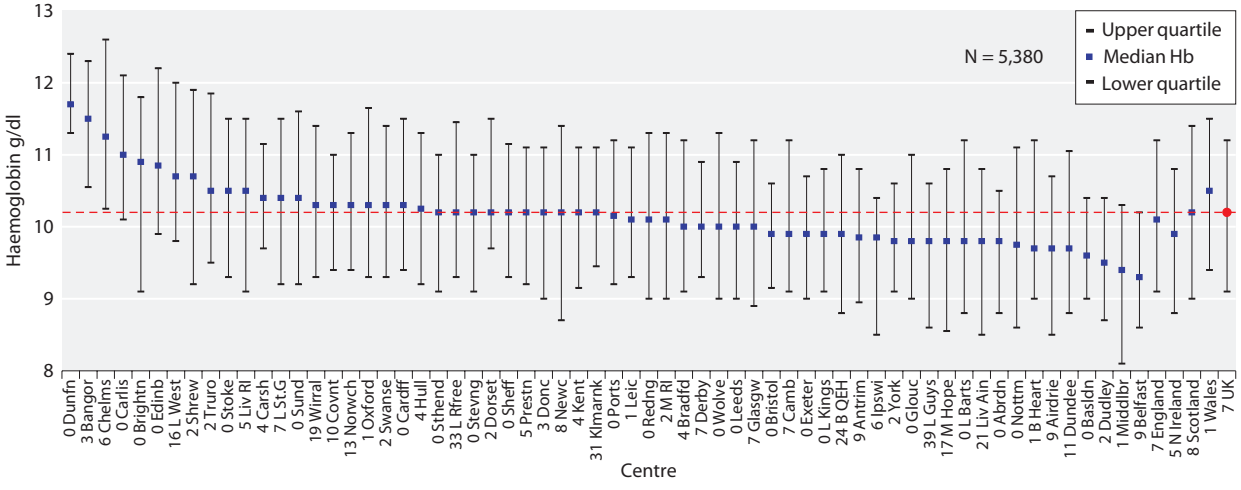

Fig. 9.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2009

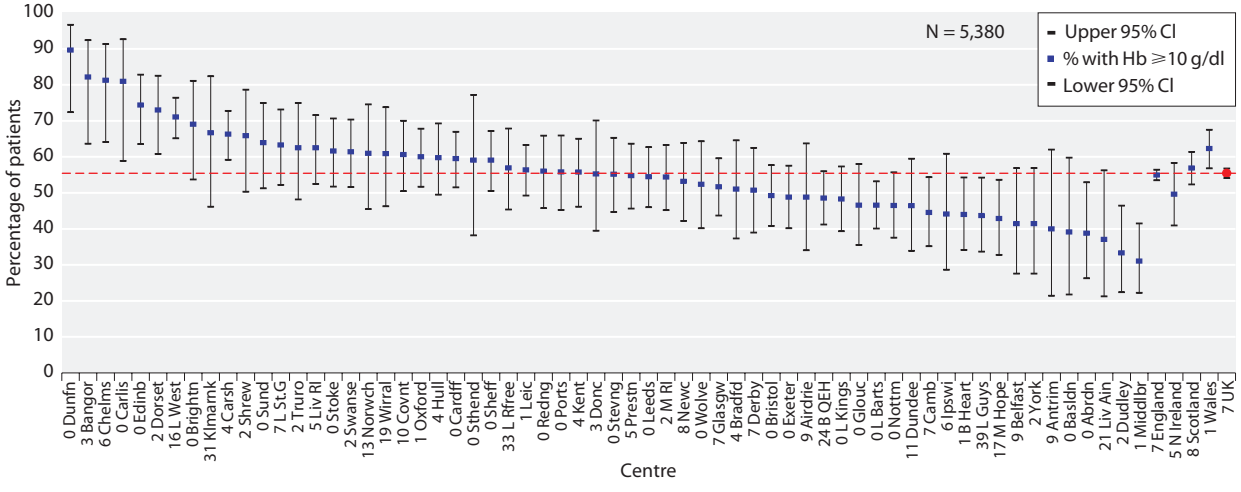

Fig. 9.2. Percentage of incident dialysis patients with Hb ⩾10 g/dl at start of dialysis treatment in 2009

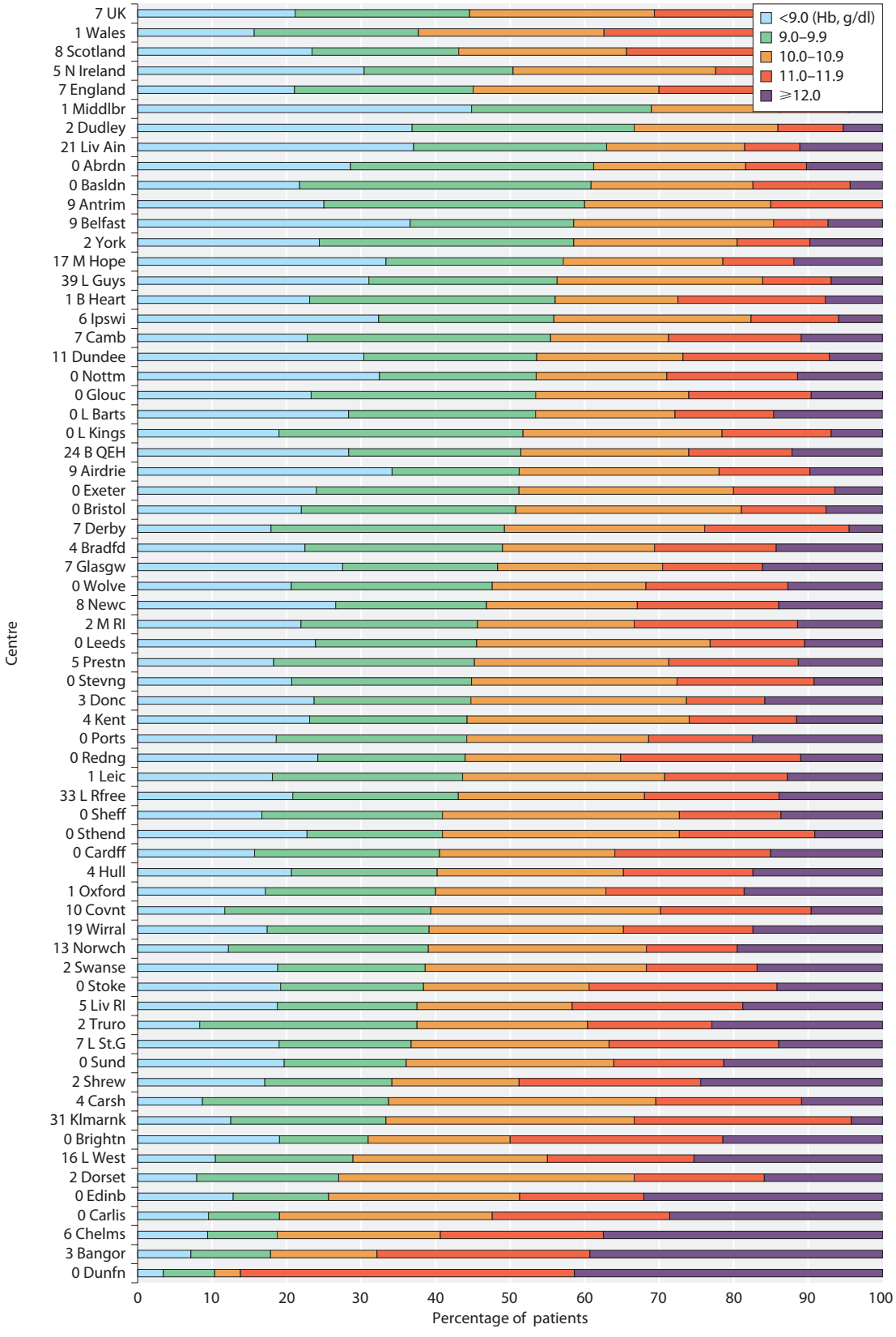

Fig. 9.3. Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment in 2009

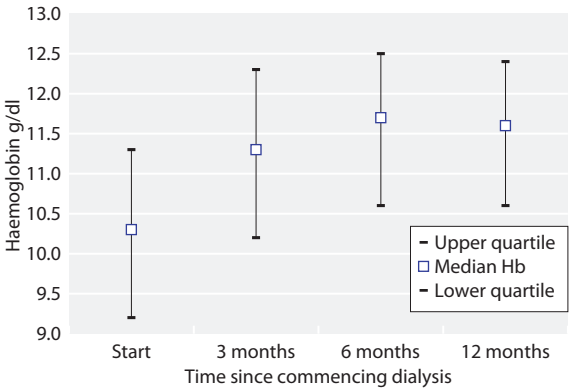

Fig. 9.4. Median haemoglobin, by time on dialysis, for incident dialysis patients in 2008

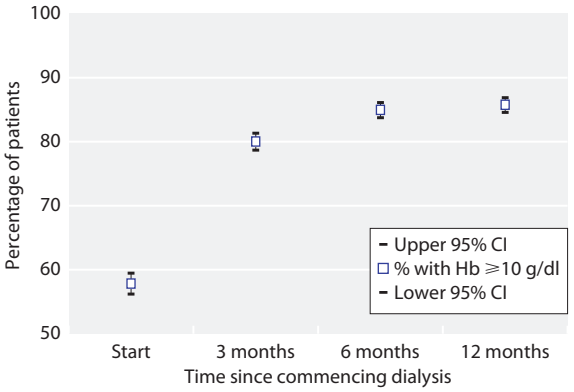

Fig. 9.5. Percentage of incident dialysis patients in 2008 with Hb ⩾10 g/dl, by time on dialysis

quarter was calculated (figures 9.4 and 9.5). Hb is markedly higher in those surviving 3 months reflecting both the treatment administered and poor survival of sicker, more anaemic patients.

The annual distribution (figure 9.6) of Hb in incident dialysis patients has remained relatively stable since 2002. The reduction in the proportion of patients with Hb ⩾12.0 g/dl seen in 2008 was sustained in 2009.

Haemoglobin in prevalent haemodialysis patients

Compliance with data returns and Hb outcome for prevalent HD patients in the 72 UK renal centres are shown in table 9.2.

The median Hb of patients on HD in the UK was 11.6 g/dl with an IQR of 10.6–12.4 g/dl. In the UK, 85% of HD patients had a Hb ⩾10.0 g/dl. These UK averages are very similar to the values for 2008 published in the 2009 Report. The median Hb by centre, compliance with the previous UK minimum standard of Hb ⩾10.0 g/dl and EBPG standard of Hb ⩾11.0 g/dl are shown in figures 9.7, 9.8 and 9.9 respectively. The distribution of Hb in HD patients by centre is shown in figure 9.10. The compliance with the NICE and RA Clinical Practice Guidelines recommended range of 10.5–12.5 g/dl is shown in figure 9.11. The majority of centres complied well with respect to both outcomes but it was possible to fall within 2–3 SDs of the mean in the funnel plot (figure 9.12) for a percentage of patients with Hb ⩾10.5 and ⩽12.5 g/dl and yet have a poor compliance with percentage of Hb ⩾10.0 g/dl (figure 9.13). This demonstrates that compliance with one standard (Hb ⩾10.5 and ⩽12.5 g/dl) can be achieved without compliance with another standard (Hb ⩾10.0 g/dl). Table 9.2 can be used in conjunction with figures 9.12 and 9.13 to identify centres.

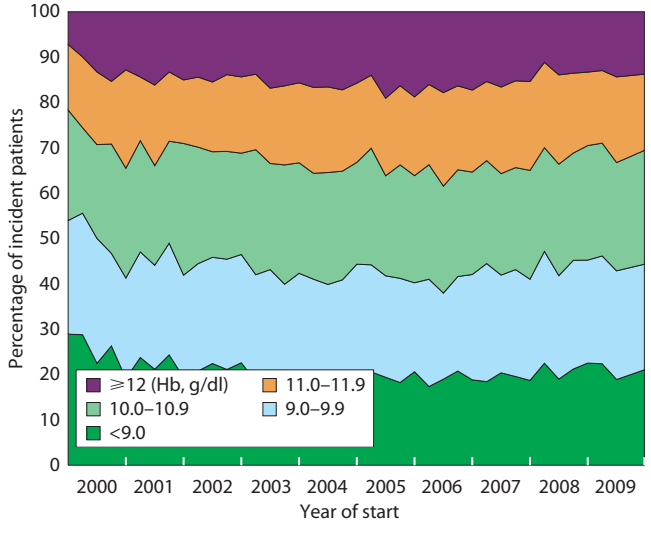

Fig. 9.6. Distribution of haemoglobin in incident dialysis patients, 2000–2009

Haemoglobin in prevalent peritoneal dialysis patients

In the UK 88% of patients on PD had a Hb ⩾10.0 g/dl (table 9.3). The median Hb of patients on PD in the UK was 11.7 g/dl with an IQR of 10.7–12.6 g/dl. These UK averages are very similar to the values for 2008 published in the 2009 Report. The median Hb by centre, compliance with the UK minimum standard Hb ⩾10.0 g/dl and EBPG Hb ⩾11.0 g/dl are shown in figures 9.14, 9.15 and 9.16 respectively. The compliance with recommended range Hb ⩾10.5 and ⩽12.5 g/dl (NICE & RA) is shown in figure 9.17. The distribution of Hb in PD patients by centre is shown in figure 9.18. The funnel plot for percentage Hb ⩾10.0 g/dl is shown in figure 9.19. Table 9.3 can be used to identify centres in the funnel plot.

