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# Chapter 9

## Haemoglobin, ferritin and erythropoietin amongst patients receiving dialysis in the UK in 2007: national and centre-specific analyses

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### Key Words

Anaemia · Chronic kidney disease · Dialysis · End stage renal disease · Erythropoietin · Ferritin · Haemoglobin · Renal Registry · Epidemiology · Quality improvement

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### Abstract

**Background:** The UK Renal Association (RA) and National Institute for Health and Clinical Excellence (NICE) have published Clinical Practice Guidelines which include recommendations for management of anaemia in established renal failure. **Aims:** To determine the extent to which the guidelines for anaemia management are met in the UK. **Methods:** Quarterly data (haemoglobin (Hb) and factors that influence Hb) extracts from renal centres in England, Wales and Northern Ireland (EWNI), and annual data from the Scottish Renal Registry for incident and prevalent renal replacement therapy (RRT) cohorts for 2007 were analysed by the UK Renal Registry (UKRR). **Results:** In the UK, in 2007 58% of patients commenced dialysis therapy with Hb  $\geq 10.0$  g/dl (median Hb 10.3 g/dl). Of incident patients 81% and 87% had a Hb  $\geq 10.0$  g/dl by 3 and 6 months of dialysis treatment respectively. The median Hb of haemodialysis (HD) patients was 11.6 g/dl with an interquartile range

(IQR) of 10.6–12.6 g/dl. Of HD patients 86% had a Hb  $\geq 10.0$  g/dl. The median Hb of peritoneal dialysis (PD) patients in the UK was 11.9 g/dl (IQR 11.0–12.8 g/dl). 91% of UK PD patients had a Hb  $\geq 10.0$  g/dl. The median ferritin in HD patients in EWNI was 417  $\mu\text{g/L}$  (IQR 270–598) and 95% of HD patients had a ferritin  $\geq 100$   $\mu\text{g/L}$ . The median ferritin in PD patients was 255  $\mu\text{g/L}$  (IQR 143–411) with 85% of PD patients having a ferritin  $\geq 100$   $\mu\text{g/L}$ . In EWNI the mean ESA dose was higher for HD than PD patients (9,300 vs. 6,100 IU/week). **Conclusions:** This year for the first time there has been a small fall (from 85.9% in 2006 to 85.6%) in the percentage of HD patients with an Hb of  $\geq 10$  g/dl. This contrasts with previous annual improvements in this figure and is related to implementation of the new Hb Standard which has a target range of 10.5–12.5 g/dl.

### Introduction

This chapter describes data reported to the UKRR relating to management of renal anaemia during 2007.

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 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. The UKRR does not collect a specific measurement from patients 6 months after meeting a nephrologist. Some indication of the standard comes from the Hb of the incident patient population (i.e. the Hb at the start of dialysis).

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 2007 [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 the 2006 Report much of the data collection had preceded the publication of the NICE guidelines. The 2007 Report begins to show how the attempt to comply with both the 10.5–12.5 g/dl range and the minimum standard of Hb  $\geq$ 10.0 g/dl has impacted on the performance against a combination of measures. The risks associated with low (<10 g/dl) and high (>13 g/dl) Hb are not necessarily equivalent.

National and international recommendations for target iron status in CKD remained unchanged from the 2006 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  $\mu$ g/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  $\mu$ g/L for HD patients.

The NICE guidelines suggest that a hypochromic red cell value >6% suggests ongoing iron deficiency (HRC).

To achieve adequate iron status across a patient population, RA guidelines and EBPGII advocate population target medians for ferritin of 200–500  $\mu$ g/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  $\mu$ g/L ensures that 85–90% of patients attain a serum ferritin of 100  $\mu$ g/L.

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

## Methods

The incident and prevalent RRT cohorts for 2007 were analysed. The UKRR extracted quarterly data electronically from renal centres in EWNI, data were sent annually from the Scottish Renal Registry. Patients treated with dialysis during the last quarter of 2007 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 2007 was used for analysis.

For the incident patient analyses, data from the first quarter after starting dialysis was used. Patients commencing RRT on PD or HD were included. Those receiving a pre-emptive transplant were excluded. Patients were analysed as a complete cohort and divided by modality into groups.

The last available ferritin measurement was taken from the last three quarters of the year and analysed for prevalent patients. Ferritin data were only received for three patients from Scotland, so all Scottish centres were excluded from ferritin analyses.

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

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

The percentage achieving RA and other standards was also calculated for Hb. The percentage of patients achieving serum ferritin  $\geq 100 \mu\text{g/L}$  and  $\geq 200 \mu\text{g/L}$  were also calculated. These are represented as caterpillar plots with 95% confidence intervals shown. For the percentage achieving standards, chi-squared values have also been calculated to identify significant variability between centres and between nations.

Longitudinal analysis has also been done to calculate overall changes in achievement of standards from 1998 to 2007.

The UK RA Clinical Practice [1,6] 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  $\mu\text{g/L}$  and percentage transferrin saturation (TSAT) of more than 20%.***

***Serum ferritin levels in patients with CKD should not exceed 800  $\mu\text{g/L}$ .***

Data regarding ESAs were collected from all centres. Centres were excluded if fewer than 90% of patients were on the ESA file. Centres reporting that fewer than 80% of HD patients or fewer than 65% of PD patients were 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' doses. The UK percentage of patients on ESAs is calculated from this data and incomplete data returns risk seriously impacting on any conclusions drawn. Scotland is excluded from the analysis as there were ESA data returns for only 2 patients.

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 end stage renal failure were by definition excluded from the dataset. The UKRR plans to collect and report CKD 5 data from patients who subsequently commence RRT as well as those managed conservatively.

The percentage of data returned and outcome Hb are listed in table 9.1.

The median Hb of patients at the time of starting dialysis in the UK was 10.3 g/dl with 58% of patients having a Hb  $\geq 10.0$  g/dl (vs. 60% for 2006 Report). The variation between centres remained high (35–88%).

The median starting Hb is shown in figure 9.1 and the percentage starting with a Hb  $\geq 10.0$  g/dl by centre is given in figure 9.2. The distribution of Hb in incident dialysis patients during 2007 is shown in figure 9.3. The median Hb and the percentage of incident dialysis patients in 2006 with Hb  $\geq 10.0$  g/dl by time on dialysis are shown in figures 9.4 and 9.5.

The annual distribution (figure 9.6) of Hb in incident dialysis patients has not changed significantly since 2002.

#### *Haemoglobin in prevalent haemodialysis patients*

The compliance with data returns and Hb outcome for prevalent HD patients 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 10.6–12.6 g/dl. In the UK, 86% of HD patients had a Hb  $\geq 10.0$  g/dl. The median Hb by centre, compliance with the previous UK minimum standard of Hb  $\geq 10.0$  g/dl and EBPG standard of Hb  $\geq 11.0$  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 sd limits of the mean in the funnel

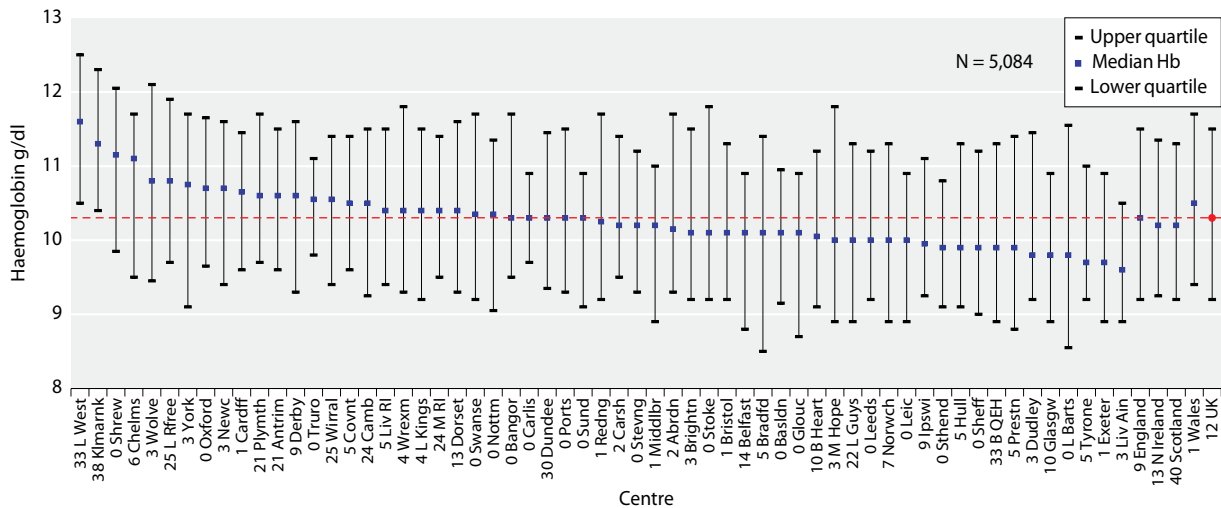
**Table 9.1.** Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis during 2007

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb $\geq$ 10 g/dl
Abrdn	98	10.2	7.9–13.4	9.3–11.7	54
Airdrie	18				
Antrim	79	10.6	9.2–11.8	9.6–11.5	69
B Heart	90	10.1	7.7–13.6	9.1–11.2	51
B QEH	67	9.9	7.6–12.7	8.9–11.3	48
Bangor	100	10.3	7.6–12.9	9.5–11.7	56
Basldn	100	10.1	7.4–12.0	9.2–11.0	56
Belfast	86	10.1	7.8–13.3	8.8–10.9	58
Bradfd	95	10.1	7.6–13.0	8.5–11.4	52
Brightn	97	10.1	8.0–14.2	9.2–11.5	53
Bristol	99	10.1	7.9–13.7	9.2–11.3	54
Camb	76	10.5	8.0–13.3	9.3–11.5	57
Cardff	99	10.7	8.1–13.3	9.6–11.5	65
Carlis	100	10.3	8.8–13.5	9.7–10.9	63
Carsh	98	10.2	7.8–12.7	9.5–11.4	60
Chelms	94	11.1	7.5–12.9	9.5–11.7	68
Clwyd	87				
Covnt	95	10.5	8.7–12.7	9.6–11.4	62
D & Gall	94				
Derby	91	10.6	8.2–13.0	9.3–11.6	63
Derry	60				
Donc	100				
Dorset	87	10.4	7.4–13.7	9.3–11.6	69
Dudley	97	9.8	7.6–13.3	9.2–11.5	47
Dundee	70	10.3	7.6–13.1	9.4–11.5	58
Dunfn	9				
Edinb	0				
Exeter	99	9.7	7.5–13.1	8.9–10.9	42
Glasgw	90	9.8	7.8–13.1	8.9–10.9	45
Glouc	100	10.1	7.7–12.1	8.7–10.9	55
Hull	95	9.9	7.6–13.3	9.1–11.3	48
Inverns	81				
Ipswi	91	10.0	8.4–11.8	9.3–11.1	50
Klmarnk	63	11.3	8.4–13.4	10.4–12.3	80
L Barts	100	9.8	7.2–13.3	8.6–11.6	48
L Guys	78	10.0	7.8–13.0	8.9–11.3	54
L Kings	96	10.4	8.2–12.9	9.2–11.5	59
L Rfree	75	10.8	8.7–13.2	9.7–11.9	70
L West	67	11.6	9.1–13.7	10.5–12.5	88
Leeds	100	10.0	7.9–12.8	9.2–11.2	52
Leic	100	10.0	7.4–12.8	8.9–10.9	54
Liv Ain	97	9.6	7.8–12.0	8.9–10.5	35
Liv RI	95	10.4	7.7–13.1	9.4–11.5	62
M Hope	97	10.0	7.3–13.6	8.9–11.8	51
M RI	76	10.4	7.8–13.2	9.5–11.4	61
Middlbr	99	10.2	8.0–12.6	8.9–11.0	54
Newc	97	10.7	8.1–13.2	9.4–11.6	67
Newry	100				
Norwch	93	10.0	7.8–13.0	8.9–11.3	52
Nottm	100	10.4	7.6–12.9	9.1–11.4	60
Oxford	100	10.7	8.5–12.8	9.7–11.7	70
Plymth	79	10.6	7.9–13.7	9.7–11.7	63
Ports	100	10.3	7.8–13.4	9.3–11.5	55
Prestn	95	9.9	7.0–12.6	8.8–11.4	49
Redng	99	10.3	8.0–14.0	9.2–11.7	59
Sheff	100	9.9	7.7–12.7	9.0–11.2	50
Shrew	100	11.2	7.7–13.5	9.9–12.1	71
Stevng	100	10.2	8.3–12.7	9.3–11.2	57

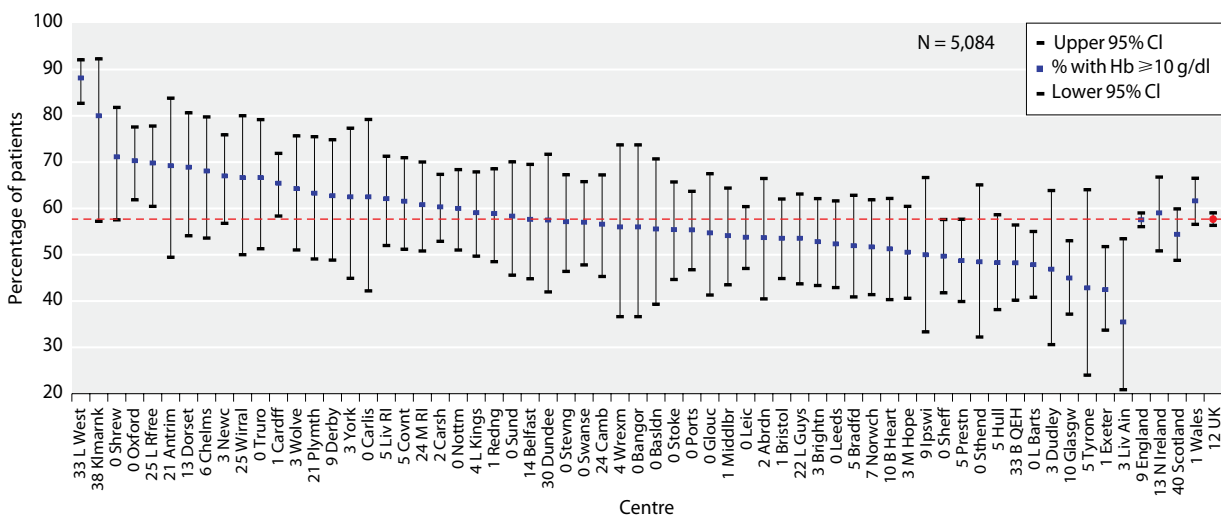
**Table 9.1.** Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb $\geq$ 10 g/dl
Sthend	100	9.9	8.2–14.2	9.1–10.8	48
Stoke	100	10.1	8.0–13.5	9.2–11.8	55
Sund	100	10.3	7.6–13.0	9.1–10.9	58
Swanse	100	10.4	7.7–13.4	9.2–11.7	57
Truro	100	10.6	9.0–12.2	9.8–11.1	67
Tyrone	95	9.7	7.4–12.3	9.2–11.0	43
Ulster	95				
Wirral	75	10.6	8.6–13.7	9.4–11.4	67
Wolve	97	10.8	7.6–14.2	9.5–12.1	64
Wrexm	96	10.4	8.3–12.6	9.3–11.8	56
York	97	10.8	7.2–13.8	9.1–11.7	63
<b>England</b>	<b>91</b>	<b>10.3</b>	<b>7.8–13.1</b>	<b>9.2–11.5</b>	<b>58</b>
<b>N Ireland</b>	<b>87</b>	<b>10.2</b>	<b>7.8–12.6</b>	<b>9.3–11.4</b>	<b>59</b>
<b>Scotland</b>	<b>60</b>	<b>10.2</b>	<b>7.9–13.2</b>	<b>9.2–11.3</b>	<b>54</b>
<b>Wales</b>	<b>99</b>	<b>10.5</b>	<b>8.0–13.3</b>	<b>9.4–11.7</b>	<b>62</b>
<b>UK</b>	<b>88</b>	<b>10.3</b>	<b>7.8–13.1</b>	<b>9.2–11.5</b>	<b>58</b>

