UK Renal Registry 16th Annual Report: Chapter 10 Haemoglobin, Ferritin and Erythropoietin amongst UK Adult Dialysis Patients in 2012: National and Centre-specific Analyses

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Key Words
Anaemia · Chronic kidney disease · Dialysis · End stage renal disease · Epidemiology · Erythropoietin · Erythropoietin stimulating agent · European Best Practice Guidelines · Ferritin · Haemodialysis · Haemoglobin · NICE · Peritoneal dialysis · Renal Association

Summary

In the UK in 2012:

- The median Hb of patients at the time of starting dialysis was 100 g/L with 51% of patients having a Hb $\geqslant$100 g/L.
- The median Hb in patients starting haemodialysis (HD) was 97 g/L (IQR 89–106) and in patients starting peritoneal dialysis (PD) was 109 g/L (IQR 99–118).
- At start of dialysis, 54% of patients presenting early had Hb $\geqslant$100 g/L whilst 34% of patients presenting late had Hb $\geqslant$100 g/L.
- The median Hb of prevalent patients on HD was 112 g/L with an IQR of 103–121 g/L.
- The median Hb of prevalent patients on PD was 114 g/L with an IQR of 105–123 g/L.
- 82% of HD and 85% of PD patients had Hb $\geqslant$100 g/L.
- 57% of HD patients and 55% of PD patients had Hb $\geqslant$100 and $\leqslant$120 g/L.
- The median ferritin in HD patients was 431 μg/L (IQR 285–623) and 95% of HD patients had a ferritin $\geqslant$100 μg/L.

In England, Wales and Northern Ireland in 2012:

- The median ferritin in PD patients was 285 μg/L (IQR 164–466) with 88% of PD patients having a ferritin $\geqslant$100 μg/L.
- The median erythropoietin stimulating agent (ESA) dose was higher for HD than PD patients (7,248 vs. 4,250 IU/week).

Introduction

This chapter describes the UK Renal Registry (UKRR) data relating to the management of anaemia in dialysis patients during 2012. The chapter reports on the analyses of submitted variables in the context of the UK Renal Association – Anaemia in CKD guidelines and recommendations.

In this report, haemoglobin levels are given in g/L as the majority of UK laboratories have now switched to reporting using these units.

Anaemia in adults with CKD is diagnosed when the Hb concentration is $<$130 g/L in males and $<$120 g/L in females [1]. The degree of renal impairment affects the likelihood of any patient developing anaemia. Although current treatment with ESAs is not recommended unless Hb falls consistently below 110 g/L, other causes of anaemia should be excluded in patients with Hb below the normal range.

The renal National Service Framework (NSF) part one [2] and the RA minimum standards document 3rd edition [3] state that individuals with chronic kidney disease (CKD) should achieve a haemoglobin (Hb) of at least 100 g/L within six months of being seen by a nephrologist, unless there is a specific reason why it is unachievable. The UKRR does not collect Hb measurements from patients with CKD six months after meeting a nephrologist. However, an indication of the attainment of this standard is given by the Hb of the incident patient population at the start of dialysis. 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) published in 2009 recommend that Hb values of 110–120 g/L should be generally sought in the CKD population without intentionally exceeding 130 g/L [4]. The 5th edition of the UK Renal Association's Anaemia in CKD guideline was published at the end of 2010 and attempted to unify targets with those published in the 2011 update NICE guideline on anaemia management in CKD and other guidelines [5, 6]. The target outcome Hb for RRT patients on ESA treatment in these guidelines is between 100 and 120 g/L. The rationale behind choosing a wide target Hb range (100–120 g/L) is that when the target Hb level is narrow (e.g. 100 g/L), variability in achieved Hb levels around the target is high, the proportion of prevalent patients with achieved Hb levels within the target range is low and ESA dose titration is required frequently during maintenance therapy. The recently updated KDOQI guidelines suggest ESAs should not be used to maintain Hb concentration routinely above 115 g/L with careful consideration in patients who require individualization of therapy for improvements in quality of life at Hb concentration above 115 g/L [7]. The target of Hb 100–120 g/L has been used for both HD and PD patients in keeping with the above recommendations. There are also some analyses showing attainment of the minimum standard of Hb $\geqslant$100 g/L.

In patients on peritoneal dialysis (PD), the timing of the blood sample draw is not critical because plasma volume in these patients remains relatively constant. In haemodialysis (HD) patients, interdialytic weight gain contributes to a decrease in Hb level, whereas intradialytic ultrafiltration leads to an increase. Thus, a predialysis sample underestimates the euvolaemic Hb level, whereas a postdialysis sample overestimates the euvolaemic Hb. Given the relationship between Hb level and the dialysis related weight change, midweek pre-dialysis sampling is recommended for regular Hb monitoring [8].

The 2010 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 target reticulocyte Hb content (CHr) of greater than 29 pg/cell. KDOQI recommends a serum ferritin $>$200 μg/L for HD patients. The NICE guidelines suggest that a hypochromic red cell value $>$6% indicates ongoing iron deficiency.

To achieve adequate iron status across a patient population, RA guidelines [6] advocate population target medians for ferritin of 200–500 μg/L in HD patients and 100–500 μg/L for PD patients, 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. Serum ferritin level is less reliable in the evaluation of iron stores in HD patients, because ferritin level is affected by other factors in addition to iron storage status. In relatively healthy HD patients, before widespread use of IV iron therapy, the finding of a ferritin level less than 50 ng/ml was not uncommon and was associated with absent bone marrow iron in approximately 80% of patients. However, in HD patients with several comorbidities, absent iron stores may still be found at ferritin levels approaching or even exceeding 200 ng/ml [9].

Of the alternative measures of iron status available, HRC and CHr are generally considered superior to TSAT. Both however require specialised analysers to which not all UK renal centres have easy access. Since TSAT is measured infrequently in many centres and most UK centres continue to use serum ferritin for routine iron management, ferritin remains the chosen index of iron status for this report.

Anaemia treatment in CKD patients has changed dramatically since the implementation of erythropoietin stimulating agents (ESAs) into clinical practice in 1987. This has reduced the need for blood transfusions and improved quality of life for patients [10]. These agents are relatively expensive and thus approaches to achieving optimal haemoglobin levels with the lowest possible doses are desirable. The health economics of anaemia therapy using ESAs has been subject to a NICE systematic review [5] which concluded that treating to a target Hb 110–120 g/L is cost effective in HD patients.

The risks associated with low ($<$100 g/L) and high ($>$130 g/L) Hb are not necessarily equivalent. Two important studies of patients not yet on dialysis, CHOIR [11] and CREATE [12] showed an increased risk of cardiovascular events amongst the patients assigned to the higher Hb targets. In the TREAT study [13] although there was no difference between the two arms in the primary outcome of death, cardiovascular event or end stage renal disease, there was an increase in fatal or non-fatal stroke in the treatment arm.

Methods

The incident and prevalent RRT cohorts for 2012 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.

For the analyses of Hb for incident patients, those patients commencing RRT on PD or HD were included whilst those receiving a pre-emptive transplant were excluded. Hb measurements from after starting dialysis but still within the same quarter of the year were used. Therefore, depending on when in the quarter a patient started RRT the Hb could be from 0 to 90 days later. The haemoglobin values the UKRR receives should be the closest available measurement to the end of the quarter. Patients who died within the first 90 days on treatment were excluded. Results are also shown with the cohort subdivided into early and late presenters (date first seen by a nephrologist, 90 or more days and less than 90 days before starting dialysis respectively).

For the analyses of prevalent patients, those patients receiving dialysis on 31st December 2012 were included if they had been on the same modality of dialysis in the same centre for at least three months. In order to improve completeness the last available measurement for each patient from the last two quarters for Hb and from the last three quarters for ferritin was used. Scotland was excluded from the analysis for ferritin for PD patients as this data was not available.

The completeness of data items were 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 10 patients were also excluded from the plots. The number preceding the centre name in the caterpillar plots indicates the percentage of data missing for that centre.

The data were analysed to calculate summary statistics including maximum, minimum and average (mean and median) values. Standard deviations and inter-quartile ranges (IQR) were also calculated. These are shown using caterpillar plots giving median values and the inter-quartile ranges.

The percentages achieving RA and other standards were calculated for Hb and ferritin. These are displayed using caterpillar plots with the percentages meeting the targets and 95% confidence intervals (CIs) shown. Funnel plots show the distribution of the percentages meeting the various targets and also whether any of the centres are significantly different from the average.

Longitudinal analysis was performed to show overall changes in achievement of standards from 1998 to 2012.

Erythropoietin data from the last quarter of 2012 were used to define which patients were receiving ESAs. Scotland was excluded from this analysis as data regarding ESA was not included in its return. Each individual was defined as being on ESA if a drug type and/or a dose was present in the data. Centres reporting fewer than 60% of HD patients or fewer than 45% of PD patients being treated with ESAs were considered to have incomplete data and were excluded from further analysis. It is recognised that these exclusion criteria are relatively arbitrary but they are in part based upon the frequency distribution graph of centres' ESA use as it appears in the data. The percentage of patients on ESAs is calculated from these data and incomplete data returns risk seriously impacting on any conclusions drawn.

For analyses of ESA dose, values are presented as weekly erythropoietin dose. Doses of less than 150 IU/week (likely to be darbepoietin) were harmonised with erythropoietin data by multiplying by 200. No adjustments were made with respect to route of

administration. Patients who were not receiving ESAs were not included in analyses of dose (rather than being included with dose = 0).

Until last year, reports have only used the dose from the final quarter of the year. Now, as last year, starting with the cohort of patients receiving ESAs in the final quarter and having a dose value present for that quarter, any further dose values available from the earlier three quarters of the year were used (provided the patient was on the same treatment and receiving the same drug in those quarters). The average (mean) of the available values was then used in analyses rather than the dose in the final quarter.

The ESA data were collected electronically from renal IT systems but in contrast to laboratory linked variables the ESA data required manual data entry. The reliability depended upon the data source, 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

Anaemia management in incident dialysis patients

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.

The percentage of data returned and outcome Hb are listed in table 10.1. Results are not shown for two centres (Kent and Inverness) because data completeness was less than 50%.

The median Hb of patients at the time of starting dialysis in the UK was 100 g/L. The median starting Hb by centre is shown in figure 10.1. The percentage of patients having a Hb $\geqslant$100 g/L has fallen over the last couple of years to 51% from 55% in the 2009 cohort. The percentage starting with a Hb $\geqslant$100 g/L by centre is given in figure 10.2.

The variation in the proportion of patients starting renal replacement therapy with Hb $\geqslant$100 g/L between centres remained high (32–87%). Using only centres with time of presentation data, the median Hb in the late presenters was 94 g/L with only 34% of patients having a Hb $\geqslant$100 g/L compared with a median Hb of 101 g/L and 54% of the patients having a Hb $\geqslant$100 g/L in the early presenters group. In the late presenters group there was a large variation between centres in percentage of patients having a Hb $\geqslant$100 g/L (9%–64%). The lower median Hb in late presenters may reflect inadequate pre-dialysis care with limited anaemia management, anaemia of multisystem disease or inter-current illness.

Median Hb of patients at the time of starting HD was 97 g/L (IQR 89–106 g/L) and in those starting PD was 109 g/L (IQR 99–118 g/L). When starting dialysis, 44% of HD patients had a Hb $\geqslant$100 g/L, compared with 75% of PD patients.

Incident dialysis patients from 2011 were followed for one year and the median haemoglobin (and percentage with a Hb $\geqslant$100 g/L) of survivors on the same treatment at the same centre after a year was calculated for each quarter. Only patients who had Hb data for each of the four time points were included in this analysis. This was sub-analysed by modality and length of pre-RRT care (figures 10.3 and 10.4). Hb was higher in the second quarter on dialysis than during the quarter at start of dialysis reflecting the benefits of treatment administered. Over 76% of incident patients surviving to a year had Hb $\geqslant$100 g/L regardless of the modality or the length of pre-RRT care.

The annual distribution of Hb in incident dialysis patients is shown in figure 10.5. Since 2006, the proportion of incident patients with Hb $\geqslant$120 g/L has fallen from 17% to 10% and the proportion of patients with Hb $<$100 g/L continues to gradually increase over the years from 40% to 49%. In the 2012 cohort, 66% of patients in the late presentation group had Hb $<$100 g/L compared with 46% in the early presentation group.

ESA by time on dialysis in early vs. late presenters

Incident dialysis patients from 2011 were followed for one year and the percentages receiving an ESA were calculated for each quarter for survivors on the same treatment at the same centre after a year. This was sub-analysed by modality and length of pre-RRT care (figure 10.6). For HD patients at the start of treatment there was a relatively small difference between early and late presenters in the percentage of patients receiving an ESA. This difference had disappeared within one year of starting dialysis. For PD patients there was a more marked difference between the early and late group which was highest in the second quarter at more than 10%. The difference was lowest 1 year after starting dialysis. Caution is advised in interpreting this figure as the number of patients in the PD late group is relatively small (22).