Table 9.2. Haemoglobin data for prevalent HD patients

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Abrdn	99	185	11.6	8.9–13.2	10.6–12.3	11.3	1.4	84	66	61
Airdrie	100	147	11.4	9.2–13.5	10.7–12.0	11.4	1.2	93	69	67
Antrim	99	120	11.4	9.2–13.1	10.9–12.2	11.5	1.2	88	71	70
B Heart	96	388	11.5	8.6–13.5	10.4–12.4	11.3	1.5	81	63	54
B QEH	98	792	11.4	8.5–13.7	10.3–12.3	11.3	1.6	82	62	54
Bangor	100	74	11.8	9.4–13.4	10.8–12.5	11.6	1.3	89	70	55
Basldn	99	131	11.1	8.8–13.2	10.1–11.9	11.0	1.5	77	55	51
Belfast	96	220	11.1	8.8–13.6	10.3–12.1	11.2	1.4	81	57	56
Bradfd	94	166	11.4	9.2–13.7	10.5–12.4	11.4	1.4	87	63	57
Brightn	100	291	11.6	9.4–13.5	10.7–12.3	11.5	1.2	89	70	67
Bristol	100	403	11.2	8.7–13.7	10.3–12.1	11.2	1.5	81	55	53
Camb	93	304	11.7	8.7–13.5	10.7–12.5	11.5	1.4	86	70	57
Cardff	99	445	11.6	9.1–13.7	10.6–12.4	11.5	1.4	87	65	55
Carlis	100	57	11.4	9.8–13.6	11.0–12.2	11.6	1.1	93	81	70
Carsh	98	602	11.4	9.4–13.3	10.6–12.1	11.4	1.2	88	63	66
Chelms	100	109	12.0	9.6–14.0	11.2–12.9	12.0	1.5	88	79	45
Clwyd	91	67	12.1	8.8–14.7	10.7–13.3	11.9	1.9	84	70	46
Colchr	99	101	11.8	9.6–13.5	10.9–12.8	11.7	1.3	90	73	54
Covnt	98	307	11.1	9.0–13.2	10.3–11.9	11.1	1.4	82	55	57
D & Gall	98	49	11.3	9.1–13.2	10.8–12.1	11.3	1.3	84	65	65
Derby	100	236	11.8	9.1–13.5	10.8–12.5	11.6	1.4	86	71	57
Derry	100	60	11.6	9.0–13.5	11.0–12.5	11.6	1.3	92	75	63
Donc	100	109	11.9	9.2–14.1	10.6–12.7	11.7	1.5	88	70	53
Dorset	100	215	12.0	8.8–14.1	11.0–12.8	11.8	1.6	89	75	53
Dudley	85	122	10.5	8.4–13.1	9.6–11.9	10.7	1.7	67	39	42
Dundee	99	167	11.8	9.1–14.1	11.0–12.8	11.9	1.5	91	77	54
Dunfn	99	105	12.0	9.2–15.4	11.0–13.3	12.2	1.9	90	76	52
Edinb	100	246	12.0	9.7–14.7	11.2–13.0	12.1	1.6	92	80	54
Exeter	100	302	11.3	9.0–13.0	10.2–12.1	11.1	1.3	82	58	60
Glasgw	98	562	11.4	8.7–14.6	10.4–12.7	11.6	1.8	83	64	46
Glouc	100	173	11.5	9.3–13.5	10.3–12.4	11.4	1.4	87	64	55
Hull	100	300	11.6	8.9–13.9	10.8–12.4	11.6	1.4	89	71	60
Inverns	93	76	11.6	8.6–14.1	10.4–12.8	11.5	1.6	82	68	45
Ipswi	100	97	11.5	8.9–12.8	10.5–12.1	11.2	1.2	88	59	69
Kent	100	313	11.6	9.2–13.6	10.8–12.4	11.6	1.3	87	69	63
Klmarnk	97	136	11.5	9.2–13.4	10.5–12.3	11.4	1.3	88	65	60
L Barts	100	646	11.1	8.5–13.3	10.0–12.1	11.0	1.5	75	53	52
L Guys	97	519	11.0	8.6–13.1	10.0–11.9	10.9	1.4	75	51	51
L Kings	99	369	11.2	9.0–13.1	10.5–12.0	11.2	1.2	86	61	65
L Rfree	76	470	11.6	8.8–13.6	10.6–12.5	11.4	1.5	86	67	52
L St.G	100	247	11.3	8.6–13.4	10.1–12.1	11.2	1.6	77	59	51
L West	100	1,191	12.3	10.0–14.1	11.5–13.0	12.2	1.3	95	84	52
Leeds	99	463	11.5	9.0–13.6	10.6–12.3	11.4	1.4	86	65	58
Leic	100	705	11.6	8.8–13.8	10.6–12.4	11.5	1.5	87	69	57
Liv Ain	71	96	11.5	9.2–13.0	10.6–12.2	11.4	1.2	86	68	64
Liv RI	98	363	12.2	8.7–14.4	10.9–13.2	12.0	1.7	87	75	41
M Hope	79	259	11.5	8.2–13.9	10.3–12.4	11.3	1.8	78	62	48
M RI	61	247	11.7	9.0–13.8	10.4–12.7	11.6	1.5	83	66	48
Middlbr	99	264	11.4	8.1–13.7	10.4–12.2	11.2	1.6	81	66	54
Newc	100	252	11.7	8.4–14.2	10.6–12.7	11.6	1.8	81	69	49
Newry	99	93	11.8	8.6–13.5	10.7–12.6	11.5	1.6	85	69	52
Norwch	100	295	11.7	9.4–13.4	10.9–12.4	11.6	1.3	91	71	61
Nottm	100	379	11.6	9.0–13.6	10.9–12.5	11.6	1.4	89	75	61
Oxford	100	334	11.5	8.9–13.7	10.4–12.3	11.4	1.6	83	64	53
Plymth	53	60	11.4	9.3–13.1	10.5–12.2	11.2	1.3	82	58	63
Ports	100	441	11.6	9.1–14.0	10.6–12.7	11.6	1.5	86	66	47
Prestn	96	432	11.4	9.1–13.7	10.6–12.2	11.4	1.4	86	66	59
Redng	100	248	11.6	9.0–13.6	10.8–12.4	11.5	1.3	87	72	62
Sheff	100	570	11.6	9.0–13.7	10.6–12.5	11.5	1.4	84	69	54
Shrew	100	182	11.6	9.6–13.7	10.8–12.6	11.7	1.3	94	70	55

Table 9.2. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Stevng	100	351	11.4	9.2–13.2	10.5–12.1	11.3	1.2	86	65	64
Sthend	98	119	11.3	8.9–12.9	10.3–11.9	11.1	1.2	82	59	61
Stoke	100	277	11.6	9.2–13.5	10.5–12.4	11.4	1.4	81	66	56
Sund	99	164	11.7	8.8–13.9	10.6–12.6	11.5	1.6	84	67	49
Swanse	100	318	11.2	8.9–13.0	10.3–11.9	11.1	1.2	85	59	61
Truro	99	138	11.5	9.2–13.3	10.5–12.1	11.4	1.2	88	67	62
Tyrone	94	81	12.0	10.0–13.5	11.2–12.6	11.9	1.3	95	83	62
Ulster	100	86	11.4	9.1–13.1	10.6–12.1	11.3	1.2	87	62	67
Wirral	69	118	11.8	9.4–14.4	10.5–12.7	11.8	1.5	86	69	50
Wolve	100	287	11.6	8.7–14.2	10.8–12.6	11.6	1.5	89	70	58
Wrexm	100	71	11.7	10.1–13.7	11.0–12.8	11.9	1.2	97	76	54
York	98	166	12.0	9.0–14.5	11.0–12.6	11.9	1.5	90	76	55
England	**96**	**16,170**	**11.6**	**8.9–13.7**	**10.6–12.4**	**11.5**	**1.5**	**85**	**66**	**56**
N Ireland	**98**	**660**	**11.5**	**9.1–13.5**	**10.7–12.3**	**11.4**	**1.4**	**86**	**67**	**61**
Scotland	**98**	**1,673**	**11.6**	**9.0–14.3**	**10.7–12.6**	**11.6**	**1.6**	**87**	**69**	**53**
Wales	**99**	**975**	**11.5**	**9.0–13.7**	**10.5–12.3**	**11.4**	**1.4**	**87**	**65**	**56**
UK	**96**	**19,478**	**11.6**	**8.9–13.7**	**10.6–12.4**	**11.5**	**1.5**	**85**	**67**	**56**

