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UK Renal Registry 20th Annual Report: Chapter 7 Haemoglobin, Ferritin and Erythropoietin in UK Adult Dialysis Patients in 2016: National and Centre-specific Analyses

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Keywords

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

Summary

In the UK in 2016:

- The median haemoglobin (Hb) of patients at the time of starting dialysis was 99 g/L with 47% of patients having a Hb ⩾100 g/L.
- The median Hb in patients starting haemodialysis (HD) was 96 g/L (IQR 87–105) and in patients starting peritoneal dialysis (PD) was 108 g/L (IQR 98–116).
- At the start of dialysis, 50% of patients presenting early had Hb ⩾100 g/L compared with only 34% of patients presenting late.
- The median Hb of prevalent patients on HD was 111 g/L (IQR 102–119).
- The median Hb of prevalent patients on PD was 111 g/L (IQR 102–120).
- 80% of prevalent HD patients and 79% of PD patients had Hb ⩾100 g/L.
- 59% of prevalent HD patients and 55% of PD patients had Hb ⩾100 and ⩽120 g/L.
- The median serum ferritin in HD patients was 410 μg/L and 94% of HD patients had a ferritin ⩾100 μg/L.
- The median serum ferritin in PD patients was 306 μg/L and 88% of PD patients had a ferritin ⩾100 μg/L.

In England, Wales and Northern Ireland in 2016:

- The median erythropoiesis stimulating agent (ESA) dose in HD patients was 7,750 IU/week.
- The median ESA dose in PD patients was 4,500 IU/week.

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Introduction

Anaemia is a common complication of chronic kidney disease (CKD). It is associated with morbidity and mortality as well as reduced exercise tolerance and quality of life. Iron therapies and erythropoiesis stimulating agents (ESAs) remain the mainstay of the management of patients with renal anaemia, minimising the need for blood transfusions. This chapter describes analyses of the management of anaemia in dialysis patients in the UK in 2016. The attainment of parameters is compared at a renal centre and national level as well as against national performance measures as set out in the Renal Association (RA) practice guidelines which are published online.

The audit measures applied to the care of dialysis patients in 2016 and recommended in this chapter are taken from the Renal Association Clinical Practice Guideline for Anaemia of CKD (5th edition) published online in 2010 [1]. Table 7.1 lists the audit measures recommended in these guidelines alongside those parameters measured in this chapter and where applicable reasons for exclusion.

In mid-2017, an updated 6th edition of the Renal Association guideline was published [2] which endorses the National Institute for Health and Care Excellence (NICE) guideline for anaemia management in chronic kidney disease 2015 [3]. The recommended haemoglobin targets remain the same although the indices for assessing patient iron status have changed. Specifically, percentage hypochromic red blood cells (HRC) or reticulocyte haemoglobin content (CHr) are recommended as preferable markers of iron deficiency to serum ferritin or transferrin saturation. The impact this will have on both clinical

Table 7.1. Summary of recommended Renal Association audit measures

RA audit measure	Included in UKRR annual report?	Reason for exclusion
1. Proportion of CKD patients with eGFR <30 ml/min by 4 variable MDRD method with an annual Hb level	No	Data not available for the period covered by this report
2. Proportion of patients starting an ESA without prior measurement of serum ferritin and/or TSAT	No	UKRR does not know when all patients start ESA treatment. UKRR does not collect TSAT data
3. Proportion of patients on renal replacement therapy with Hb level <10 who are not prescribed an ESA	Yes	
4. Each renal unit should audit the type, route and frequency of administration and weekly dose of ESA prescribed	Partly	UKRR reports the completeness of these data items
5. The proportion of CKD stage 4–5 patients with Hb 10–12 g/dl	No	Data not available for the period covered by this report
6. The proportion of patients treated with an ESA with Hb >12 g/dl	Yes	
7. Each renal unit should monitor ESA dose adjustments	No	UKRR does not collect this data
8. Proportion of patients with serum ferritin levels <100 ng/ml at start of treatment with ESA	No	UKRR does not know when all patients start ESA treatment
9. Proportion of pre-dialysis and PD patients receiving iron therapy; type: oral vs parenteral	No	Data not available for the period covered by this report/poor data completeness
10. Proportion of HD patients receiving IV iron	No	Poor data completeness
11. Prevalence of resistance to ESA among renal replacement therapy patients	Yes	
12. Proportion of HD patients who received a blood transfusion within the past year	No	Data held at NHS Blood and Transplant

practice and centre reporting through the UKRR remains to be seen. The guidelines acknowledge the practical challenges of measuring HRC due to the need for timely testing on specialist analysers. CHr does not currently form part of the UKRR renal dataset and further work will be undertaken by the UKRR in collaboration with renal centres to explore the ability to report this variable. Internationally, The Kidney Disease Improving Global Outcomes (KDIGO) Clinical Practice Guideline for Anemia in Chronic Kidney Disease was published in August 2012 [4] and is yet to be updated.

Methods

Most of the analyses in this chapter use the incident or prevalent renal replacement therapy (RRT) cohorts for 2016. Some analyses use data from earlier years. Haemoglobin levels are given in g/L as the majority of UK laboratories have now switched to reporting using these units rather than g/dl.

The UKRR extracted quarterly data electronically from renal centres in England, Wales and Northern Ireland (E,W & NI) taking the latest available result from each quarter. Data from Scotland were provided by the Scottish Renal Registry (SRR).

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 data could be from zero to 90 days later. Due to possible deficiencies with extract routines it is possible that a small number of the values extracted electronically may actually be from before the person started dialysis. This problem will not occur for Scottish data. 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 these analyses only centres with at least 75% completeness of presentation time data were included.

For the analyses of prevalent dialysis patients those patients receiving dialysis on 31 December 2016 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 was used for Hb and from the last three quarters for ferritin.

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 level results. Centres providing relevant data from less than ten patients were also excluded from the plots. The number preceding the centre name in the caterpillar plots is the percentage of patients who have data missing.