Anaemia management in prevalent dialysis patients

Compliance with data returns for haemoglobin and serum ferritin and percentages on ESA are shown for the 71 renal centres in the UK in table 10.2 for both HD and PD patients. Completeness of data returns was

Table 10.1. Haemoglobin data for incident patients starting haemodialysis or peritoneal dialysis during 2012, both overall and by presentation time

	All incident patients				Early presenters only (⩾90 days)		Late presenters only (<90 days)	
Centre	% data return	*N* with data	Median Hb g/L	% Hb ⩾100 g/L	Median Hb g/L	% Hb ⩾100 g/L	Median Hb g/L	% Hb ⩾100 g/L
England								
B Heart	100	96	96	39	94	37		
B QEH	94	179	95	36	98	44	88	17
Basldn	100	45	94	40	97	44		
Bradfd	97	56	103	59	104	64		
Brightn	97	118	103	63	107	67	93	40
Bristol	100	128	97	45	99	48	85	26
Camb	94	81	100	51	102	58	94	36
Carlis	100	15	114	87	116	92		
Carsh	99	204	103	60	103	63	99	48
Chelms	97	37	101	59	104	65		
Colchr	52	14	97	36	97	42		
Covnt	96	90	101	56	101	58	94	44
Derby	97	68	100	53	102	57	93	27
Donc	100	41	96	41	96	45		
Dorset	97	63	106	57	106	59		
Dudley	96	47	100	51	100	53		
Exeter	100	125	102	57	103	61	97	44
Glouc	100	68	101	53	104	57	96	40
Hull	88	74	106	64	109	68		
Ipswi	100	38	97	45	96	40	108	58
Kent	46	44						
L Barts	100	241	99	49				
L Guys	56	63	98	44				
L Kings	99	114	96	42	96	43	96	39
L Rfree	68	140	103	55	105	60	98	44
L St.G	89	64	95	39				
L West	79	176	105	69				
Leeds	98	111	95	36	96	40	90	14
Leic	98	186	95	38	97	43	90	20
Liv Ain	98	57	102	58	103	60		
Liv RI	95	70	102	51	104	55	95	41
M RI	97	116	98	47	97	46	104	64
Middlbr	98	93	93	32	97	38	83	16
Newc	98	82	102	57	101	56	109	64
Norwch	95	61	105	64				
Nottm	99	72	98	49	100	51		
Oxford	99	131	96	44	97	45	90	30
Plymth*	100	41	100	51				
Ports	100	134	102	60	104	63	99	40
Prestn	100	116	99	45	99	45	99	43
Redng	100	67	103	61	108	71	94	31
Salford	90	110	99	47				
Sheff	100	133	100	50	101	52	95	38
Shrew	100	49	106	57	106	56		
Stevng	99	73	98	48	98	48	98	50
Sthend	100	25	99	48	100	53		
Stoke	99	66	102	55	104	60	95	39
Sund	96	54	101	52	101	53		
Truro	100	42	102	62	106	80	91	9
Wirral	98	44	104	70				
Wolve	99	72	102	54	111	65	92	22
York	100	46	95	33	98	40	87	9

Table 10.1. Continued

Centre	All incident patients				Early presenters only (⩾90 days)		Late presenters only (<90 days)	
	% data return	*N* with data	Median Hb g/L	% Hb ⩾100 g/L	Median Hb g/L	% Hb ⩾100 g/L	Median Hb g/L	% Hb ⩾100 g/L
N Ireland								
Antrim	100	26	102	54	104	58		
Belfast	95	57	101	56	101	58	98	42
Newry	100	18	104	61	104	67		
Ulster	100	21	109	71	109	76		
West NI	89	16	98	38	98	36		
Scotland								
Abrdn	100	54	98	46				
Airdrie	68	40	95	40				
D & Gall	65	11	99	45				
Dundee	89	33	98	42				
Dunfn	77	20	107	60				
Edinb	83	53	101	57				
Glasgw	64	103	98	47				
Inverns	46	6						
Klmarnk	78	29	94	45				
Wales								
Bangor	95	18	102	67	101	64		
Cardff	100	137	103	61	104	65	94	29
Clwyd	100	19	103	63	103	67		
Swanse	99	97	99	46	103	58	89	16
Wrexm	97	30	108	67	109	71		
England	**93**	**4,480**	**100**	**51**	**101**	**53**	**94**	**34**
N Ireland	**97**	**138**	**103**	**57**	**104**	**59**	**95**	**38**
Scotland	**75**	**349**	**99**	**48**				
Wales	**99**	**301**	**102**	**57**	**104**	**64**	**92**	**26**
UK	**92**	**5,268**	**100**	**51**	**101**	**54**	**94**	**34**

Blank cells denote centres excluded from analyses due to poor data completeness or low patient numbers or because presentation time data not available

*Plymouth, approximately 33% of incident patients were missing from the data extract

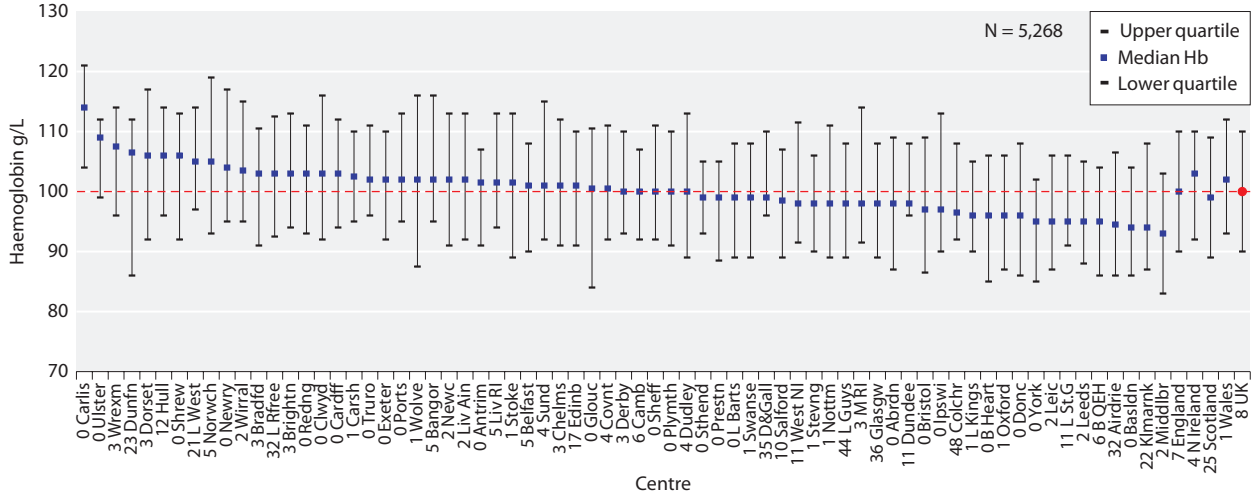

Fig. 10.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2012

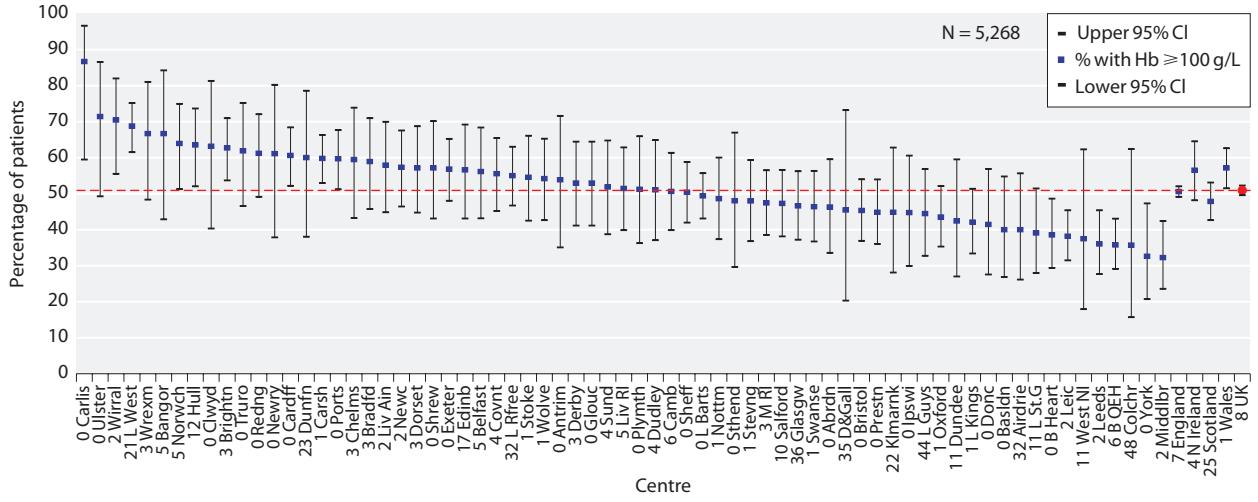

Fig. 10.2. Percentage of incident dialysis patients with Hb ⩾100 g/L at start of dialysis treatment in 2012

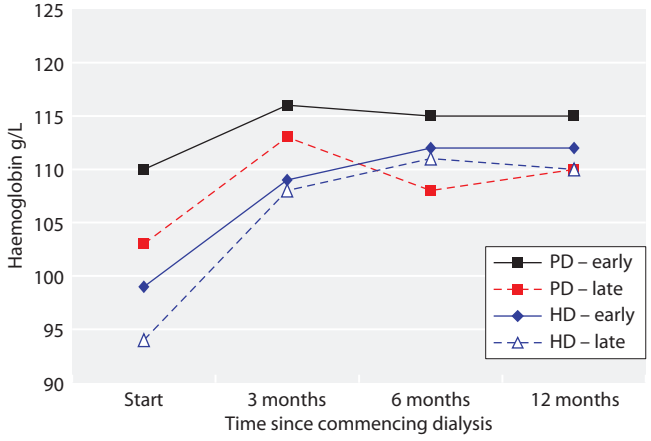

Fig. 10.3. Median haemoglobin, by time on dialysis and length of pre-RRT care, for incident dialysis patients in 2011

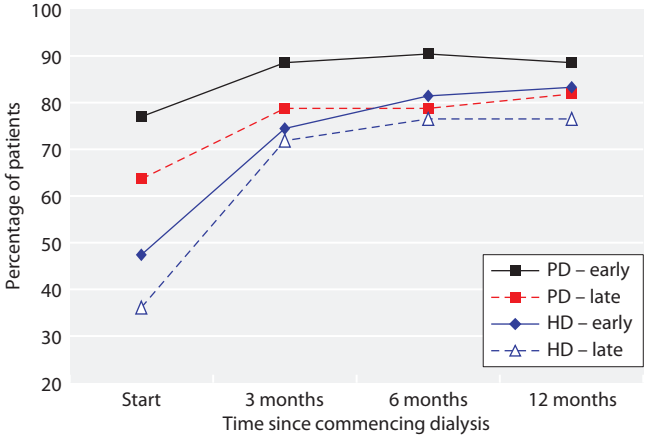

Fig. 10.4. Percentage of incident dialysis patients in 2011 with Hb ⩾100 g/L, by time on dialysis and by length of pre-RRT care

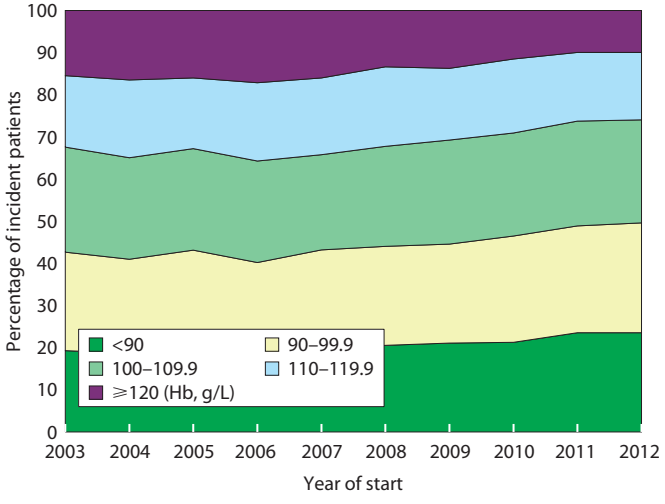

Fig. 10.5. Distribution of haemoglobin in incident dialysis patients by year of start

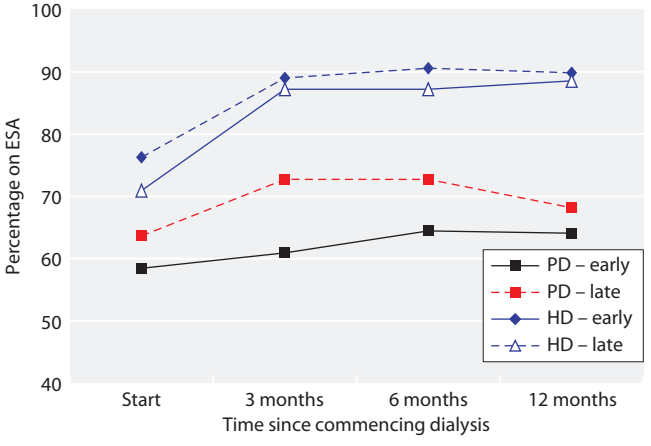

Fig. 10.6. Percentage of incident dialysis patients in 2011 on ESA, by time on dialysis and by length of pre-RRT care

Table 10.2. Percentage completeness of data returns for haemoglobin and serum ferritin and percentages on ESA for prevalent HD and PD patients in 2012

	HD				PD			
Centre	*N*	Hb	Ferritin	% on ESA	*N*	Hb	Ferritin	% on ESA
England								
B Heart	401	100	100	77	42	100	98	48
B QEH	864	97	96	84	149	99	97	62
Basldn	150	98	97	91	28	100	100	61
Bradfd	189	98	98	96	24	100	100	83
Brightn	338	96	86	0	69	94	83	0
Bristol	461	100	100	92	56	100	100	66
Camb	324	95	76	43	32	100	97	59
Carlis	57	100	70	68	21	100	95	67
Carsh	698	95	92	0	97	98	99	0
Chelms	121	100	99	97	25	100	100	76
Colchr	108	93	95	29				
Covnt	335	100	99	91	84	96	89	68
Derby	209	100	99	0	84	100	99	0
Donc	158	100	100	91	23	100	100	70
Dorset	244	100	98	97	38	95	87	68
Dudley	153	100	99	3	53	100	89	4
Exeter	351	100	100	93	69	100	100	72
Glouc	193	100	98	91	31	100	77	55
Hull	310	100	99	0	79	97	95	0
Ipswi	124	100	99	65	30	100	90	70
Kent	361	100	99	91	55	100	96	67
L Barts	846	100	99	0	167	99	95	0
L Guys	592	91	81	19	27	96	96	7
L Kings	460	100	97	0	76	100	99	0
L Rfree	668	86	81	0	102	99	86	0
L St.G	271	97	92	0	48	98	96	0
L West	1,342	98	99	0	47	98	98	0
Leeds	454	100	100	94	77	100	100	78
Leic	801	100	100	98	143	98	98	80
Liv Ain	166	99	98	0	17	100	100	0
Liv RI	345	99	99	0	55	98	96	0
M RI	474	93	92	0	76	100	100	0
Middlbr	312	98	98	78	8	88	88	75
Newc	262	100	100	69	37	86	92	0
Norwch	303	100	98	91	48	100	98	71
Nottm	355	100	100	90	72	100	100	69
Oxford	389	100	100	93	69	100	99	81
Plymth	119	100	98	0	31	97	77	0
Ports	510	100	99	10	78	100	100	12
Prestn	496	100	99	88	59	100	100	75
Redng	251	100	100	90	63	100	98	2
Salford	345	88	0	68	90	93	0	77
Sheff	562	100	100	86	67	100	100	60
Shrew	184	100	99	88	33	97	94	61
Stevng	380	99	99	0	27	100	89	0
Sthend	107	100	100	97	14	100	100	57
Stoke	294	86	99	1	69	100	99	0
Sund	184	99	93	95	17	100	94	65
Truro	134	99	99	0	19	100	89	0
Wirral	177	98	97	0	29	79	62	0