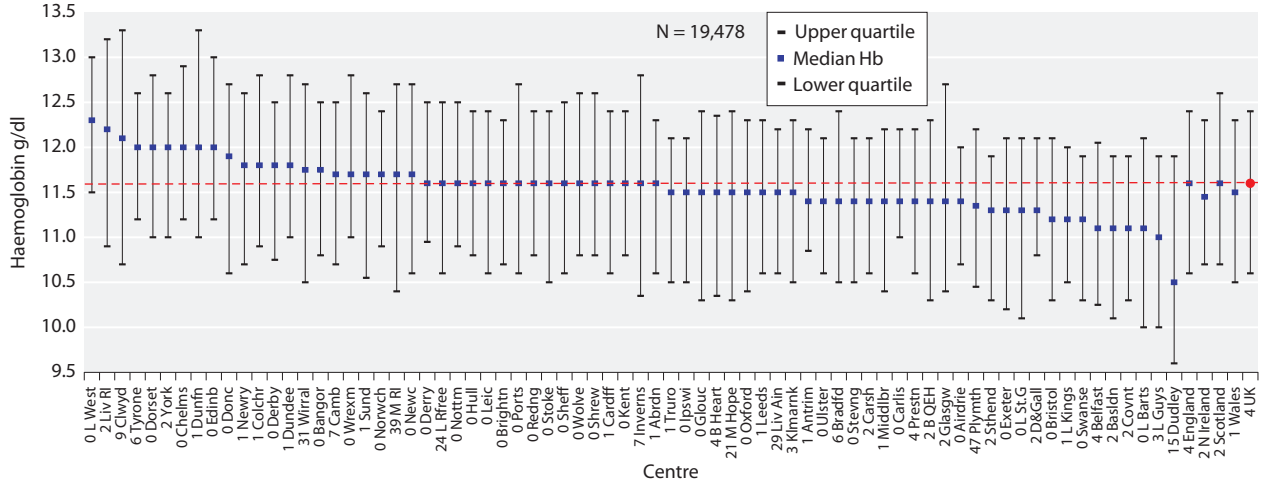

Fig. 9.7. Median haemoglobin in patients treated with HD

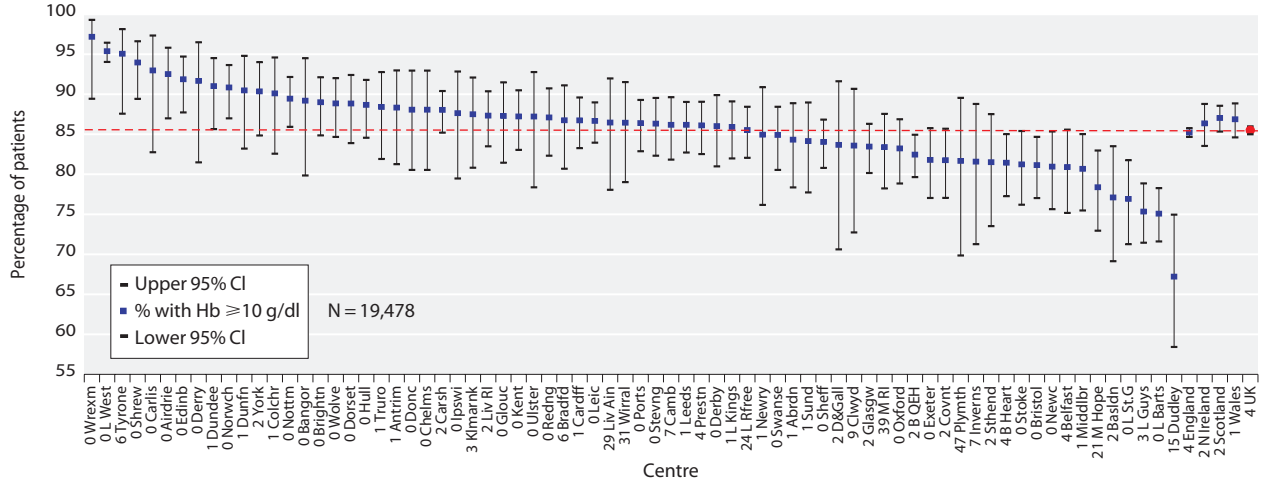

Fig. 9.8. Percentage of HD patients with Hb ⩾10 g/dl

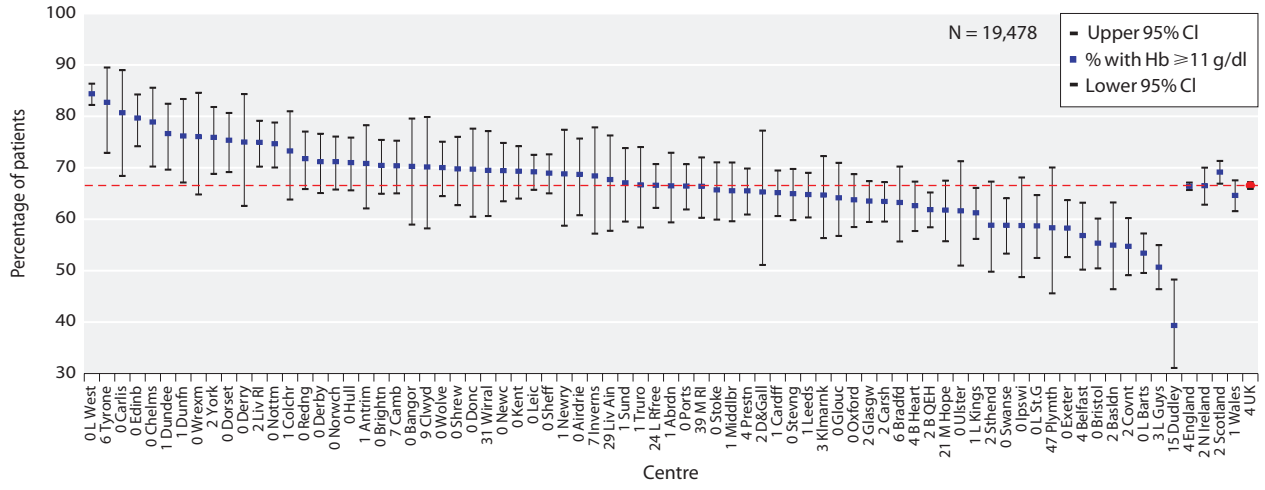

Fig. 9.9. Percentage of HD patients with Hb ⩾11 g/dl

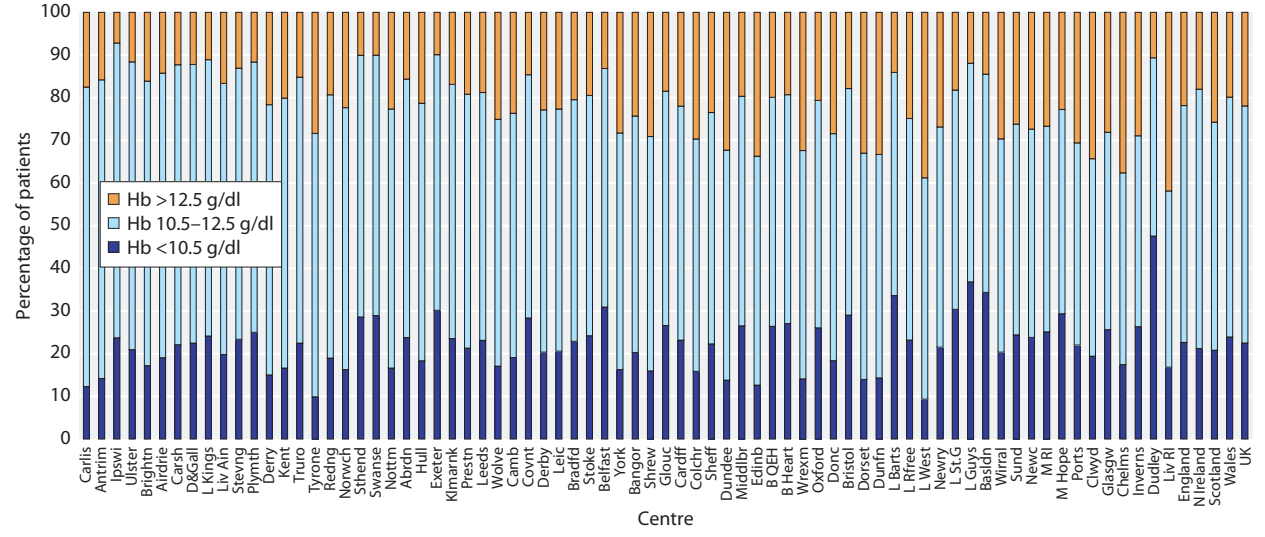

Fig. 9.10. Distribution of haemoglobin in patients treated with HD

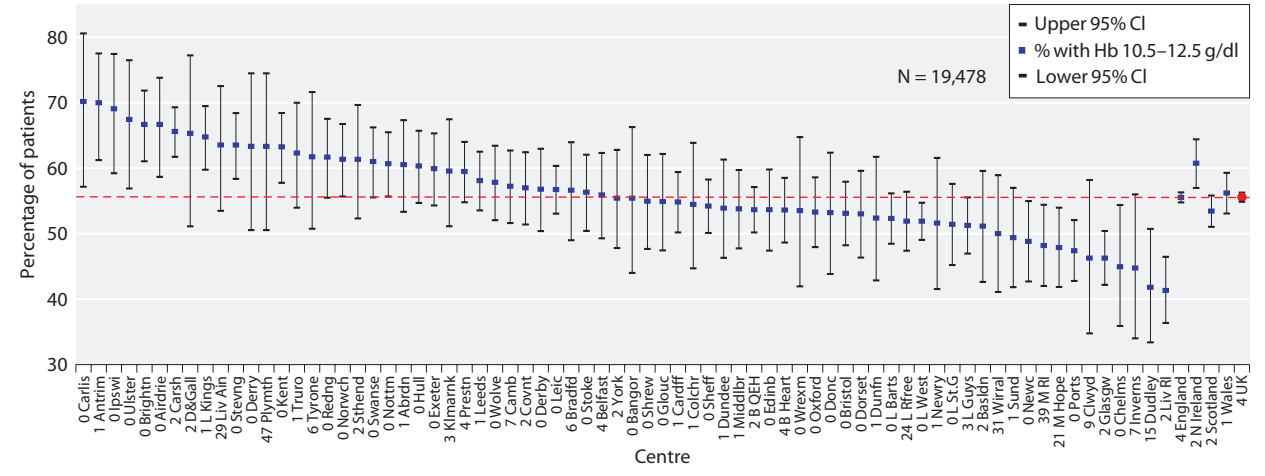

Fig. 9.11. Percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

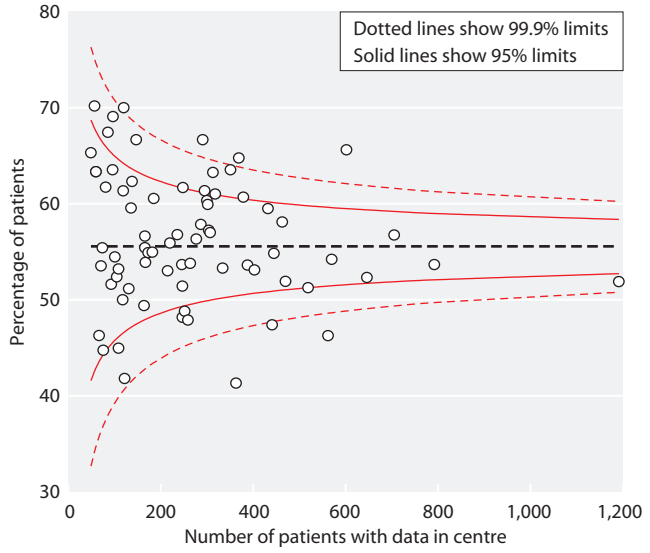

Fig. 9.12. Funnel plot of percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

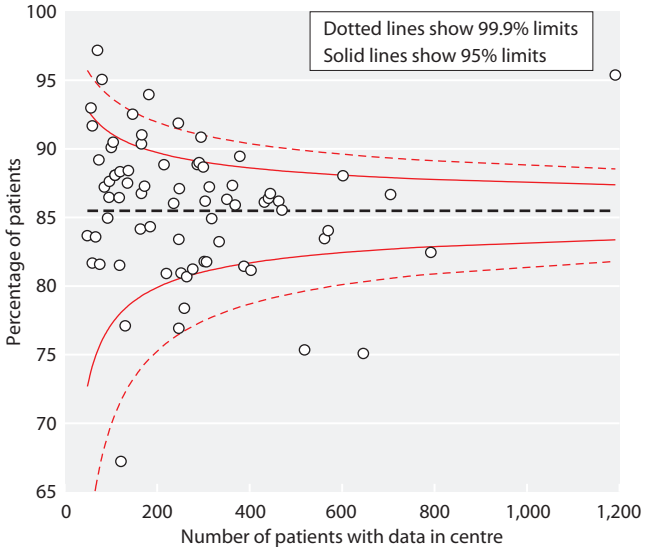

Fig. 9.13. Funnel plot of percentage of HD patients with Hb ⩾10 g/dl

Table 9.3. Haemoglobin data for prevalent PD patients

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Abrdn	100	28	12.3	10.7–13.8	11.6–13.3	12.3	1.1	100	89	61
Airdrie	100	9								
Antrim	100	14								
B Heart	100	27	12.0	9.3–14.3	10.1–12.5	11.6	1.6	78	67	44
B QEH	84	120	11.8	8.8–14.4	10.5–12.7	11.6	1.7	85	67	48
Bangor	100	29	12.5	10.3–13.9	11.8–13.1	12.4	1.1	100	86	48
Basldn	100	25	11.6	9.4–15.0	11.0–12.4	11.7	1.7	84	76	56
Belfast	100	34	11.0	9.6–13.7	10.1–12.1	11.2	1.2	79	50	53
Bradfd	100	31	11.3	9.0–13.1	10.6–12.2	11.4	1.2	90	68	65
Brightn	100	76	11.5	8.1–14.3	10.5–12.6	11.4	1.7	82	66	50
Bristol	100	68	12.0	8.9–14.7	11.0–13.3	12.0	1.9	87	75	43
Camb	100	31	11.9	8.3–14.2	10.5–12.9	11.6	1.8	87	74	52
Cardff	100	97	11.8	9.9–14.8	11.0–13.0	12.0	1.5	95	75	58
Carlis	100	13								
Carsh	99	110	11.7	8.7–13.8	10.7–12.8	11.6	1.6	84	65	52
Chelms	100	31	12.2	9.9–14.3	11.3–13.0	12.2	1.4	94	81	52
Clwyd	86	6								
Colchr	n/a	n/a								
Covnt	97	71	11.4	9.6–13.4	10.8–12.2	11.5	1.2	92	68	66
D & Gall	100	11								
Derby	100	82	12.0	9.3–14.4	10.8–12.8	11.9	1.5	93	74	49
Derry	100	3								
Donc	97	29	11.9	9.3–13.9	11.3–12.6	11.9	1.4	90	79	59
Dorset	98	53	11.9	10.1–13.8	11.2–12.6	11.8	1.3	96	79	62
Dudley	98	49	11.7	9.2–13.9	10.3–12.3	11.5	1.4	86	63	51
Dundee	100	20	12.0	9.3–15.3	11.3–12.9	12.1	1.6	90	80	55
Dunfn	95	19								
Edinb	95	53	11.2	7.9–13.8	10.3–12.5	11.2	1.6	81	55	49
Exeter	100	64	11.8	9.2–14.0	11.0–12.7	11.8	1.4	91	77	52
Glasgw	100	54	11.8	8.4–14.5	10.3–12.9	11.7	1.7	89	72	43
Glouc	100	39	11.5	8.1–14.0	10.5–12.2	11.3	1.4	79	69	59
Hull	98	62	11.8	8.5–14.7	10.8–13.0	11.8	1.9	82	71	44

Table 9.3. Continued

Centre	% data return	N with data	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl	% with Hb 10.5–12.5 g/dl
Inverns	14	3								
Ipswi	100	42	11.5	8.9–13.4	10.5–12.6	11.5	1.4	88	64	52
Kent	100	64	11.7	9.4–13.1	10.9–12.6	11.7	1.2	91	72	56
Klmarnk	94	32	11.9	9.3–13.3	10.0–12.5	11.4	1.4	75	69	53
L Barts	99	164	11.7	9.7–14.2	10.8–12.6	11.7	1.4	92	71	59
L Guys	100	44	11.4	8.6–13.2	10.2–12.2	11.2	1.6	80	61	52
L Kings	100	68	11.6	9.0–14.4	10.7–12.7	11.5	1.9	90	72	53
L Rfree	80	51	10.8	8.0–14.0	10.3–11.6	11.1	1.7	82	45	51
L St.G	97	56	11.8	9.0–13.8	10.8–12.8	11.8	1.5	93	71	52
L West	100	31	11.5	9.9–13.1	10.4–12.1	11.4	1.3	94	58	65
Leeds	99	85	11.6	8.7–13.8	10.6–12.2	11.5	1.5	87	66	58
Leic	98	145	11.6	9.1–14.2	10.8–12.5	11.6	1.6	88	68	57
Liv Ain	43	3								
Liv RI	100	80	11.9	9.8–14.3	11.1–12.9	11.9	1.5	94	76	59
M Hope	88	98	11.5	8.6–14.1	10.3–12.5	11.3	1.7	79	58	48
M RI	99	88	11.5	8.7–13.7	10.5–12.6	11.4	1.6	80	60	49
Middlbr	94	15								
Newc	100	48	11.8	9.0–13.9	11.0–12.4	11.7	1.4	88	77	65
Newry	100	12								
Norwch	91	50	12.1	9.9–14.3	11.3–13.1	12.1	1.6	94	82	54
Nottm	100	101	11.5	9.1–14.0	10.7–12.6	11.6	1.5	87	70	53
Oxford	100	93	11.8	9.0–13.7	10.8–12.8	11.8	1.5	88	74	49
Plymth	97	37	12.1	9.8–14.4	11.2–13.1	12.1	1.3	92	78	54
Ports	99	80	12.1	9.0–14.5	10.9–13.1	12.0	1.7	86	71	46
Prestn	100	65	11.9	9.2–13.5	10.9–12.8	11.8	1.5	89	74	51
Redng	99	72	11.6	9.2–13.9	10.8–12.4	11.6	1.5	89	68	60
Sheff	100	68	11.9	10.0–13.9	11.3–12.6	11.8	1.1	96	81	60
Shrew	100	27	11.9	9.6–14.0	10.2–12.6	11.6	1.5	81	70	44
Stevng	96	27	11.6	9.6–13.6	10.4–12.3	11.4	1.4	85	63	52
Sthend	94	16								
Stoke	99	68	11.6	9.7–14.0	10.6–12.6	11.6	1.4	91	66	53
Sund	100	24	11.9	9.7–14.3	11.0–12.6	11.7	1.4	88	75	54
Swanse	100	50	11.9	10.1–13.7	11.1–12.6	11.8	1.5	96	76	62
Truro	100	21	12.0	9.8–13.5	11.3–12.4	11.8	1.2	90	76	62
Tyrone	91	10								
Ulster	100	2								
Wirral	69	18								
Wolve	100	40	12.0	8.8–13.6	10.9–12.8	11.8	1.4	88	73	53
Wrexm	95	21	12.0	10.0–15.1	11.1–12.6	12.0	1.6	95	76	52
York	100	15								
England	**97**	**2,885**	**11.7**	**9.1–14.1**	**10.7–12.6**	**11.7**	**1.5**	**88**	**70**	**54**
N Ireland	**99**	**75**	**11.7**	**9.6–13.8**	**10.4–12.6**	**11.6**	**1.3**	**84**	**65**	**49**
Scotland	**91**	**229**	**11.7**	**9.1–14.0**	**10.7–12.7**	**11.6**	**1.6**	**87**	**71**	**51**
Wales	**99**	**203**	**11.9**	**10.1–14.4**	**11.1–12.9**	**12.0**	**1.4**	**96**	**77**	**57**
UK	**97**	**3,392**	**11.7**	**9.2–14.1**	**10.7–12.6**	**11.7**	**1.5**	**88**	**70**	**54**