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



**Fig. 9.1.** Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2007



**Fig. 9.2.** Percentage of incident dialysis patients with Hb  $\geq$  10 g/dl at start of dialysis treatment in 2007

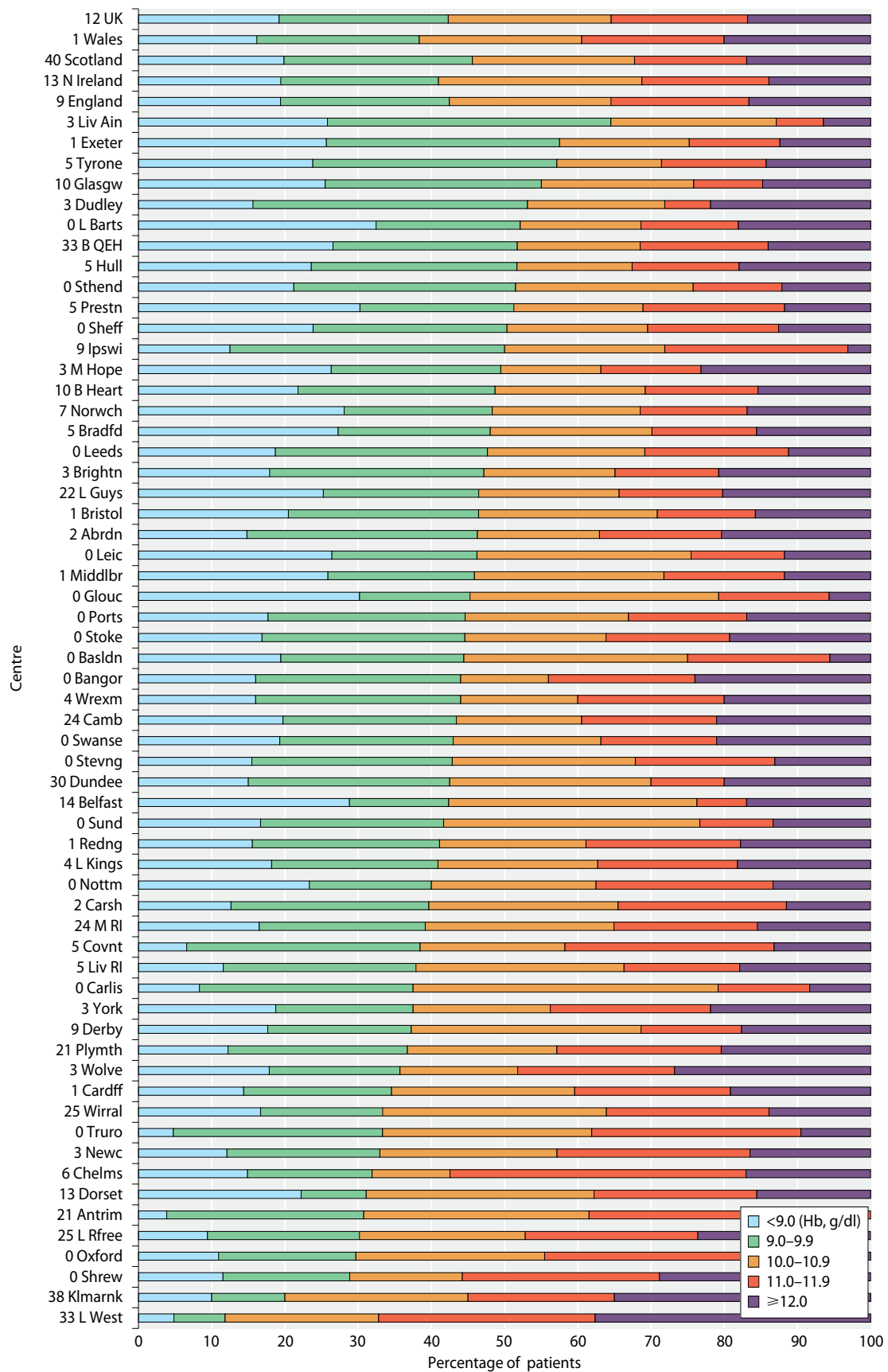
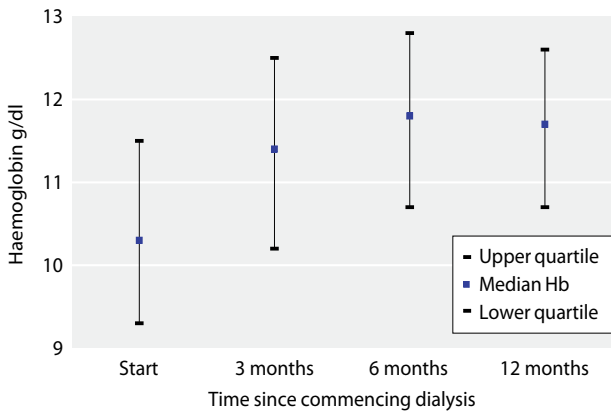
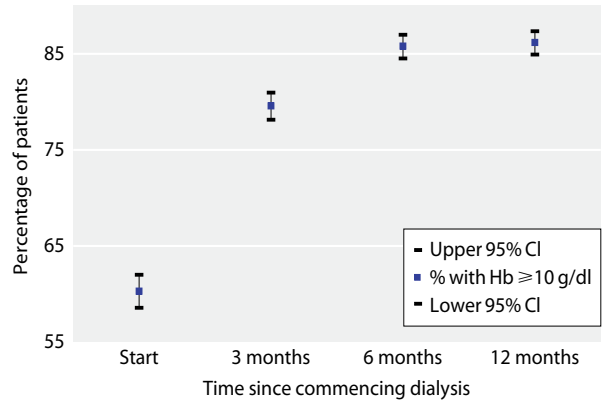


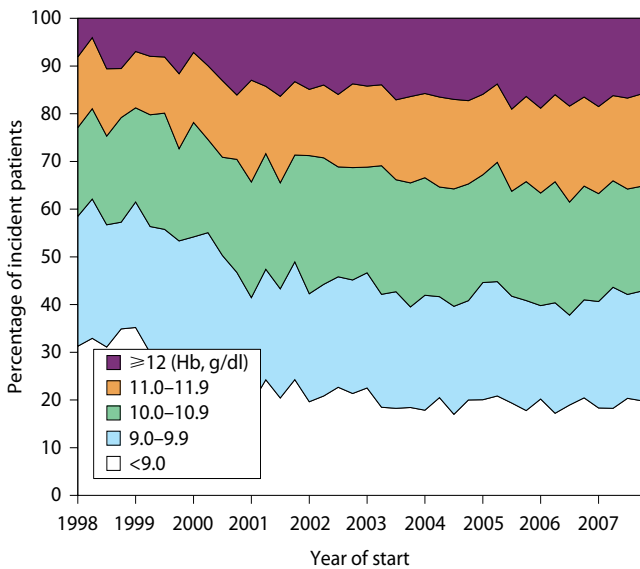
Fig. 9.3. Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment in 2007



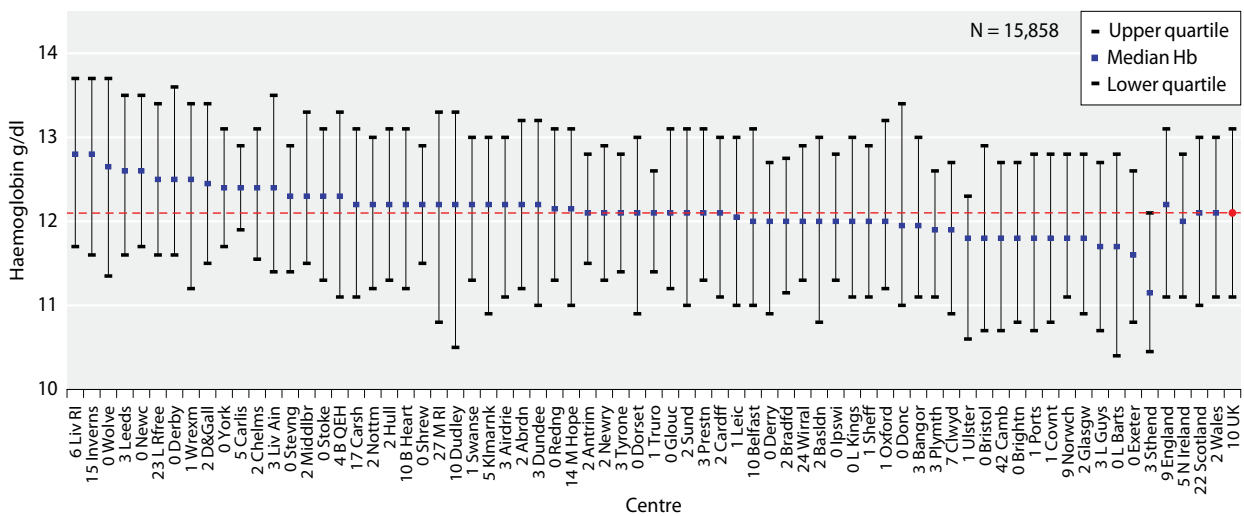
**Fig. 9.4.** Median haemoglobin, by time on dialysis, for incident dialysis patients in 2006



**Fig. 9.5.** Percentage of incident dialysis patients in 2006 with Hb ≥ 10 g/dl, by time on dialysis



**Fig. 9.6.** Distribution of haemoglobin in incident dialysis patients by year of start



**Fig. 9.7.** Median haemoglobin in patients treated with HD

**Table 9.2.** Haemoglobin data for prevalent HD patients

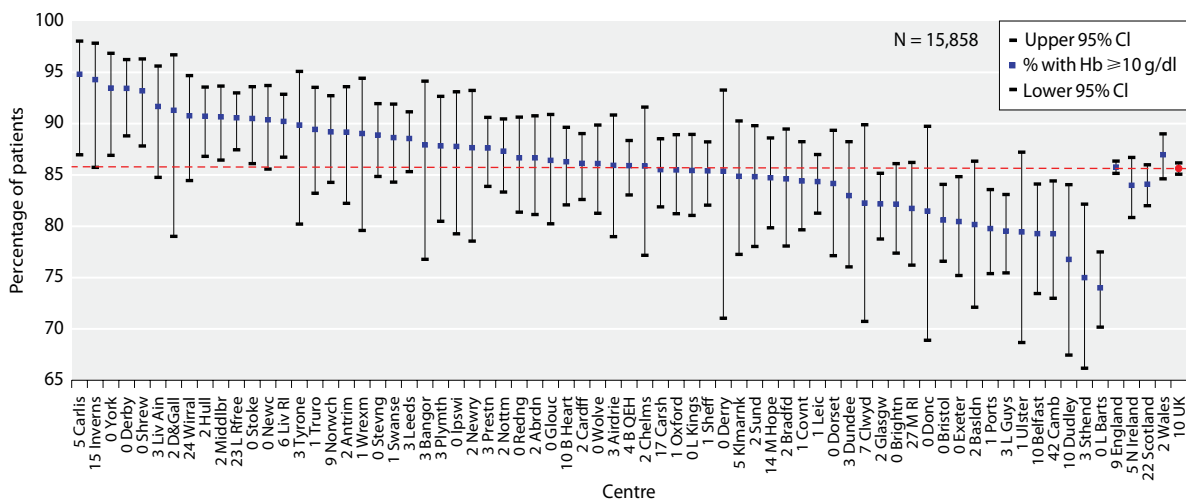
Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb $\geq 10$ g/dl	% with Hb $\geq 11$ g/dl
Abrdn	98	11.7	8.8–13.9	10.7–12.7	11.6	1.5	87	70
Airdrie	97	11.7	9.0–14.2	10.6–12.5	11.6	1.5	86	67
Antrim	98	11.6	8.6–13.4	11.0–12.3	11.5	1.4	89	76
B Heart	90	11.7	8.9–14.0	10.7–12.6	11.6	1.5	86	72
B QEH	96	11.8	8.5–14.1	10.6–12.8	11.6	1.7	86	68
Bangor	97	11.5	8.8–14.1	10.6–12.5	11.5	1.5	88	64
Basldn	98	11.5	9.0–13.6	10.3–12.5	11.4	1.6	80	60
Belfast	90	11.5	8.4–14.1	10.5–12.6	11.4	1.7	79	63
Bradfd	98	11.5	9.3–14.1	10.7–12.3	11.4	1.4	85	67
Brightn	100	11.3	8.7–13.3	10.3–12.2	11.2	1.4	82	61
Bristol	100	11.3	8.8–14.0	10.2–12.4	11.3	1.6	81	61
Camb	58	11.3	8.6–13.9	10.2–12.2	11.2	1.6	79	59
Cardff	98	11.6	9.2–14.1	10.6–12.5	11.5	1.5	86	64
Carlisle	95	11.9	9.8–14.1	11.4–12.4	11.9	1.2	95	77
Carsh	83	11.7	9.0–14.2	10.6–12.6	11.6	1.6	86	69
Chelms	98	11.9	9.2–14.3	11.1–12.6	11.8	1.4	86	77
Clwyd	93	11.4	8.4–13.6	10.4–12.2	11.2	1.6	82	58
Covnt	99	11.3	9.1–13.4	10.3–12.3	11.3	1.3	84	61
D & Gall	98	12.0	9.5–14.0	11.0–12.9	11.9	1.4	91	78
Derby	100	12.0	9.9–14.5	11.1–13.1	12.1	1.4	93	80
Derry	100	11.5	9.2–13.0	10.4–12.2	11.3	1.2	85	63
Donc	100	11.5	8.9–14.4	10.5–12.9	11.6	1.6	81	61
Dorset	100	11.6	8.4–14.1	10.4–12.5	11.5	1.6	84	66
Dudley	90	11.7	7.6–13.7	10.0–12.8	11.3	1.8	77	64
Dundee	97	11.7	8.8–13.8	10.5–12.7	11.5	1.7	83	67
Dunfn	25							
Edinb	1							
Exeter	100	11.1	8.9–13.0	10.3–12.1	11.1	1.3	80	55
Glasgw	98	11.3	8.7–13.8	10.4–12.3	11.3	1.5	82	61
Glouc	100	11.6	9.1–14.1	10.7–12.6	11.7	1.6	86	67
Hull	98	11.7	9.3–13.6	10.8–12.6	11.6	1.4	91	73
Inverns	85	12.3	9.9–14.3	11.1–13.2	12.2	1.7	94	79
Ipswi	100	11.5	8.5–13.3	10.8–12.3	11.4	1.4	88	70
Klmarnk	95	11.7	8.6–13.8	10.4–12.5	11.5	1.5	85	64
L Barts	100	11.2	8.0–13.6	9.9–12.3	11.0	1.8	74	55
L Guys	97	11.2	8.4–13.6	10.2–12.2	11.1	1.5	80	59
L Kings	100	11.5	8.9–13.5	10.6–12.5	11.4	1.4	85	67
L Rfree	77	12.0	9.3–14.3	11.1–12.9	11.9	1.5	91	76
L West	44							
Leeds	97	12.1	9.0–14.7	11.1–13.0	12.0	1.7	89	77
Leic	99	11.6	8.8–14.1	10.5–12.5	11.5	1.6	84	65
Liv Ain	97	11.9	9.6–13.6	10.9–13.0	11.9	1.4	92	74
Liv RI	94	12.3	9.4–14.8	11.2–13.2	12.2	1.6	90	80
M Hope	86	11.7	8.6–14.0	10.5–12.6	11.5	1.7	85	66
M RI	73	11.7	8.6–14.5	10.3–12.8	11.6	1.8	82	66
Middlbr	98	11.8	9.3–14.2	11.0–12.8	11.8	1.5	91	75
Newc	100	12.1	9.1–14.3	11.2–13.0	12.0	1.5	90	78
Newry	98	11.6	9.3–13.1	10.8–12.4	11.5	1.3	88	73
Norwch	91	11.3	9.2–14.0	10.6–12.3	11.4	1.5	89	63



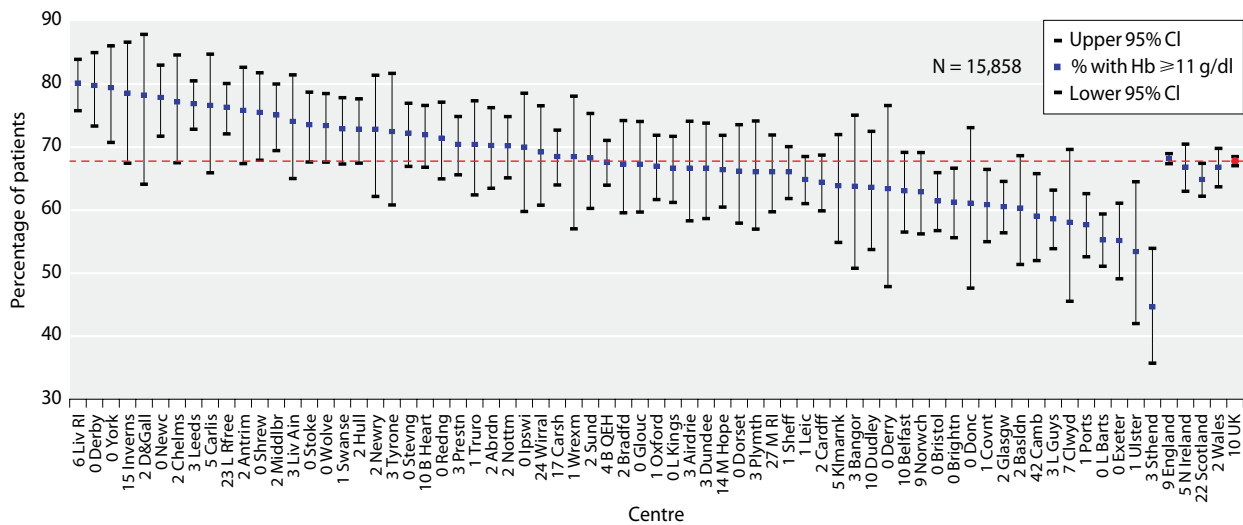
**Table 9.2.** Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb $\geq 10$ g/dl	% with Hb $\geq 11$ g/dl
Nottm	98	11.7	9.1–13.9	10.7–12.5	11.6	1.6	87	70
Oxford	99	11.5	8.8–13.8	10.7–12.7	11.6	1.6	85	67
Plymth	97	11.4	9.3–13.0	10.6–12.1	11.4	1.3	88	66
Ports	99	11.3	8.5–13.8	10.2–12.3	11.2	1.6	80	58
Prestn	97	11.6	9.0–14.0	10.8–12.6	11.7	1.5	88	70
Redng	100	11.7	9.3–13.9	10.8–12.6	11.7	1.4	87	71
Sheff	99	11.5	9.0–13.5	10.6–12.4	11.5	1.4	85	66
Shrew	100	11.7	9.7–13.7	11.0–12.4	11.7	1.2	93	76
Stevng	100	11.8	9.3–13.5	10.9–12.4	11.6	1.4	89	72
Sthend	97	10.7	8.8–12.8	10.0–11.6	10.8	1.3	75	45
Stoke	100	11.8	9.4–14.0	10.8–12.6	11.7	1.4	91	74
Sund	98	11.6	8.8–13.7	10.5–12.6	11.5	1.6	85	68
Swanse	99	11.7	9.1–13.4	10.8–12.5	11.6	1.3	89	73
Truro	99	11.6	9.0–13.2	10.9–12.1	11.4	1.2	89	70
Tyrone	97	11.6	9.5–13.2	10.9–12.3	11.5	1.1	90	72
Ulster	99	11.3	8.5–13.5	10.1–11.8	11.1	1.4	79	53
Wirral	76	11.5	9.3–14.2	10.8–12.4	11.7	1.4	91	69
Wolve	100	12.2	8.8–14.9	10.9–13.2	12.0	1.8	86	73
Wrexm	99	12.0	8.9–13.8	10.7–12.9	11.6	1.5	89	68
York	100	11.9	9.5–13.8	11.2–12.6	11.9	1.2	93	79
<b>England</b>	<b>91</b>	<b>11.7</b>	<b>8.9–14.0</b>	<b>10.6–12.6</b>	<b>11.6</b>	<b>1.6</b>	<b>86</b>	<b>68</b>
<b>N Ireland</b>	<b>95</b>	<b>11.5</b>	<b>8.8–13.5</b>	<b>10.6–12.3</b>	<b>11.4</b>	<b>1.5</b>	<b>84</b>	<b>67</b>
<b>Scotland</b>	<b>78</b>	<b>11.6</b>	<b>8.8–13.9</b>	<b>10.5–12.5</b>	<b>11.5</b>	<b>1.5</b>	<b>84</b>	<b>65</b>
<b>Wales</b>	<b>98</b>	<b>11.6</b>	<b>9.0–13.8</b>	<b>10.6–12.5</b>	<b>11.5</b>	<b>1.5</b>	<b>87</b>	<b>67</b>
<b>UK</b>	<b>90</b>	<b>11.6</b>	<b>8.9–14.0</b>	<b>10.6–12.6</b>	<b>11.6</b>	<b>1.5</b>	<b>86</b>	<b>68</b>

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



**Fig. 9.8.** Percentage of HD patients with Hb  $\geq 10$  g/dl



**Fig. 9.9.** Percentage of HD patients with Hb  $\geq 11$  g/dl

plot (figure 9.12) for percentage of patients with Hb  $\geq 10.5$  and  $\leq 12.5$  g/dl and yet have a poor compliance with percentage of Hb  $\geq 10.0$  g/dl (figure 9.13). This demonstrated that compliance with one standard (Hb  $\geq 10.5$  and  $\leq 12.5$  g/dl) can be achieved without compliance with another standard (Hb  $\geq 10.0$  g/dl). Figures 9.12 and 9.13 should be used in conjunction with table 9.3 to identify centres.