Table 10.2. Continued

	HD				PD			
Centre	*N*	Hb	Ferritin	% on ESA	*N*	Hb	Ferritin	% on ESA
Wolve	270	100	99	85	83	100	100	63
York	122	100	100	93	27	100	96	70
N Ireland								
Antrim	126	100	100	92	10	100	100	80
Belfast	208	99	97	90	25	100	96	80
Newry	85	99	28	95	14	100	100	86
Ulster	101	100	100	93	6	100	100	100
West NI	129	98	59	92	15	100	100	67
Scotland								
Abrdn	214	100	93		20	100		
Airdrie	176	100	97		10	100		
D & Gall	48	100	98		14	93		
Dundee	171	99	88		19	95		
Dunfn	140	100	89		20	95		
Edinb	250	100	93		35	100		
Glasgw	579	99	72		40	100		
Inverns	73	100	64		15	93		
Klmarnk	141	100	91		40	100		
Wales								
Bangor	82	100	100	79	14	100	100	50
Cardff	448	100	99	61	71	100	73	27
Clwyd	76	100	100	0	15	100	93	0
Swanse	308	100	100	92	54	100	89	78
Wrexm	86	100	73	91	20	100	45	55
England	**18,324**	**98**	**95**	**88**	**2,864**	**98**	**92**	**69**
N Ireland	**649**	**99**	**82**	**92**	**70**	**100**	**99**	**80**
Scotland	**1,792**	**100**	**85**		**213**	**98**		
Wales	**1,000**	**100**	**97**	**76**	**174**	**100**	**79**	**68**
UK	**21,765**	**98**	**93**	**87***	**3,321**	**99**	**94***	**69***

*The overall averages given are for E, W & NI (not UK)
Blank cells denote centres with no PD patients or because data was not available
Percentages on ESA are shown, but it is believed that there were data problems for those centres with apparently less than 60% of HD patients or 45% of PD patients on ESA
The country level averages for the % on ESA are based only on those centres whose % was above the limits mentioned above

generally good for Hb and ferritin. The percentages on ESA are shown as they appear in the data received by the registry. For some centres, the ESA data was completely missing and for others it appears to be partially complete with, for example, only 10 or 20% of patients appearing to be on ESAs. It is believed that there were problems with data entry and/or data transfer in those centres with apparently less than 60% of HD patients or 45% of PD patients on ESA. These centres have been excluded from further analyses of ESA use.

Summary statistics for haemoglobin, serum ferritin and ESA are shown for the 71 renal centres in the UK in tables 10.3 for HD and 10.4 for PD patients respectively.

Haemoglobin in prevalent haemodialysis patients

The median Hb of patients on HD in the UK was 112 g/L with an IQR of 103–121 g/L and 82% of HD patients had a Hb $\geqslant$100 g/L (table 10.3). The median Hb by centre is shown in figure 10.7. Compliance with the target range of Hb $\geqslant$100 and $\leqslant$120 g/L continues to increase year on year, 52.7% in 2010, 56.1% in 2011 and 57% in 2012 (figure 10.8). The percentages of HD patients with Hb below 100 g/L and above 120 g/L, as well as the percentages meeting the target, are shown by centre in figure 10.9.

Funnel plots are shown for the minimum (Hb $\geqslant$100 g/L) and target range (Hb $\geqslant$100 and $\leqslant$120 g/L) in figures 10.10 and 10.11 respectively. Many centres

Table 10.3. Summary statistics for haemoglobin, serum ferritin and ESA for prevalent HD patients in 2012

Centre	*N* with Hb data	Median Hb g/L	% Hb ⩾100 g/L	% Hb 100–120 g/L	Median ferritin μg/L	% ferritin ⩾100 μg/L	% ferritin >200 and ⩽500 μg/L	% on ESA	Median ESA dose (IU/week)	% with Hb ⩾100 g/L and not on ESA
England										
B Heart	401	108	70	52	333	94	57	77	6,667	21
B QEH	838	111	82	59	354	95	77	84	7,000	14
Basldn	147	108	67	47	339	93	72	91	6,000	6
Bradfd	186	112	78	52	497	95	39	96	6,500	4
Brightn	323	110	81	65	510	99	45			
Bristol	461	113	85	57	564	96	31	92	7,500	8
Camb	309	113	85	59	306	88	56			
Carlis	57	115	84	42	439	93	50	68	4,750	32
Carsh	660	111	84	70	375	95	63			
Chelms	121	118	93	50	631	100	22	97	10,000	3
Colchr	100	117	89	50	500	99	48			
Covnt	335	110	78	61	336	95	67	91	11,000	8
Derby	208	113	84	61	428	97	47			
Donc	158	111	77	53	401	99	59	91	6,500	9
Dorset	244	115	85	52	453	97	51	97	9,250	3
Dudley	153	111	76	50	333	95	70			
Exeter	351	112	83	62	265	90	62	93	7,500	6
Glouc	193	111	83	63	330	89	49	91		8
Hull	309	116	88	51	393	99	64			
Ipswi	124	111	80	55	611	98	28	65	7,500	29
Kent	361	113	86	59	445	93	38	91	8,250	7
L Barts	844	109	76	61	432	95	53			
L Guys	537	107	71	55	693	97	26			
L Kings	460	107	73	61	579	98	35			
L Rfree	576	112	84	58	425	91	41			
L St.G	263	111	80	59	458	97	47			
L West	1,314	117	91	54	477	99	50			
Leeds	454	110	78	57	499	95	39	94	4,000	5
Leic	799	113	83	54	337	95	63	98	6,190	1
Liv Ain	164	110	78	59	703	98	22			
Liv RI	343	118	83	41	475	92	35			
M RI	439	114	82	53	396	94	56			
Middlbr	307	112	79	56	676	94	22	78	5,000	18
Newc	262	116	84	50	424	95	43	69	11,025	28
Norwch	302	115	87	59	444	93	35	91	8,000	9
Nottm	354	113	84	62	582	99	24	90	7,500	10
Oxford	389	112	81	55	308	94	57	93	8,000	6
Plymth	119	112	83	60	752	97	22			
Ports	509	117	89	49	357	97	67			
Prestn	494	113	83	58	577	94	30	88		11
Redng	251	116	84	56	536	98	38	90		8
Salford	303	108	73	58				68	6,000	14
Sheff	562	112	79	54	488	96	45	86	7,500	11
Shrew	184	115	89	55	391	98	57	88		11
Stevng	376	114	86	60	521	97	37			
Sthend	107	111	82	66	313	98	72	97	9,000	3
Stoke	254	115	84	54	405	97	49			
Sund	183	111	81	56	615	95	26	95		5
Truro	133	111	83	66	460	97	52			
Wirral	173	112	82	62	537	98	35			
Wolve	269	115	86	53	473	96	44	85	6,750	14
York	122	110	75	57	414	97	69	93	4,000	6

Table 10.3. Continued

Centre	*N* with Hb data	Median Hb g/L	% Hb ⩾100 g/L	% Hb 100–120 g/L	Median ferritin µg/L	% ferritin ⩾100 µg/L	% ferritin >200 and ⩽500 µg/L	% on ESA	Median ESA dose (IU/week)	% with Hb ⩾100 g/L and not on ESA
N Ireland										
Antrim	126	115	88	60	469	98	52	92	6,000	7
Belfast	205	111	78	57	434	95	41	90	8,000	7
Newry	84	112	86	62				95	4,300	5
Ulster	101	113	86	61	677	99	20	93	5,875	6
West NI	126	111	79	61	640	93	17	92	8,000	8
Scotland										
Abrdn	213	108	69	50	634	99	32			
Airdrie	176	113	86	62	669	99	30			
D & Gall	48	108	85	67	648	96	23			
Dundee	170	113	82	64	289	84	47			
Dunfn	140	118	92	50	622	90	21			
Edinb	249	119	91	47	372	94	47			
Glasgw	573	115	85	53	437	96	44			
Inverns	73	116	97	59	426	98	57			
Klmarnk	141	113	82	52	332	91	54			
Wales										
Bangor	82	116	89	59	432	96	54	79	9,000	17
Cardff	447	112	83	58	301	94	64	61		33
Clwyd	76	113	89	61	358	100	68			
Swanse	308	112	85	66	386	94	45	91	7,500	8
Wrexm	86	113	87	58	485	97	43	92	5,000	8
England	**17,885**	**112**	**82**	**57**	**432**	**96**	**48**	**88**	**7,333**	**10**
N Ireland	**642**	**112**	**82**	**60**	**535**	**96**	**35**	**92**	**6,500**	**7**
Scotland	**1,783**	**114**	**85**	**54**	**448**	**94**	**40**			
Wales	**999**	**113**	**85**	**60**	**348**	**95**	**56**	**76**	**7,500**	**21**
UK	**21,309**	**112**	**82**	**57**	**431**	**95**	**48**	**87**	**7,248**	**11**

Blank cells denote centres excluded from analyses due to poor data completeness or low patient numbers or because the data item was not available
ESA data only shown for those centres for which the % on ESA was 60% or more
For ESA, the overall averages given are for E, W & NI not UK

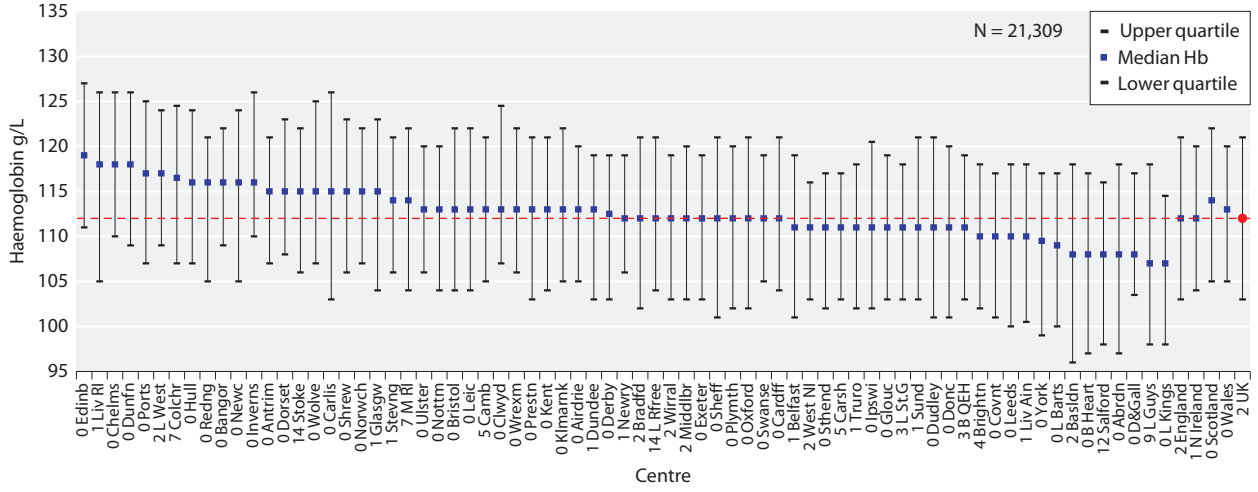

Fig. 10.7. Median haemoglobin in patients treated with HD by centre in 2012

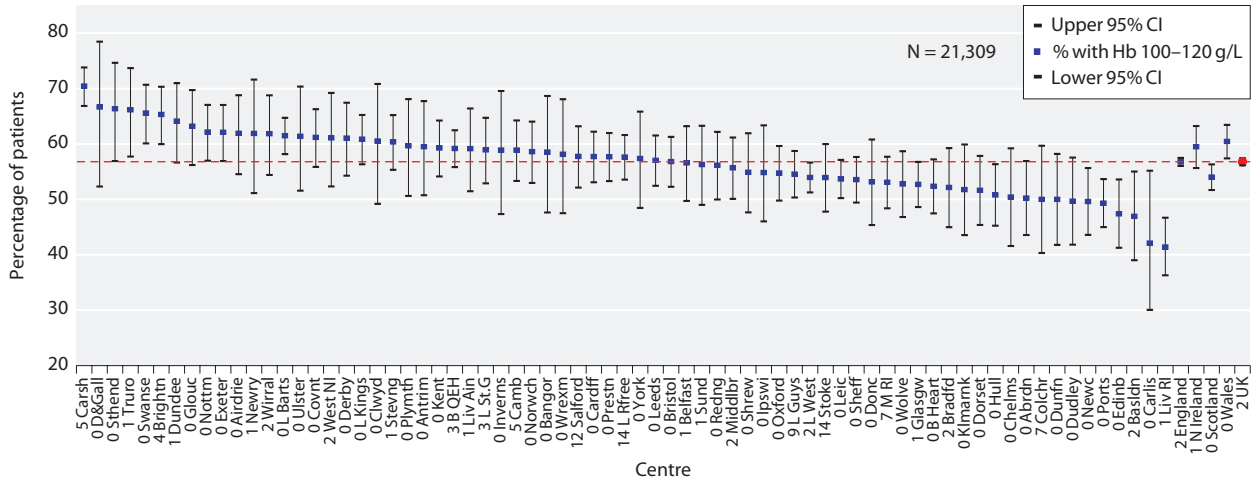

Fig. 10.8. Percentage of HD patients with Hb ⩾100 and ⩽120 g/L by centre in 2012

complied well with respect to both the minimum and target range Hb standards. Some centres complied well with the percentage with Hb ⩾100 g/L (figure 10.10) but had a poor compliance with percentage of patients with Hb ⩾100 and ⩽120 g/L (figure 10.11). This demonstrates that compliance with one standard can be achieved without compliance with another standard. Table 10.3 can be used in conjunction with figures 10.10 and 10.11 to identify centres.