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

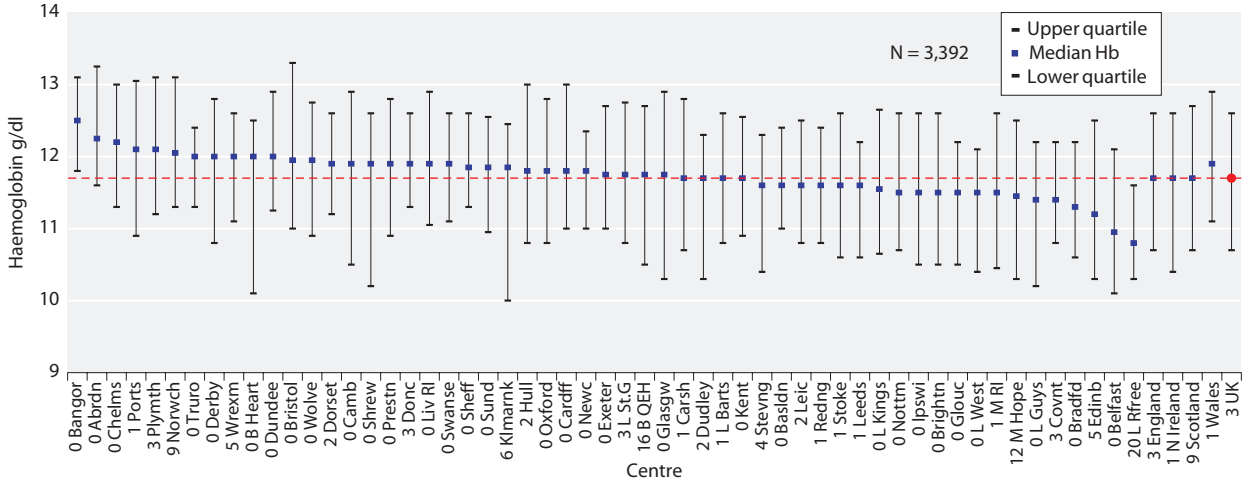

Fig. 9.14. Median haemoglobin in patients treated with PD

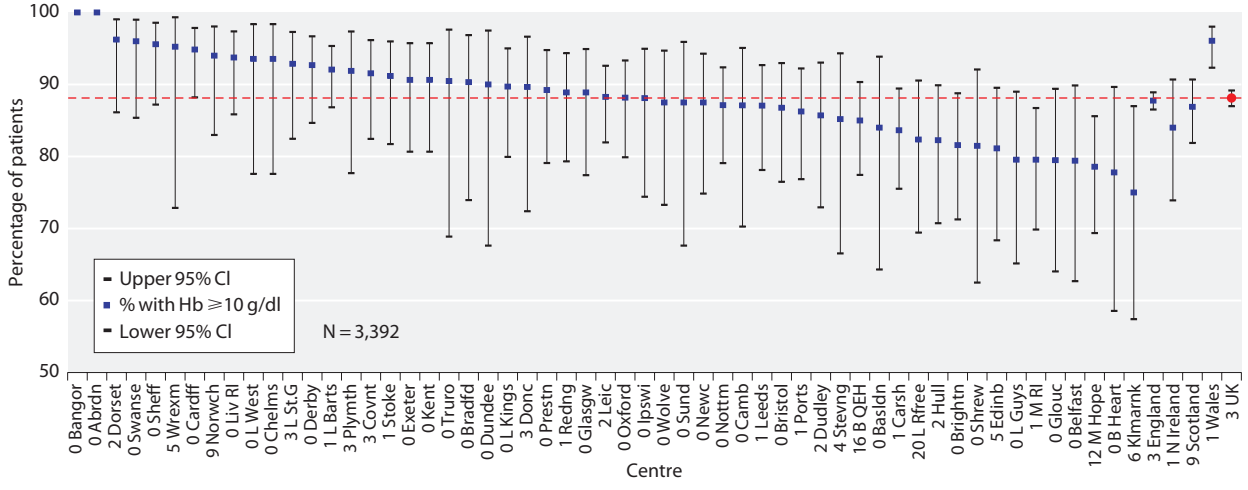

Fig. 9.15. Percentage of PD patients with Hb ⩾10 g/dl

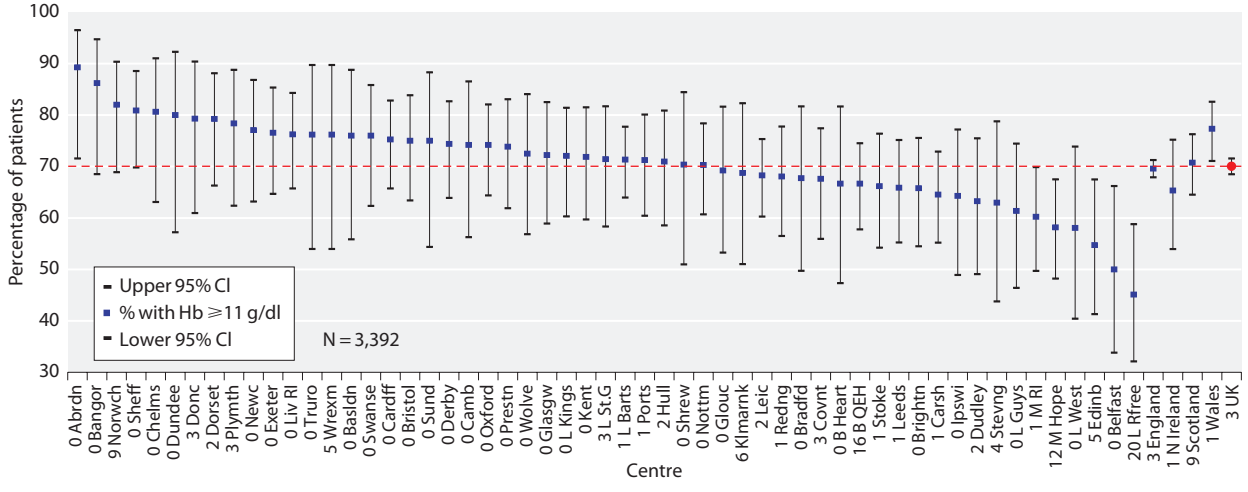

Fig. 9.16. Percentage of PD patients with Hb ⩾11 g/dl

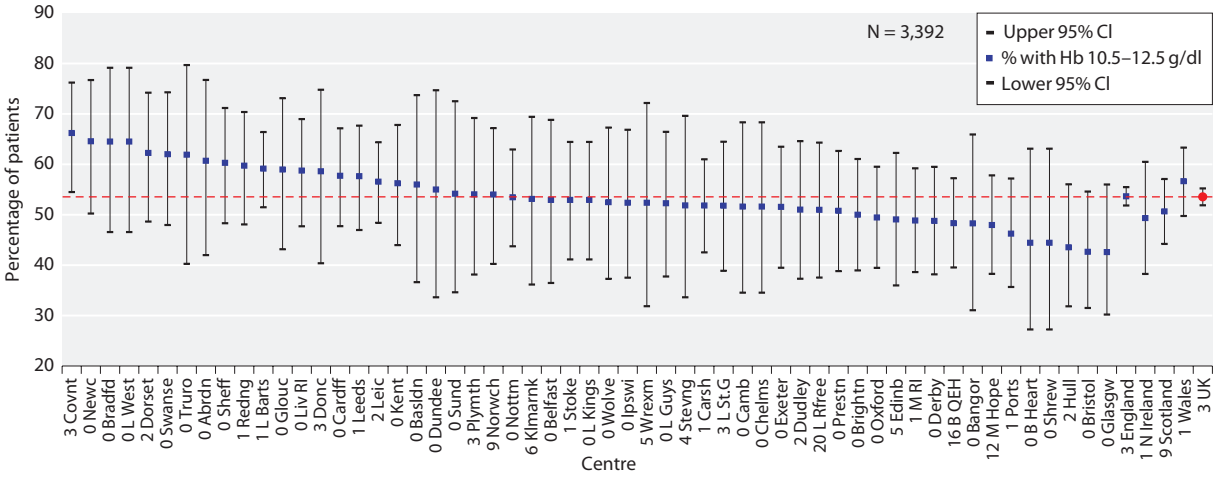

Fig. 9.17. Percentage of PD patients with Hb ⩾10.5 and ⩽12.5 g/dl

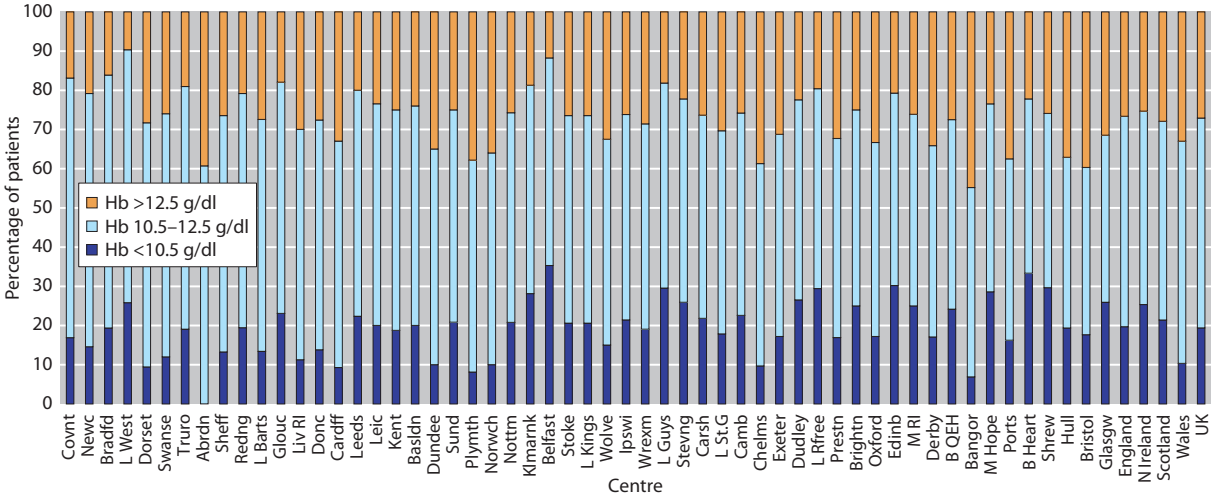

Fig. 9.18. Distribution of haemoglobin in patients treated with PD

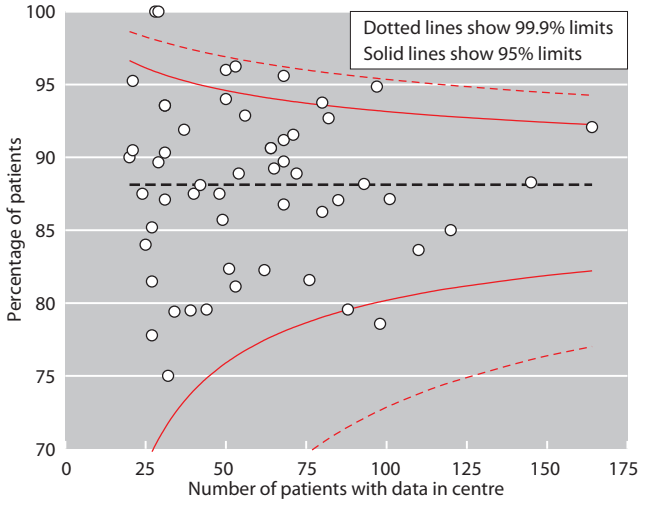

Fig. 9.19. Funnel plot of percentage of PD patients with Hb ⩾10 g/dl

Relationship between Hb in incident and prevalent dialysis patients in 2009

The relationship between the percentage of new and prevalent dialysis (HD and PD) patients with a Hb ⩾10.0 g/dl is shown in figure 9.20. As expected, all centres have a higher percentage of prevalent patients achieving a Hb ⩾10.0 g/dl than incident patients. Overall in the UK, 86% of prevalent patients, compared to 55% of incident patients, had a Hb ⩾10.0 g/dl in 2009.

Correlation between median haemoglobin and compliance with clinical guidelines

Rose-Day plots (figures 9.21 to 9.24) are used to show the relationship between a centre's median Hb and their compliance with minimum standards for Hb ⩾10.0 g/dl and ⩾11.0 g/dl in HD and PD populations. Compliance

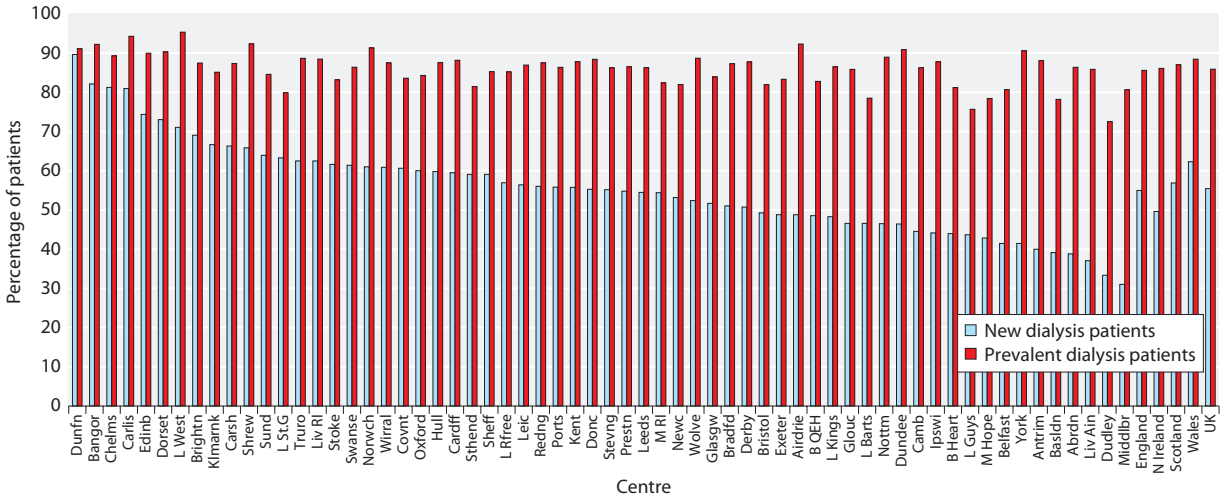

Fig. 9.20. Percentage of new and prevalent dialysis patients with Hb ⩾10 g/dl

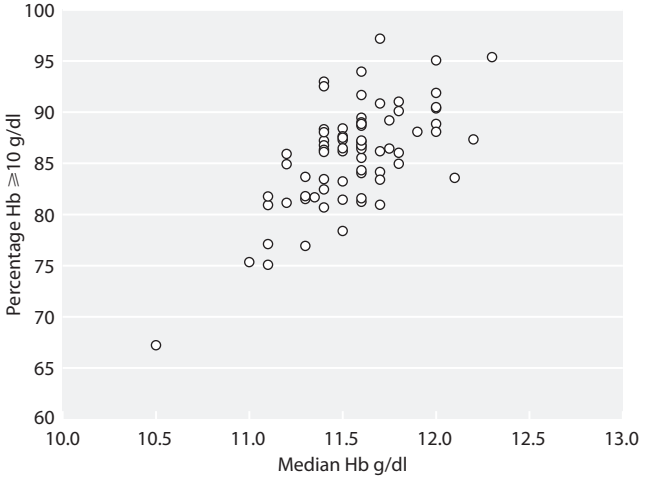

Fig. 9.21. Percentage of HD patients with Hb ⩾10 g/dl plotted against median haemoglobin

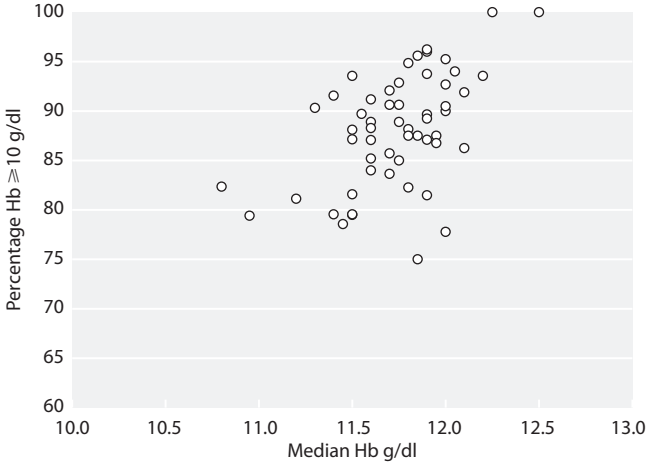

Fig. 9.23. Percentage of PD patients with Hb ⩾10 g/dl plotted against median haemoglobin

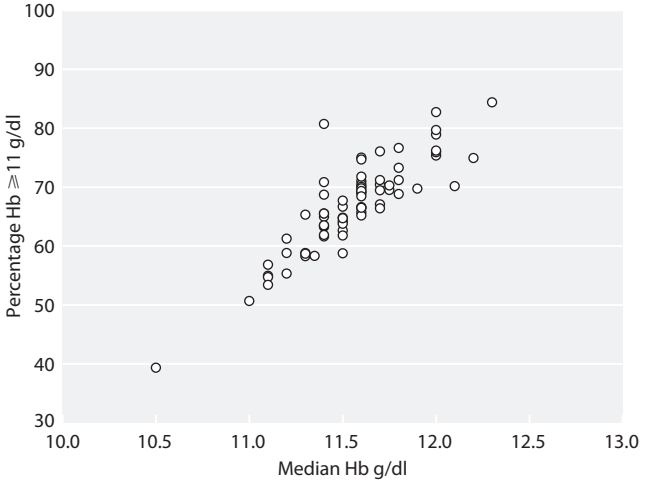

Fig. 9.22. Percentage of HD patients with Hb ⩾11 g/dl plotted against median haemoglobin

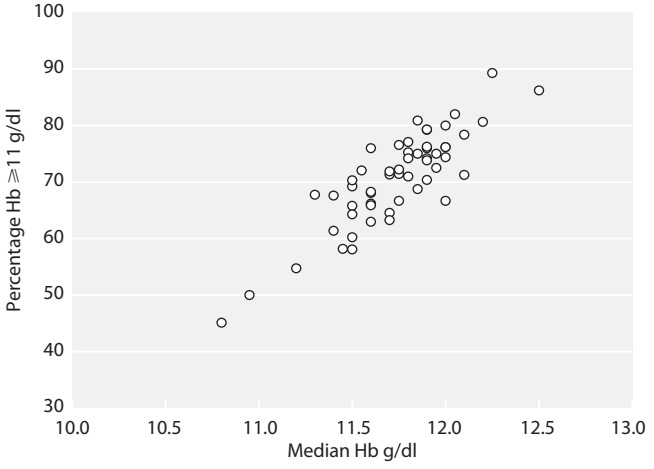

Fig. 9.24. Percentage of PD patients with Hb ⩾11 g/dl plotted against median haemoglobin

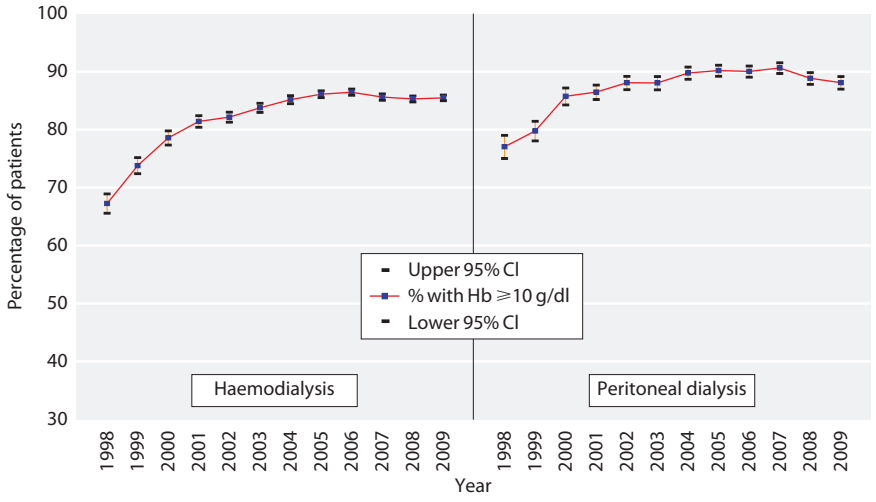

Fig. 9.25. Percentage of prevalent HD and PD patients (1998–2009) with Hb ⩾10 g/dl

with minimum standards by year (1998 to 2009) is shown in figure 9.25 for prevalent patients (by treatment modality) and in figure 9.26 for incident and prevalent patients (all dialysis patients).