*Haemoglobin in prevalent peritoneal dialysis patients*

In the UK 91% of patients on PD had a Hb  $\geq 10.0$  g/dl (table 9.4). The median Hb of patients on PD in the UK was 11.9 g/dl with an IQR of 11.0–12.8 g/dl (table 9.4). The median Hb by centre, compliance with the UK minimum standard Hb  $\geq 10.0$  g/dl and EBPG Hb  $\geq 11.0$  g/dl are shown in figures 9.14, 9.15 and 9.16 respectively. The compliance with recommended range Hb  $\geq 10.5$  and  $\leq 12.5$  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  $\geq 10.0$  g/dl is shown in figure 9.19 which can be used in conjunction with table 9.5 to identify centres.

*Relationship between Hb in incident and prevalent dialysis patients in 2007*

The relationship between the percentage of new and

prevalent dialysis (HD and PD) patients with a Hb  $\geq 10.0$  g/dl is demonstrated in figure 9.20.

*Correlation between median haemoglobin and compliance with clinical guidelines*

The use of Rose-Day plots demonstrated the relationship between the population mean (and standard deviation) and the compliance with minimum standards. The plots for Hb  $\geq 10.0$  g/dl and  $\geq 11.0$  g/dl for HD and PD populations are given in figures 9.21 to 9.24. The compliance with minimum standards over time between 1998 and 2007 are shown in figure 9.25 for prevalent patients and in figure 9.26 for incident and prevalent patients between 1998 and 2007.

*Changes in haemoglobin by length of time on renal replacement therapy over time*

The median Hb of patients treated with HD increased during the first year of treatment (figure 9.27) but did not do so in patients treated with PD (figure 9.28). The median Hb of HD patients in 2007 (figure 9.27) was lower than in 2006 irrespective of time on RRT. The Hb in PD patients (figure 9.28) had been stable for some years and remained higher than in HD patients.

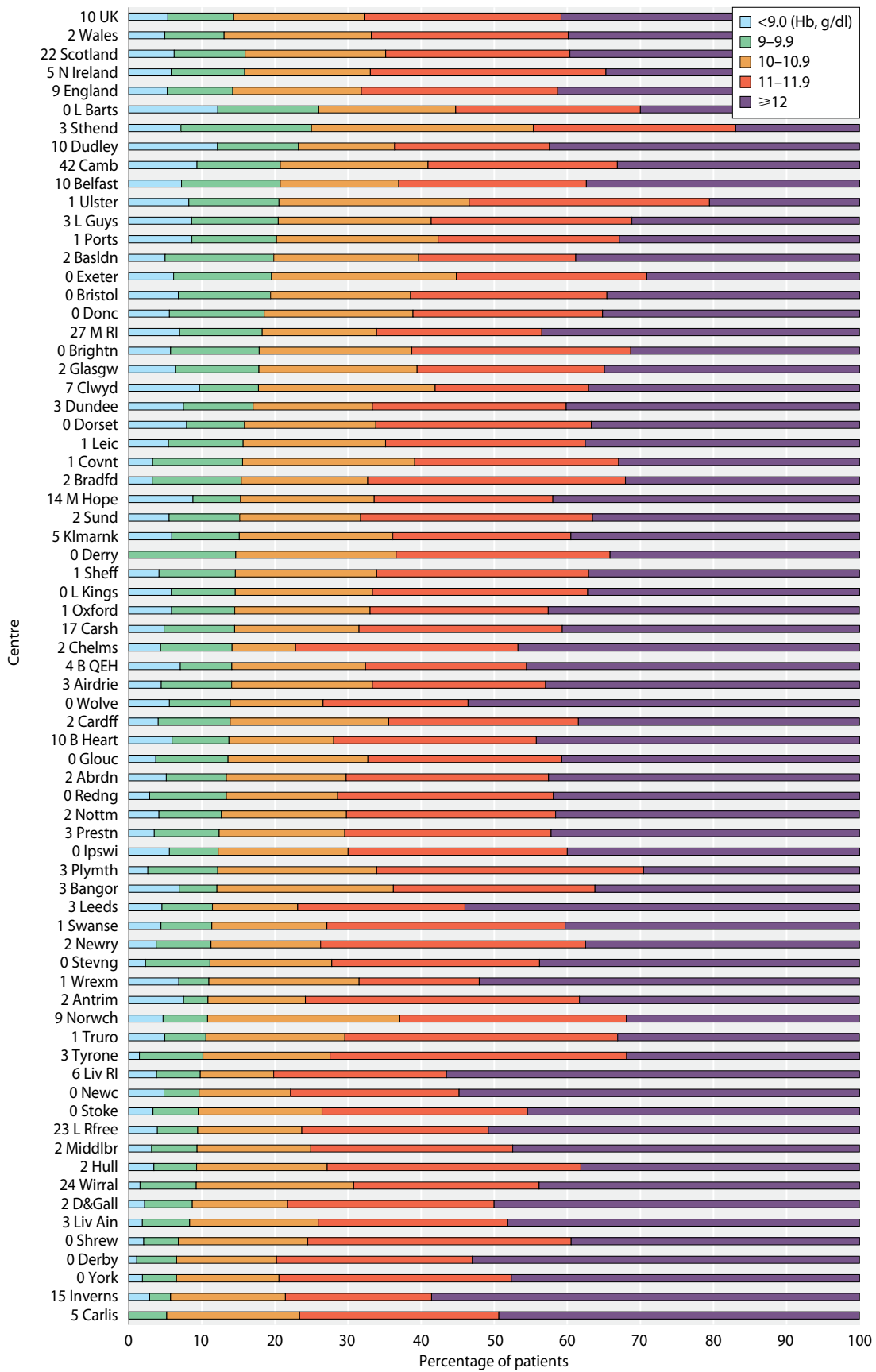
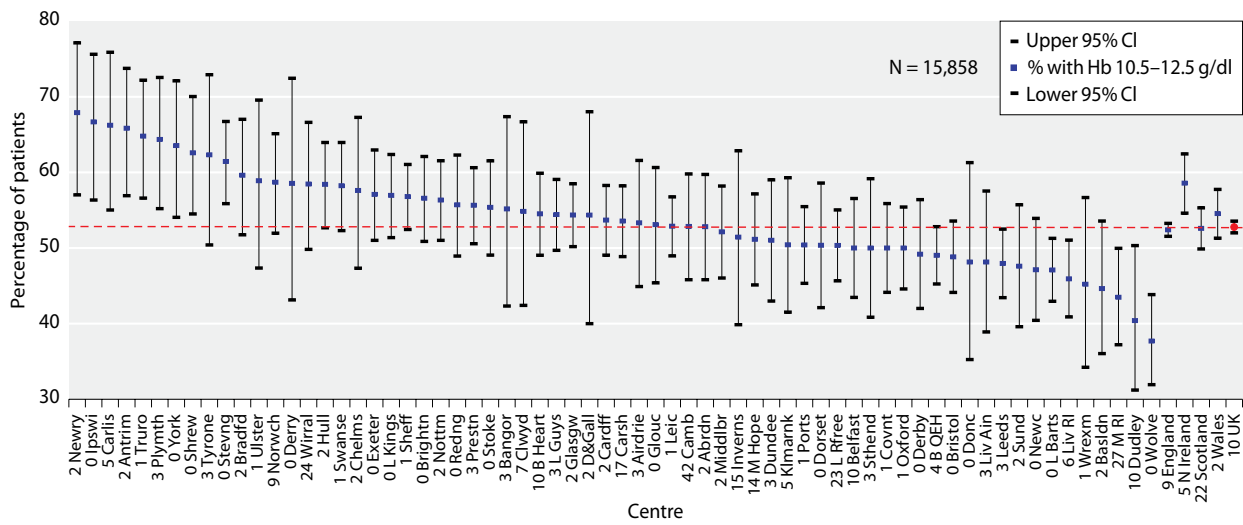
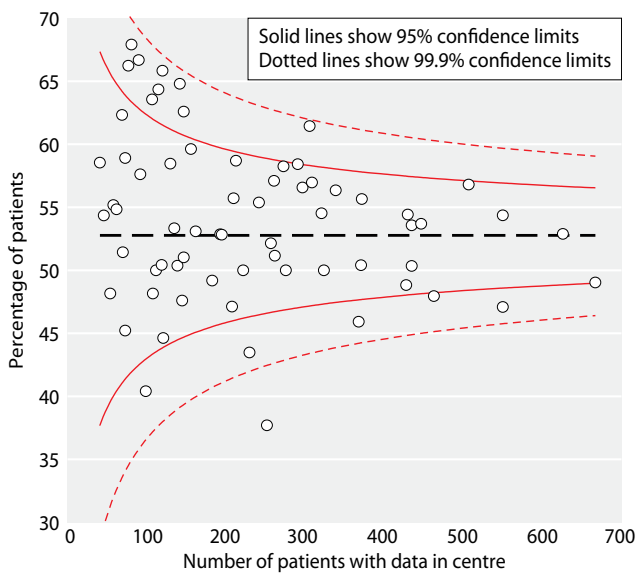


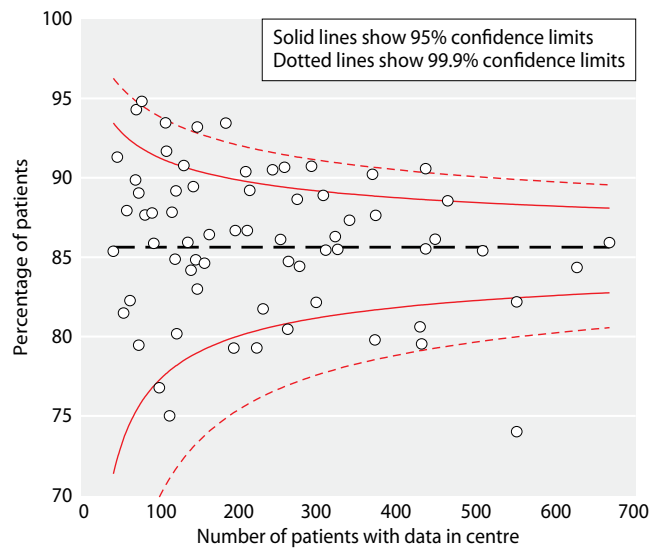
Fig. 9.10. Distribution of haemoglobin in patients treated with HD



**Fig. 9.11.** Percentage of HD patients with Hb  $\geq 10.5$  and  $\leq 12.5$  g/dl



**Fig. 9.12.** Funnel plot of percentage of HD patients with Hb  $\geq 10.5$  and  $\leq 12.5$  g/dl



**Fig. 9.13.** Funnel plot of percentage of HD patients with Hb  $\geq 10$  g/dl

**Table 9.3.** Percentage of HD patients achieving Hb  $\geq 10$  g/dl and Hb 10.5–12.5 g/dl

Centre	N with Hb	% with Hb $\geq 10$ g/dl	% Hb 10.5–12.5 g/dl	Centre	N with Hb	% with Hb $\geq 10$ g/dl	% Hb 10.5–12.5 g/dl
Derry	41	85	59	Newc	208	90	47
D & Gall	46	91	54	Redng	210	87	56
Donc	54	81	48	Norwch	213	89	59
Bangor	58	88	55	Belfast	222	79	50
Clwyd	62	82	55	M RI	230	82	43
Tyrone	69	90	62	Stoke	242	91	55
Inverns	70	94	51	Wolve	252	86	38
Ulster	73	79	59	Middlbr	257	91	52
Wrexm	73	89	45	Exeter	261	80	57
Carlisle	77	95	66	M Hope	262	85	51
Newry	81	88	68	Swanse	273	89	58
Ipswi	90	88	67	Covnt	276	84	50
Chelms	92	86	58	Hull	291	91	58
Dudley	99	77	40	Brightn	297	82	57
York	107	93	64	Stevng	306	89	61
Liv Ain	108	92	48	L Kings	309	85	57
Sthend	112	75	50	B Heart	321	86	55
Plymth	115	88	64	Oxford	324	85	50
Klmarnk	119	85	50	Nottm	339	87	56
Antrim	120	89	66	Liv RI	368	90	46
Basldn	121	80	45	Ports	371	80	50
Wirral	130	91	58	Prestn	372	88	56
Airdrie	135	86	53	Bristol	428	81	49
Dorset	139	84	50	L Guys	430	80	54
Truro	142	89	65	Carsh	435	86	54
Sund	145	85	48	L Rfree	435	91	50
Dundee	147	83	51	Cardff	447	86	54
Shrew	147	93	63	Leeds	463	89	48
Bradfd	156	85	60	Sheff	507	85	57
Glouc	162	86	53	Glasgw	550	82	54
Derby	183	93	49	L Barts	550	74	47
Camb	193	79	53	Leic	626	84	53
Abrdn	195	87	53	B QEH	667	86	49

**Table 9.4.** Haemoglobin data for prevalent PD patients

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb $\geq 10$ g/dl	% with Hb $\geq 11$ g/dl
Abrdn	97	12.0	10.6–14.2	11.2–12.9	12.1	1.1	97	93
Airdrie	82							
Antrim	94							
B Heart	97	12.4	9.4–14.9	11.6–13.2	12.3	1.4	93	87
B QEH	86	11.5	9.3–14.0	10.9–12.7	11.7	1.5	92	73
Bangor	100	12.1	10.4–14.5	11.4–13.4	12.3	1.3	97	90
Basldn	100	12.3	11.0–14.6	11.7–13.3	12.5	1.2	100	96
Belfast	96	11.4	10.0–14.4	11.1–12.9	11.8	1.4	96	76
Bradfd	100	11.9	8.9–14.0	10.6–12.5	11.6	1.6	89	67
Brightn	100	11.8	10.1–14.5	11.1–12.8	12.0	1.4	96	82
Bristol	100	12.1	9.3–14.9	11.0–12.9	12.0	1.7	85	76
Camb	100	11.9	9.3–13.6	11.3–12.6	11.9	1.3	94	79
Cardff	99	12.2	9.6–14.3	11.2–13.0	12.1	1.5	90	77
Carlisle	100							
Carsh	96	11.4	9.5–13.8	10.6–12.5	11.5	1.3	87	67
Chelms	97	12.8	9.9–14.0	12.1–13.3	12.5	1.2	94	91
Clwyd	92							
Covnt	94	12.0	9.4–13.5	11.1–12.8	11.9	1.5	90	75
D & Gall	100							