Summary statistics including minimum, maximum, interquartile ranges (IQR), averages (mean and median) and standard deviations were calculated. The median values and the IQRs are shown using caterpillar plots. The percentages achieving standards were also calculated and 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 targets and also whether any of the centres were significantly different from the average. Longitudinal analyses were performed to show overall changes in achievement of standards over time.

Erythropoietin data from the last quarter of 2016 were used to define which patients were receiving erythropoietin stimulating agents (ESAs). Scotland was excluded from this analysis due to incomplete data. 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 40% 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 was 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 (assumed to be darbepoietin or methoxy polyethylene glycol–epoetin beta) were harmonised with erythropoietin data by calculating a weekly dose and 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). Many centres provided data on ESA dose but not on ESA frequency. The ESA dose field is defined as the weekly dose and the dose is presumed to have been converted accordingly on submission to the UKRR. This may be an incorrect assumption for a number of patients and this needs to be considered when interpreting the ESA information.

Starting with the cohort of patients receiving ESAs in the final quarter of the year 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 was indirect. The three centres in North Wales, namely Wrexham, Bangor and Clwyd used several databases including their renal IT system for ESA data in HD patients and were therefore excluded from the HD ESA analysis.

Cambridge renal centre (Addenbrooke's) was unable to submit their 2016 (and 2015) data at patient level prior to the UKRR closing the database and only provided summary numbers of patients starting RRT by treatment modality. This centre is therefore excluded from most analyses in this chapter.

The data were analysed using SAS 9.3.

Table 7.2. Haemoglobin data for incident patients starting RRT on haemodialysis or peritoneal dialysis during 2016, both overall and by presentation time

	All incident dialysis patients				Early presenters (⩾90 days)		Late presenters (<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	119	96	40	96	42		
B QEH	98	190	99	48	100	51	93	41
Basldn	100	35	95	31	97	37		
Bradfd	88	64	99	48	99	48		
Brightn	100	135	101	51	102	54	97	43
Bristol	100	134	103	72				
Camb	n/a	n/a						
Carlis	100	33	101	55	103	64		
Carsh	100	225	100	51				
Chelms	98	49	102	53	107	64		
Colchr	54	15	95	40				
Covnt	98	101	97	42	96	39	100	50
Derby	99	76	104	57	106	59	97	40
Donc	97	57	97	46	100	53		
Dorset	98	61	100	54	103	61	87	30
Dudley	98	49	94	39	96	41		
Exeter	100	124	103	72	103	75	101	55
Glouc	98	58	101	53	102	58		
Hull	87	74	98	43	99	48		
Ipswi	97	35	95	40				
Kent	100	121	98	45	98	44	101	55
L Barts	100	257	96	38				
L Guys	99	142	91	30	92	32	88	19
L Kings	96	133	97	46	99	49	89	28
L Rfree	98	191	97	46	98	48	91	38
L St.G	77	58	98	47				
L West	89	306	100	50	100	50	100	50
Leeds	90	115	94	32				
Leic	100	254	96	39	98	44	91	24
Liv Ain	96	47	97	47	101	51		
Liv Roy	100	94	102	56	103	61	95	43
M RI	99	167	95	40	97	45	90	24
Middlbr	99	89	96	43	98	44	87	38
Newc	99	109	96	37	96	39	93	21
Norwch	100	86	94	37				
Nottm	96	92	94	40	96	44	85	26
Oxford	99	169	97	44	98	46	92	33
Plymth	98	45	101	56	101	58		
Ports	100	161	102	60				
Prestn	99	115	99	49	100	51	95	40
Redng	100	76	99	46	100	50		
Salford	98	132	99	48				
Sheff	100	137	97	42	98	46	93	29
Shrew	100	54	106	63	107	65	103	55
Stevng	99	144	97	42	98	47	90	25
Sthend	100	43	105	63	105	64		
Stoke	97	87	103	59	103	60		
Sund	99	88	99	49	103	53		
Truro	100	45	103	56	104	59		
Wirral	97	59	101	56	101	54	101	55
Wolve	93	55	102	55	102	53		
York	94	60	95	42	97	45	85	31

Table 7.2. Continued

Centre	All incident dialysis patients				Early presenters (⩾90 days)		Late presenters (<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	95	36	97	39	98	45		
Belfast	99	68	102	62	107	68		
Newry	95	21	99	48	99	44		
Ulster	100	27	102	63	102	68		
West NI	100	34	105	65	104	66		
Scotland								
Abrdn	90	44	98	41				
Airdrie	60	36	93	33				
D&Gall	64	7						
Dundee	76	34	102	56				
Edinb	65	47	107	72				
Glasgw	75	126	98	44				
Inverns	31	5						
Klmarnk	68	34	100	50				
Krkcldy	75	24	97	46				
Wales								
Bangor	100	23	105	74	106	77		
Cardff	99	140	99	49	100	52	90	25
Clwyd	100	12	95	25				
Swanse	100	114	96	39	98	44	88	21
Wrexm	98	46	102	52	102	52		
England	**97**	**5,365**	**98**	**47**	**99**	**49**	**93**	**35**
N Ireland	**98**	**186**	**102**	**56**	**103**	**61**	**91**	**35**
Scotland	**71**	**357**	**99**	**49**				
Wales	**99**	**335**	**99**	**47**	**100**	**51**	**90**	**24**
UK	**95**	**6,243**	**99**	**47**	**100**	**50**	**92**	**34**

n/a – not available
Blank cells – centres excluded from the analysis due to poor data completeness or low patient numbers

Results

Anaemia management in incident dialysis patients

Haemoglobin in incident dialysis patients

As the UKRR does not collect comprehensive data on patients who are not yet receiving RRT, Hb at the time of starting RRT is the only indication of concordance with anaemia clinical practice guidelines in the pre-dialysis (CKD not (yet) on dialysis) group. The percentage data returned and outcome Hb are listed in table 7.2.