Median haemoglobin and length of survival on RRT

Median Hb of cohorts of patients who had survived different lengths of time on RRT were analysed in both HD and PD patients (figures 9.27 and 9.28). The results suggest that incident patients selected for PD have higher Hb than incident HD patients. There has been little change over the last 5 years.

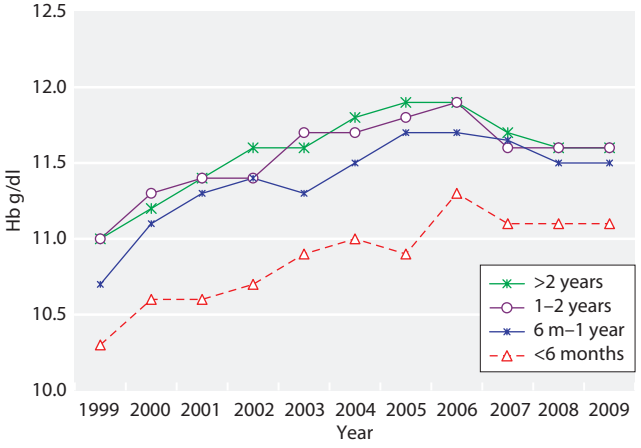

Fig. 9.27. Median haemoglobin and length of survival on RRT (HD patients)

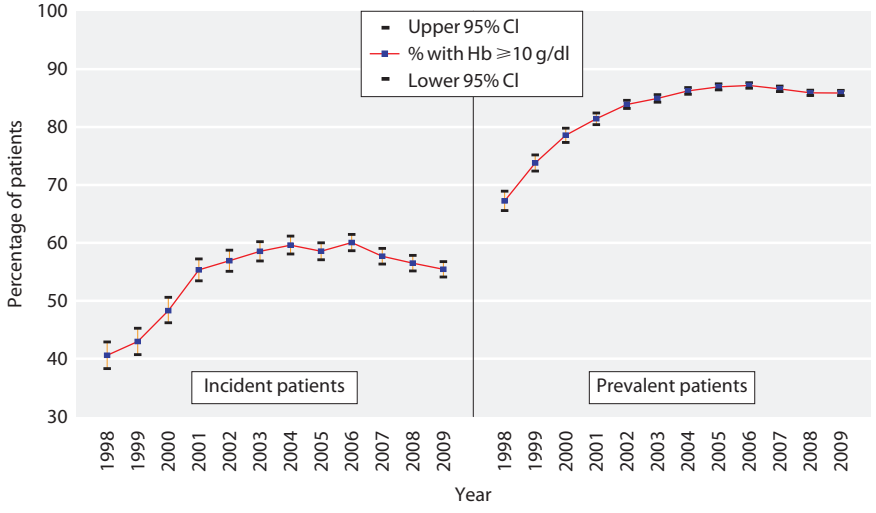

Fig. 9.26. Percentage of incident and prevalent dialysis patients (1998–2009) with Hb ⩾10 g/dl

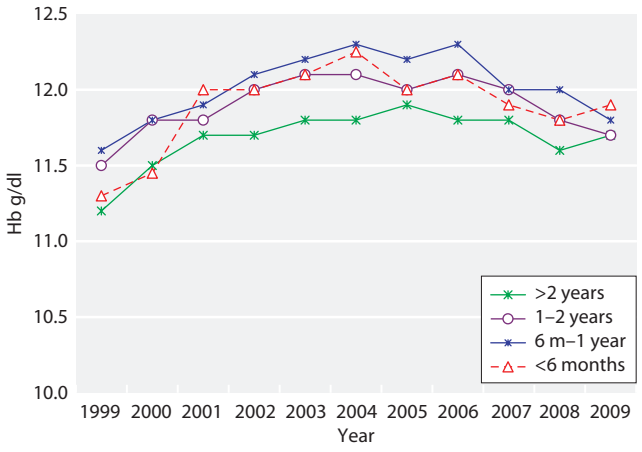

Fig. 9.28. Median haemoglobin and length of survival on RRT (PD patients)

Factors affecting haemoglobin

Ferritin

Ferritin in prevalent dialysis patients

Percentage returns and summary statistics for serum ferritin are shown for the 63 renal centres in England, Northern Ireland and Wales in tables 9.4 and 9.5 for HD and PD patients respectively.

The median and IQR for serum ferritin for HD and PD patients is given, by centre, in figures 9.29 and 9.30 respectively. The percentage of patients with serum ferritin ⩾100 µg/L, ⩾200 µg/L and ⩾800 µg/L are shown in figures 9.31, 9.32 and 9.33 for HD and figures 9.34, 9.35 and 9.36 for PD respectively.

All centres achieved greater than 80% compliance with a serum ferritin ⩾100 µg/L for HD patients and all but 4 centres achieved >90% compliance. The PD population had a lower median ferritin value (249 µg/L, IQR 142–412 vs. 441 µg/L, IQR 289–629 for HD). In 2009, 29 centres (compared to 35 in 2008) reported less than 90% of PD patients compliant with serum ferritin ⩾100 µg/L.

Changes in ferritin 2001–2009

The compliance with guidelines for ferritin in the HD populations was stable at approximately 95% for 4 years and increased slightly in 2009. In the PD population the compliance decreased every year for 5 years but increased from 2008 to 2009 negating much of this 5 year drop. The serial values are shown in figure 9.37. The difference between the compliance in HD and PD was probably because more PD patients achieve adequate Hb without any iron or ESA therapy. The median serum ferritin outcome over time is shown in figure 9.38.

Ferritin and length of time on renal replacement therapy

In HD (but not PD patients), the median serum ferritin was greatest in those who had survived longest (figures 9.39 and 9.40).

Erythropoiesis stimulating agents in prevalent dialysis patients

Patients treated and dose variation–ESA prescription and modality

Treatment of renal anaemia with ESAs has offered a major way to improve quality of life for dialysis patients. These agents represent some of the most expensive prescribed drugs in hospital based practice and thus approaches to achieving normal haemoglobin levels

Table 9.4. Ferritin in HD patients

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Antrim	99	120	453	194–1007	326–651	100.0	15.8
B Heart	92	375	285	56–662	186–410	89.3	2.4
B QEH	97	784	399	142–790	305–488	97.2	5.0
Bangor	100	74	437	131–950	327–594	97.3	10.8
Basldn	99	131	329	134–598	242–405	97.0	1.5
Belfast	98	224	579	107–1221	358–793	95.1	24.1
Bradfd	93	163	518	168–953	336–706	98.2	14.7
Brightn	80	234	449	170–964	322–592	97.4	11.5
Bristol	99	400	414	78–1026	266–592	93.8	11.8
Camb	80	263	257	39–716	149–393	87.8	4.2
Cardff	97	438	281	93–605	187–388	93.8	2.3
Carlis	100	57	617	272–1983	489–912	100.0	29.8
Carsh	96	587	385	76–880	278–515	93.2	8.4

Table 9.4. Continued

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Chelms	100	109	383	192–992	324–497	97.3	8.3
Clwyd	99	73	466	194–837	274–607	100.0	9.6
Colchr	99	101	751	377–1463	573–939	100.0	44.6
Covnt	99	310	320	91–786	204–505	93.9	4.5
Derby	100	236	406	94–964	292–607	94.5	8.1
Derry	98	59	447	85–1165	255–685	91.5	15.3
Donc	100	109	489	212–945	362–677	98.2	10.1
Dorset	99	213	449	168–777	349–578	97.7	3.8
Dudley	80	115	306	26–972	147–468	80.9	6.1
Exeter	99	298	273	95–615	196–370	94.0	2.7
Glouc	95	165	450	148–886	300–599	97.6	7.3
Hull	99	298	423	177–788	317–547	98.0	4.7
Ipswi	91	88	524	139–928	362–608	97.7	12.5
Kent	99	310	395	77–1035	211–570	91.9	11.3
L Barts	99	644	449	160–1003	311–600	98.5	9.9
L Guys	96	513	465	100–1073	326–630	95.1	12.5
L Kings	99	368	547	193–1109	414–727	98.9	16.9
L Rfree	79	491	419	86–1380	247–679	93.5	18.7
L St.G	99	245	403	174–933	291–498	97.1	7.4
L West	92	1093	556	262–1397	425–760	98.9	23.2
Leeds	99	461	429	92–792	279–568	94.6	4.8
Leic	100	703	375	102–820	252–518	95.2	5.8
Liv Ain	63	86	701	166–1503	478–946	98.8	41.9
Liv RI	98	364	594	127–1631	344–933	97.3	34.6
M Hope	18	59					
M RI	52	210	359	54–763	241–503	91.4	3.3
Middlbr	97	260	563	69–1619	275–1032	92.3	36.9
Newc	100	252	634	224–1361	440–858	99.2	31.4
Newry	99	93	754	121–1267	479–996	95.7	46.2
Norwch	97	287	591	111–1426	355–887	96.2	32.8
Nottm	100	379	611	272–1080	500–744	98.4	19.3
Oxford	98	329	280	70–731	169–422	90.6	3.7
Plymth	98	111	487	174–1381	338–660	98.2	13.5
Ports	99	438	257	55–692	173–363	88.1	2.7
Prestn	99	443	577	137–1536	364–905	96.2	33.2
Redng	99	247	516	202–1113	377–671	98.8	13.8
Sheff	100	570	488	114–1020	352–638	95.1	12.6
Shrew	100	182	390	73–983	230–564	91.2	10.4
Stevng	97	340	438	155–866	295–588	98.5	6.2
Sthend	98	119	308	161–549	257–388	97.5	1.7
Stoke	100	277	837	281–1916	574–1191	99.6	53.1
Sund	98	161	631	284–1736	442–874	100.0	32.3
Swanse	100	317	359	66–806	218–558	92.4	5.1
Truro	99	138	486	228–1020	354–650	100.0	10.9
Tyrone	88	76	580	236–1375	385–917	98.7	35.5
Ulster	100	86	519	168–1408	368–666	98.8	11.6
Wirral	65	111	794	247–1971	512–1062	98.2	48.7
Wolve	100	286	521	220–987	417–622	99.0	8.0
Wrexm	73	52	372	194–945	270–550	100.0	7.7
York	81	137	501	51–953	343–638	92.0	11.0
England	**93**	**15,650**	**444**	**112–1153**	**294–630**	**95.6**	**14.0**
N Ireland	**97**	**658**	**536**	**138–1243**	**357–790**	**96.7**	**24.6**
Wales	**97**	**954**	**325**	**93–794**	**215–481**	**94.4**	**4.7**
E, W & NI	**93**	**17,262**	**441**	**111–1146**	**289–629**	**95.6**	**13.9**

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

Table 9.5. Ferritin in PD patients

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 μg/L	% ferritin ⩾800 μg/L
Antrim	100	14					
B Heart	96	26	149	54–586	104–337	76.9	3.9
B QEH	84	120	184	37–620	103–298	77.5	1.7
Bangor	97	28	188	18–544	125–305	85.7	3.6
Basldn	100	25	138	48–631	89–412	68.0	0.0
Belfast	100	34	200	19–974	124–342	79.4	5.9
Bradfd	100	31	167	38–469	109–310	83.9	0.0
Brightn	96	73	307	112–1007	208–456	97.3	12.3
Bristol	97	66	206	28–688	116–396	81.8	1.5
Camb	97	30	324	55–646	229–408	90.0	0.0
Cardff	99	96	128	19–443	67–216	67.7	1.0
Carlis	100	13					
Carsh	98	109	217	59–949	153–344	90.8	5.5
Chelms	100	31	202	49–745	73–335	67.7	3.2
Clwyd	86	6					
Colchr	n/a	n/a					
Covnt	88	64	183	44–614	99–278	75.0	3.1
Derby	99	81	336	96–803	250–532	93.8	6.2
Derry	100	3					
Donc	97	29	191	25–599	108–307	75.9	3.5
Dorset	98	53	243	67–523	170–341	88.7	0.0
Dudley	92	46	164	22–457	59–246	60.9	2.2
Exeter	100	64	203	44–559	140–334	89.1	0.0
Glouc	85	33	199	35–881	154–277	87.9	6.1
Hull	97	61	348	110–849	207–487	95.1	6.6
Ipswi	90	38	206	29–768	120–392	81.6	2.6
Kent	97	62	303	76–857	212–558	91.9	8.1
L Barts	98	163	277	73–921	161–432	87.7	8.0
L Guys	100	44	143	36–433	86–209	68.2	0.0
L Kings	100	68	199	54–575	139–306	83.8	1.5
L Rfree	98	63	347	86–1494	234–563	92.1	15.9
L St.G	97	56	276	60–996	163–358	94.6	5.4
L West	100	31	233	76–499	182–345	93.6	0.0
Leeds	100	86	253	85–667	176–360	91.9	4.7
Leic	98	145	281	51–820	194–414	89.7	6.2
Liv Ain	0	0					
Liv RI	100	80	330	58–932	148–550	85.0	5.0
M Hope	1	1					
M RI	98	87	145	47–376	97–200	74.7	1.2
Middlbr	88	14					
Newc	100	48	442	48–1258	220–751	93.8	20.8
Newry	100	12					
Norwch	87	48	203	41–851	102–469	75.0	6.3
Nottm	100	101	269	61–847	166–399	89.1	5.9
Oxford	94	87	207	51–657	122–328	80.5	4.6
Plymth	97	37	267	76–837	174–505	91.9	5.4
Ports	86	70	229	43–761	122–377	82.9	2.9
Prestn	100	65	331	59–857	181–527	90.8	7.7
Redng	100	73	453	112–855	343–575	97.3	6.9
Sheff	100	68	257	77–759	151–394	94.1	4.4
Shrew	100	27	220	106–517	142–377	96.3	0.0
Stevng	82	23	227	89–820	161–338	78.3	8.7
Sthend	94	16					
Stoke	100	69	586	77–1507	294–810	94.2	27.5
Sund	96	23	457	174–1480	242–567	100.0	8.7
Swanse	100	50	226	57–829	130–346	84.0	6.0

Table 9.5. Continued

Centre	% data return	N with data	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L	% ferritin ⩾800 µg/L
Truro	90	19					
Tyrone	100	11					
Ulster	100	2					
Wirral	62	16					
Wolve	100	40	213	30–641	101–377	77.5	2.5
Wrexm	23	5					
York	100	15					
England	**92**	**2,738**	**257**	**52–842**	**148–422**	**86.7**	**5.8**
N Ireland	**100**	**76**	**202**	**42–1346**	**124–403**	**80.3**	**6.6**
Wales	**90**	**185**	**171**	**31–535**	**103–284**	**76.8**	**2.7**
E, W & NI	**92**	**2,999**	**249**	**50–829**	**142–412**	**86.0**	**5.7**