Haemoglobin in prevalent peritoneal dialysis patients

Overall, 85% of patients on PD had a Hb ⩾100 g/L (table 10.4). The median Hb of patients on PD in the UK in 2012 was 114 g/L with an IQR of 105–123 g/L. The median Hb by centre is shown in figure 10.12. The compliance with Hb ⩾100 and ⩽120 g/L is shown in figure 10.13. In 2012, 55% of prevalent PD patients had a Hb within the target range. The distribution of Hb in PD patients by centre is shown in figure 10.14. The funnel plots for percentage with Hb ⩾100 g/L and for the percentage of patients with Hb ⩾100 and ⩽120 g/L are shown in figures 10.15 and 10.16 respectively. Table 10.4 can be used in conjunction with figures 10.15 and 10.16 to identify centres in the funnel plot.

Relationship between Hb in incident and prevalent dialysis patients in 2012

The relationship between the percentage of incident and prevalent dialysis (HD and PD) patients with a Hb ⩾100 g/L is shown in figure 10.17. As expected, all

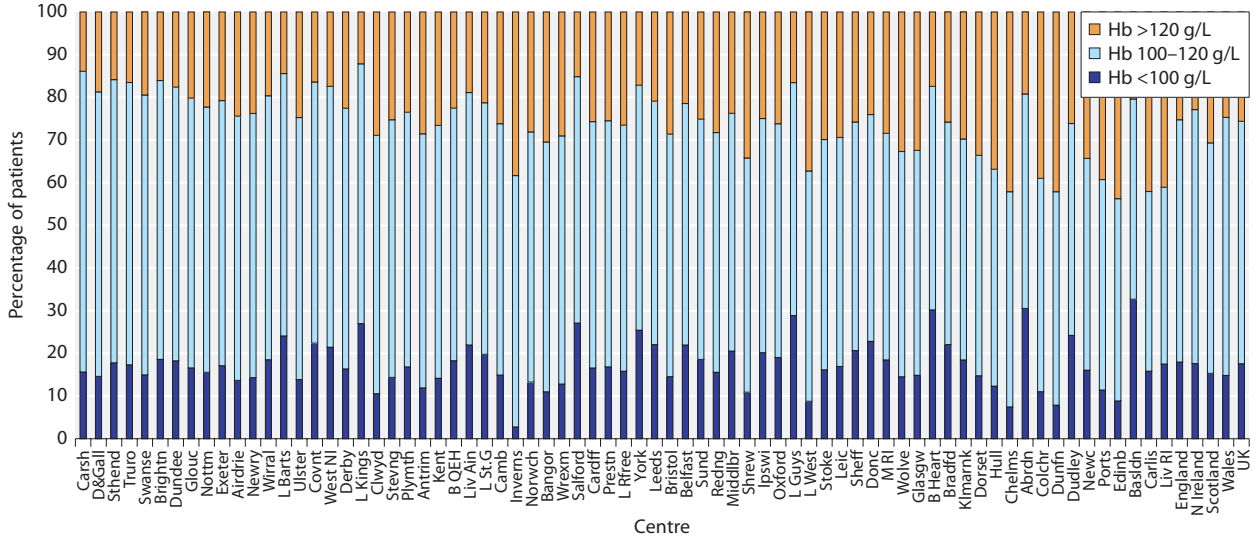

Fig. 10.9. Distribution of haemoglobin in patients treated with HD by centre in 2012

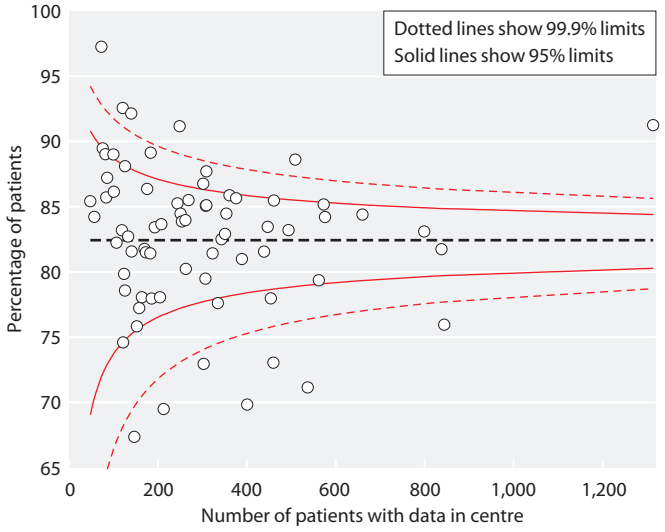

Fig. 10.10. Funnel plot of percentage of HD patients with Hb ⩾100 g/L by centre in 2012

centres had a higher percentage of prevalent patients achieving a Hb ⩾100 g/L than that for incident patients. Overall in the UK, 83% of prevalent patients, compared with 51% of incident patients, had a Hb ⩾100 g/L in 2012. Compliance with 'current' minimum standards by year (1998–2012) for incident and prevalent patients (all dialysis patients) is shown in figure 10.18. The decline in achieving this standard for incident and prevalent patients continues.

Ferritin in prevalent haemodialysis patients

The median and IQR for serum ferritin for patients treated with HD are shown in figure 10.19. The

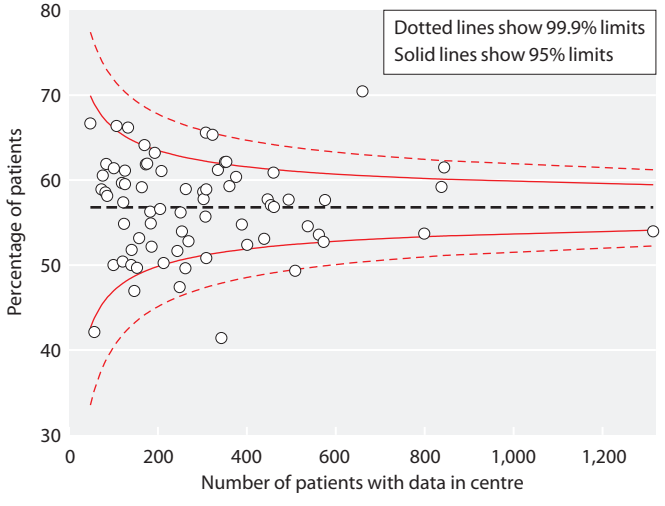

Fig. 10.11. Funnel plot of percentage of HD patients with Hb ⩾100 and ⩽120 g/L by centre in 2012

percentages with serum ferritin ⩾100 μg/L, >200 μg/L and ⩽500 μg/L, and ⩾800 μg/L are shown in figures 10.20, 10.21 and 10.22 respectively. Most centres achieved greater than 90% compliance with a serum ferritin ⩾100 μg/L for HD patients. The HD population had a median ferritin value of 431 μg/L, IQR 285–623. Seventeen of the 69 centres who had returns for ferritin had greater than 20% (21–47%) of their patients with ferritin ⩾800 μg/L (figure 10.22). The serum ferritin correlated poorly with median Hb achieved and ESA dose (table 10.3).

Ferritin in prevalent peritoneal dialysis patients

The median and IQR for serum ferritin for patients treated with PD are shown in figure 10.23. The percentages with serum ferritin ⩾100 μg/L, >100 μg/L and ⩽500 μg/L, and ⩾800 μg/L are shown in figures 10.24, 10.25 and 10.26 respectively. The PD population had a lower median ferritin value (285 μg/L, IQR 164–466) than the HD population. In 2012, 31 centres reported less than 90% of PD patients compliant with serum ferritin ⩾100 μg/L, although this had little bearing on their achieved median Hb or median ESA dose when compared with other centres (table 10.4).

Erythropoietin stimulating agents in prevalent haemodialysis patients

As shown in previous reports there was substantial variation in the average dose of ESA prescription used. The median dose for prevalent HD patients in England, Wales and Northern Ireland was 7,248 IU/week. The median dose varied from 4,000 IU/week (Leeds, York) to 11,025 IU/week (Newcastle) with a median Hb for these centres of 110 g/L (Leeds, York) and 116 g/L (Newcastle) (table 10.3). Over the last three years there has been a fall in the median ESA dose, 8000 IU in 2010, 7,450 IU in 2011 and 7,248 IU in 2012.

Erythropoietin stimulating agents in prevalent peritoneal dialysis patients

In 2012, the median dose was substantially lower in prevalent PD patients at 4,250 (range 2,231–9,500) IU/week (table 10.4) compared with HD patients.

ESA prescription and association with achieved haemoglobin

For HD patients, centre level median Hb is plotted against median ESA dose in figure 10.27 and compliance with the RA standards for Hb ⩾100 g/L and ⩽120 g/L is plotted against median ESA dose in figure 10.28. For these figures, Hb data was only used for those patients

Table 10.4. Summary statistics for haemoglobin, serum ferritin and ESA for prevalent PD patients in 2012

Centre	*N* with Hb data	Median Hb g/L	% Hb ⩾100 g/L	% Hb 100–120 g/L	Median ferritin μg/L	% ferritin ⩾100 μg/L	% ferritin >100 and ⩽500 μg/L	% on ESA	Median ESA dose (IU/week)	% with Hb ⩾100 g/L and not on ESA
England										
B Heart	42	114	86	57	182	85	73	48	6,000	50
B QEH	147	114	81	49	308	85	66	62	5,000	37
Basldn	28	112	71	46	189	82	68	61	3,750	39
Bradfd	24	111	83	58	302	88	54	83	4,000	17
Brightn	65	113	88	52	314	95	74			
Bristol	56	112	73	50	383	95	66	66	4,885	32
Camb	32	114	91	63	334	90	65	59	3,600	41
Carlis	21	116	95	62	346	95	65	67	4,125	33
Carsh	95	112	81	56	173	79	72			
Chelms	25	119	96	48	200	76	60	76	4,000	24
Colchr	n/a									
Covnt	81	114	89	62	257	84	72	68	8,000	30
Derby	84	114	81	52	341	94	63			
Donc	23	113	78	52	266	96	65	70	4,000	30
Dorset	36	120	92	44	347	94	61	68	2,900	31
Dudley	53	112	85	53	150	68	66			
Exeter	69	114	96	67	212	83	74	72	4,000	28
Glouc	31	114	84	58	173	75	71	55		35
Hull	77	114	84	48	295	99	75			
Ipswi	30	116	87	50	390	85	44	70	3,000	30
Kent	55	113	85	55	259	83	68	67	4,000	31
L Barts	165	113	78	44	307	89	63			
L Guys	26	112	81	58	207	81	73			
L Kings	76	110	84	58	219	83	77			
L Rfree	101	110	76	53	430	95	49			
L St.G	47	114	87	55	317	93	87			
L West	46	114	83	46	251	89	76			
Leeds	77	114	88	62	328	92	74	78	3,333	22
Leic	140	115	86	56	344	95	74	80	3,900	14
Liv Ain	17	112	76	53	434	100	59			
Liv RI	54	115	83	52	325	85	49			
M RI	76	116	84	54	174	83	70			
Middlbr	7									
Newc	32	114	88	50	426	97	50			
Norwch	48	117	96	58	131	68	53	71	3,725	29
Nottm	72	113	83	60	339	93	71	69	3,333	29
Oxford	69	113	80	55	179	87	76	81	6,000	16
Plymth	30	119	90	53	345	92	58			
Ports	78	119	95	53	310	96	72			
Prestn	59	115	85	58	339	83	54	75		25
Redng	63	116	87	54	378	92	65			
Salford	84	112	86	56				77	9,500	19
Sheff	67	113	85	60	538	97	42	60	5,292	39
Shrew	32	116	84	44	214	74	61	61	4,000	41
Stevng	27	109	78	59	196	75	63			
Sthend	14	117	93	57	241	100	100	57	7,500	43
Stoke	69	115	86	59	447	94	50			
Sund	17	117	82	41	570	94	25	65	2,231	29
Truro	19	114	89	63	268	100	82			
Wirral	23	113	87	57	497	94	44			
Wolve	83	116	88	51	244	76	54	63	4,000	36
York	27	109	81	59	170	88	73	70	4,000	30

Table 10.4. Continued

Centre	*N* with Hb data	Median Hb g/L	% Hb ⩾100 g/L	% Hb 100–120 g/L	Median ferritin µg/L	% ferritin ⩾100 µg/L	% ferritin >100 and ⩽500 µg/L	% on ESA	Median ESA dose (IU/week)	% with Hb ⩾100 g/L and not on ESA
N Ireland										
Antrim	10	115	100	70	239	80	60	80	3,833	20
Belfast	25	114	88	56	221	96	75	80	3,000	20
Newry	14	108	86	71	192	64	57	86	2,458	14
Ulster	6									
West NI	15	122	93	40	277	100	73	67	2,500	33
Scotland										
Abrdn	20	115	85	55						
Airdrie	10	113	90	70						
D & Gall	13	115	92	69						
Dundee	18	109	78	72						
Dunfn	19	118	84	42						
Edinb	35	113	86	60						
Glasgw	40	113	90	60						
Inverns	14	116	100	79						
Klmarnk	40	111	73	45						
Wales										
Bangor	14	117	86	43	179	57	50	50	4,000	50
Cardff	71	110	87	65	151	67	63			
Clwyd	15	108	73	53	238	86	64			
Swanse	54	111	87	69	328	85	63	78	4,500	22
Wrexm	20	121	85	35				55	8,000	40
England	**2,819**	**114**	**85**	**54**	**288**	**88**	**66**	**69**	**4,500**	**29**
N Ireland	**70**	**115**	**91**	**56**	**239**	**88**	**67**	**80**	**3,000**	**20**
Scotland	**209**	**114**	**85**	**58**						
Wales	**174**	**112**	**86**	**60**	**198**	**76**	**64**	**68**	**6,000**	**31**
UK	**3,272**	**114**	**85**	**55**	**285**	**88**	**65**	**69**	**4,250**	**29**