**Table 9.4.** Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb $\geq 10$ g/dl	% with Hb $\geq 11$ g/dl
Derby	100	11.8	9.7–13.9	11.2–12.6	11.9	1.3	92	83
Derry	100							
Donc	100	11.8	8.8–14.2	11.1–13.2	12.0	1.6	91	76
Dorset	98	12.1	9.6–13.6	11.1–12.9	11.9	1.2	95	80
Dudley	94	12.3	7.0–15.2	10.5–13.7	12.0	2.3	86	67
Dundee	96	12.0	9.5–13.9	11.2–12.6	11.8	1.4	89	78
Dunfn	17							
Edinb	0							
Exeter	100	11.5	9.7–13.7	10.6–12.1	11.5	1.2	91	73
Glasgw	97	11.6	9.2–14.0	10.8–12.6	11.6	1.4	85	73
Glouc	100	11.9	10.2–13.8	11.0–12.4	11.8	1.0	97	77
Hull	94	12.3	9.2–14.4	11.1–13.1	12.1	1.6	91	81
Inverns	0							
Ipswi	98	11.9	10.1–13.9	10.9–12.6	11.8	1.2	95	73
Klmarnk	95	11.9	8.8–15.1	11.1–12.4	11.9	1.6	93	78
L Barts	99	12.1	9.0–14.8	10.7–13.1	11.9	1.9	86	71
L Guys	98	11.8	8.0–13.8	10.9–12.5	11.5	1.8	83	71
L Kings	100	12.0	9.0–14.3	11.1–12.9	11.9	1.5	93	79
L Rfree	89	11.5	10.2–13.8	11.0–12.3	11.7	1.2	96	76
L West	5							
Leeds	99	12.1	8.8–15.4	11.1–13.1	12.0	1.8	86	80
Leic	99	11.9	8.7–14.4	11.1–12.8	11.8	1.6	89	77
Liv Ain	n/a							
Liv RI	92	12.1	9.6–14.0	11.1–12.9	12.0	1.4	92	81
M Hope	95	11.9	9.2–14.6	10.7–13.0	11.8	1.6	91	65
M RI	99	11.9	9.3–14.7	10.9–13.1	12.0	1.7	89	74
Middlbr	92	12.4	10.8–14.2	11.3–13.2	12.3	1.5	96	91
Newc	100	12.0	8.5–13.8	10.8–12.8	11.7	1.6	87	74
Newry	100							
Norwch	96	12.3	9.8–14.5	11.4–13.3	12.3	1.5	93	84
Nottm	100	11.8	9.5–13.9	11.0–12.7	11.8	1.4	92	76
Oxford	100	11.7	9.0–14.2	10.9–13.0	11.8	1.6	86	71
Plymth	84	12.3	9.1–14.0	11.5–13.1	12.1	1.3	94	78
Ports	99	12.1	9.1–15.0	11.0–13.2	12.1	1.7	90	76
Prestn	97	11.7	9.2–14.3	10.7–12.4	11.7	1.5	88	75
Redng	100	11.7	9.3–13.5	10.8–12.1	11.5	1.3	90	70
Sheff	100	11.5	9.1–13.9	10.8–12.5	11.6	1.5	88	70
Shrew	100	12.3	10.2–14.5	11.1–13.0	12.2	1.4	97	82
Stevng	100	12.4	8.7–14.8	11.5–13.2	12.3	1.6	92	84
Sthend	94							
Stoke	100	11.8	8.6–14.0	10.9–13.0	11.7	1.6	89	73
Sund	100							
Swanse	96	11.8	9.6–14.2	11.0–12.8	11.8	1.4	93	76
Truro	100	11.7	10.3–13.8	11.1–12.9	11.9	1.2	96	78
Tyrone	100							
Ulster	100							
Wirral	71	11.7	9.3–13.8	11.0–12.3	11.7	1.3	95	75
Wolve	98	12.6	9.3–14.9	11.7–13.6	12.5	1.6	92	83
Wrexm	90	12.0	10.5–14.4	11.4–12.4	12.0	1.1	96	93
York	100	12.1	10.8–15.1	11.4–13.3	12.5	1.5	100	87
<b>England</b>	<b>95</b>	<b>11.9</b>	<b>9.3–14.3</b>	<b>11.0–12.9</b>	<b>11.9</b>	<b>1.5</b>	<b>90</b>	<b>76</b>
<b>N Ireland</b>	<b>97</b>	<b>11.6</b>	<b>10.0–13.8</b>	<b>11.1–12.9</b>	<b>11.9</b>	<b>1.4</b>	<b>96</b>	<b>79</b>
<b>Scotland</b>	<b>62</b>	<b>11.8</b>	<b>9.5–14.2</b>	<b>11.1–12.7</b>	<b>11.8</b>	<b>1.5</b>	<b>90</b>	<b>78</b>
<b>Wales</b>	<b>97</b>	<b>12.1</b>	<b>9.7–14.3</b>	<b>11.2–12.9</b>	<b>12.0</b>	<b>1.4</b>	<b>93</b>	<b>80</b>
<b>UK</b>	<b>93</b>	<b>11.9</b>	<b>9.3–14.3</b>	<b>11.0–12.8</b>	<b>11.9</b>	<b>1.5</b>	<b>91</b>	<b>76</b>

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

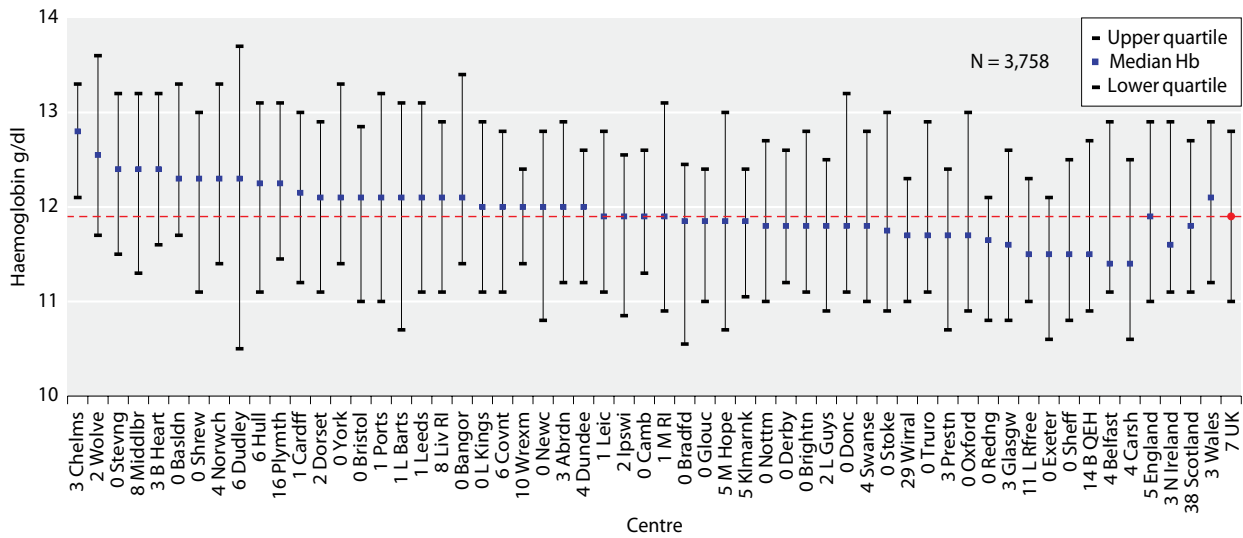


Fig. 9.14. Median haemoglobin in patients treated with PD

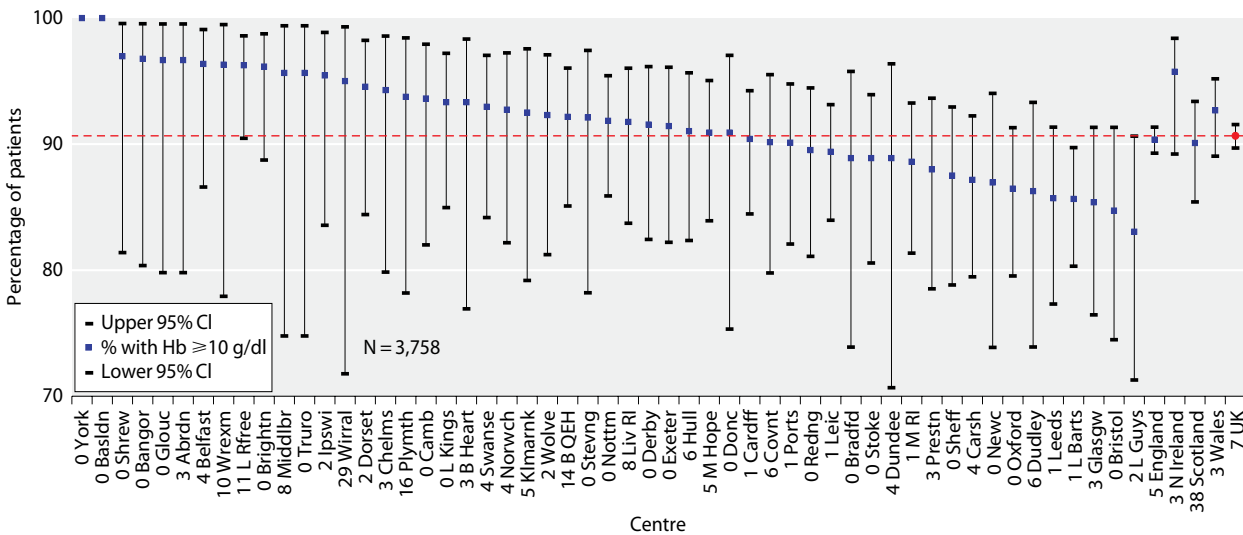


Fig. 9.15. Percentage of PD patients with Hb ≥ 10 g/dl

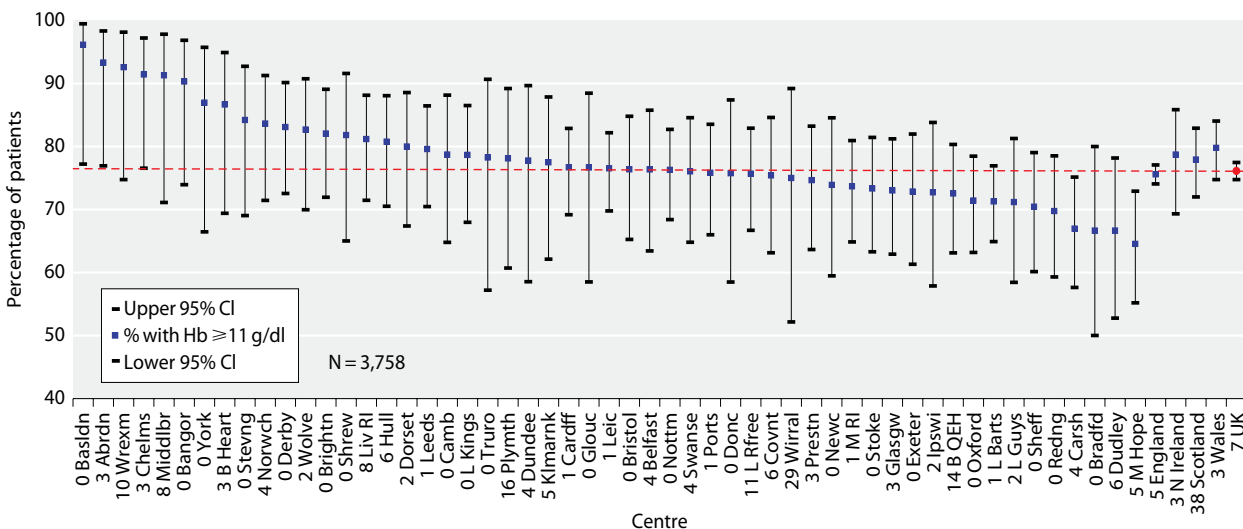


Fig. 9.16. Percentage of PD patients with Hb ≥ 11 g/dl

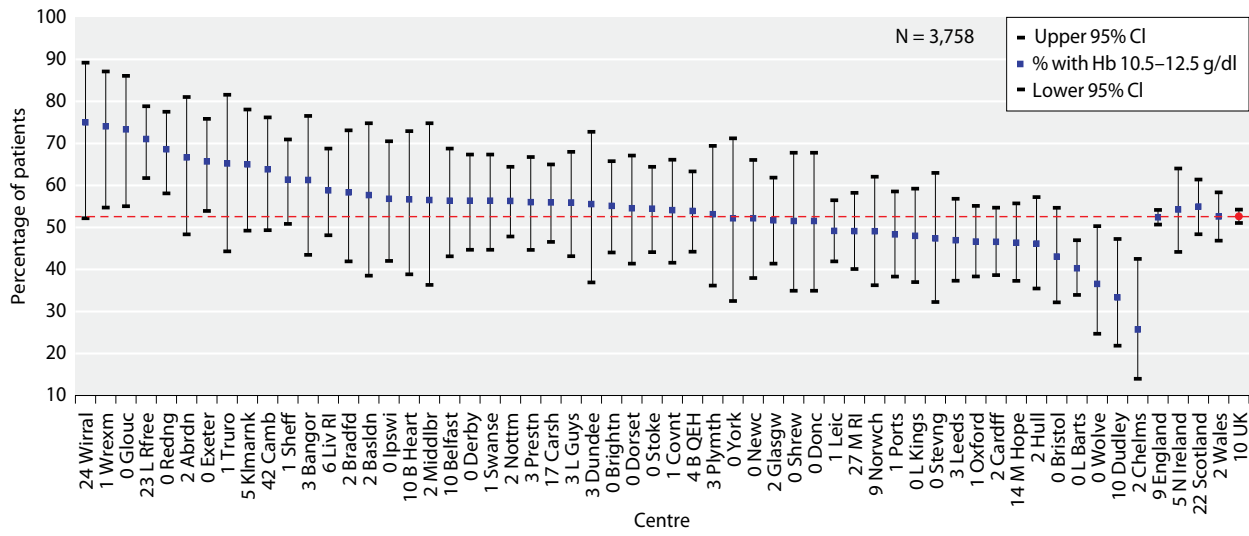


Fig. 9.17. Percentage of PD patients with Hb  $\geq 10.5$  and  $\leq 12.5$  g/dl



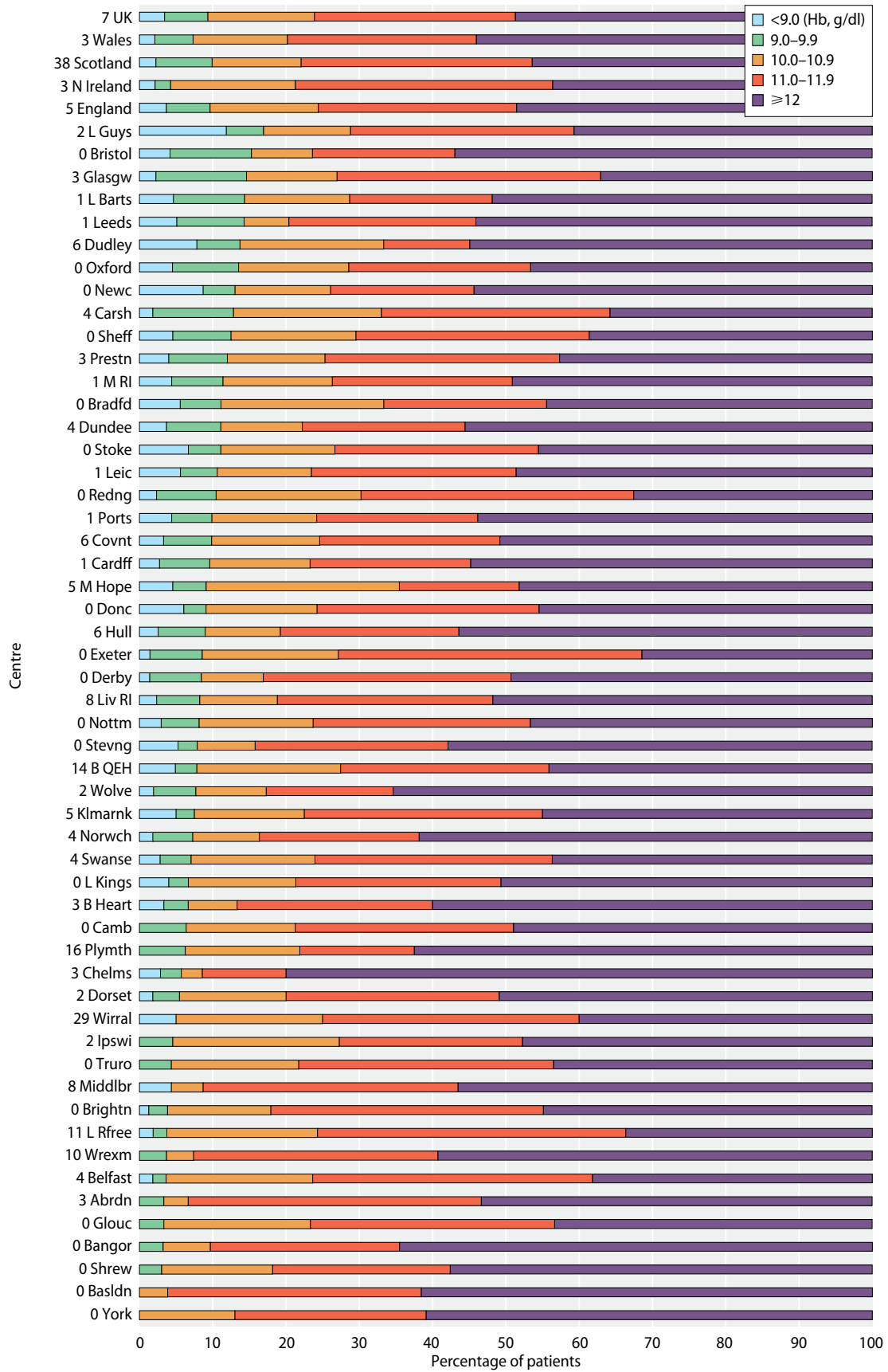
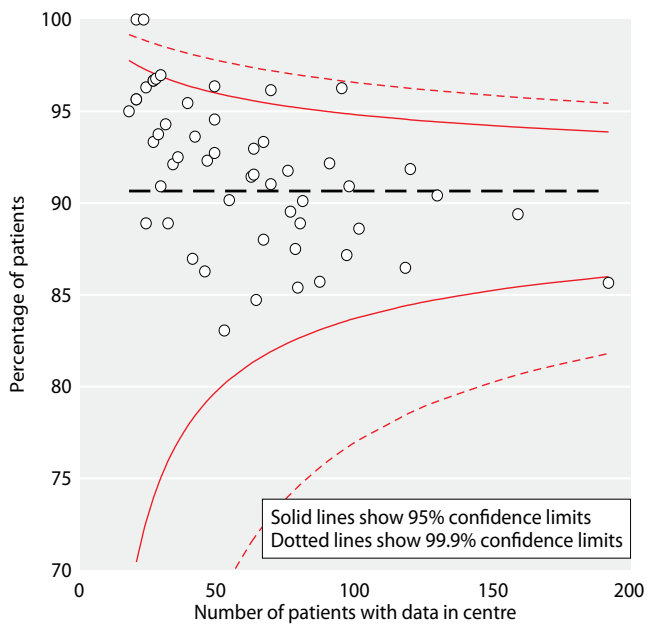