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

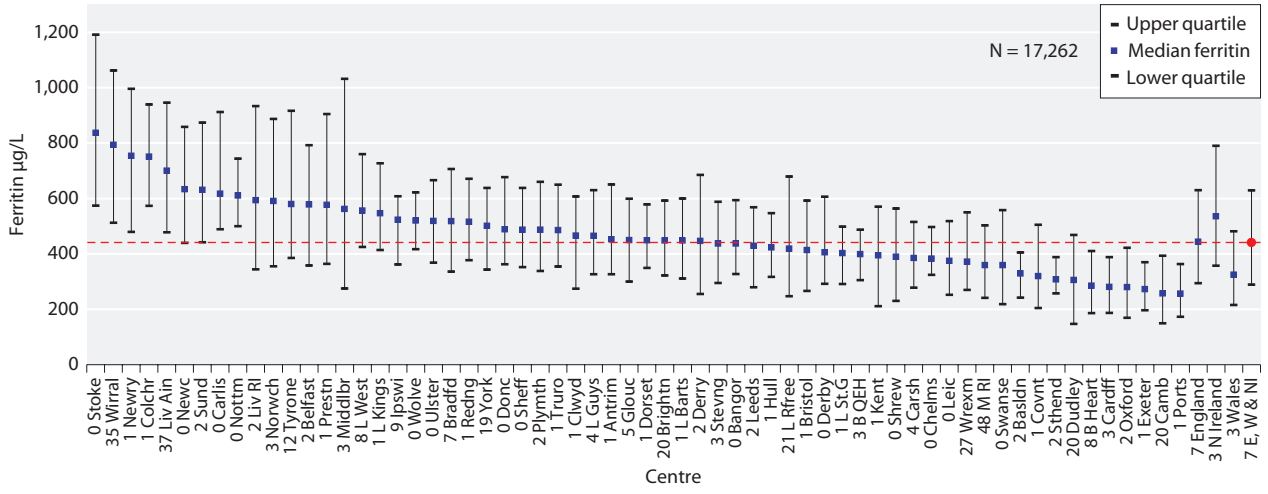

Fig. 9.29. Median ferritin in patients treated with HD

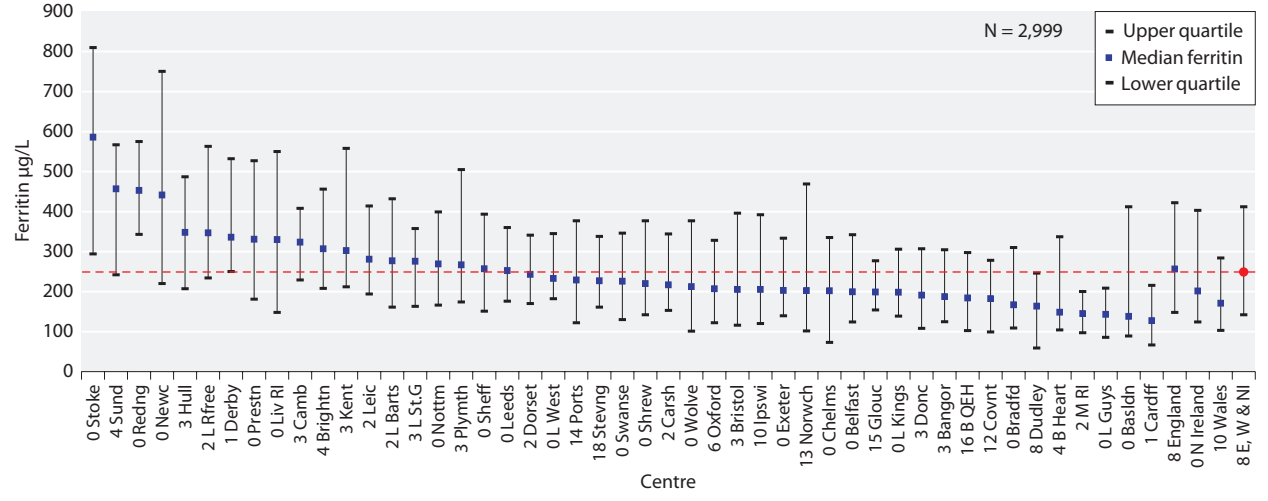

Fig. 9.30. Median ferritin in patients treated with PD

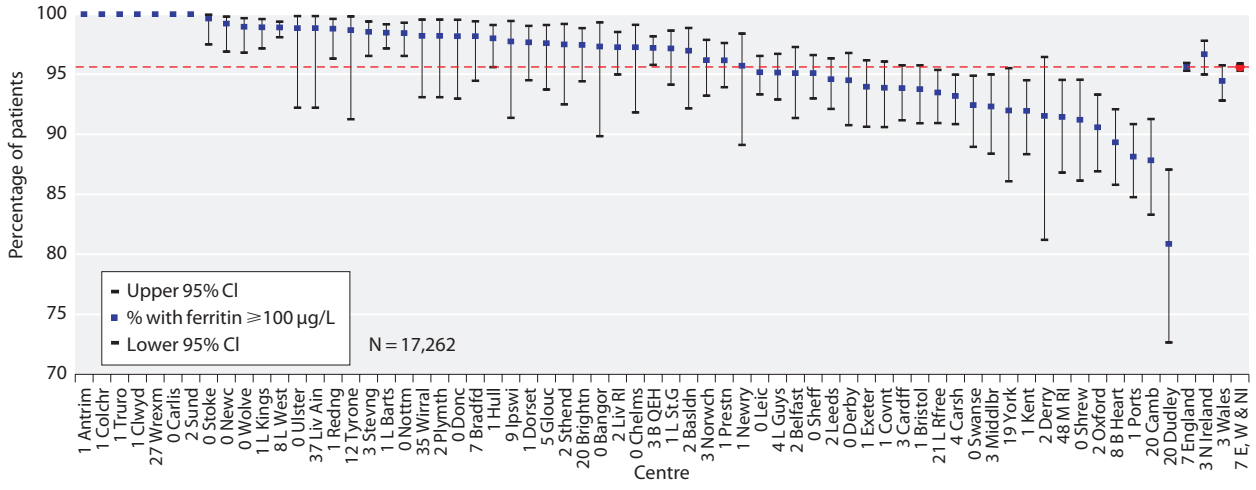

Fig. 9.31. Percentage of HD patients with ferritin ⩾100 µg/L

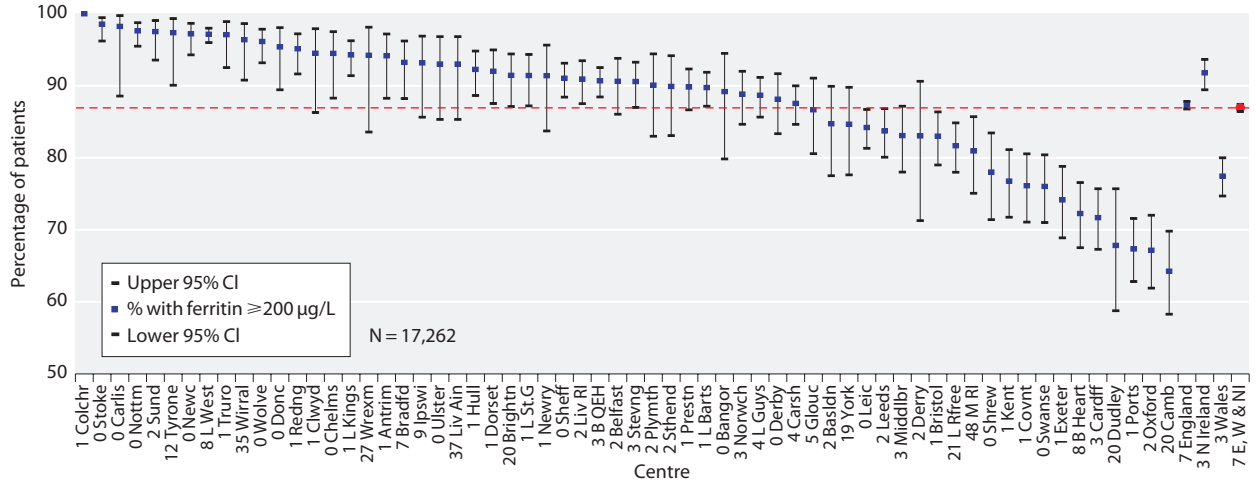

Fig. 9.32. Percentage of HD patients with ferritin ⩾200 µg/L

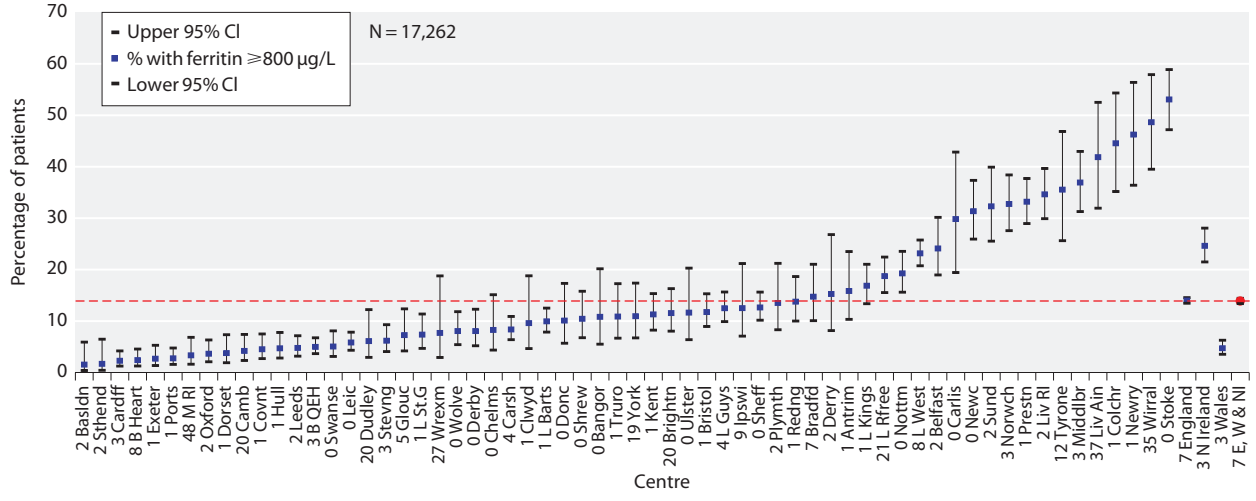

Fig. 9.33. Percentage of HD patients with ferritin ⩾800 µg/L

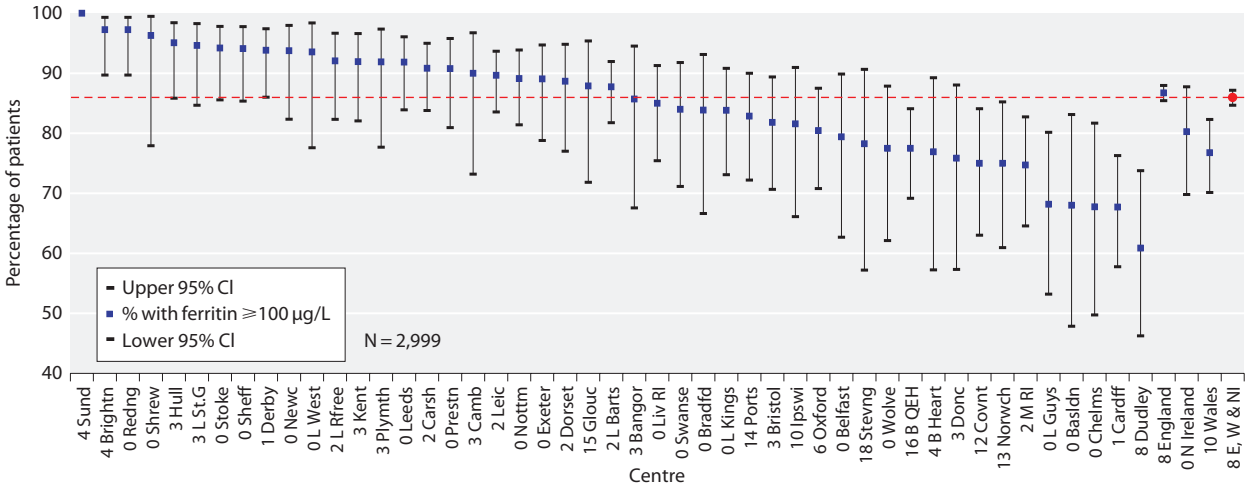

Fig. 9.34. Percentage of PD patients with ferritin ⩾100 µg/L

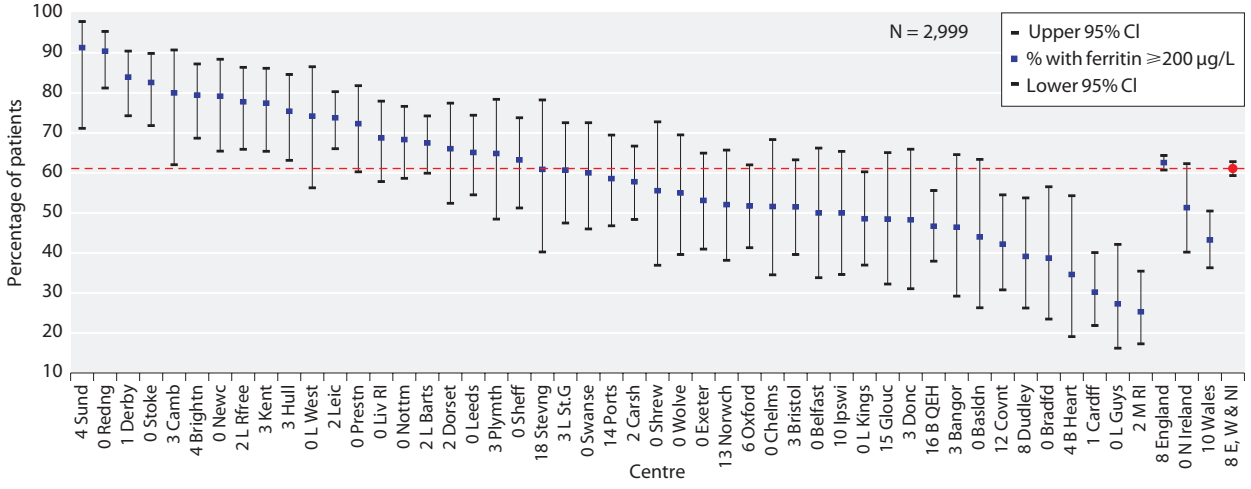

Fig. 9.35. Percentage of PD patients with ferritin ⩾200 µg/L

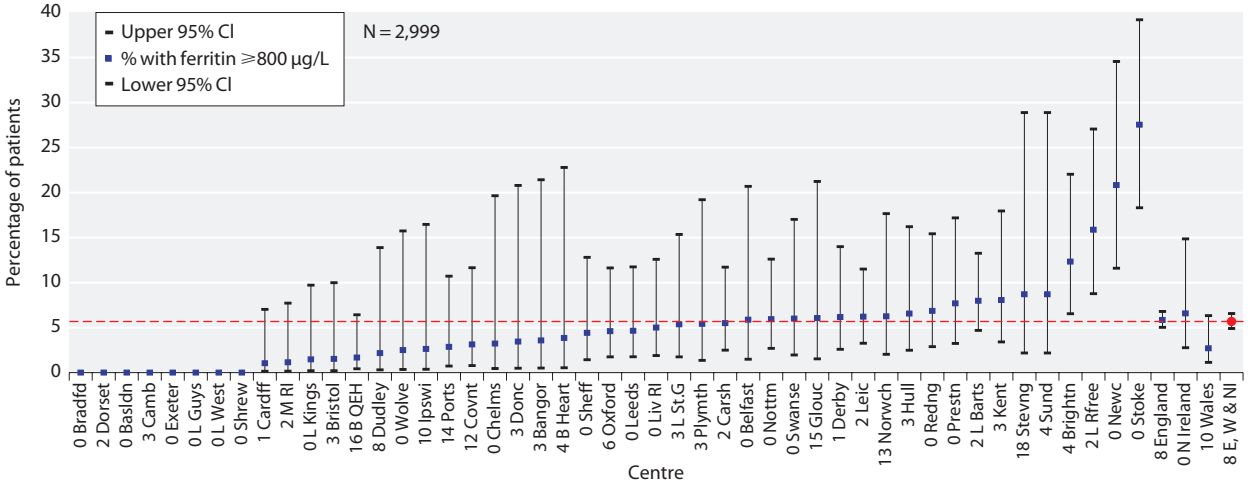

Fig. 9.36. Percentage of PD patients with ferritin ⩾800 µg/L

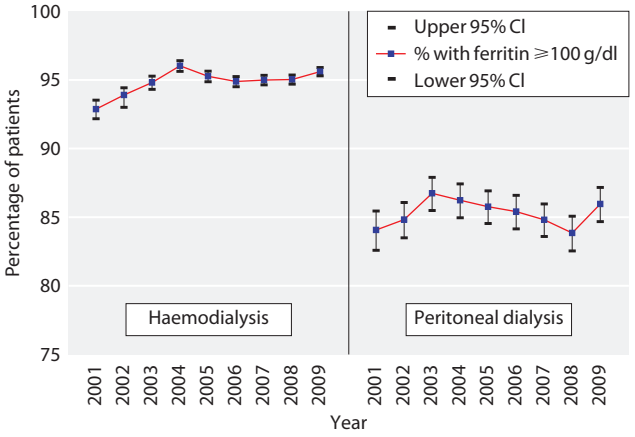

Fig. 9.37. Percentage of patients with ferritin ⩾100 µg/L (2001–2009)