The median Hb of patients at the time of starting dialysis in the UK in 2016 was 99 g/L. The median Hb for patients at the time of starting dialysis by renal centre is shown in figure 7.1. The percentage of patients starting dialysis with Hb ⩾100 g/L is shown in figure 7.2. Using data from centres with adequate completeness for date of first presentation the difference in median Hb between early (100 g/L) and late (92 g/L) presenters is shown in table 7.2. These figures are unchanged from the analysis of 2015 incident patients. Of the early presenters, 50% had a Hb ⩾100 g/L compared with 34% of late presenters.

Again, there was a substantial difference between Hb at the time of starting dialysis by modality. Patients starting on HD had a median Hb of 96 g/L (IQR 87–105) whilst those starting on PD had a median Hb of 108 g/L (IQR 98–116). Of HD patients, 40% started dialysis with a Hb ⩾100 g/L compared with 72% of PD patients.

Incident dialysis patients from 2015 were followed for one year and the median haemoglobin and percentage with ⩾100 g/L in survivors on the same treatment at the same centre were calculated for each quarter. Only patients with Hb data for each of the four time points were included in this analysis. Results by modality and length of pre-dialysis care are shown in figures 7.3 and 7.4. The 'PD-late' group consisted of only 38 patients, so care should be taken in interpreting the results.

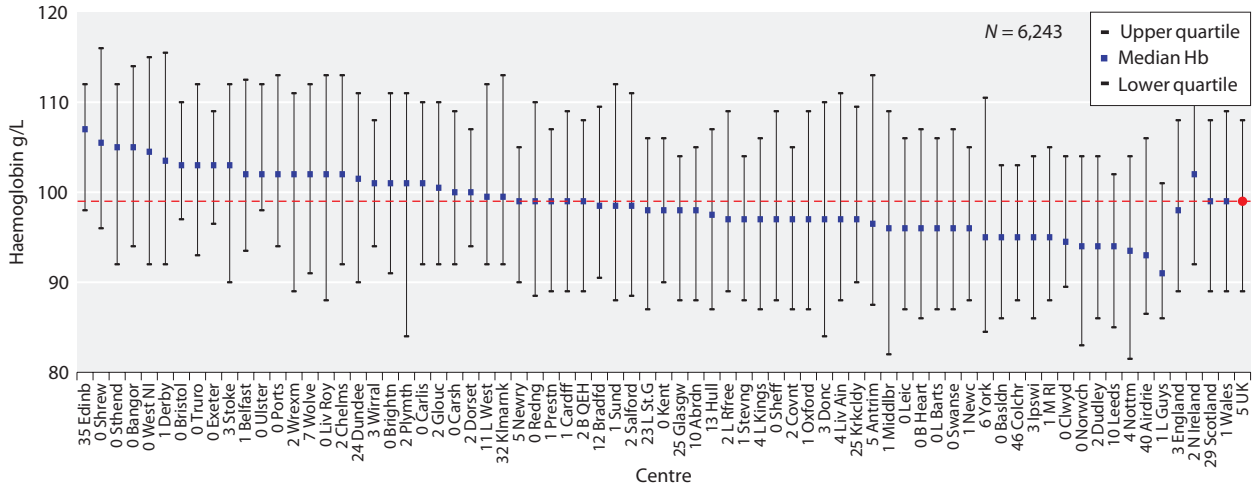

Fig. 7.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2016

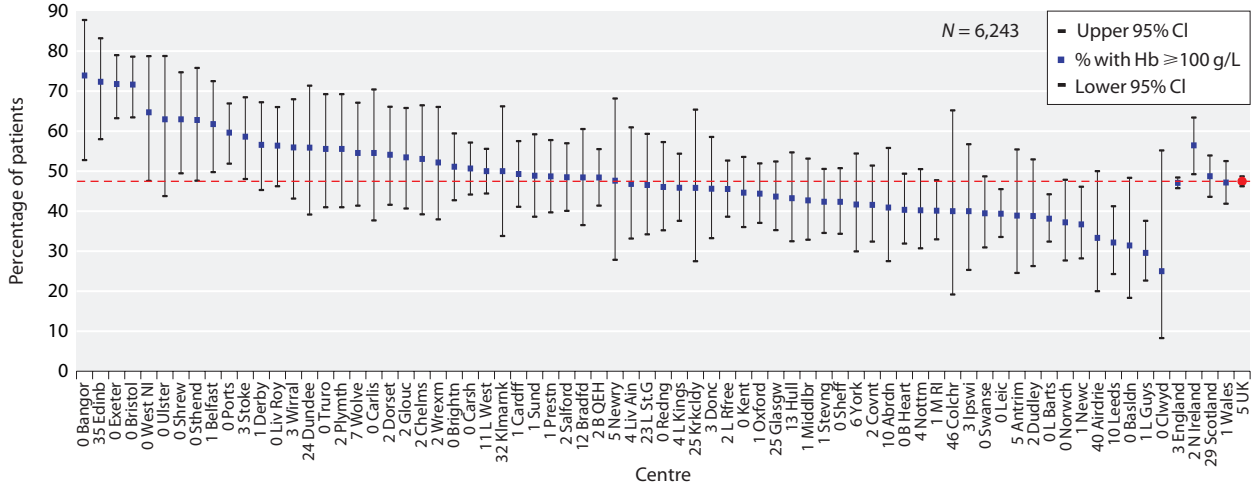

Fig. 7.2. Percentage of incident dialysis patients with Hb ⩾100 g/L at start of dialysis treatment in 2016