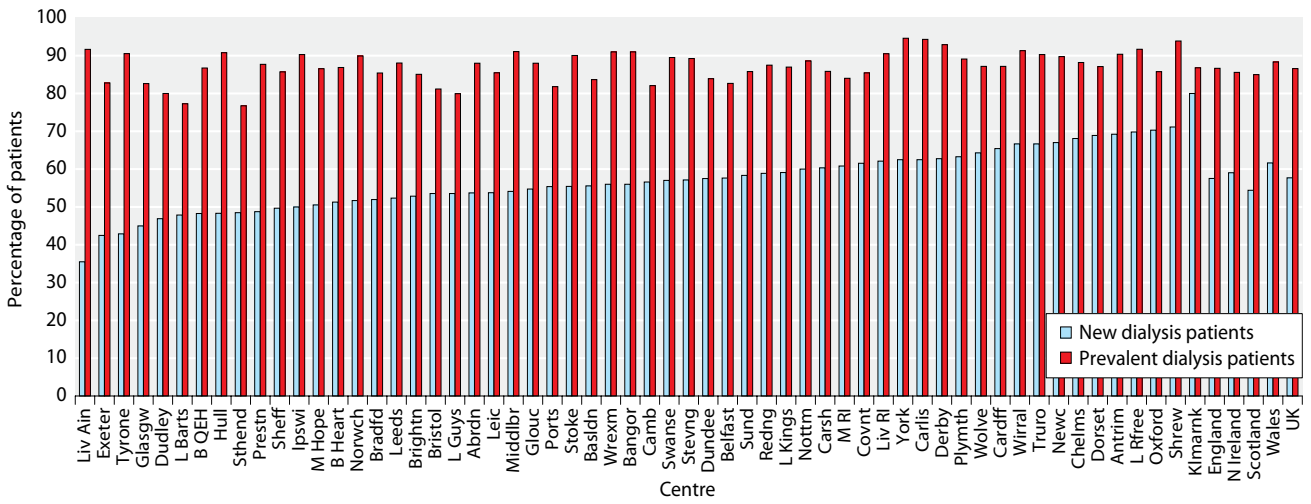
Fig. 9.18. Distribution of haemoglobin in patients treated with PD



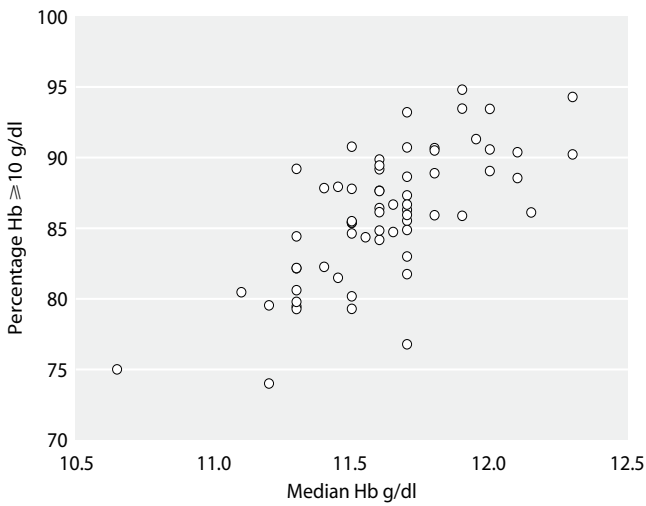
**Fig. 9.19.** Funnel plot of percentage of PD patients with Hb  $\geq 10$  g/dl

**Table 9.5.** Percentage of PD patients achieving Hb  $\geq 10$  g/dl

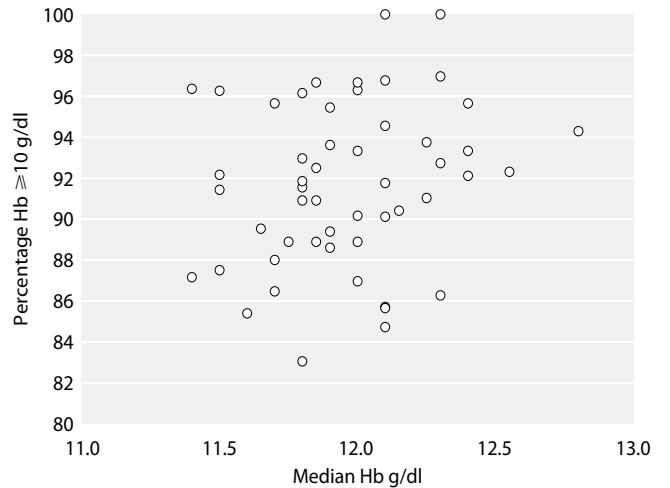
Centre	N with Hb	% with Hb $\geq 10$ g/dl	Centre	N with Hb	% with Hb $\geq 10$ g/dl
Wirral	20	95	Covnt	61	90
Middlbr	23	96	Exeter	70	91
Truro	23	96	Derby	71	92
York	23	100	Swanse	71	93
Basldn	26	100	Bristol	72	85
Dundee	27	89	L Kings	75	93
Wrexm	27	96	Prestn	75	88
Abrdn	30	97	Brightn	78	96
B Heart	30	93	Hull	78	91
Glouc	30	97	Liv RI	85	92
Bangor	31	97	Redng	86	90
Plymth	32	94	Sheff	88	88
Donc	33	91	Glasgw	89	85
Shrew	33	97	Stoke	90	89
Chelms	35	94	Ports	91	90
Bradfd	36	89	Leeds	98	86
Stevng	38	92	B QEH	102	92
Klmarnk	40	93	L Rfree	107	96
Ipswi	44	95	Carsh	109	87
Newc	46	87	M Hope	110	91
Camb	47	94	M RI	114	89
Dudley	51	86	Oxford	133	86
Wolve	52	92	Nottm	135	92
Belfast	55	96	Cardff	146	90
Dorset	55	95	Leic	179	89
Norwch	55	93	L Barts	216	86
L Guys	59	83			



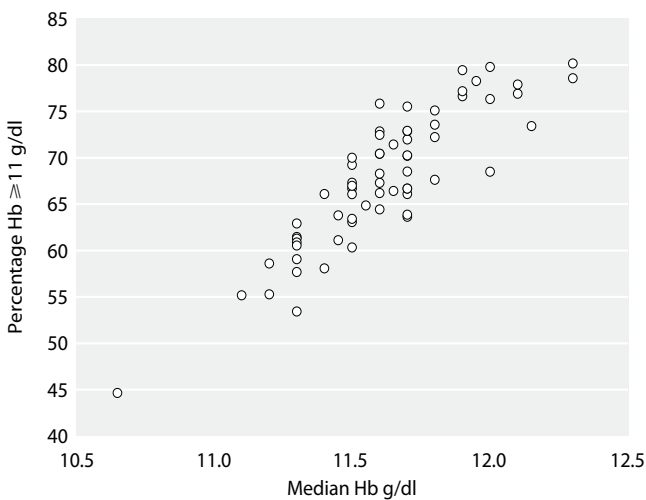
**Fig. 9.20.** Percentage of new and prevalent dialysis patients with Hb  $\geq 10$  g/dl



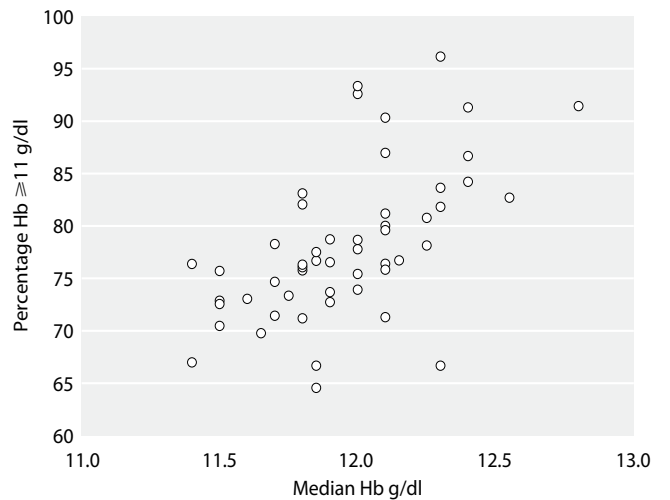
**Fig. 9.21.** Percentage of HD patients with Hb  $\geq 10$  g/dl plotted against median haemoglobin



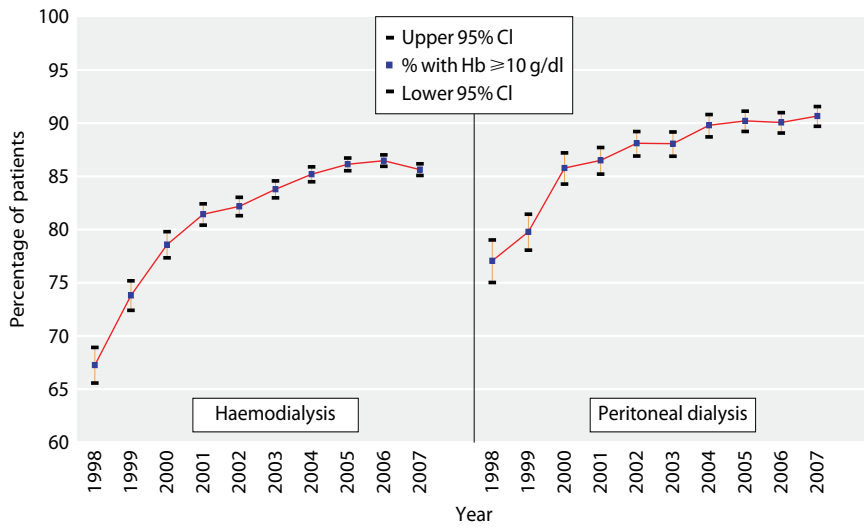
**Fig. 9.23.** Percentage of PD patients with Hb  $\geq 10$  g/dl plotted against median haemoglobin



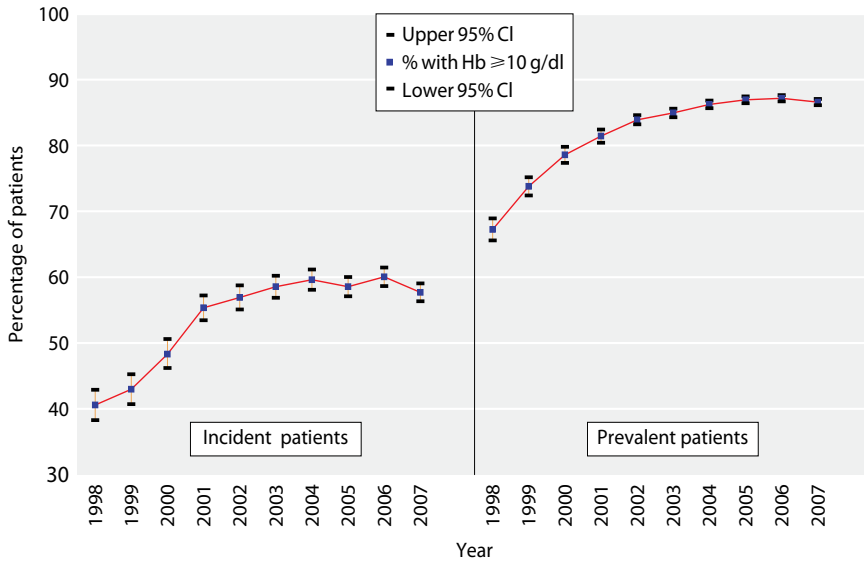
**Fig. 9.22.** Percentage of HD patients with Hb  $\geq 11$  g/dl plotted against median haemoglobin



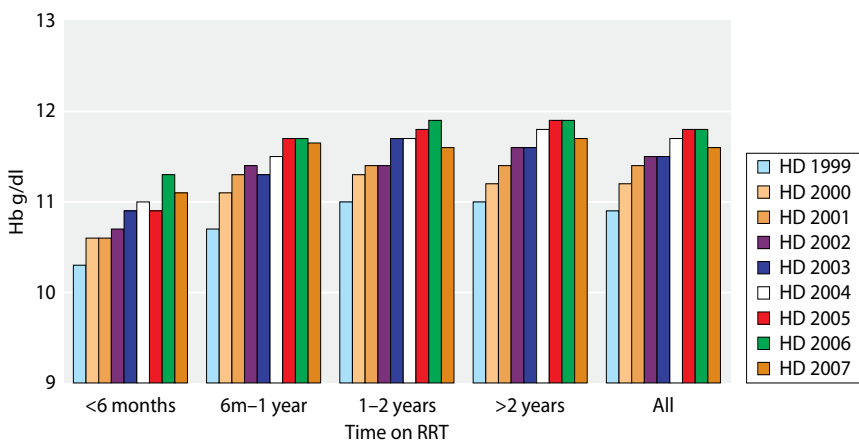
**Fig. 9.24.** Percentage of PD patients with Hb  $\geq 11$  g/dl plotted against median haemoglobin



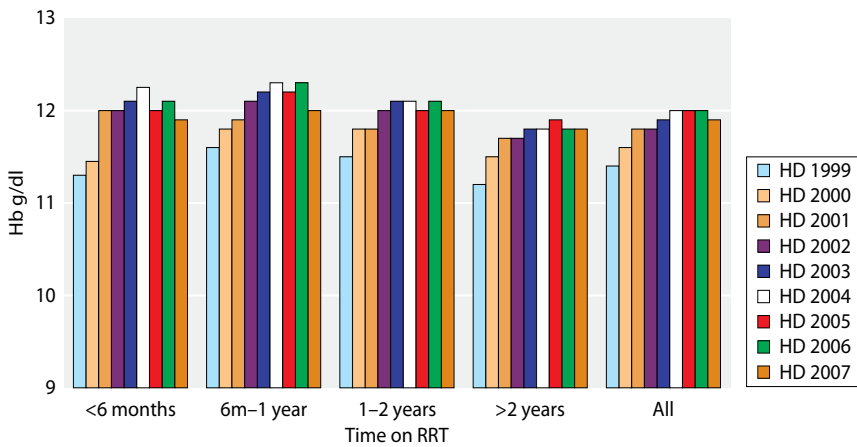
**Figure 9.25.** Percentage of prevalent HD and PD patients (1998–2007) with Hb  $\geq 10$  g/dl



**Figure 9.26.** Percentage of incident and prevalent dialysis patients (1998–2007) with Hb  $\geq 10$  g/dl



**Figure 9.27.** Median haemoglobin plotted by length of time on RRT (HD patients)



**Figure 9.28.** Median haemoglobin plotted by length of time on RRT (PD patients)

**Factors affecting haemoglobin**

*Ferritin*

*Completeness of ferritin returns for patients treated with HD and PD*

The completeness of serum ferritin returns to the UKRR is shown in table 9.6. Not all centres used serum ferritin as the sole indicator of iron status. Completeness of data for serum ferritin returned for England, Wales and Northern Ireland improved by comparison with the previous year. For Scotland a lack of an automated biochemistry link to the renal IT system is thought to account for the low rate of return. In other cases of missing data, renal centres may need to address organisational processes in dealing with automatic download facilities to ensure that serum ferritin is checked, or alternatively that a declaration is made that alternative measures of iron status are being utilised.

*Ferritin in prevalent dialysis patients*

Percentage returns, serum ferritin concentrations and IQR are presented in tables 9.7 and 9.8 for HD and PD patients respectively. The percentage of patients with a ferritin  $\geq 800 \mu\text{g/L}$  by centre for HD and PD patients is shown in table 9.9.

The median and IQR for serum ferritin for HD and PD patients by centre are given in figures 9.29 and 9.30 respectively. The percentage of patients with a serum ferritin  $\geq 100 \mu\text{g/L}$ ,  $\geq 200 \mu\text{g/L}$  and  $\geq 800 \mu\text{g/L}$  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 75% compliance with a serum of ferritin  $\geq 100 \mu\text{g/L}$  for HD patients and all but 5 centres achieved  $>90\%$  compliance. The PD population had a lower median ferritin value ( $255 \mu\text{g/L}$ , IQR 143–411 vs.  $417 \mu\text{g/L}$ , IQR 270–598 for HD). All but 5 centres achieved greater than 90% compliance for serum ferritin  $\geq 100 \mu\text{g/L}$  in the PD population.

*Changes in ferritin 2000–2007*

The compliance with guidelines for ferritin in the HD and PD populations has remained stable over the last 5 years at approximately 95% and 85% respectively. The serial values are shown in figure 9.37. The difference between the compliance in HD and PD was probably because of the lower requirement for ESA to achieve target Hb levels in the PD population. There was therefore a lower requirement for intravenous iron supplementation. The median serum ferritin outcome over time is shown in figure 9.38.

*Ferritin and length of time on renal replacement therapy*

The median serum ferritin increased during the first year in patients treated with HD and during the first 2 years in those treated with PD (figures 9.39 and 9.40). After 2 years the levels remained stable in both groups of patients.