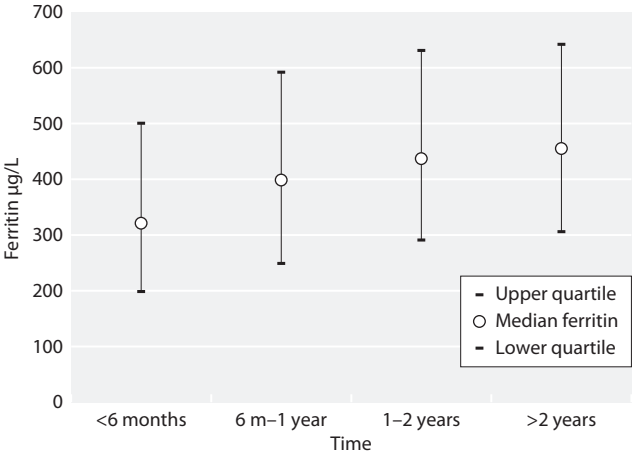

Fig. 9.39. Median ferritin and length of survival on RRT (HD)

with the lowest possible doses are desirable. Furthermore, recent studies such as the CREATE and CHOIR studies suggest that driving the haemoglobin levels above 13 g/dl and/or high doses of ESAs per se may be associated with an excess of cardiovascular risk compared to the comparator groups in these and other studies [10, 11]. Table 9.6 shows the percentage of patients treated and the dose of ESA given in HD patients. Equivalent data for PD patients are shown in table 9.7. As shown in previous reports there is substantial variation in the average doses of ESA prescription used in UK dialysis units. The median dose for prevalent HD patients varied from 4,000 to 13,500 IU/week. In PD patients, in whom target haemoglobin can be achieved with substantially less agent, the median dose varied from 3,000–8,000 IU/week. The mean doses for 2009 prevalent patients in England, Wales and Northern Ireland were 9,507 IU/week for HD and 6,212 IU/week for PD patients.

ESA prescription: age and modality associations

The proportion of patients on an ESA was higher for HD (91%) than PD (75%) and this difference was present and similar across all age bands (figure 9.41). The percentage of the whole cohort which maintained a Hb ⩾10 g/dl without requiring ESA (by age band and modality) is shown in figure 9.42. Overall 7% of HD patients and 24% of PD patients maintained their Hb ⩾10 g/dl without an ESA (figure 9.41). Interestingly for HD patients, older patients were less

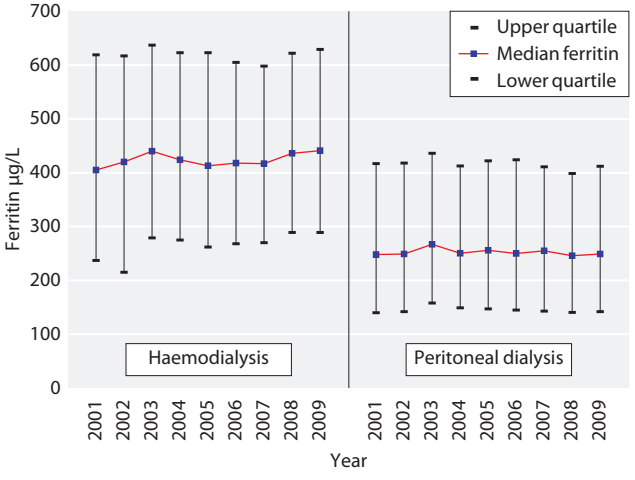

Fig. 9.38. Median ferritin of prevalent patients (2001–2009)

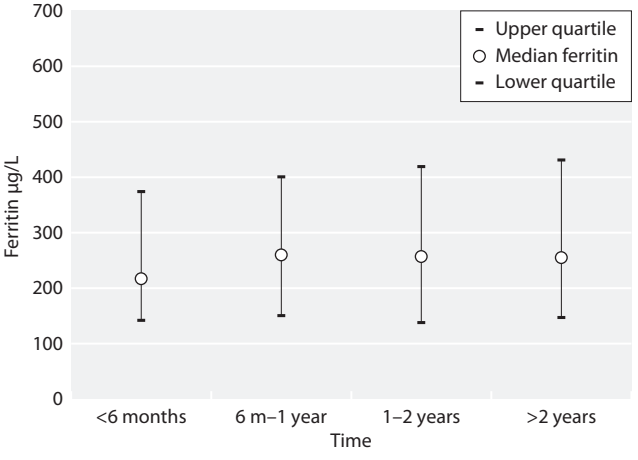

Fig. 9.40. Median ferritin and length of survival on RRT (PD)

Table 9.6. ESA prescribing in HD patients

Centre	N in ESA data file	% on ESA	N on ESA	% with dose data	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb ⩾10 g/dl and not on ESA
Antrim	121	93	113	100	9,637	8,000	7
B Heart	406	85	344	100	10,430	8,000	13
Bangor	74	77	57	98	12,124	9,000	22
Basldn	133	94	125	100	10,056	8,000	5
Belfast	229	93	214	100	7,668	6,000	5
Bradfd	176	87	153	97	6,909	6,000	8
Bristol	403	94	380	100	10,431	8,000	5
Chelms	109	97	106	100	14,755	13,500	2
Covnt	314	92	290	99	12,380	12,000	7
Derry	60	93	56	100	10,536	9,000	7
Donc	109	97	106	100	9,641	8,000	3
Dorset	215	89	192	100	11,596	8,000	10
Exeter	302	97	293	99	9,693	8,000	3
Ipswi	97	97	94	100	8,670	8,000	3
Kent	314	93	292	100	11,354	9,000	6
Leeds	468	92	430	97	5,875	4,000	7
Leic	706	98	690	98	8,447	6,000	2
Liv RI	370	95	351	100	9,646	8,000	4
Middlbr	268	80	214	100	6,334	6,000	16
Newry	94	95	89	100	7,528	4,000	5
Norwch	295	92	270	100	8,826	8,000	8
Nottm	379	96	365	100	10,123	9,000	3
Oxford	335	92	308	100	12,266	10,000	7
Prestn	448	87	389	7			10
Redng	249	94	233	0			5
Sheff	571	91	518	100	10,438	8,000	9
Shrew	182	90	163	95	8,587	8,000	9
Sthend	121	95	115	100	12,017	12,000	4
Swanse	318	81	259	0			17
Truro	139	98	136	95	7,239	5,000	1
Tyrone	86	97	83	100	9,530	9,000	2
Ulster	86	99	85	100	6,536	5,000	1
Wolve	287	92	264	100	9,017	6,000	7
Wrexm	71	90	64	92	7,678	6,000	8
York	169	71	120	99	7,520	6,000	27
England	**7,565**	**92**	**6,941**	**91**	**9,620**	**8,000**	**7**
N Ireland	**676**	**95**	**640**	**100**	**8,338**	**6,000**	**5**
Wales	**463**	**82**	**380**	**31**	**9,810**	**8,000**	**16**
E, W & NI	**8,704**	**91**	**7,961**	**89**	**9,507**	**8,000**	**7**

Blank cells denote centres excluded from analyses due to missing or very incomplete dosage data

likely to have a haemoglobin above 10 g/dl without an ESA if they were on HD but this association was not apparent for older patients on PD.

Figure 9.43 shows the percentage of anaemic patients (Hb <10.0 g/dl) receiving an ESA. A minority of patients had a Hb <10 g/dl and appeared to not be receiving ESA therapy. There are several potential explanations for this including some patients being declared unresponsive to ESA therapy and therefore no longer on treatment, some individuals may have just become anaemic and not yet started therapy and others may have been on ESA treatment but not had it recorded.

ESA prescription and gender

Provision of ESA by age and gender for HD and PD patients is shown in figures 9.44 and 9.45. For both modalities across all age ranges, a higher percentage of females were on ESA treatment. In HD patients, 94% of females were receiving ESA therapy compared to 90% of males. In PD patients, 78% of

Table 9.7. ESA prescribing in PD patients

Centre	N in ESA data file	% on ESA	N on ESA	% with dose data	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb ⩾10 g/dl and not on ESA
Antrim	14						
B Heart	27	70	19	100	6,368	4,000	30
Bangor	29	69	20	100	4,740	4,000	31
Basldn	25	52	13	100	6,385	4,000	48
Belfast	34	74	25	100	4,820	3,000	26
Bradfd	31	81	25	76	7,053	6,000	19
Bristol	68	75	51	98	6,578	4,000	25
Camb	31	81	25	100	6,528	4,000	16
Cardff	97	60	58	0			39
Carlis	13						
Chelms	31	77	24	100	7,042	5,500	23
Clwyd	7						
Covnt	73	73	53	100	8,321	6,000	25
Derry	3						
Donc	30	83	25	100	6,220	4,000	14
Dorset	54	83	45	100	5,300	4,000	13
Dudley	50	62	31	94	4,745	4,000	35
Exeter	64	81	52	100	5,430	4,000	19
Ipswi	42	81	34	100	5,842	4,000	19
Leeds	86	87	75	99	5,486	4,000	12
Leic	148	84	125	97	4,936	4,000	15
Liv RI	80	86	69	100	9,169	8,000	14
Newry	12						
Norwch	55	58	32	100	4,198	4,000	38
Nottm	101	77	78	100	5,067	3,750	22
Oxford	93	78	73	100	8,329	4,000	22
Plymth	38	61	23	100	6,348	4,000	38
Prestn	65	65	42	2			34
Redng	73	81	59	0			18
Sheff	68	65	44	100	7,500	6,000	35
Shrew	27	67	18	94	6,000	4,000	33
Sthend	17						
Swanse	50	82	41	0			18
Truro	21	95	20	95	5,227	4,000	5
Tyrone	11						
Ulster	2						
Wolve	40	75	30	100	6,183	4,000	23
York	15						
England	**1,466**	**76**	**1,115**	**89**	**6,306**	**4,000**	**23**
N Ireland	**76**	**71**	**54**	**100**	**5,065**	**3,000**	**29**
Wales	**183**	**67**	**123**	**20**	**4,867**	**4,000**	**32**
E, W & NI	**1,725**	**75**	**1,292**	**83**	**6,212**	**4,000**	**24**

Blank cells denote centres excluded from analyses due to low patient numbers or very incomplete dosage data

females compared to 73% of males were on ESA treatment.

ESAs and time on renal replacement therapy

The percentage of patients on ESA by time on RRT and dialysis modality is shown in figure 9.46. This is a cross-sectional analysis at the final quarter of 2009. Patients who had previously changed RRT modality were still included in this analysis. Interestingly, the proportion of PD patients requiring ESA rises with duration of RRT from 73% after 1 year of PD, to 86% after 10 or more years. This almost certainly reflects the loss of residual renal function. For at least the first 10 years on RRT, a greater percentage of HD patients are receiving ESA treatment than patients on PD at any given time point.

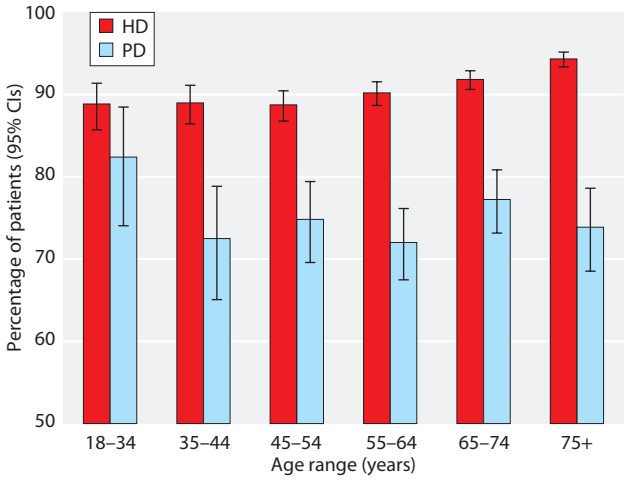

Fig. 9.41. Percentage of dialysis patients on ESA, by age group and treatment modality

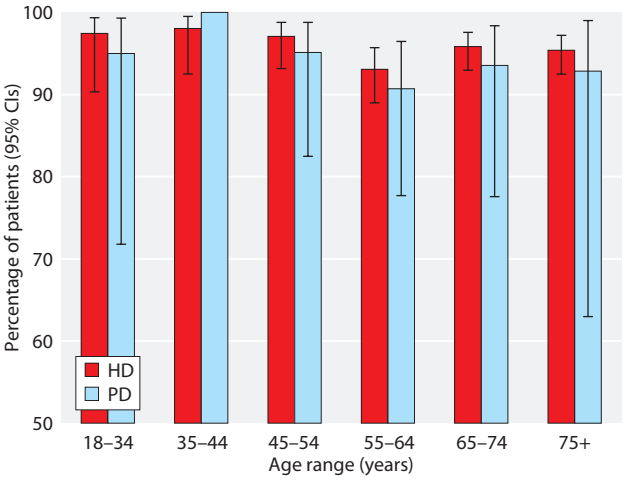

Fig. 9.43. Percentage of patients with Hb <10 g/dl who are on ESA, by age group and treatment modality

ESA dose and success with guideline compliance

There is no significant relationship between centres' mean ESA dose and median Hb for HD patients (figure 9.47) or compliance with the EPBG minimum standard for Hb for HD patients (figure 9.48). This is not surprising as the most anaemic patients and those least responsive to ESAs are often those given the biggest doses. Figure 9.49 shows the frequency distribution of weekly ESA dose by treatment modality.

It is known that not all patients treated with dialysis who have a Hb above the new RA guideline ceiling of 12.5 g/dl are receiving ESA. As a result, it has been suggested that it may be inappropriate to include these patients within the group not meeting this RA target for two reasons: firstly, the high Hb remains outside the control of the clinician, and secondly, the recent trials suggesting that it may be detrimental to achieve a high Hb in renal patients were based only upon patients treated with ESAs [10, 11].