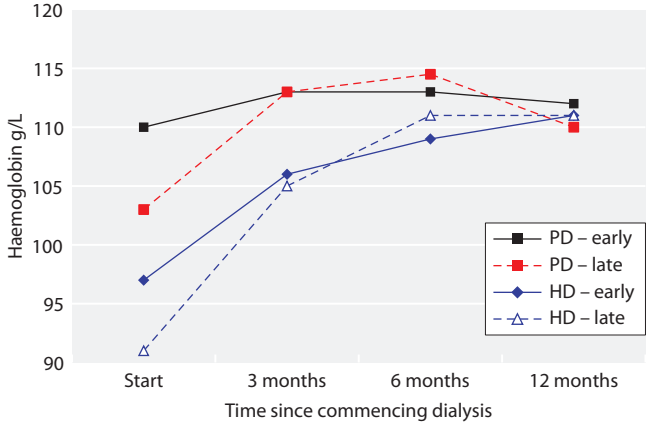

Fig. 7.3. Median haemoglobin, by time on dialysis and length of pre-RRT care, for incident dialysis patients in 2015

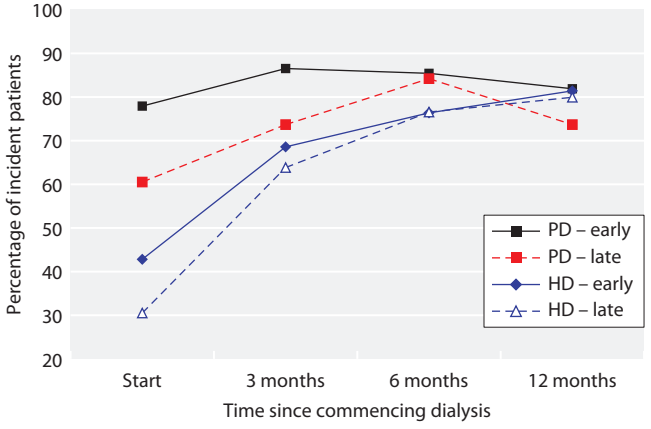

Fig. 7.4. Percentage of incident dialysis patients in 2015 with Hb ⩾100 g/L by time on dialysis and by length of pre-RRT care

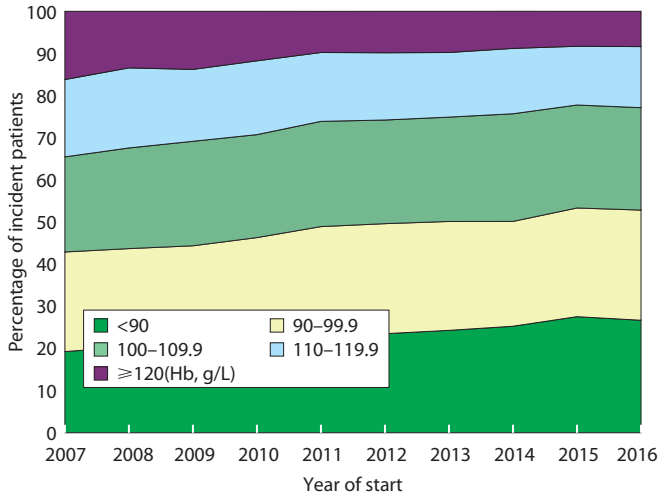

Fig. 7.5. Distribution of haemoglobin in incident dialysis patients by year of start

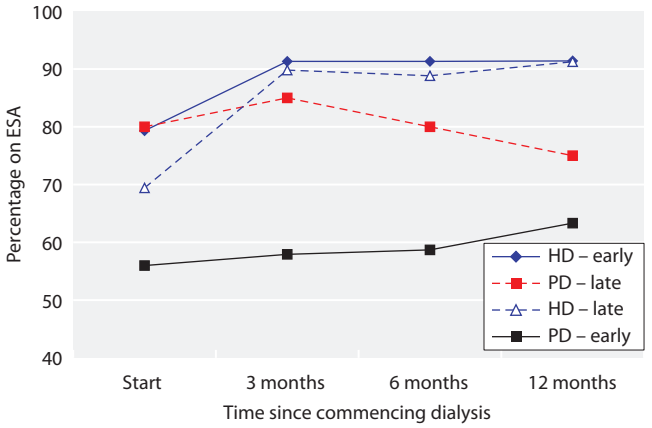

Fig. 7.6. Percentage of incident dialysis patients in 2015 on ESA, by time on dialysis and by length of pre-RRT care

The distribution of Hb ranges in incident dialysis patients by year of start is shown in figure 7.5. The proportion of incident dialysis patients with Hb ⩾120 g/L has fallen from 16.2% in 2007 to 8.4% in 2016. In contrast, the proportion of patients starting dialysis with Hb <100 g/L has increased from 42.9% in 2007 to 52.8% in 2016.

The proportion of patients receiving an ESA by length of time on dialysis for patients starting dialysis in 2015 is shown in figure 7.6. The difference in ESA use between early and late starters was reduced substantially after six months of treatment. Only 20 patients presenting late to dialysis and starting on PD had ESA data, so care should be taken in interpreting this result.

Anaemia management in prevalent dialysis patients

Compliance with data returns for Hb and serum ferritin are shown in table 7.3. Data completeness was generally good for Hb and ferritin. Salford did not submit any ferritin data. Percentages of patients reportedly receiving ESAs are shown in table 7.3. These are as received by the UKRR.

Summary statistics for haemoglobin, serum ferritin and ESA are shown in table 7.4 for HD and 7.5 for PD.