**Table 9.6.** Completeness of ferritin returns

Centre	HD %	PD %	Centre	HD %	PD %
Abrdn	0	0	L Rfree	79	96
Airdrie	0	0	L West	80	70
Antrim	98	100	Leeds	98	99
B Heart	93	97	Leic	89	95
B QEH	97	87	Liv Ain	96	n/a
Bangor	95	100	Liv RI	91	92
Basldn	98	100	M Hope	60	93
Belfast	96	96	M RI	73	100
Bradfd	99	100	Middlbr	96	92
Brightn	98	99	Newc	100	100
Bristol	100	100	Newry	96	100
Camb	72	100	Norwch	87	93
Cardff	96	97	Nottm	99	100
Carlis	95	100	Oxford	98	97
Carsh	81	96	Plymth	97	100
Chelms	100	97	Ports	95	90
Clwyd	93	92	Prestn	100	99
Covnt	98	89	Redng	100	100
D & Gall	0	0	Sheff	99	100
Derby	100	99	Shrew	100	100
Derry	100	100	Stevng	99	95
Donc	98	76	Sthend	98	94
Dorset	100	96	Stoke	100	99
Dudley	100	87	Sund	97	100
Dundee	1	0	Swanse	99	96
Dunfn	0	0	Truro	99	100
Edinb	1	0	Tyrone	96	100
Exeter	100	100	Ulster	100	100
Glasgw	0	0	Wirral	63	71
Glouc	98	100	Wolve	99	96
Hull	98	93	Wrexm	86	13
Inverns	0	0	York	100	100
Ipswi	100	82	<b>England</b>	<b>93</b>	<b>96</b>
Klmarnk	0	0	<b>N Ireland</b>	<b>97</b>	<b>98</b>
L Barts	100	99	<b>Scotland</b>	<b>0</b>	<b>0</b>
L Guys	97	98	<b>Wales</b>	<b>96</b>	<b>88</b>
L Kings	100	100	<b>UK</b>	<b>84</b>	<b>87</b>

**Table 9.7.** Ferritin in HD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin $\geq 100$ $\mu\text{g/L}$
Antrim	98	447	108–1010	298–613	95.0
B Heart	93	233	44–718	137–356	86.1
B QEH	97	365	156–684	286–459	96.6
Bangor	95	411	102–920	278–581	96.5
Basldn	98	337	97–651	262–408	94.2
Belfast	96	556	114–1151	318–782	96.2
Bradfd	99	462	130–984	310–611	98.7
Brightn	98	450	144–942	298–633	97.9
Bristol	100	417	104–849	243–575	95.8
Camb	72	328	54–693	217–430	93.7
Cardff	96	423	109–962	283–612	95.0
Carlis	95	442	269–1011	358–587	100.0
Carsh	81	322	91–671	240–427	94.3
Chelms	100	666	301–1360	543–804	100.0
Clwyd	93	372	178–854	276–554	98.4
Covnt	98	293	82–847	183–427	91.2
Derby	100	323	113–712	217–494	97.3
Derry	100	593	196–1145	341–751	95.1
Donc	98	390	145–910	283–639	98.1
Dorset	100	441	189–856	303–553	98.6
Dudley	100	334	48–837	173–496	87.3
Exeter	100	289	105–645	207–374	95.0
Glouc	98	451	128–1013	301–608	97.5
Hull	98	381	180–719	296–491	98.3
Ipswi	100	341	78–904	195–498	93.3
L Barts	100	404	125–803	295–540	97.3
L Guys	97	365	92–820	231–533	94.7
L Kings	100	527	211–1108	382–700	99.0
L Rfree	79	449	23–1414	179–690	83.5
L West	80	573	225–1201	438–767	97.7
Leeds	98	463	111–912	338–614	95.3
Leic	89	351	94–862	219–502	94.0
Liv Ain	96	450	61–1013	307–675	94.4
Liv RI	91	511	118–1386	346–785	95.8
M Hope	60	465	89–1282	262–653	94.0
M RI	73	371	97–838	237–499	94.8
Middlbr	96	368	72–1425	193–706	92.8
Newc	100	466	242–1200	364–629	98.6
Newry	96	620	162–1694	394–1032	97.5
Norwch	87	564	177–1205	360–779	98.5
Nottm	99	542	226–964	446–656	97.7
Oxford	98	325	98–810	219–445	94.3
Plymth	97	430	140–1183	331–573	96.6
Ports	95	196	35–706	104–334	76.4
Prestn	100	656	183–1643	430–940	97.1
Redng	100	441	166–844	311–583	98.6
Sheff	99	424	117–929	288–581	95.9
Shrew	100	200	46–727	116–302	81.6
Stevng	99	374	114–823	256–539	98.0
Sthend	98	335	169–737	245–433	96.5
Stoke	100	870	315–1907	604–1277	99.6

**Table 9.7.** Continued

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin $\geq$ 100 $\mu$ g/L
Sund	97	447	168–909	326–588	99.3
Swansea	99	352	88–835	207–528	93.0
Truro	99	468	190–1407	347–616	98.6
Tyrone	96	723	276–1623	507–924	98.5
Ulster	100	570	114–1395	385–847	96.0
Wirral	63	579	238–1501	411–807	99.1
Wolve	99	468	204–915	380–564	97.6
Wrexam	86	258	104–583	196–367	96.9
York	100	522	205–821	448–629	97.2
<b>England</b>	<b>93</b>	<b>413</b>	<b>100–1061</b>	<b>269–592</b>	<b>94.9</b>
<b>N Ireland</b>	<b>97</b>	<b>563</b>	<b>121–1284</b>	<b>347–816</b>	<b>96.3</b>
<b>Wales</b>	<b>96</b>	<b>389</b>	<b>99–899</b>	<b>247–555</b>	<b>94.9</b>
<b>E, W &amp; NI</b>	<b>93</b>	<b>417</b>	<b>101–1067</b>	<b>270–598</b>	<b>95.0</b>

**Table 9.8.** Ferritin in PD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin $\geq$ 100 $\mu$ g/L
Antrim	100				
B Heart	97	186	30–867	96–307	73.3
B QEH	87	196	41–509	109–329	78.6
Bangor	100	367	41–946	253–495	93.6
Basldn	100	205	51–562	134–362	84.6
Belfast	96	276	63–938	134–506	85.5
Bradfd	100	268	23–838	170–371	88.9
Brightn	99	372	157–964	273–487	100.0
Bristol	100	259	35–685	175–356	86.1
Camb	100	238	98–803	163–376	93.6
Cardff	97	150	30–513	80–260	60.8
Carlis	100				
Carsh	96	180	44–449	115–260	81.7
Chelms	97	277	29–567	163–376	88.6
Clwyd	92				
Covnt	89	192	57–661	139–310	87.9
Derby	99	265	92–562	167–363	94.3
Derry	100				
Donc	76	222	57–515	117–324	76.0
Dorset	96	301	90–619	206–382	88.9
Dudley	87	186	35–601	113–284	89.4
Exeter	100	197	25–516	126–279	82.9
Glouc	100	267	78–766	188–360	90.0
Hull	93	346	76–836	261–484	93.5
Ipswi	82	257	76–860	167–387	91.9
L Barts	99	280	54–768	145–464	85.7
L Guys	98	160	41–700	102–232	78.0
L Kings	100	239	61–575	148–392	85.3



**Table 9.8.** Continued

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin $\geq 100 \mu\text{g/L}$
L Rfree	96	281	24–785	136–470	80.0
L West	70	257	135–1021	205–511	97.8
Leeds	99	223	43–711	138–397	86.7
Leic	95	287	42–762	195–445	87.7
Liv Ain	n/a				
Liv RI	92	259	64–918	134–454	84.7
M Hope	93	240	48–1061	151–408	87.0
M RI	100	130	22–443	83–235	65.2
Middlbr	92	225	46–735	152–404	87.0
Newc	100	320	110–776	238–456	97.8
Newry	100				
Norwch	93	346	45–1179	175–548	79.3
Nottm	100	289	84–613	192–413	93.3
Oxford	97	228	40–773	127–345	80.6
Plymth	100	191	18–703	97–296	73.7
Ports	90	208	42–737	126–323	83.1
Prestn	99	242	56–876	162–489	89.5
Redng	100	417	170–1017	306–568	98.8
Sheff	100	255	78–610	166–398	89.8
Shrew	100	226	32–709	129–416	78.8
Stevng	95	186	32–775	119–353	80.6
Sthend	94				
Stoke	99	484	94–1283	305–708	93.3
Sund	100				
Swanse	96	228	23–710	96–360	73.2
Truro	100	279	116–381	185–313	95.7
Tyrone	100				
Ulster	100				
Wirral	71	535	272–1017	424–717	100.0
Wolve	96	186	19–679	102–390	76.5
Wrexm	13				
York	100	344	75–668	246–522	91.3
<b>England</b>	<b>96</b>	<b>259</b>	<b>46–775</b>	<b>149–418</b>	<b>86.2</b>
<b>N Ireland</b>	<b>98</b>	<b>270</b>	<b>52–934</b>	<b>130–451</b>	<b>83.2</b>
<b>Wales</b>	<b>88</b>	<b>189</b>	<b>29–648</b>	<b>88–341</b>	<b>68.6</b>
<b>E, W &amp; NI</b>	<b>95</b>	<b>255</b>	<b>42–775</b>	<b>143–411</b>	<b>84.8</b>

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

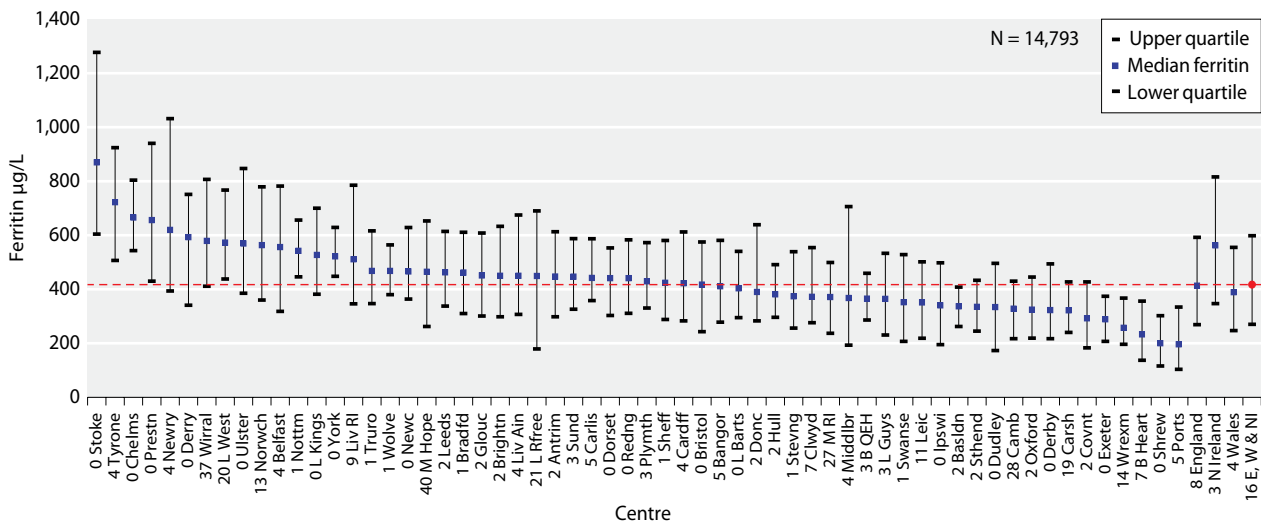
**Table 9.9.** Percentage of patients with ferritin  $\geq 800$   $\mu\text{g/L}$ 

Centre	HD		PD	
	% ferritin $\geq 800$ $\mu\text{g/L}$	95% CI	% ferritin $\geq 800$ $\mu\text{g/L}$	95% CI
Antrim	12.5	7.7–19.7		
B Heart	3.0	1.6–5.5	6.7	1.7–23.1
B QEH	3.0	1.9–4.6	1.9	0.5–7.4
Bangor	7.0	2.7–17.3	6.5	1.6–22.4
Basldn	0.8	0.1–5.6	0.0	
Belfast	23.0	18.0–28.8	10.9	5.0–22.2
Bradfd	11.4	7.3–17.4	5.6	1.4–19.7
Brightn	10.0	7.0–14.0	5.2	2.0–13.0
Bristol	6.3	4.4–9.1	1.4	0.2–9.2
Camb	2.5	1.1–5.5	6.4	2.1–18.0
Cardff	11.4	8.8–14.8	2.1	0.7–6.3
Carlis	10.4	5.3–19.4		
Carsh	2.6	1.4–4.6	0.9	0.1–6.2
Chelms	25.5	17.7–35.3	0.0	
Clwyd	8.1	3.4–18.0		
Covnt	5.8	3.6–9.3	3.5	0.9–12.8
Derby	4.4	2.2–8.5	1.4	0.2–9.5
Derry	22.0	11.8–37.1		
Donc	17.0	9.1–29.5	0.0	
Dorset	5.8	2.9–11.1	1.9	0.3–12.0
Dudley	6.4	3.1–12.8	2.1	0.3–13.6
Exeter	3.5	1.8–6.5	1.4	0.2–9.5
Glouc	12.6	8.3–18.7	3.3	0.5–20.2
Hull	3.8	2.1–6.7	5.2	2.0–13.0
Ipswi	6.7	3.0–14.1	8.1	2.6–22.3
L Barts	4.9	3.4–7.1	4.6	2.5–8.4
L Guys	5.8	3.9–8.4	0.0	
L Kings	17.2	13.4–21.8	2.7	0.7–10.0
L Rfree	18.7	15.4–22.6	3.5	1.3–8.9
L West	21.0	18.3–23.9	8.9	3.4–21.4
Leeds	8.8	6.6–11.8	4.1	1.5–10.4
Leic	6.0	4.3–8.3	3.5	1.6–7.6
Liv Ain	15.0	9.4–23.0	n/a	n/a
Liv RI	23.7	19.6–28.4	8.2	4.0–16.3
M Hope	16.3	11.6–22.4	6.5	3.1–13.0
M RI	6.6	4.0–10.6	0.9	0.1–5.9
Middlbr	20.4	15.9–25.9	4.4	0.6–25.2
Newc	14.9	10.7–20.4	4.4	1.1–15.8
Newry	40.0	29.9–51.1		
Norwch	23.3	18.0–29.6	13.2	6.4–25.2
Nottm	8.8	6.2–12.3	0.7	0.1–5.1
Oxford	4.4	2.6–7.3	3.1	1.2–8.0
Plymth	11.2	6.6–18.4	2.6	0.4–16.5
Ports	3.7	2.1–6.2	3.6	1.2–10.6
Prestn	35.8	31.1–40.7	7.9	3.6–16.5
Redng	6.2	3.7–10.4	11.6	6.4–20.3
Sheff	9.3	7.0–12.1	3.4	1.1–10.0
Shrew	4.8	2.3–9.7	3.0	0.4–18.6
Stevng	6.6	4.3–10.0	0.0	
Sthend	2.7	0.9–7.9		
Stoke	56.2	49.9–62.3	16.9	10.4–26.1
Sund	12.5	8.0–19.0		
Swanse	5.5	3.3–8.9	2.8	0.7–10.6
Truro	14.8	9.8–21.6	0.0	

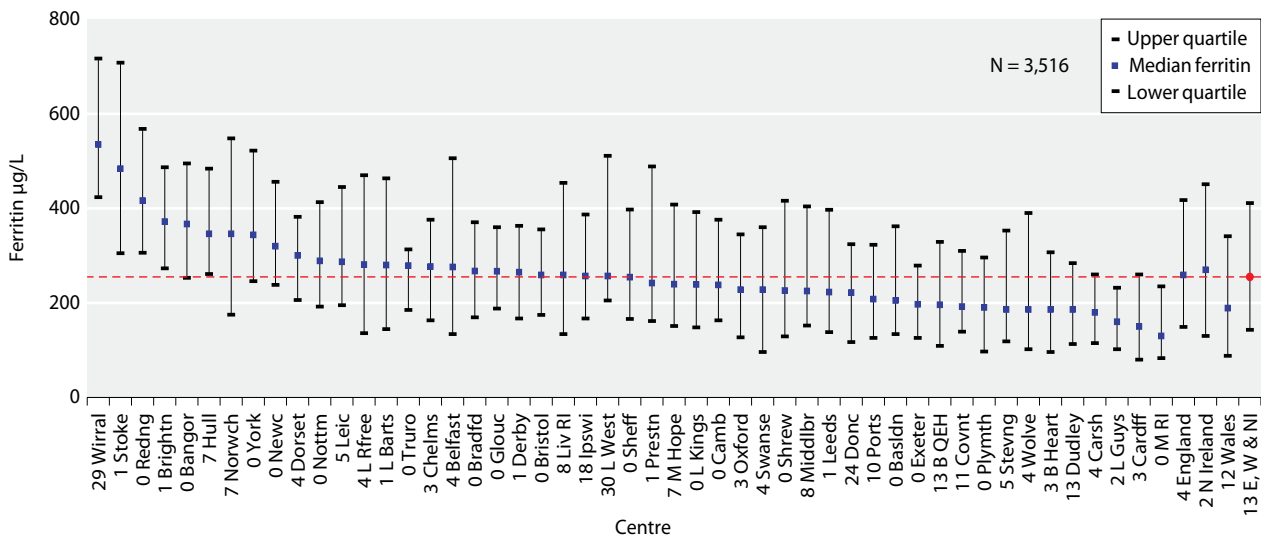
**Table 9.9.** Continued

Centre	HD		PD	
	% ferritin $\geq$ 800 $\mu$ g/L	95% CI	% ferritin $\geq$ 800 $\mu$ g/L	95% CI
Tyrone	39.7	28.8–51.7		
Ulster	29.7	20.5–41.1		
Wirral	25.9	18.5–35.0	20.0	7.7–42.8
Wolve	6.8	4.3–10.6	2.0	0.3–12.7
Wrexm	3.1	0.8–11.7		
York	6.5	3.2–13.1	0.0	
<b>England</b>	<b>11.1</b>	<b>10.6–11.7</b>	<b>4.3</b>	<b>3.7–5.1</b>
<b>N Ireland</b>	<b>25.7</b>	<b>22.4–29.3</b>	<b>8.4</b>	<b>4.3–15.9</b>
<b>Wales</b>	<b>8.5</b>	<b>6.8–10.5</b>	<b>2.7</b>	<b>1.3–5.5</b>
<b>E, W &amp; NI</b>	<b>11.6</b>	<b>11.1–12.1</b>	<b>4.3</b>	<b>3.7–5.1</b>