Blank cells denote centres excluded from analyses due to poor data completeness or low patient numbers or because the data item was not available
n/a – no PD patients
ESA data only shown for those centres for which the % on ESA was 45% or more
For ferritin and for ESA the overall averages given are for E, W & NI not UK

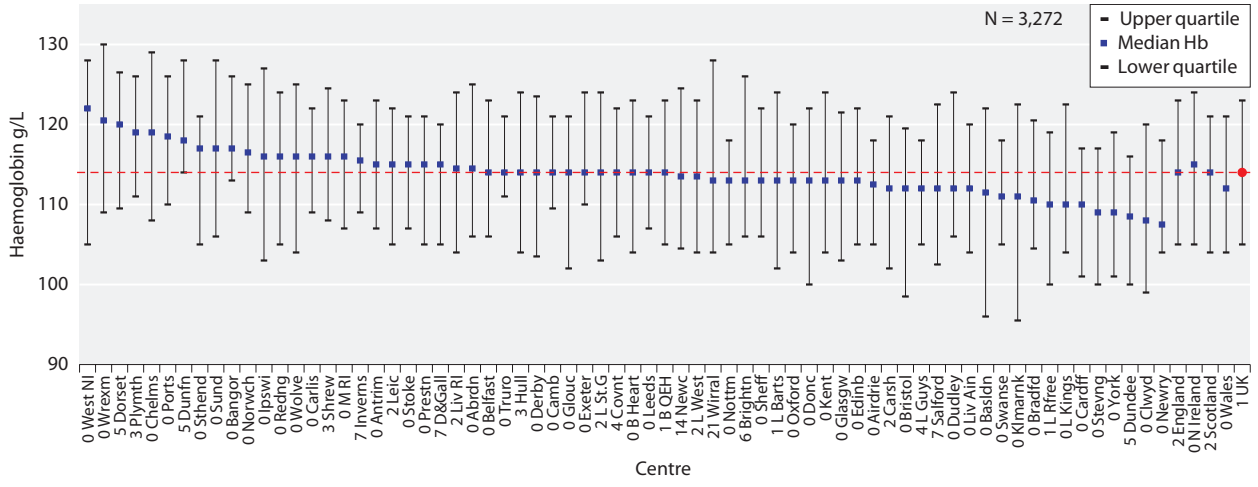

Fig. 10.12. Median haemoglobin in patients treated with PD by centre in 2012

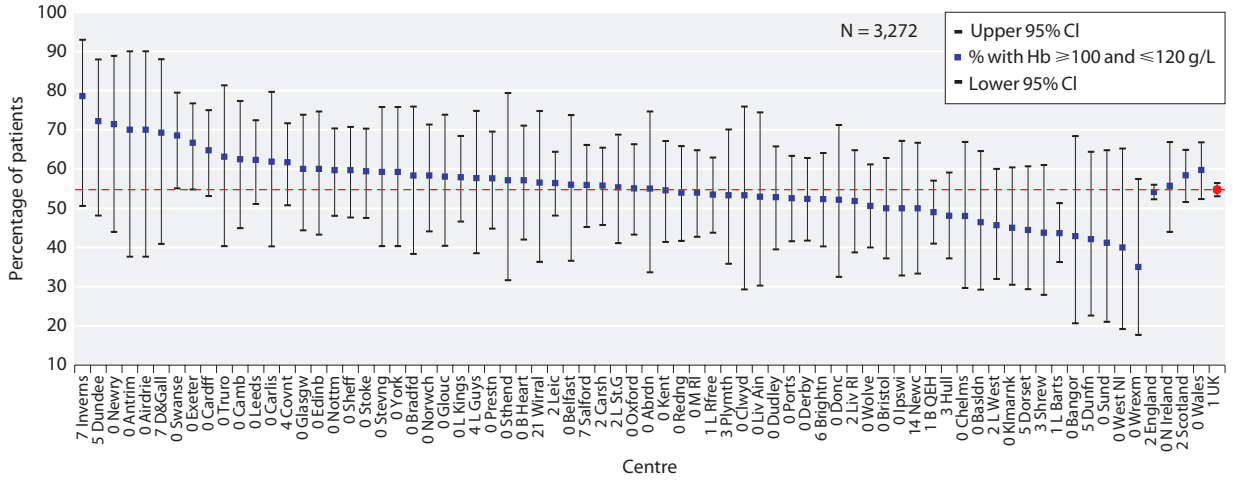

Fig. 10.13. Percentage of PD patients with Hb ⩾100 and ⩽120 g/L by centre in 2012

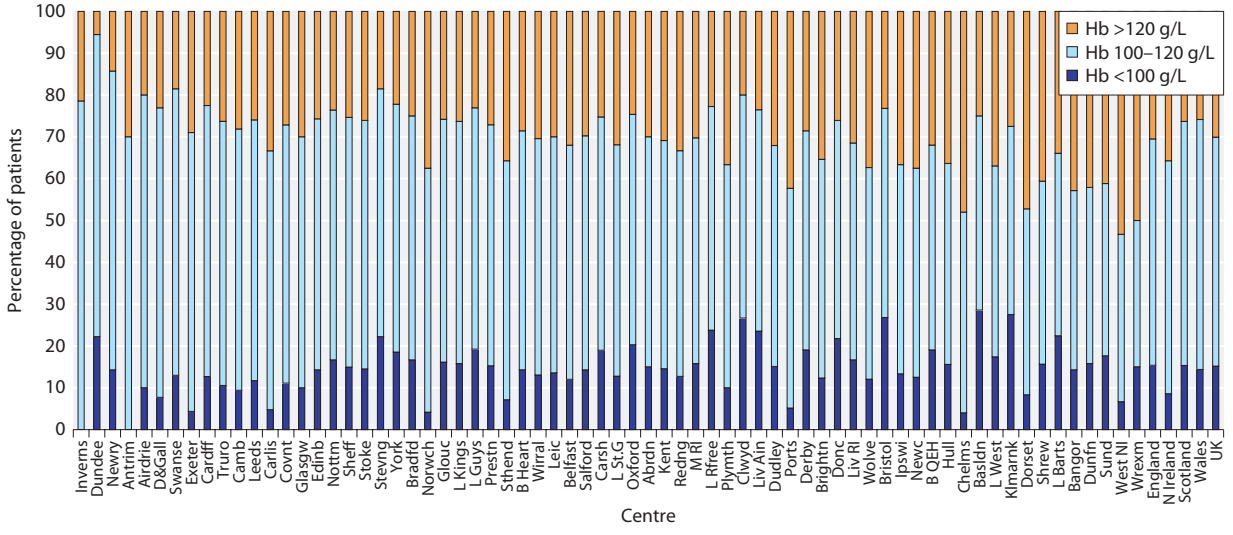

Fig. 10.14. Distribution of haemoglobin in patients treated with PD by centre in 2012

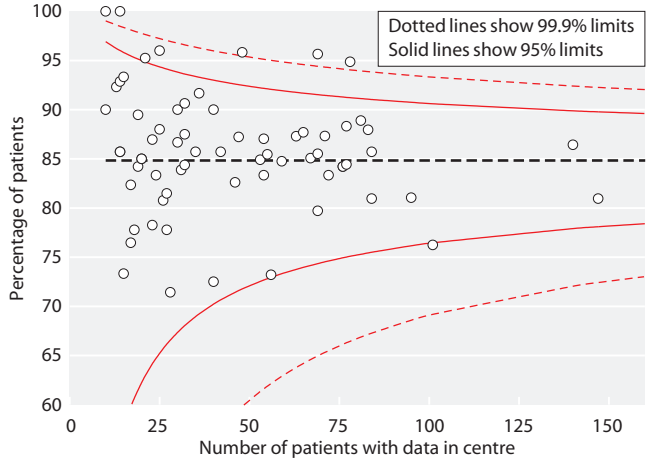

Fig. 10.15. Funnel plot of percentage of PD patients with Hb ⩾100 g/L by centre in 2012

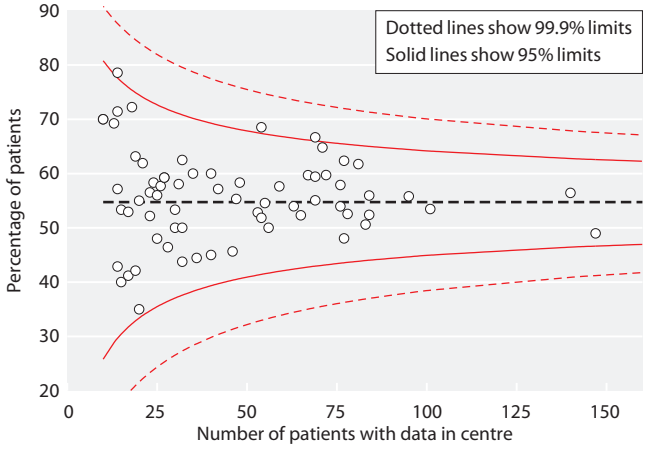

Fig. 10.16. Funnel plot of percentage of PD patients with Hb ⩾100 g/L and ⩽120 g/L by centre in 2012

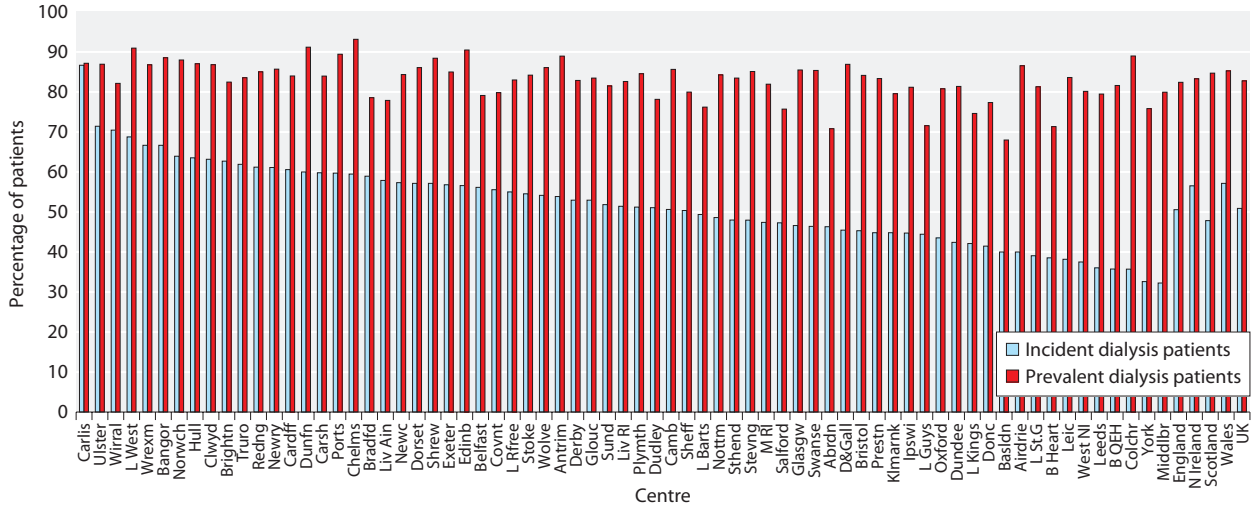

Fig. 10.17. Percentage of incident and prevalent dialysis patients with Hb ⩾100 g/L by centre in 2012

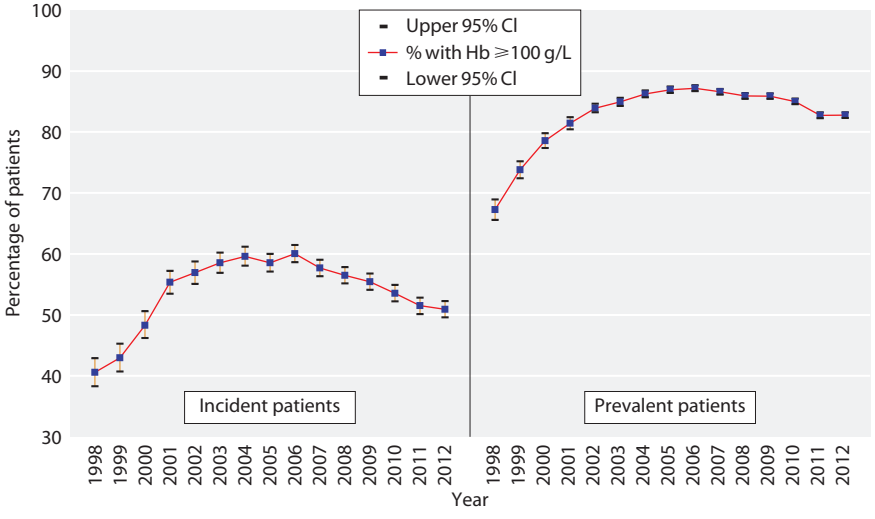

Fig. 10.18. Percentage of incident and prevalent dialysis patients (1998–2012) with Hb ⩾100 g/L