Figures 9.50 and 9.51 show the percentages of HD and PD patients in each centre whose Hb lies above, within or below the RA guidelines of 10.5–12.5 g/dl. These charts also show the proportion of patients with a Hb above 12.5 g/dl who were receiving, or were not receiving ESAs. These analyses are restricted to the centres with acceptable ESA returns as stipulated above. These figures

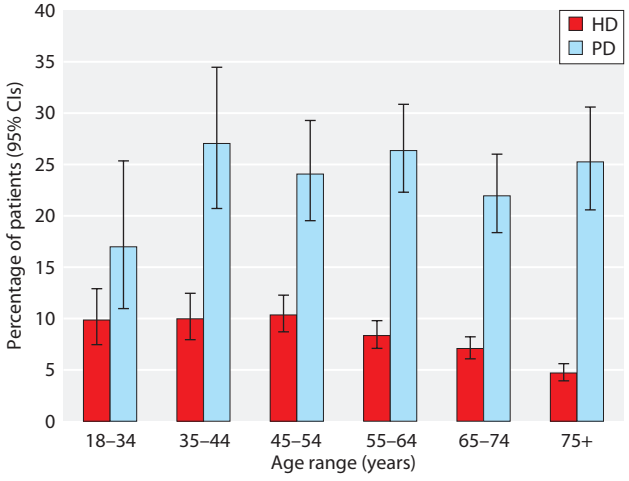

Fig. 9.42. Percentage of whole cohort who are not on ESA and have Hb ⩾10 g/dl, by age group and treatment modality

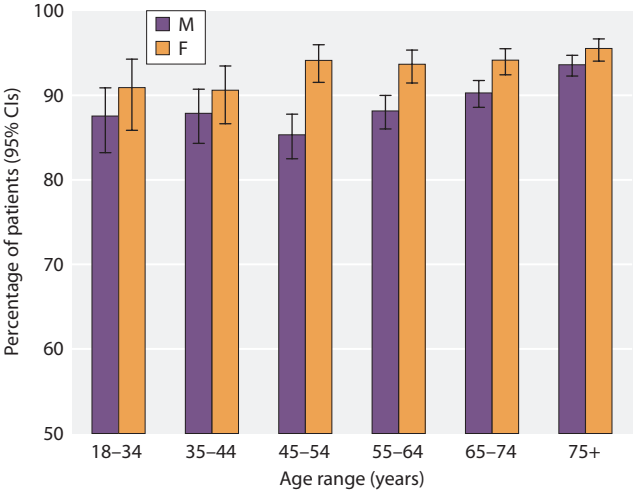

Fig. 9.44. Prescription of ESA by age and gender in patients treated with HD

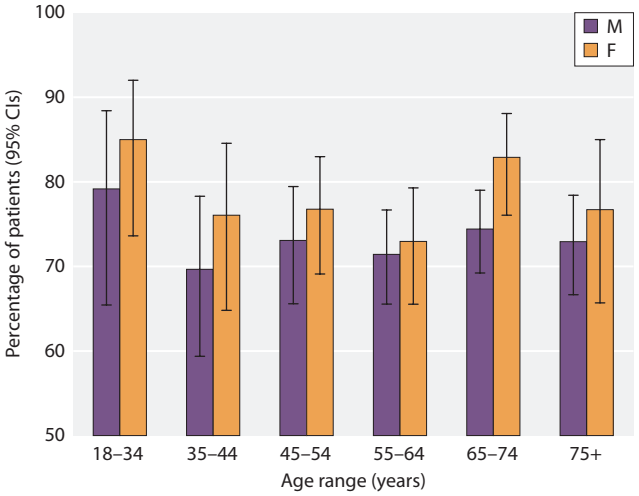

Fig. 9.45. Prescription of ESA by age and gender in patients treated with PD

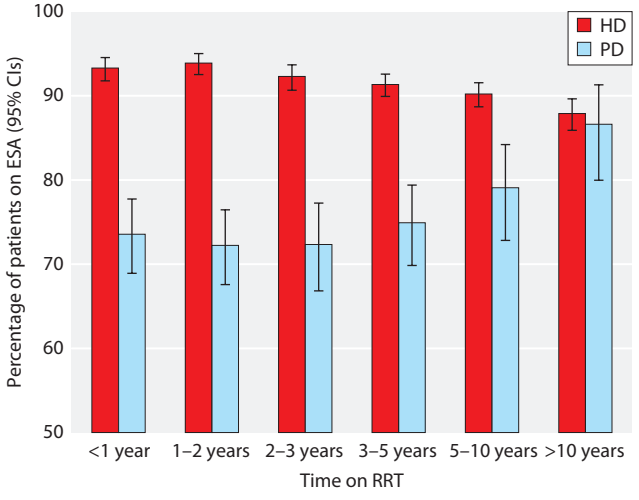

Fig. 9.46. Percentage of patients on ESA by time on RRT

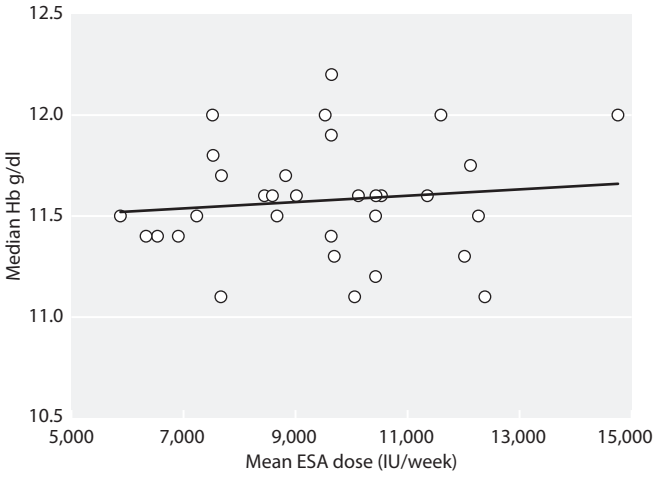

Fig. 9.47. Median Hb versus mean ESA dose in patients treated with HD, by centre

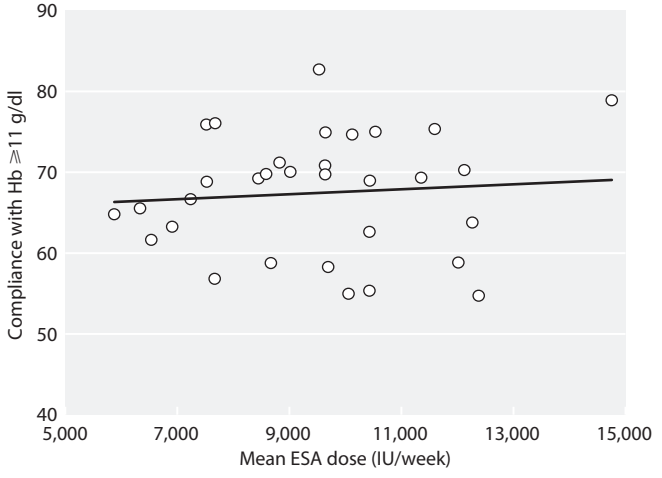

Fig. 9.48. Compliance with European Best Practice Guidelines versus mean ESA dose in patients treated with HD, by centre

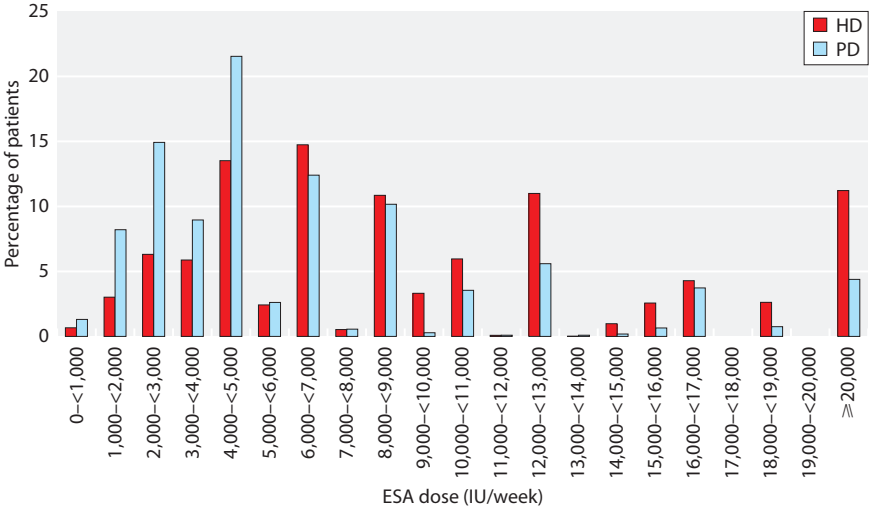

Fig. 9.49. Frequency distribution of weekly ESA dose

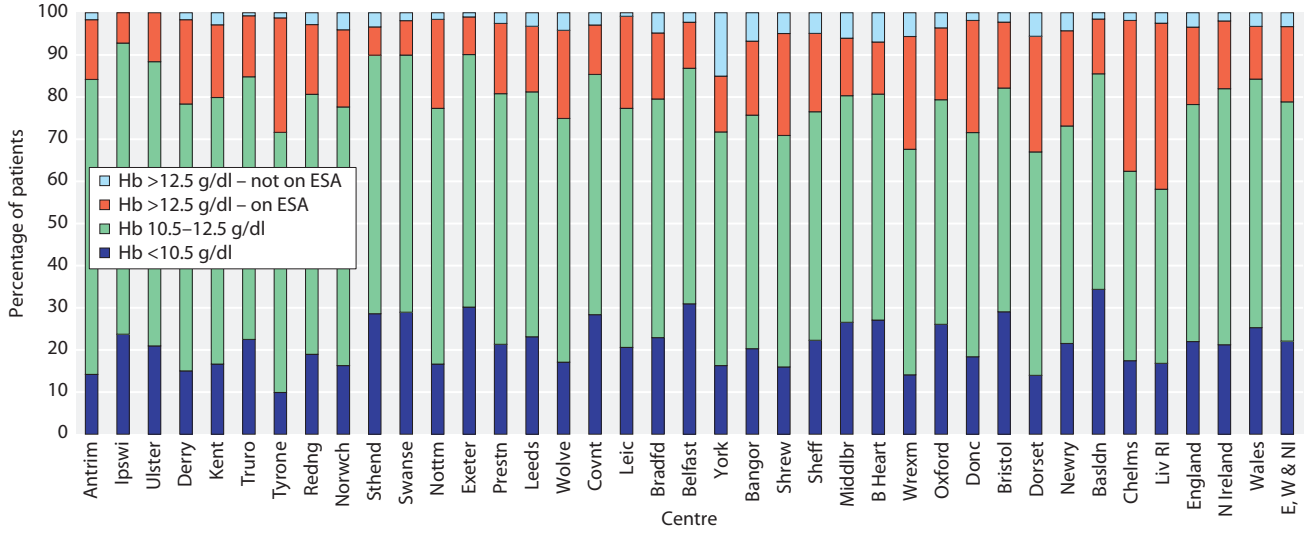

Fig. 9.50. Distribution of haemoglobin in patients treated with HD and the proportion of patients with Hb >12.5 g/dl receiving ESA

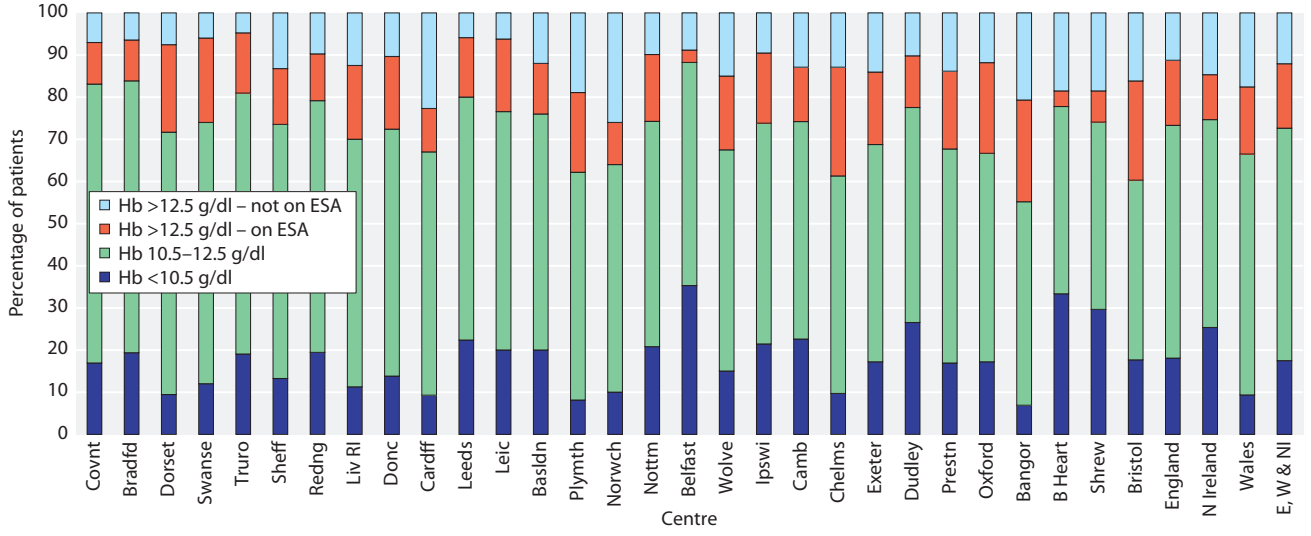

Fig. 9.51. Distribution of haemoglobin in patients treated with PD and the proportion of patients with Hb >12.5 g/dl receiving ESA

show that 21.2% of HD patients had a Hb above the RA ceiling of 12.5 g/dl, but 3.3% were not receiving ESA. Patients on PD were more likely to have a high Hb without the use of ESA (27.4% with Hb >12.5, with 12.1% not on ESAs).

Discussion

Haemoglobin outcomes for patients on HD and PD in the UK were largely compliant with the RA minimum standard of Hb ⩾10.0 g/dl (85% and 88% respectively). Achieving compliance whilst also attempting compliance with the NICE guidelines published in 2006 and the 4th edition of the RA Clinical Practice Guidelines 2006 [6] recommended outcome Hb of between 10.5 and 12.5 g/dl requires careful positioning of the median outcome Hb for each centre. It also requires a reduction in the standard deviation of Hb to reach compliance levels higher than ~60% even if the median Hb falls on 11.5 g/dl.

Of the 44 centres achieving >85% compliance with Hb ⩾10.0 g/dl in HD patients, 19 centres achieved ⩾60% compliance with Hb between 10.5–12.5 g/dl. This is an improvement from the 9 centres out of 47

which were reported last year. The presentation of funnel plots for compliance with Hb $\geqslant$10.0 g/dl and Hb between 10.5–12.5 g/dl (figures 9.12 and 9.13) may enable centres to continue adjusting their desired Hb outcome in light of the NICE guidelines.

Narrowing the population Hb distribution would appear to be important if centres wish to achieve compliance with Hb >10 g/dl whilst avoiding higher Hb outcomes i.e. >12.5 g/dl [10–12]. Nine of the 10 centres achieving the greatest compliance with Hb between 10.5 and 12.5 g/dl had the lowest standard deviations for Hb (1.1 to 1.2 g/dl) in HD patients. If some centres consistently achieve these narrow distributions and the critical behaviour(s) by which they achieve these outcomes were identified, other centres could attempt to copy their behaviour.

Previous reports have highlighted the need to avoid improving compliance with the NICE guidelines at the expense of the Hb $\geqslant$10.0 g/dl minimum standard. This year's analyses confirm that the UK dialysis population are maintaining compliance with more than 85% of patients having a Hb $\geqslant$10.0 g/dl. The use of a target Hb between 10.5–12.5 g/dl alone would infer equivalent risk of Hb >12.5/dl as for <10.5 g/dl. The NICE guidance [5] on limiting upper Hb was primarily a health economic decision and at the time was not given on the grounds of safety. However recent studies highlight the lack of benefit and possible harm related to higher Hb outcomes. The evidence for improving Hb $\geqslant$10 g/dl remains unchanged.

Compliance with advice regarding iron stores as reflected by ferritin has remained stable in the UK and the percentage of patients with serum ferritin greater than 100 μg/L showed that the provision of iron to UK dialysis patients has been maintained.

Overall the data demonstrated that UK renal centres continued to give a high priority to the management of factors influencing Hb. The improvements to compliance with the NICE guidelines shown in the last report have been maintained with 61 centres achieving $\geqslant$50% compliance with Hb between 10.5–12.5 g/dl for HD patients compared with 60, 51 and 35 centres respectively in the previous 3 UKRR reports. The overall UK compliance with this range has also improved from 48% to 56% over the same period.

Conflicts of interest: none

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