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



**Fig. 9.29.** Median ferritin in patients treated with HD



**Fig. 9.30.** Median ferritin in patients treated with PD

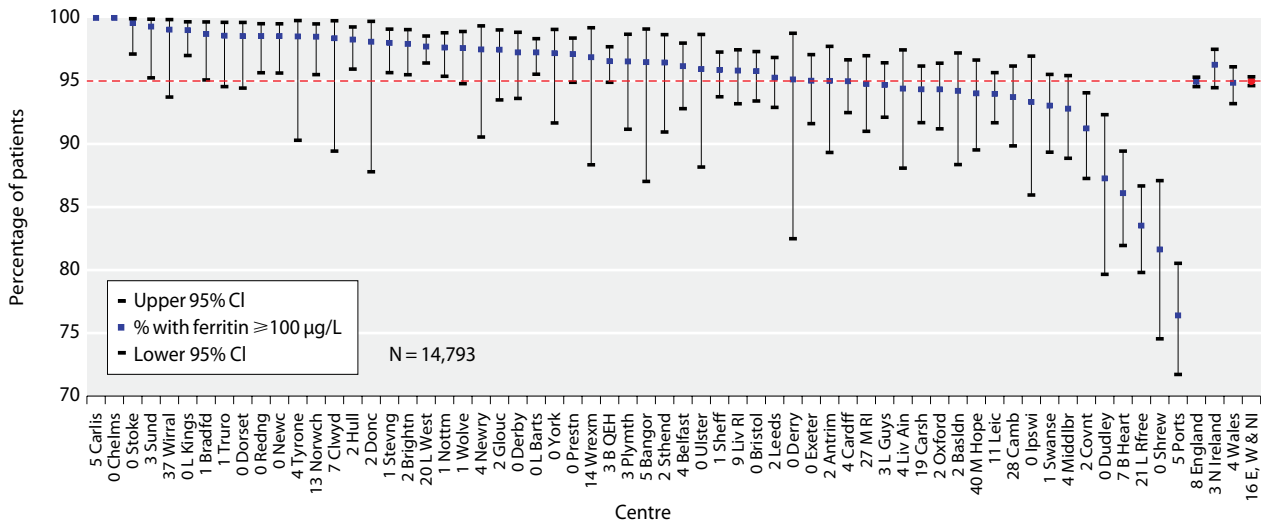


Fig. 9.31. Percentage of HD patients with ferritin  $\geq 100 \mu\text{g/L}$

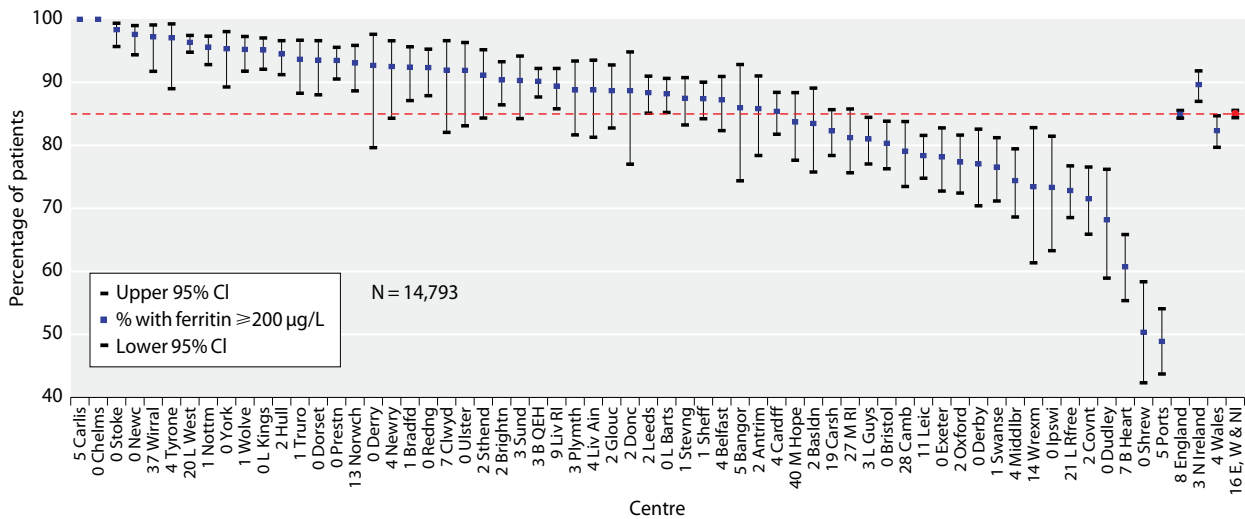


Fig. 9.32. Percentage of HD patients with ferritin  $\geq 200 \mu\text{g/L}$

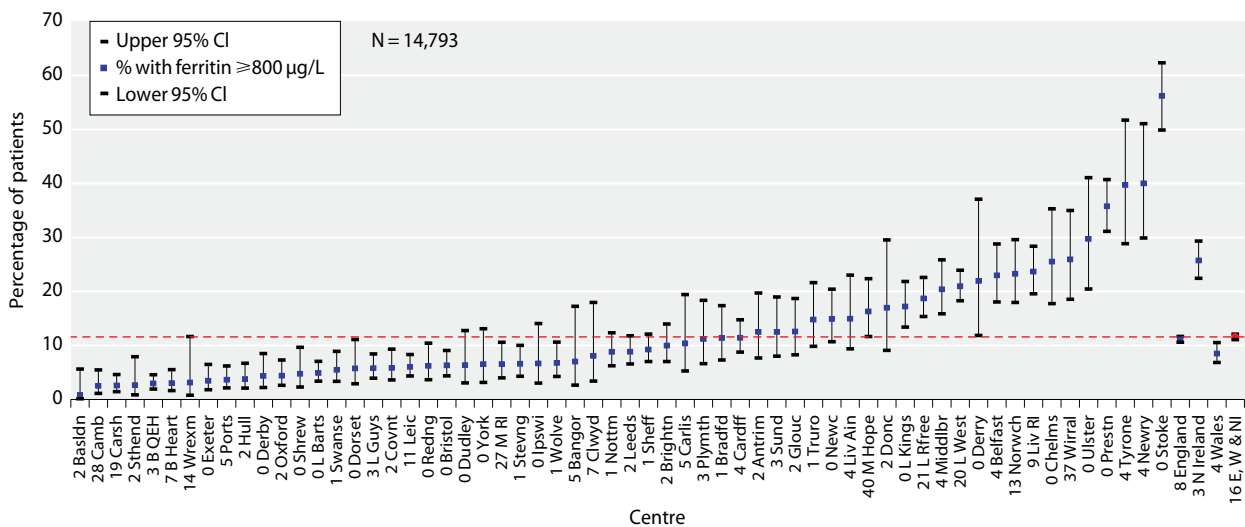


Fig. 9.33. Percentage of HD patients with ferritin  $\geq 800 \mu\text{g/L}$

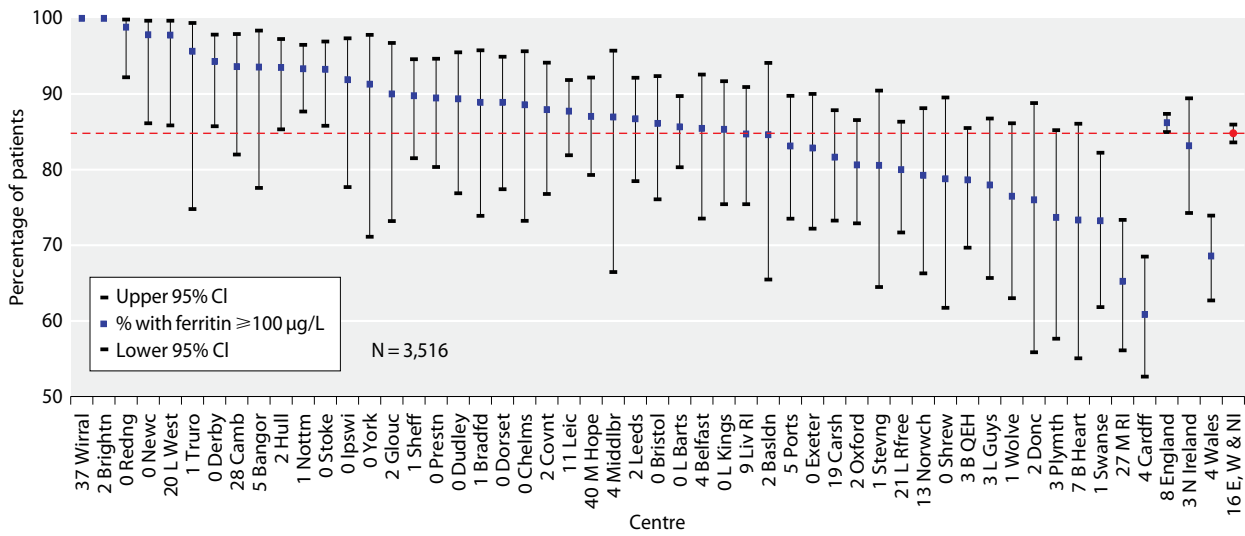


Fig. 9.34. Percentage of PD patients with ferritin  $\geq 100 \mu\text{g/L}$

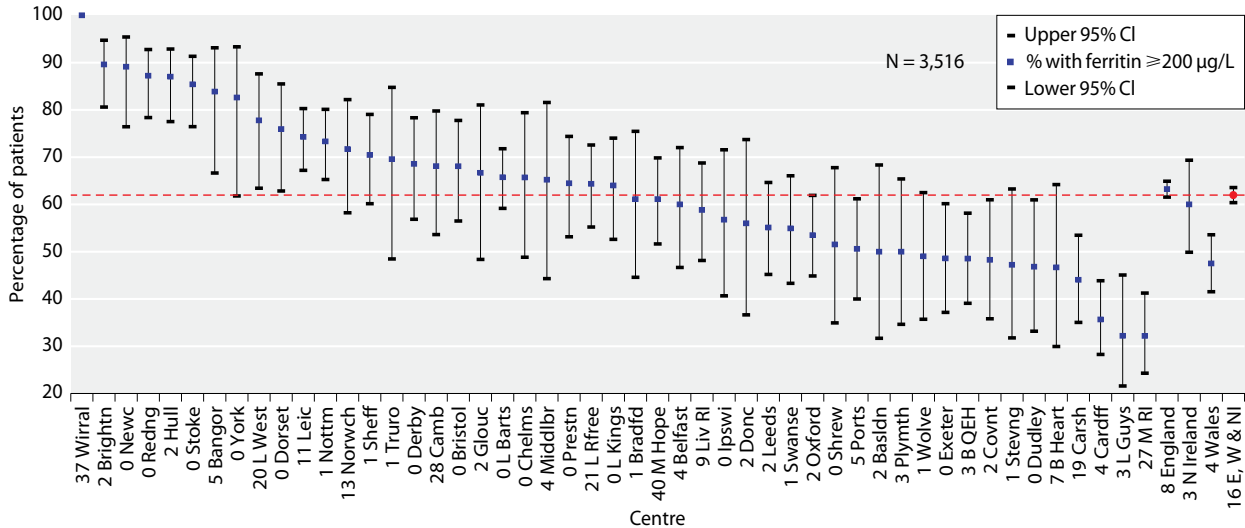


Fig. 9.35. Percentage of PD patients with ferritin  $\geq 200 \mu\text{g/L}$

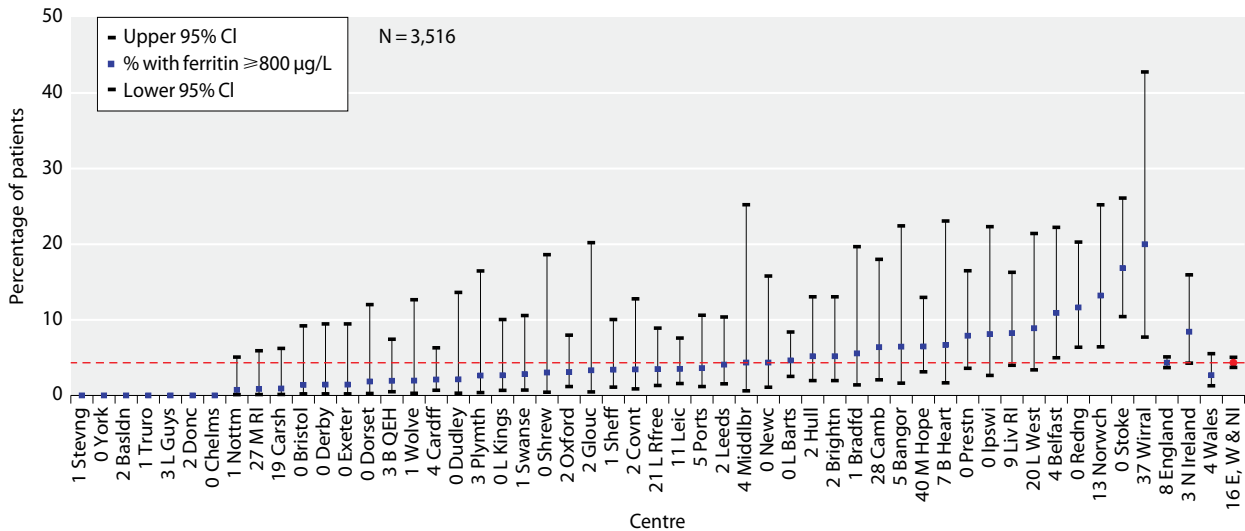
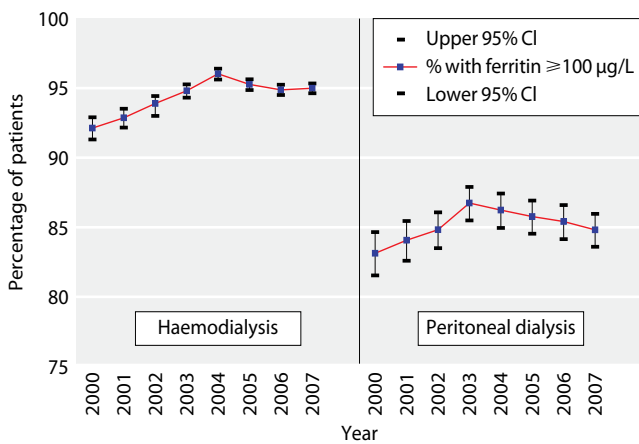
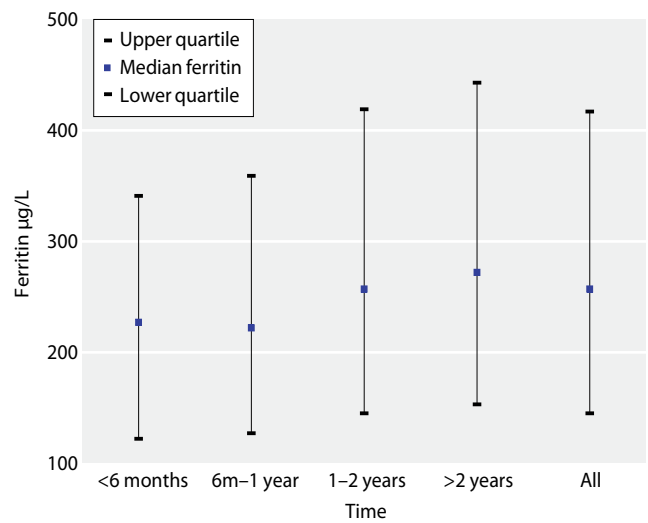


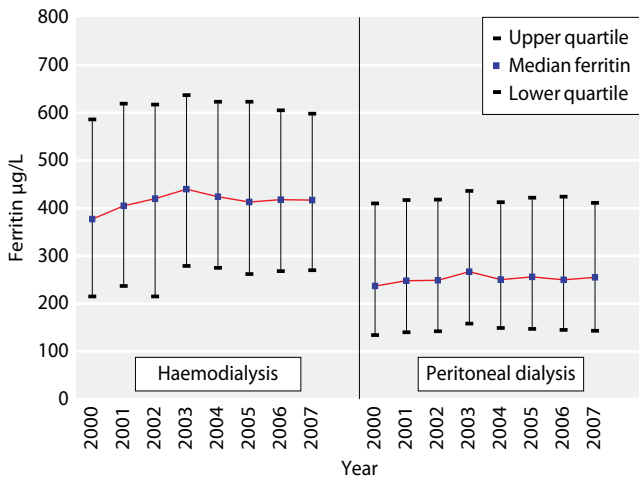
Fig. 9.36. Percentage of PD patients with ferritin  $\geq 800 \mu\text{g/L}$



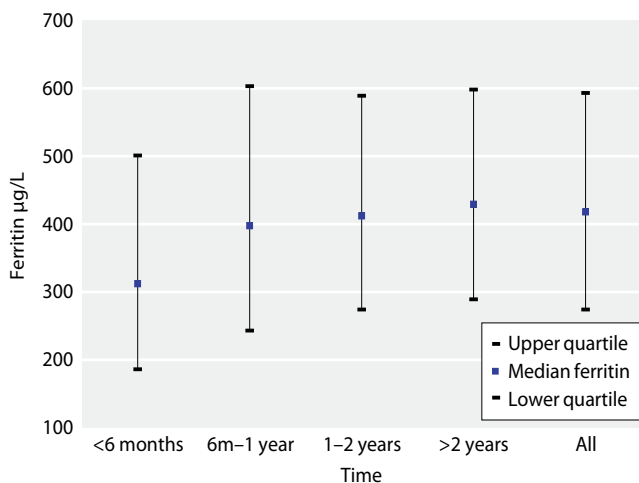
**Fig. 9.37.** Proportion of patients with ferritin  $\geq 100 \mu\text{g/L}$  (2000–2007)



**Fig. 9.40.** Median ferritin by length of time on RRT in patients treated with PD



**Fig. 9.38.** Median ferritin (2000–2007)



**Fig. 9.39.** Median ferritin by length of time on RRT in patients treated with HD

*Erythropoiesis stimulating agents*

*Patients treated and dose variation – ESA prescription and modality*

Table 9.10 shows the percentage of patients treated and the dose of ESA given in HD patients. Equivalent data for PD patients are shown in table 9.11.