Table 7.3. Percentage completeness of data returns for haemoglobin and serum ferritin and percentages on ESA for prevalent HD and PD patients in 2016

	HD				PD			
Centre	*N*	Hb	Ferritin	% on ESA	*N*	Hb	Ferritin	% on ESA
England								
B Heart	373	100	98	82	72	100	94	68
B QEH	938	100	100	92	125	100	100	67
Basldn	150	98	98	92	30	100	100	87
Bradfd	228	100	100	94	22	100	100	95
Brightn	419	100	99	88	56	98	93	4
Bristol	470	100	100	93	42	100	95	79
Carlis	88	100	100	76	31	100	100	65
Carsh	774	100	99	3	101	94	87	0
Chelms	118	100	100	94	27	89	89	63
Colchr	110	83	85	0				
Covnt	346	100	100	81	59	98	97	68
Derby	227	100	100	0	71	100	99	0
Donc	177	100	100	90	25	100	100	60
Dorset	263	100	100	91	33	100	85	70
Dudley	185	100	100	3	48	100	81	2

Table 7.3. Continued

	HD				PD			
Centre	*N*	Hb	Ferritin	% on ESA	*N*	Hb	Ferritin	% on ESA
Exeter	423	100	100	92	73	100	100	73
Glouc	228	100	98	87	33	100	91	45
Hull	302	100	100	56	61	100	100	66
Ipswi	136	99	99	60	33	100	100	0
Kent	387	100	99	93	43	98	95	53
L Barts	955	100	100	0	179	98	89	0
L Guys	644	100	99	0	32	100	94	0
L Kings	545	100	99	91	75	100	100	79
L Rfree	653	100	99	0	138	99	97	0
L St.G	324	97	95	0	37	97	97	0
L West	1,378	92	91	0	85	93	92	0
Leeds	485	100	100	94	36	100	100	75
Leic	882	100	100	97	70	99	96	76
Liv Ain	175	97	97	0	23	100	100	0
Liv Roy	343	98	99	0	64	98	98	0
M RI	487	94	85	0	49	98	96	0
Middlbr	310	100	99	69	22	100	91	55
Newc	287	100	100	81	46	100	100	0
Norwch	302	99	100	93	41	100	100	78
Nottm	365	100	100	88	67	99	100	78
Oxford	401	100	100	92	80	100	99	79
Plymth	128	99	98	0	31	100	97	0
Ports	583	100	99	6	67	99	99	3
Prestn	531	100	96	94	35	100	94	80
Redng	288	100	99	87	44	100	98	5
Salford	362	100	0	29	90	99	0	72
Sheff	578	100	100	90	47	100	100	62
Shrew	189	100	100	1	29	100	100	0
Stevng	491	100	97	93	16	100	94	56
Sthend	109	100	100	95	24	100	100	58
Stoke	322	99	98	0	71	100	99	0
Sund	223	100	83	90	17	100	94	59
Truro	156	100	100	0	17	100	82	0
Wirral	179	99	99	87	15	100	100	87
Wolve	294	99	99	83	64	95	91	64
York	181	100	100	87	27	100	100	67
N Ireland								
Antrim	115	100	99	90	14	100	100	79
Belfast	185	99	100	95	22	100	100	86
Newry	80	96	100	90	19	100	100	68
Ulster	96	100	100	93	5	100	100	80
West NI	118	100	100	93	9	100	100	89
Scotland								
Abrdn	218	100	97		19	100	95	
Airdrie	173	100	100		21	100	95	
D&Gall	47	100	100		10	100	80	
Dundee	166	98	98		13	100	92	
Edinb	269	100	100		31	100	100	
Glasgw	537	100	99		43	100	100	
Inverns	85	82	74		9	44	56	
Klmarnk	128	100	99		28	100	96	
Krkcldy	135	100	99		15	100	93	

Table 7.3. Continued

	HD				PD			
Centre	*N*	Hb	Ferritin	% on ESA	*N*	Hb	Ferritin	% on ESA
Wales								
Bangor*	68	100	100		15	100	100	33
Cardff	481	100	100	40	67	100	84	34
Clwyd*	68	100	100		14	100	100	57
Swanse	343	100	100	89	58	100	98	60
Wrexm*	113	100	100		28	100	100	39
England	**19,492**	**99**	**96**		**2,623**	**99**	**92**	
N Ireland	**594**	**99**	**100**		**69**	**100**	**100**	
Scotland	**1,758**	**99**	**98**		**189**	**97**	**94**	
Wales	**1,073**	**100**	**100**		**182**	**100**	**93**	
UK	**22,917**	**99**	**97**		**3,063**	**99**	**93**	

Blank cells – centres with no PD patients or because data were not available
*These three centres in North Wales did not only hold HD ESA data on their renal IT systems so have not been included in the analysis of ESA. Percentages of patients receiving ESA are shown but centres with less than 60% HD patients or 40% PD patients on ESA have been excluded from further analysis. Therefore, country averages are not shown – these can be found in tables 7.4 and 7.5

Table 7.4. Summary statistics for haemoglobin, serum ferritin and ESA for prevalent HD patients in 2016

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	373	109	74	58	271	86	43	82	6,500	15
B QEH	936	110	79	62	370	95	64	92	6,000	6
Basldn	147	107	67	56	168	77	32	92	7,500	5
Bradfd	228	114	77	47	508	98	39	94	8,000	4
Brightn	417	110	80	58	475	97	44	88	5,000	10
Bristol	470	113	95	66	610	98	22	93	8,000	7
Carlis	88	116	86	55	731	95	15	76	4,500	24
Carsh	772	111	83	65	307	92	65			
Chelms	118	117	88	51	536	98	38	94	11,000	6
Colchr	91	114	86	63	592	99	31			
Covnt	345	107	72	60	359	95	64	81	9,000	15
Derby	227	116	88	56	457	97	44			
Donc	177	111	80	63	380	97	54	90	6,667	8
Dorset	262	113	86	61	519	97	40	91	6,375	8
Dudley	185	114	89	58	300	88	65			
Exeter	423	112	94	74	301	94	62	92	6,500	8
Glouc	228	114	84	64	330	93	49	87		12
Hull	302	111	81	63	390	94	52			
Ipswi	135	108	76	67	576	96	30			
Kent	387	111	81	57	490	95	33	93	9,000	6
L Barts	953	110	78	61	624	95	21			
L Guys	643	107	72	56	506	94	33			
L Kings	544	111	82	64	440	94	36	91	8,250	8
L Rfree	652	110	75	58	536	97	33			
L St.G	314	108	75	60	390	94	52			
L West	1,271	112	83	63	307	94	60			
Leeds	485	109	77	56	466	95	40	94	6,000	6
Leic	882	112	79	54	311	91	58	97	7,500	2
Liv Ain	170	113	81	56	476	92	29			