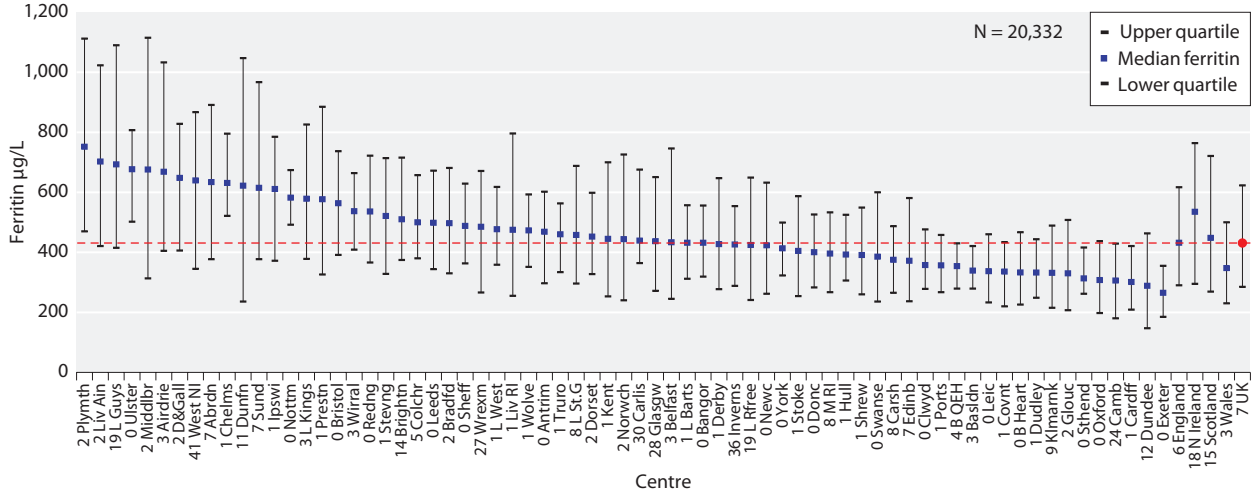

Fig. 10.19. Median ferritin in patients treated with HD by centre in 2012

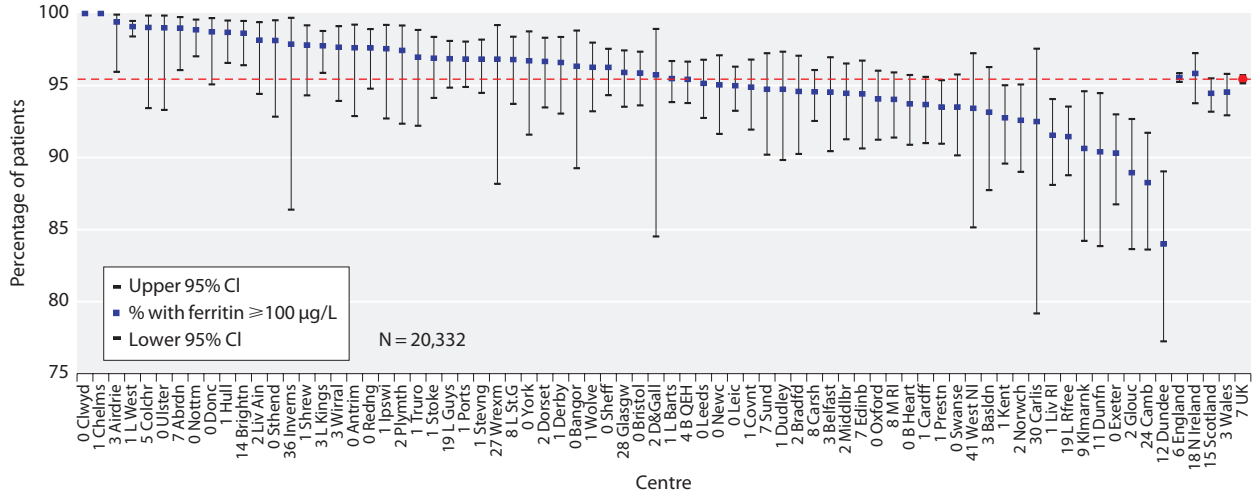

Fig. 10.20. Percentage of HD patients with ferritin ⩾100 µg/L by centre in 2012

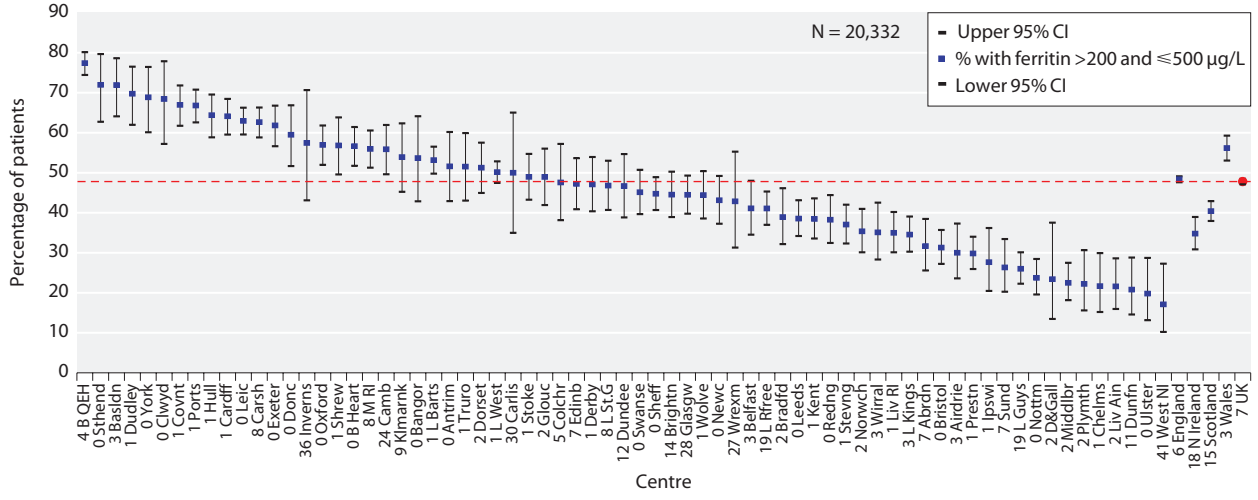

Fig. 10.21. Percentage of HD patients with ferritin >200 µg/L and ⩽500 µg/L by centre in 2012

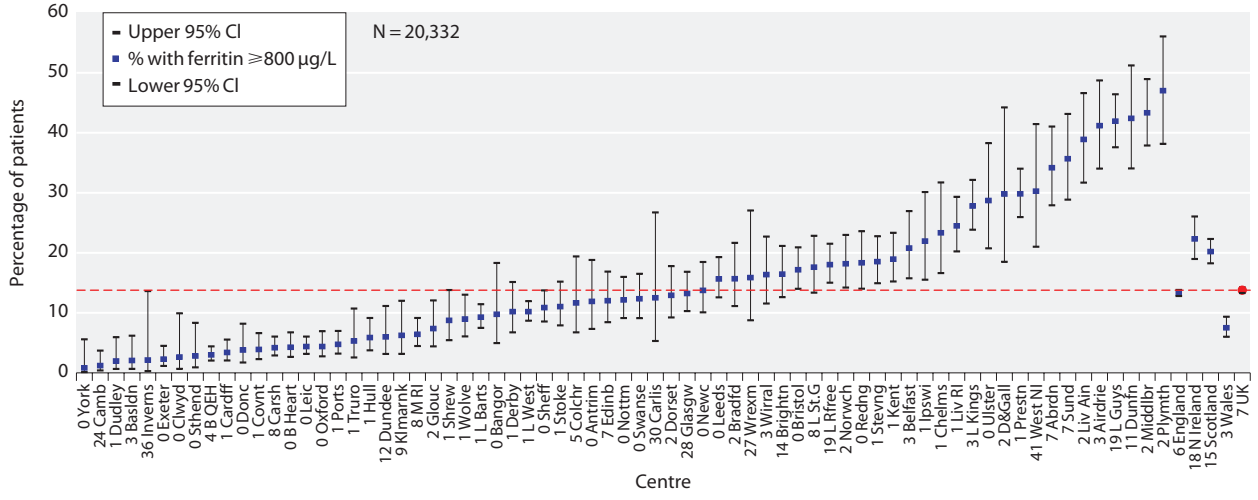

Fig. 10.22. Percentage of HD patients with ferritin ⩾800 µg/L by centre in 2012

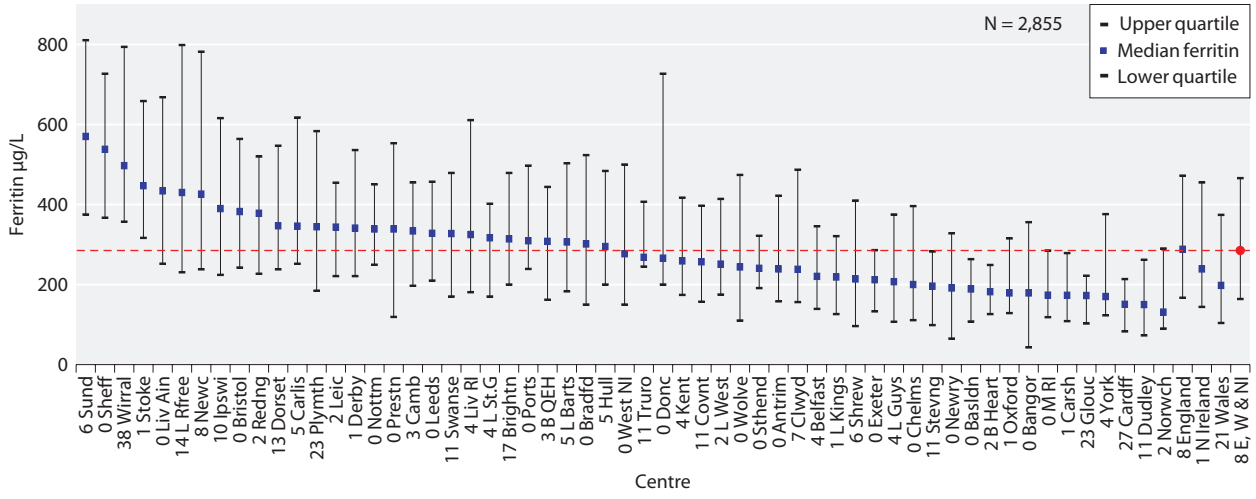

Fig. 10.23. Median ferritin in patients treated with PD by centre in 2012

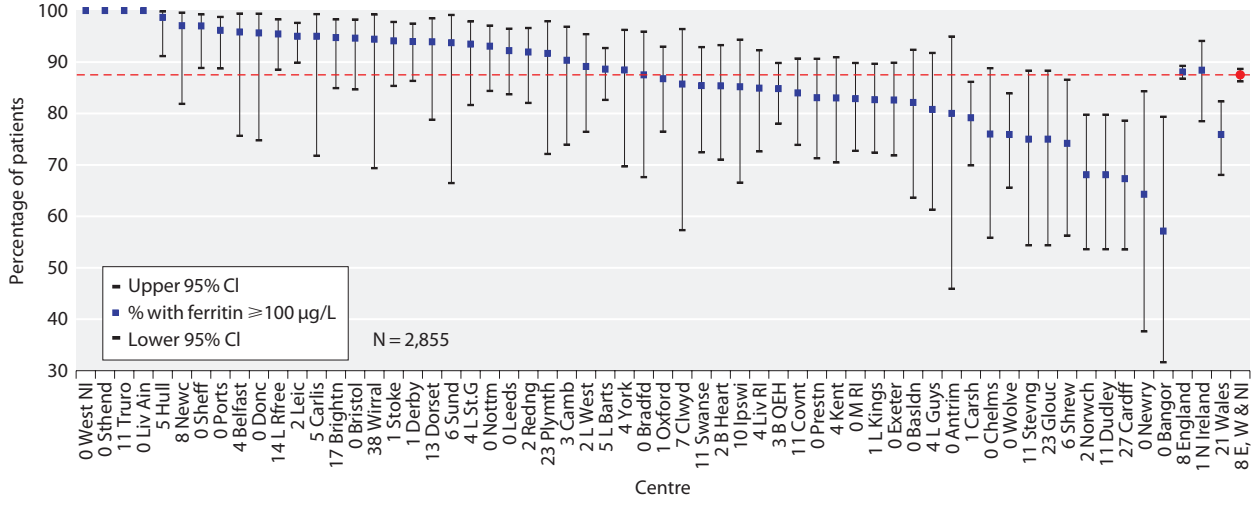

Fig. 10.24. Percentage of PD patients with ferritin ⩾100 µg/L by centre in 2012

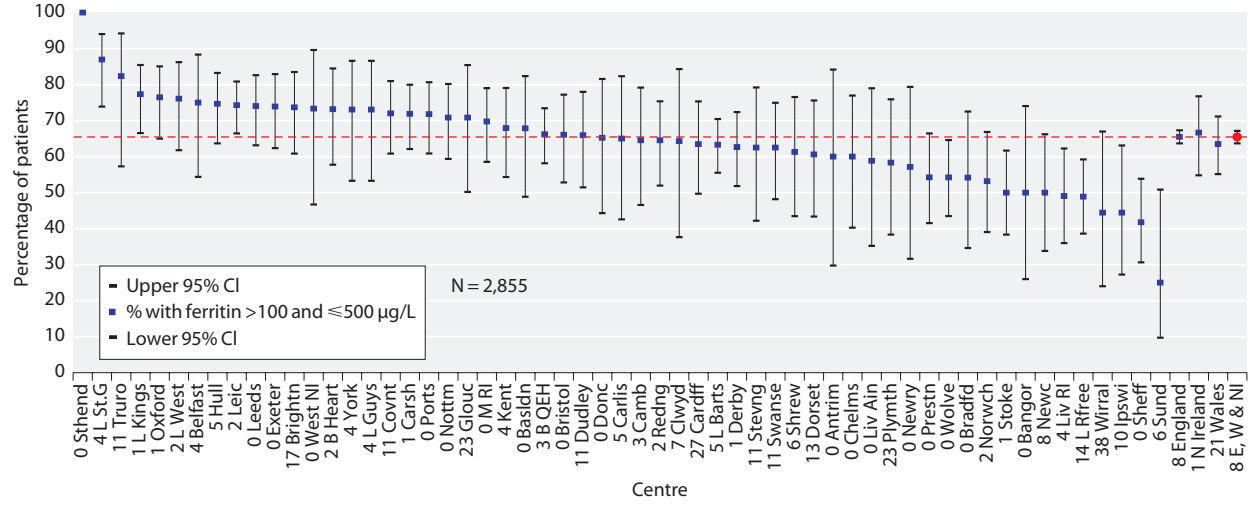

Fig. 10.25. Percentage of PD patients with ferritin >100 µg/L and ⩽500 µg/L by centre in 2012

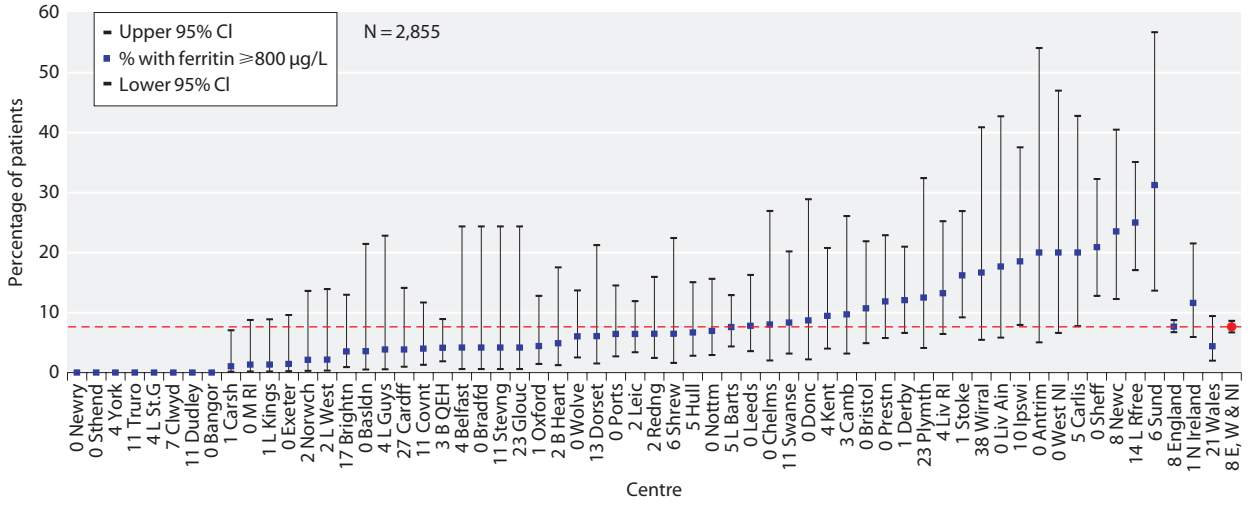

Fig. 10.26. Percentage of PD patients with ferritin ⩾800 µg/L by centre in 2012

who were receiving an ESA and had dose data available. There was no strong relationship in either figure.