*Age and ESA prescription*

The proportion of patients on an ESA was higher for HD than PD and this discrepancy was evident across the age bands. The percentage of the whole cohort which maintained a Hb  $\geq 10\text{g/dl}$  without requiring ESA (by age band and modality) is shown in figure 9.41.

The percentage of dialysis patients receiving ESA at all Hb levels is given in figure 9.42.

Figure 9.43 gives data on the percentage of anaemic patients (Hb  $<10.0\text{g/dl}$ ) receiving an ESA. Of the minority with Hb  $<10\text{g/dl}$  and not on an ESA, some may have been declared unresponsive to ESA therapy and no longer be on treatment, some may have just become anaemic and not yet started therapy or alternatively they were anaemic but still not receiving an ESA for whatever reason.

*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.

*ESAs and time on renal replacement therapy*

The percentage of patients on ESA by time on RRT and treatment modality is shown in figure 9.46. This is

**Table 9.10.** ESA prescribing in HD patients

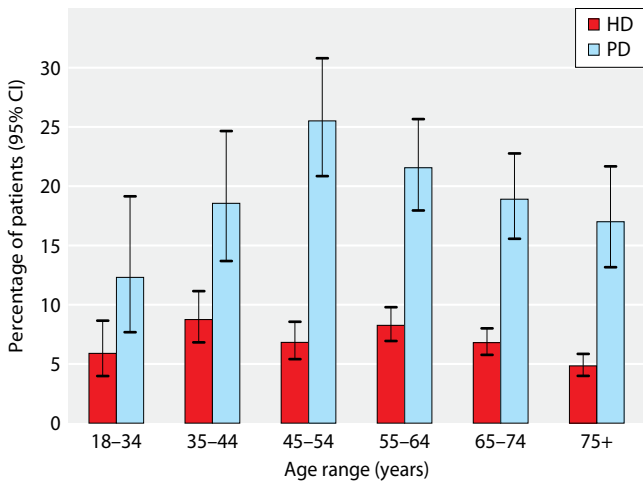
Centre	% on ESA	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb <10 g/dl who are on ESA	% with Hb ≥ 10 g/dl and not on ESA
Antrim	98	9,267	8,000	100	3
B Heart	82	9,500	8,000	95	16
Bangor	90	10,093	8,000	100	9
Basldn	94	8,845	8,000	100	5
Belfast	90	7,803	6,000	100	7
Bradfd	91	6,804	5,000	100	9
Bristol	96	10,144	8,000	100	4
Chelms	96	9,651	8,000	77	1
Covnt	93	11,661	10,000	93	5
Derry	98	7,725	4,500	100	2
Dorset	94	12,277	12,000	100	6
Dudley	81	6,372	6,000	77	16
Exeter	93	8,806	8,000	96	6
Glouc	94	10,508	9,000	95	5
Ipswi	96	10,529	8,500	100	4
Leeds	92	8,227	6,000	98	6
Leic	97	8,957	7,500	100	2
Liv RI	89	9,640	8,000	94	5
Middlbr	85	6,317	6,000	88	13
Newry	90	5,376	4,000	100	10
Norwch	81	8,989	8,000	74	12
Oxford	93	9,985	8,000	100	6
Plymth	92	10,216	9,000	93	7
Prestn	92	9,740	10,000	85	6
Redng	93	6,000	6,000	100	7
Sheff	91	9,894	8,000	97	8
Shrew	96	9,504	8,000	90	3
Sthend	97	12,117	12,000	96	1
Sund	90	11,684	10,000	95	8
Swanse	85	9,022	8,000	90	13
Truro	99	8,691	6,000	100	1
Tyrone	90	9,603	9,000	100	7
Ulster	100	7,095	5,000	100	0
Wolve	93	9,285	8,000	97	6
Wrexm	89	9,614	8,000	75	7
York	96	9,301	6,000	100	4
<b>England</b>	<b>92</b>	<b>9,449</b>	<b>8,000</b>	<b>95</b>	<b>6</b>
<b>N Ireland</b>	<b>93</b>	<b>7,890</b>	<b>6,000</b>	<b>100</b>	<b>5</b>
<b>Wales</b>	<b>87</b>	<b>9,296</b>	<b>8,000</b>	<b>89</b>	<b>11</b>
<b>E, W &amp; NI</b>	<b>92</b>	<b>9,299</b>	<b>8,000</b>	<b>96</b>	<b>7</b>

**Table 9.11.** ESA prescribing in PD patients

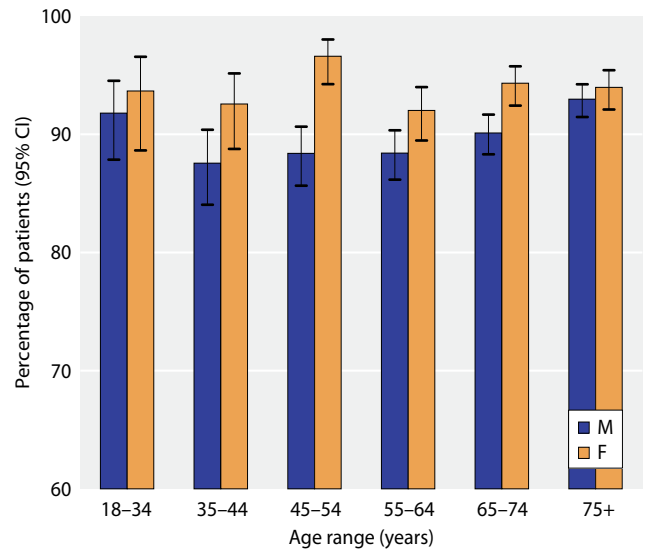
Centre	% on ESA	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb <10 g/dl who are on ESA	% with Hb ≥ 10 g/dl and not on ESA
Antrim	69				
Bangor	77	4,975	4,000	100	23
Belfast	75	4,207	3,000	100	22
Bradfd	81	7,010	6,000	100	19
Bristol	74	5,525	4,000	100	26
Camb	70	6,882	5,000	67	28
Cardff	78			93	21
Chelms	89	6,231	4,500	100	9
Clwyd	69				
Covnt	82	8,849	6,000	100	18
Derry	75				
Dorset	84	6,404	4,000	100	16
Dudley	87	5,540	6,000	100	14
Exeter	84	5,413	4,000	100	16
Glouc	80	4,987	3,346	100	20
Ipswi	73	5,224	4,000	100	27
Leeds	69	6,900	4,000	100	31
Leic	84	4,708	4,000	100	16
Liv RI	76	7,838	6,000	100	18
Norwch	67	4,351	2,800	75	29
Oxford	92	7,250	6,000	83	5
Plymth	82	6,129	6,000	100	13
Prestn	73			67	21
Redng	86			100	14
Sheff	68	7,390	6,000	100	32
Shrew	79	5,042	4,000	100	21
Sund	90				
Swanse	76	7,927	6,000	100	23
Truro	91	4,804	4,000	100	9
Ulster	100				
Wolve	74	4,513	4,000	75	25
York	74	5,571	4,000		26
<b>England</b>	<b>75</b>	<b>6,138</b>	<b>4,000</b>	<b>94</b>	<b>19</b>
<b>N Ireland</b>	<b>75</b>	<b>4,190</b>	<b>3,000</b>	<b>100</b>	<b>22</b>
<b>Wales</b>	<b>77</b>	<b>6,936</b>	<b>6,000</b>	<b>95</b>	<b>22</b>
<b>E, W &amp; NI</b>	<b>75</b>	<b>6,101</b>	<b>4,000</b>	<b>94</b>	<b>20</b>

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

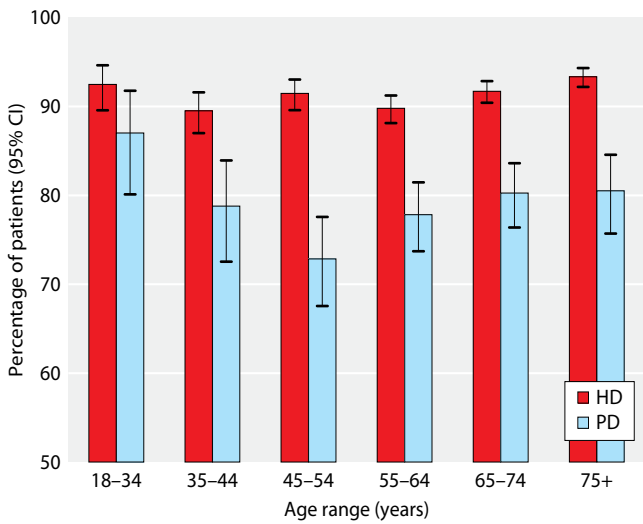




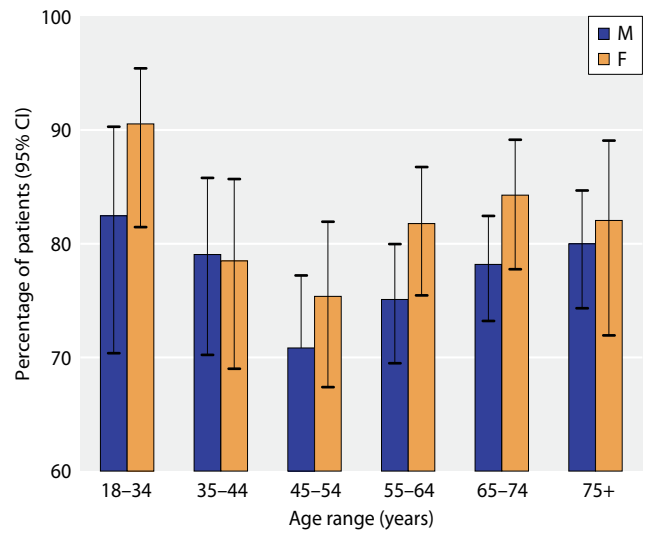
**Fig. 9.41.** Percentage of whole cohort who are not on ESA and have Hb  $\geq 10$  g/dl, by age group and treatment modality



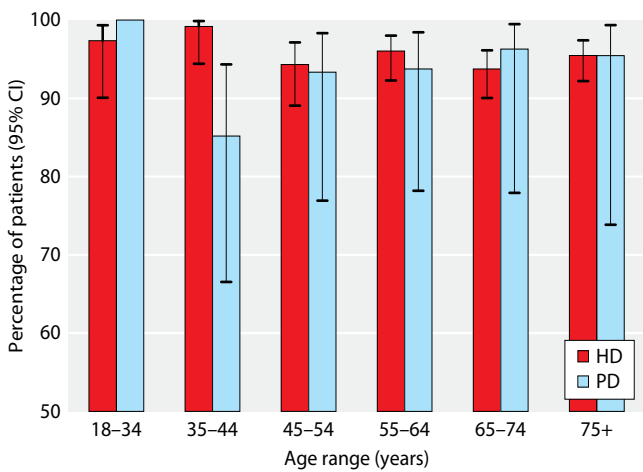
**Fig. 9.44.** Prescription of ESA by age and gender in patients treated with HD



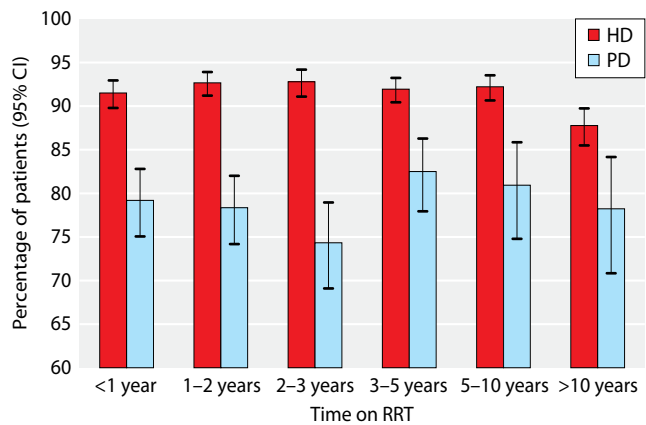
**Fig. 9.42.** Percentage of dialysis patients on ESA, by age group and treatment modality



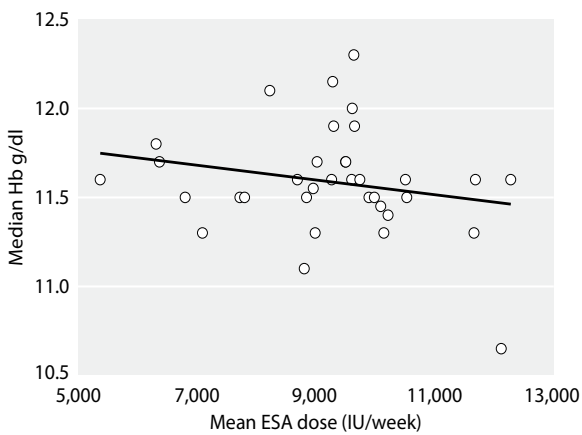
**Fig. 9.45.** Prescription of ESA by age and gender in patients treated with PD



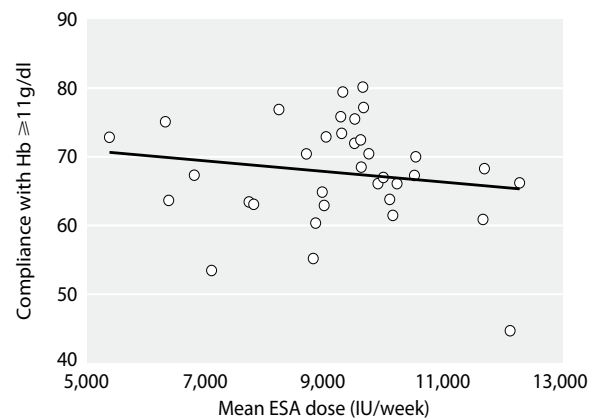
**Fig. 9.43.** Percentage of patients with Hb  $< 10$  g/dl who are on ESA, by age group and treatment modality



**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



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

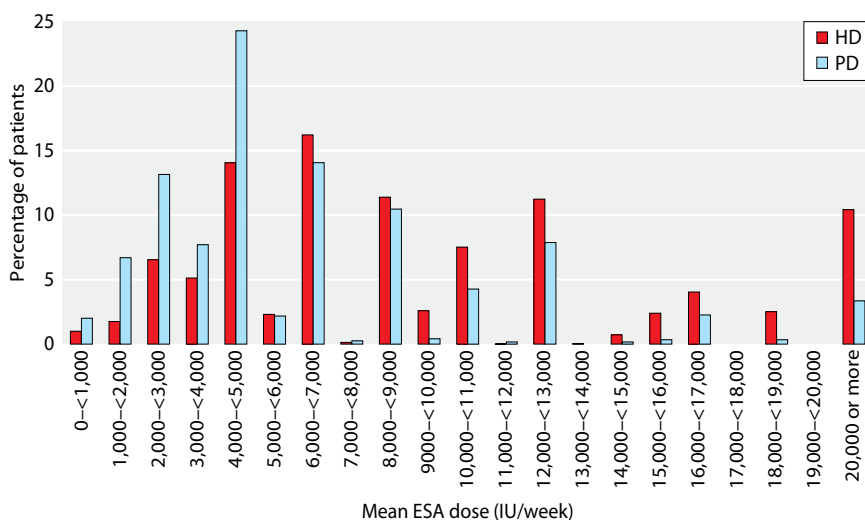
a cross-sectional analysis at the final quarter of 2007. Patients who had previously changed RRT modality were still included in this analysis.

*ESA dose and success with guideline compliance*

There appears to be no direct relationship between ESA dose and median Hb in HD patients (figure 9.47) or in patients treated with PD (chart not shown). This may be because of the wide spectrum of ESAs available, the frequency and route of administration and the differing policies for iron supplementation. The same was true for compliance with the EPBG minimum standard for Hb in HD patients (figure 9.48). Figure 9.49 shows the frequency distribution of mean weekly ESA dose by treatment modality.

**Discussion**

Haemoglobin outcomes for patients on HD and PD in the UK were largely compliant with the RA minimum standard of Hb  $\geq 10.0$  g/dl (86% and 91% respectively). Achieving compliance whilst also complying with the NICE guidelines published in 2006 and the 4th edition of the RA Clinical Practice Guidelines 2006 recommended outcome Hb of between 10.5 and 12.5 g/dl requires careful positioning of the median outcome Hb for each centre and also would require a reduction in the standard deviation of Hb to reach compliance levels higher than  $\sim 60\%$  even if the median Hb falls on 11.5 g/dl. Of 52 centres achieving  $>85\%$  compliance with Hb  $\geq 10.0$  g/dl, only 11 centres achieved  $\geq 60\%$  compliance with Hb between 10.5 and 12.5 g/dl. The



**Figure 9.49.** Frequency distribution of mean weekly ESA dose

presentation of funnel plots for compliance with Hb  $\geq 10.0$  g/dl and Hb between 10.5 and 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. In last year's report the need to avoid improving compliance with the NICE guidelines at the expense of the Hb  $\geq 10.0$  g/dl minimum standard was highlighted. This year's report confirms maintained UK compliance with more than 85% Hb  $\geq 10.0$  g/dl for dialysis patients. The use of 10.5–12.5 g/dl alone would infer equivalent risk of Hb  $>12.5$  g/dl as for  $<10.5$  g/dl. The NICE guidance on limiting upper Hb was primarily a health economic decision and not on the grounds of safety. The evidence for improving Hb  $\geq 10$  g/dl remains unchanged.

Iron stores as reflected by ferritin outcome have remained in a steady state in the UK and the percentage of patients with serum ferritin greater than 100  $\mu\text{g/L}$  showed that the provision of iron to UK dialysis patients was maintained.

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

Overall the data demonstrated that UK renal centres continued to give a high priority to the management of factors influencing Hb. Adjustments seem to have been made in many centres in accordance with the NICE guidelines since the last report was published. Fifty-one centres achieved  $\geq 50\%$  compliance with Hb between 10.5–12.5 g/dl for HD patients compared with 35 in last year's report. The overall UK compliance with this range has also improved from 48% to 53%.

Conflict of interest: none

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