Table 7.4. 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 >200 and ⩽500 μg/L	% on ESA	Median ESA dose (IU/week)	% with Hb ⩾100 g/L and not on ESA
Liv Roy	336	113	77	45	390	91	36			
M RI	458	112	78	53	480	97	40			
Middlbr	310	110	79	61	865	98	17	69	5,000	25
Newc	287	110	77	55	373	92	41	81	9,250	18
Norwch	299	113	88	61	542	95	33	93	9,625	6
Nottm	364	109	76	62	447	97	54	88	7,500	11
Oxford	401	110	76	56	285	87	48	92	12,000	8
Plymth	127	111	76	47	665	95	24			
Ports	583	113	82	55	397	94	56			
Prestn	531	110	77	56	621	95	25	94		6
Redng	288	115	83	50	481	98	45	87	13,039	9
Salford	361	109	71	51						
Sheff	577	110	75	49	462	96	50	90	7,500	8
Shrew	189	114	85	65	343	97	62			
Stevng	491	106	72	61	602	97	29	93	9,000	5
Sthend	109	111	83	70	273	99	73	95	10,000	5
Stoke	319	113	83	57	280	89	46			
Sund	222	109	71	52	252	86	41	90	8,609	9
Truro	156	106	76	68	390	97	60			
Wirral	178	109	79	65	417	94	54	87	8,000	13
Wolve	291	115	83	49	488	92	34	83	8,000	15
York	181	109	81	65	376	96	68	87	5,000	12
N Ireland										
Antrim	115	108	77	62	397	95	41	90	7,000	8
Belfast	183	115	87	54	433	97	43	95	6,750	5
Newry	77	111	75	60	386	94	40	90	6,375	10
Ulster	96	114	84	66	716	96	18	93	4,250	7
West NI	118	112	79	55	554	97	27	93	7,000	7
Scotland										
Abrdn	218	106	72	62	545	98	36			
Airdrie	173	113	84	63	636	95	29			
D&Gall	47	115	91	55	578	100	28			
Dundee	163	112	87	69	257	80	47			
Edinb	269	117	88	48	419	92	38			
Glasgw	537	110	76	55	489	92	32			
Inverns	70	112	79	64	353	89	48			
Klmarnk	128	110	71	51	248	86	50			
Krkcldy	135	115	90	65	432	84	25			
Wales										
Bangor	68	112	72	54	366	93	51			
Cardff	480	111	79	58	295	91	57			
Clwyd	68	111	82	63	344	96	62			
Swanse	343	110	80	62	265	85	36	89	10,000	10
Wrexm	113	113	87	57	429	99	48			
England	**19,283**	**111**	**80**	**59**	**412**	**94**	**45**	**90**	**7,750**	**9**
N Ireland	**589**	**112**	**82**	**58**	**488**	**96**	**35**	**93**	**6,000**	**7**
Scotland	**1,740**	**112**	**80**	**58**	**436**	**91**	**36**			
Wales	**1,072**	**111**	**80**	**59**	**306**	**91**	**49**	**89**	**10,000**	**10**
UK	**22,684**	**111**	**80**	**59**	**410**	**94**	**44**	**90***	**7,750***	**9***

Blank cells – 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 where the percentage on ESA was 60% or more

*ESA summary results are for E, W & NI (not UK)

Table 7.5. Summary statistics for haemoglobin, serum ferritin and ESA for prevalent PD patients in 2016

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	72	105	61	43	221	81	66	68	6,000	22
B QEH	125	108	74	54	293	90	70	67	4,275	29
Basldn	30	103	63	57	145	70	67	87	4,750	13
Bradfd	22	110	73	41	273	73	45	95	8,000	5
Brightn	55	107	78	69	522	87	35			
Bristol	42	116	95	64	325	93	60	79	4,846	21
Carlis	31	117	97	61	350	90	52	65	2,250	35
Carsh	95	111	79	56	197	76	70			
Chelms	24	116	88	54	168	71	58	63	4,000	38
Colchr	n/a									
Covnt	58	105	64	48	216	81	61	68	8,000	28
Derby	71	117	85	46	471	96	50			
Donc	25	112	80	60	339	96	76	60	3,000	40
Dorset	33	110	82	58	299	96	75	70	4,000	30
Dudley	48	111	73	52	132	69	64			
Exeter	73	112	92	70	280	92	81	73	4,615	27
Glouc	33	116	88	58	183	80	70	45		55
Hull	61	110	77	61	343	97	72	66	4,000	31
Ipswi	33	108	79	55	477	100	52			
Kent	42	117	90	60	332	88	61	53	4,000	
L Barts	176	110	74	54	282	85	58			
L Guys	32	99	47	44	209	93	87			
L Kings	75	110	81	59	220	85	75	79	4,500	21
L Rfree	136	109	74	59	568	93	34			
L St.G	36	112	83	64	270	92	78			
L West	79	108	68	43	428	91	47			
Leeds	36	108	78	64	337	97	78	75	4,000	25
Leic	69	110	80	55	345	90	64	76	4,000	22
Liv Ain	23	111	87	65	309	100	83			
Liv Roy	63	118	89	48	242	86	68			
M RI	48	109	63	38	294	96	74			
Middlbr	22	112	100	82	361	95	55	55	4,000	45
Newc	46	106	74	54	410	91	63			
Norwch	41	114	80	59	434	95	66	78	3,483	20
Nottm	66	102	65	52	495	96	49	78	2,550	18
Oxford	80	111	85	61	246	95	86	79	5,750	21
Plymth	31	111	81	52	443	93	50			
Ports	66	114	86	50	401	97	64			
Prestn	35	112	77	46	577	94	33	80		20
Redng	44	114	93	59	384	88	63			
Salford	89	114	84	56				72	8,000	25
Sheff	47	108	77	57	494	96	47	62	8,000	34
Shrew	29	113	93	76	256	86	72			
Stevng	16	115	88	56	281	100	73	56		44
Sthend	24	114	88	63	171	71	67	58	2,833	42
Stoke	71	110	75	45	302	91	70			
Sund	17	120	82	35	275	75	31	59	2,307	41
Truro	17	111	82	59	240	86	86			
Wirral	15	107	80	67	426	100	67	87	8,000	13
Wolve	61	111	79	51	147	55	43	64	6,000	30
York	27	112	85	74	248	85	63	67	3,000	30