It is known that not all patients treated with dialysis who have a Hb above 120 g/L are receiving ESA. It has been suggested that it may be inappropriate to include those patients not receiving ESA within the group not meeting this RA target. There are two reasons: firstly, the high Hb remains outside the control of the clinician, and secondly, the recent trials suggesting that it may be detrimental to achieve a high Hb in renal patients were based only upon patients treated with ESAs [13, 14].

Figures 10.29 and 10.30 show the percentages of HD and PD patients in each centre whose Hb lies above, within or below the RA guidelines of 100–120 g/L. These charts also show the proportion of patients with a Hb above the upper limit who were receiving, or were not receiving an ESA. These analyses are restricted to the centres with acceptable ESA returns as stipulated above. These figures show that 25% of HD patients had a Hb >120 g/L. Most of these patients (79%) were on ESAs. Whereas for PD, 30% of patients had a Hb >120 g/L, but only about 51% of these were on ESAs.

ESA prescription: age and modality associations

The proportion of patients on an ESA was higher for HD (87%) than PD (69%) and this difference was present and similar across all age groups (figure 10.31). The proportion of patients who maintained a Hb ⩾100 g/L without requiring ESA (by age group and modality) is shown in figure 10.32. This was highest in the 45–54 age group both for HD at 13.6% (95% CI: 12–15.5%) and PD at 33.8% (95% CI: 28–40%).

ESAs and time on renal replacement therapy

The percentage of patients on ESA by time on RRT and dialysis modality is shown in figure 10.33. This is a

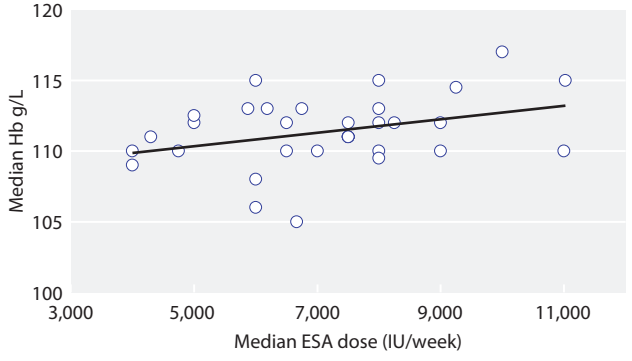

Fig. 10.27. Median Hb versus median ESA dose in HD patients on ESA, by centre in 2012

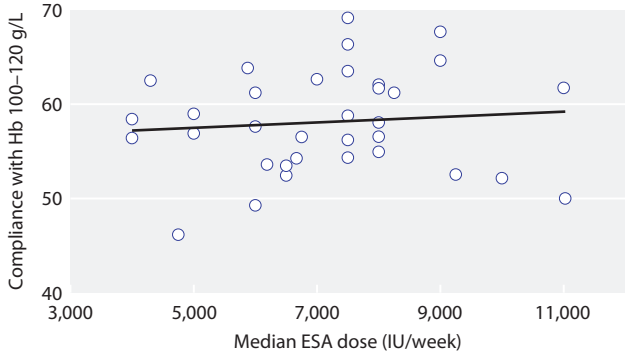

Fig. 10.28. Compliance with Hb 100–120 g/L versus median ESA dose in HD patients on ESA, by centre in 2012

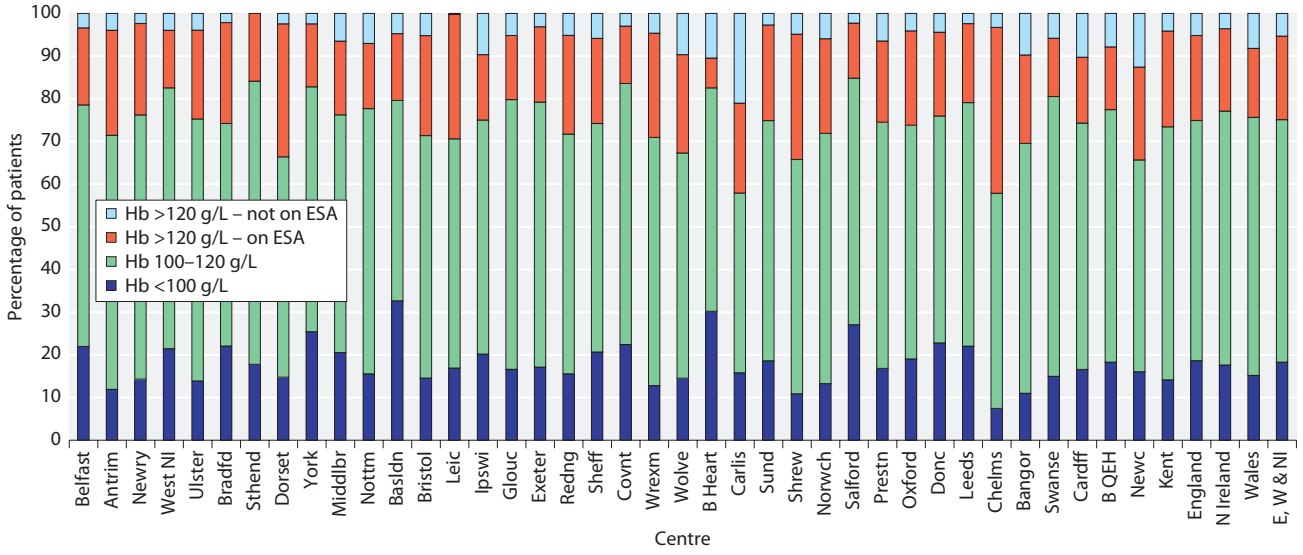

Fig. 10.29. Distribution of haemoglobin in patients treated with HD and the proportion of patients with Hb >120 g/L receiving ESA by centre in 2012

cross-sectional analysis at the final quarter of 2012. Patients who had previously changed RRT modality were included in this analysis. The proportion of PD patients requiring ESA rises with duration of RRT from 69% after 3–12 months, to 81% after 10 or more years. This almost certainly reflects 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 for any given duration on RRT.

Resistance to ESA therapy

Figure 10.34 shows the frequency distribution of weekly ESA dose by treatment modality adjusted for weight. Data regarding prevalence of ESA resistance in the literature in the ERF population is very sparse. RA guidelines define resistance to ESA therapy as '***failure to reach the target Hb level despite SC epoetin dose >300 IU/kg/week (450 IU/kg/week IV epoetin) or darbepoetin dose >1.5 mcg/kg/week'.*** For the purposes

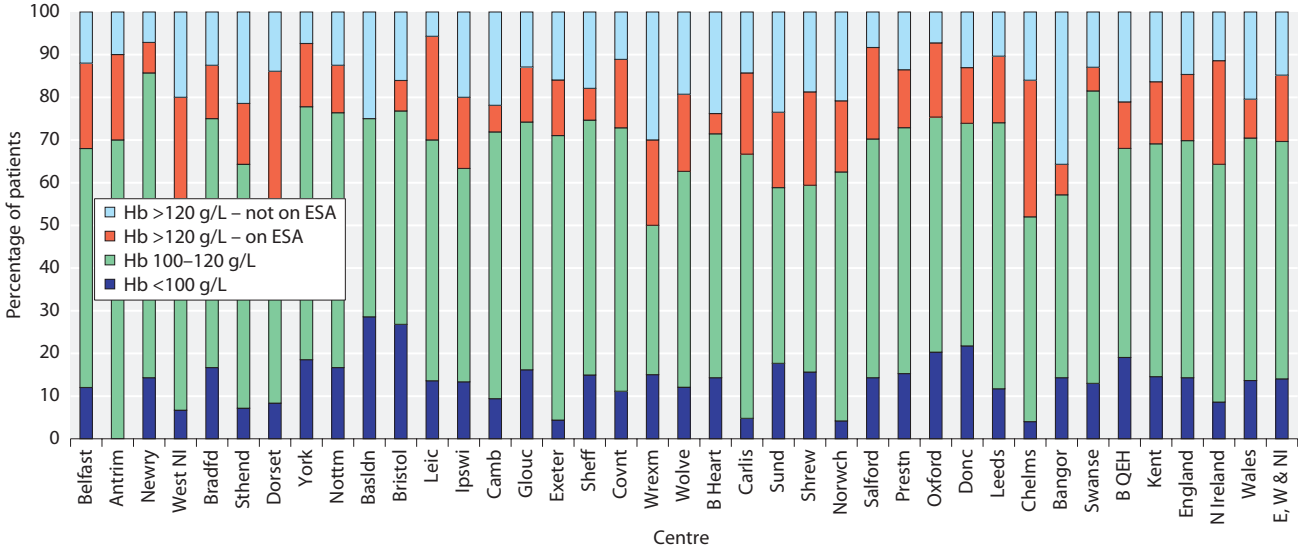

Fig. 10.30. Distribution of haemoglobin in patients treated with PD and the proportion of patients with Hb >120 g/L receiving ESA by centre in 2012

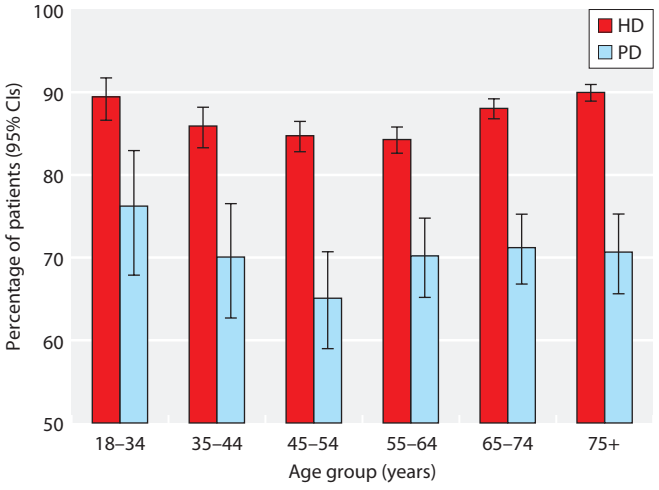

Fig. 10.31. Percentage of dialysis patients on ESA, by age group and treatment modality (2012)

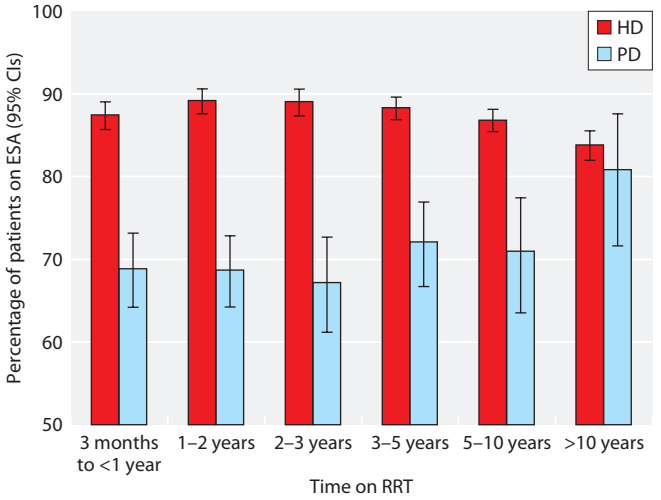

Fig. 10.33. Percentage of patients on ESA by time on RRT (2012)

of this analysis the centres were restricted to those with good completeness for weight (over 75%) and ESA dose data (33 centres for HD and 22 centres for PD). As per the above definition and assuming that HD patients largely receive ESA intravenously and PD patients receive ESA subcutaneously, the prevalence of high doses of ESA was 1.0% ($N = 72$) and 2.2% ($N = 12$) for HD and PD patients respectively. For these patients the dose range for HD was 453–772 IU/kg/week and for PD 312–535 IU/kg/week. For patients on HD with high ESA doses, 45% ($N = 32$) had Hb <100 g/L and 28% were within 100–120 g/L. For patients on PD with high ESA doses, 25% ($N = 3$) had a Hb <100 g/L and 67% were within 100–120 g/L. The percentage of patients with ESA resistance, defined by those failing to reach target Hb >100 g/L were 0.5% for HD and 0.6% for PD. Caution needs to be applied when interpreting these results as the numbers for the above calculations are small.