Table 7.5. 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	14	115	93	71	356	100	79	79	3,333	21
Belfast	22	116	95	68	341	95	68	86	3,000	14
Newry	19	111	79	53	325	95	79	68	3,500	32
Ulster	5									
West NI	9									
Scotland							57			
Abrdn	19	104	63	37	374	100	67			
Airdrie	21	110	90	71	304	95	65			
D&Gall	10	112	80	60						
Dundee	13	119	92	46	212	67	50			
Edinb	31	108	74	65	429	97	61			
Glasgw	43	115	91	56	197	77	51			
Inverns	4									
Klmarnk	28	107	75	54	327	93	59			
Krkcldy	15	112	93	60	322	71	36			
Wales										
Bangor	15	113	87	53	144	60	53			
Cardff	67	110	72	48	165	82	77			
Clwyd	14	112	86	64	414	100	71	57		43
Swanse	58	112	86	59	280	93	68	60	5,000	38
Wrexm	28	118	89	50	258	96	75			
England	**2,590**	**111**	**78**	**55**	**309**	**88**	**62**	**70**	**4,608**	**27**
N Ireland	**69**	**115**	**88**	**61**	**375**	**97**	**65**	**80**	**3,000**	**20**
Scotland	**184**	**111**	**83**	**57**	**291**	**87**	**57**			
Wales	**182**	**112**	**81**	**53**	**232**	**88**	**71**	**60**	**5,000**	**39**
UK	**3,025**	**111**	**79**	**55**	**306**	**88**	**62**	**70***	**4,500***	**28***

Blank cells – centres excluded from analyses due to poor data completeness or low patient numbers or because the data item was not available
n/a – not applicable
ESA data only shown for those centres where the percentage on ESA was 40% or more
*ESA summary results are for E, W & NI (not UK)

Haemoglobin in prevalent haemodialysis patients

The median Hb of patients on HD in the UK in 2016 was 111 g/L (IQR 102–119) and is shown in table 7.4. For HD patients, 80% had a Hb ⩾100 g/L. Figure 7.7 shows the median Hb in HD patients by renal centre. Figure 7.8 shows the proportion of patients by centre with Hb within the Renal Association guideline range (100–120 g/L) and figure 7.9 shows the distribution of Hb within, above and below this range.

Funnel plots for the percentage of patients with Hb ⩾100 g/L (figure 7.10) and between 100–120 (figure 7.11) are shown with 95% and 99.9% confidence limits. Table 7.4 can be used to identify centres in these funnel plots.

Haemoglobin in prevalent peritoneal dialysis patients

The median Hb of patients on PD in the UK in 2016 was 111 g/L (IQR 102–120, table 7.5). For PD patients, 79% had a Hb ⩾100 g/L. Figure 7.12 shows the median Hb in PD patients by centre. Figure 7.13 shows the proportion of patients by centre with Hb within the Renal Association guideline range (100–120 g/L) and figure 7.14 shows the distribution of Hb within, above and below this range.

Figures 7.15 and 7.16 are funnel plots showing the percentage of PD patients by centre in 2016 with Hb ⩾100 g/L and Hb ⩾100 g/L and ⩽ 120 g/L respectively.

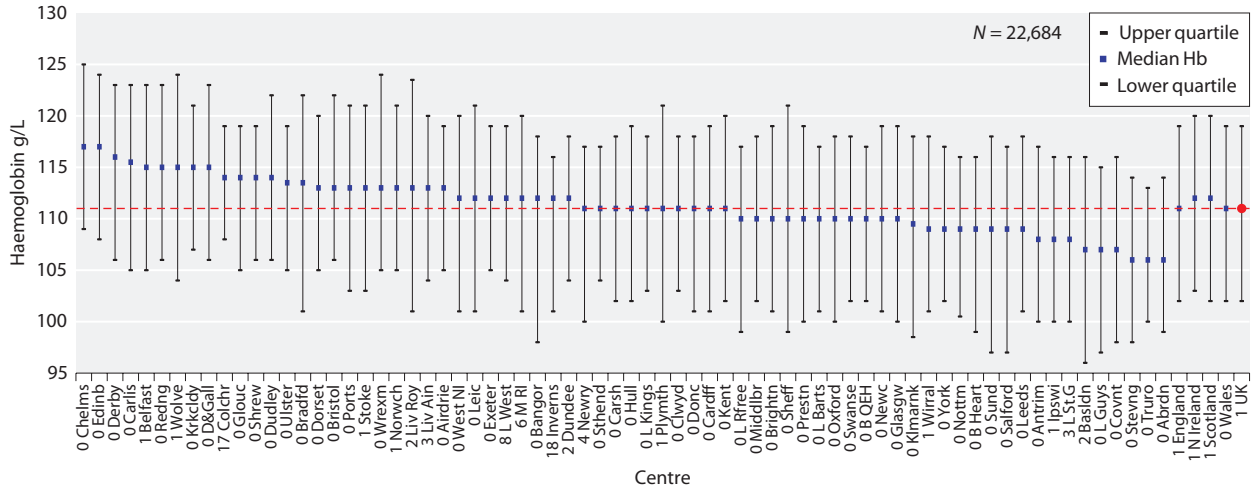

Fig. 7.7. Median haemoglobin in prevalent patients treated with HD by centre in 2016