Success with guideline compliance

Compliance with current minimum standards by year (1998 to 2012) is shown in figure 10.35 for prevalent patients (by treatment modality).

The Renal Association guidelines state that centres should audit the '***Proportion of patients on renal replacement therapy with Hb level <100 g/L who are***

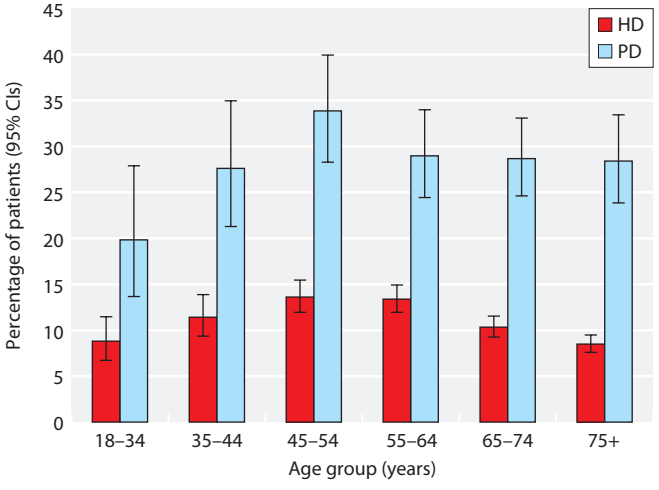

Fig. 10.32. Percentage of whole cohort (2012) who are not on ESA and have Hb ⩾100 g/L, by age group and treatment modality

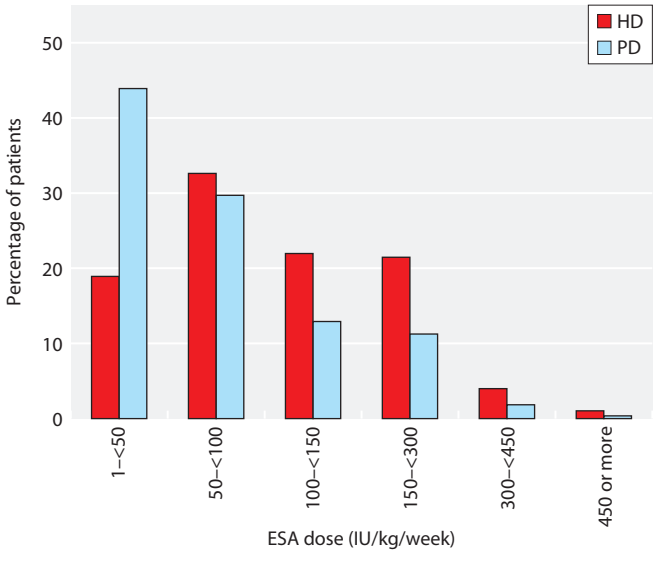

Fig. 10.34. Frequency distribution of mean weekly ESA dose corrected for weight in 2012

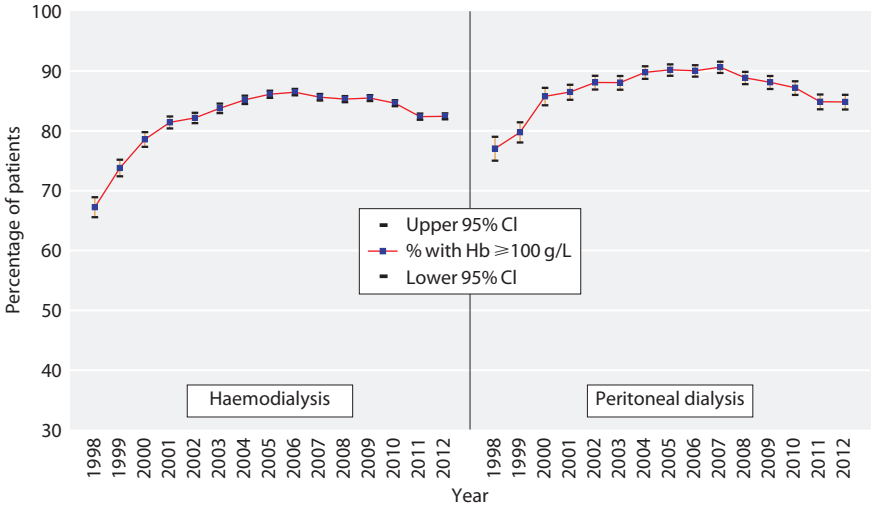

Fig. 10.35. Percentage of prevalent HD and PD patients (1998–2012) with Hb ⩾100 g/L

not prescribed an ESA'. Figure 10.36 shows the percentage of anaemic patients (Hb <100 g/L) receiving an ESA. A minority of patients had a Hb <100 g/L and were not receiving ESA therapy. Across the age groups this was between 7–10% for HD patients and 2–13% for PD patients. There are several potential explanations for this. Treatment with ESA may have been stopped in patients who were unresponsive or avoided in those with malignancy. Others may have been on ESA treatment but not had it recorded.

The Renal Association guideline states that centres should audit the '***Proportion of patients with serum ferritin levels <100 µg/L treated with an ESA'*** & '***The proportion of patients treated with an ESA with Hb >120 g/L'.*** Table 10.5 shows that the percentage of all patients treated with an ESA and having Hb >120 g/L ranged between 7–39% for HD and between 0–33% for PD. For HD, there was a small percentage of patients having ferritin levels <100 µg/L and being on an ESA (0–7%). The percentages were somewhat higher for PD (0–21%).

Renal Association guidelines state that '***Each renal unit should audit the type, route and frequency of administration and weekly dose of ESA prescribed'***. Table 10.6 shows the percentage completeness for type, route and frequency of administration for centres ($N = 40$) reporting ESA data. The completeness was generally good for drug type and dose but patchy for frequency and route of administration.

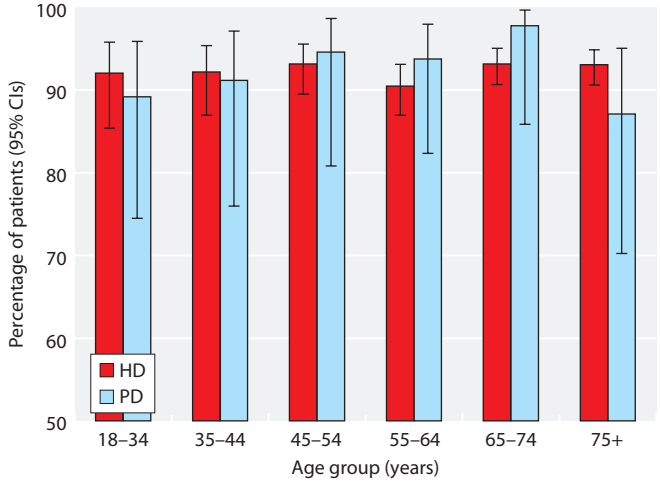

Fig. 10.36. Percentage of patients with Hb <100 g/L who were on ESA, by age group and treatment modality (2012)

Discussion

Anaemia is one of the major problems that contribute to high comorbidity and poor outcome in dialysis patients. Since the introduction of human recombinant erythropoietin for treating CKD-related anaemia over two decades ago, attention has shifted from treating severe anaemia in dialysis patients to preventing anaemia pre-dialysis and to correcting anaemia within defined target limits. Renal centres strive to meet the Renal Association standards in order to prevent adverse outcomes associated with low Hb such as impaired quality of life, increased hospitalisation, increased cardiovascular events and increased cardiovascular and all-cause mortality.

Table 10.5. Percentage of patients with serum ferritin levels <100 μg/L and on ESA and percentage of patients with Hb >120 g/L and on ESA by modality

	HD		PD	
Centre	% with Hb >120 g/L and on ESA	% with ferr <100 μg/L and on ESA	% with Hb >120 g/L and on ESA	% with ferr <100 μg/L and on ESA
England				
B Heart	7	1	5	6
B QEH	15	1	11	5
Basldn	16	6	0	4
Bradfd	24	4	13	5
Bristol	23	3	7	0
Camb			6	4
Carlis	21	4	19	6
Chelms	39	0	32	13
Covnt	13	3	16	6
Donc	20	0	13	0
Dorset	31	2	33	0
Exeter	18	7	13	7
Glouc	15	7	13	15
Ipswi	15	1	17	12
Kent	22	6	15	8
Leeds	19	2	16	4
Leic	29	5	24	2
Middlbr	17	3		
Newc	22	2		
Norwch	22	5	17	20
Nottm	15	0	11	1
Oxford	22	5	17	5
Prestn	19	2	14	14
Redng	23	2		
Salford	13		21	
Sheff	20	1	7	0
Shrew	29	2	22	10
Sthend	16	2	14	0
Sund	22	5	18	0
Wolve	23	1	18	14
York	15	1	15	4
N Ireland				
Antrim	25	1	20	10
Belfast	18	4	20	0
Newry	21		7	21
Ulster	21	1		
West NI	13	4	33	0
Wales				
Bangor	21	1	7	7
Cardff	15	3		
Swanse	14	2	6	6
Wrexm	24	2	20	
England	**20**	**3**	**16**	**6**
N Ireland	**19**	**3**	**24**	**7**
Wales	**16**	**3**	**9**	**5**
E, W & NI	**20**	**3**	**16**	**6**

Blank cells denote centres excluded from analyses due to poor completeness or small numbers with data

Table 10.6. Percentage completeness for type, dose, route and frequency of administration of ESA

	HD					PD				
Centre	*N* on ESA	% with drug type	% with dose	% with frequency	% with administration route	*N* on ESA	% with drug type	% with dose	% with frequency	% with administration route
England										
B Heart	307	100	100	0	0	20	100	100	0	0
B QEH	726	100	100	100	0	92	100	100	100	0
Basldn	137	100	99	100	100	17	100	100	100	100
Bradfd	181	100	91	0	0	20	100	100	0	0
Bristol	422	100	100	0	0	37	100	100	0	0
Camb						19	100	100	0	0
Carlis	39	100	100	0	0	14	100	100	0	0
Chelms	117	100	100	100	100	19	100	100	100	100
Covnt	305	100	99	0	0	57	100	98	0	0
Donc	144	100	100	100	100	16	100	100	100	94
Dorset	236	100	100	97	100	26	100	100	100	100
Exeter	327	100	100	0	0	50	100	100	0	0
Glouc	175	100	0	0	0	17	100	0	0	0
Ipswi	81	100	100	0	0	21	100	100	0	0
Kent	330	100	100	100	100	37	100	100	100	100
Leeds	427	100	90	0	0	60	100	100	0	0
Leic	782	100	98	0	0	115	100	93	0	0
Middlbr	242	100	100	0	0	6	100	100	0	0
Newc	180	100	100	0	0					
Norwch	275	100	100	100	100	34	100	100	97	100
Nottm	318	100	99	0	0	50	100	80	0	0
Oxford	360	100	100	0	0	56	100	100	0	0
Prestn	435	100	8	0	0	44	100	0	0	0
Redng	227	100	0	0	0					
Salford	236	100	97	100	0	69	100	96	100	0
Sheff	486	100	100	0	0	40	100	100	0	0
Shrew	162	100	99	87	94	20	100	100	100	100
Sthend	104	100	95	0	0	8	100	75	0	0
Sund	174	100	28	0	0	11	100	100	0	0
Wolve	230	100	100	0	0	52	100	100	0	0
York	113	100	100	0	0	19	100	100	0	0
N Ireland										
Antrim	116	100	100	100	100	8	100	100	100	100
Belfast	187	100	100	99	100	20	100	100	100	100
Newry	81	100	100	93	100	12	100	100	100	92
Ulster	94	100	100	100	100	6	100	100	100	100
West NI	119	100	100	98	100	10	100	100	100	100
Wales										
Bangor	65	100	96	0	0	7	100	100	0	0
Cardff	273	100	0	0	0					
Swanse	282	100	100	100	99	42	100	98	100	98
Wrexm	78	100	99	99	100	11	100	92	83	100
England	**8,278**	**100**	**88**	**28**	**17**	**1,046**	**100**	**92**	**31**	**16**
N Ireland	**597**	**100**	**100**	**98**	**100**	**56**	**100**	**100**	**100**	**98**
Wales	**698**	**100**	**61**	**51**	**51**	**60**	**100**	**97**	**85**	**87**
E, W & NI	**9,573**	**100**	**86**	**34**	**24**	**1,162**	**100**	**93**	**37**	**24**

Blank cells denote centres excluded from analyses due to poor completeness or small numbers with data

Haemoglobin outcomes for patients on HD and PD in the UK were largely compliant with the RA minimum standard of Hb $\geqslant$100 g/L (82% and 85% respectively). As would be anticipated, a greater proportion of prevalent patients (83%) than incident patients (51%) had a Hb $\geqslant$100 g/L in 2012. In the UK, the median Hb of patients on HD was 112 g/L with an IQR of 103–121 g/L, and the median Hb of patients on PD was 114 g/L with an IQR of 105–123 g/L.

Compliance with advice regarding iron stores as reflected by ferritin remained stable in the UK with 95% of HD patients and 88% of PD patients achieving a serum ferritin greater than 100 μg/L.

The analysis of ESA usage is limited by incomplete data returns. From the available data, 87% of HD patients and 69% of PD patients were on ESA treatment in England, Wales and Northern Ireland. The percentage of patients treated with an ESA and having Hb >120 g/L ranged between centres from 7–39% for HD and from 0–33% for PD. There was a small percentage of patients with ferritin levels <100 μg/L and receiving an ESA. There was substantial variation between centres in the average dose of ESA prescribed. Attainment of Hb targets correlates poorly with median ferritin and ESA usage.

Resistance to ESA has consistently been shown to be associated with an increased risk of death and cardiovascular events in CKD patients [14–17]. There is for the first time an attempt to describe the prevalence of ESA resistance in the UK and this was 0.5% and 0.6% for HD and PD patients respectively. Bearing in mind the limitations of relatively small numbers involved in the calculations, one possible reason that could explain the low prevalence is that this group of patients have poor survival. This again emphasises the need for better data returns and with improved completeness future analysis could look into whether this translates to poor patient outcomes for the UK dialysis population.

Conflicts of interest: none

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