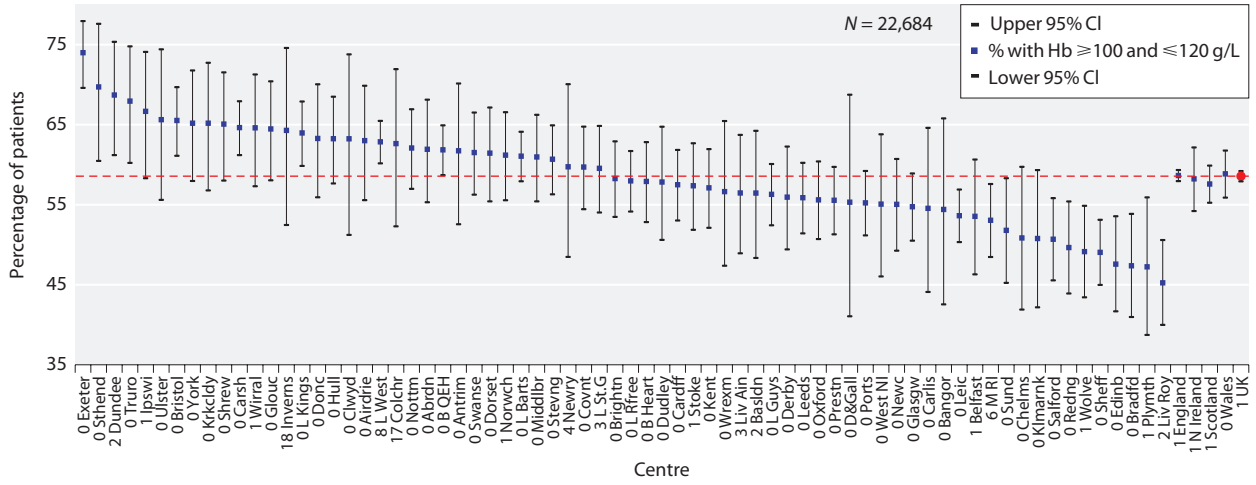

Fig. 7.8. Percentage of prevalent HD patients with Hb ⩾100 g/L and ⩽120 g/L by centre in 2016

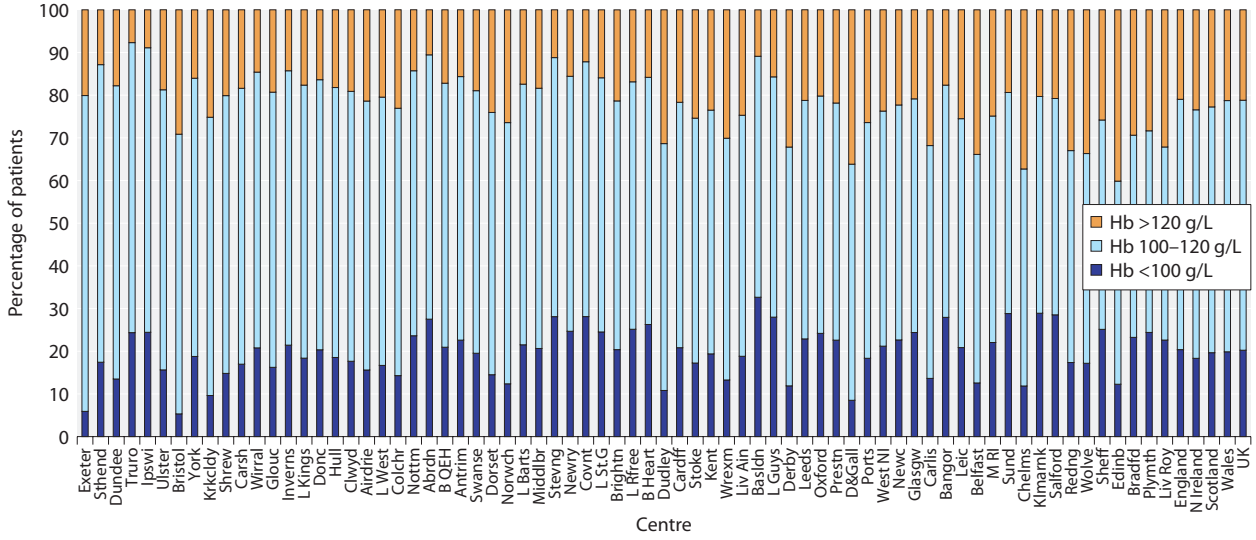

Fig. 7.9. Distribution of haemoglobin in prevalent patients treated with HD by centre in 2016

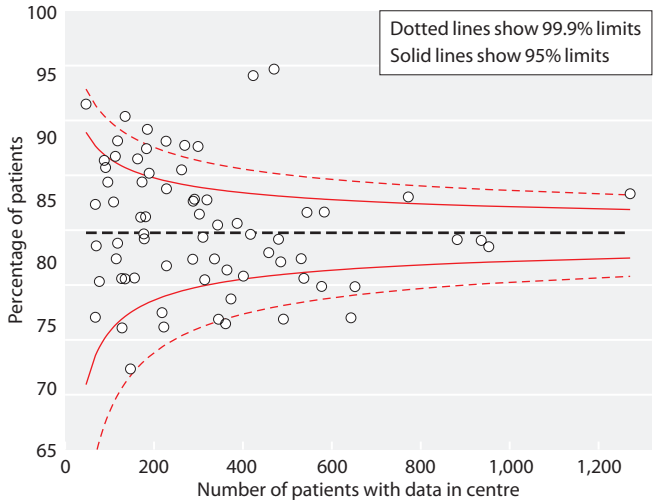

Fig. 7.10. Funnel plot of percentage of prevalent HD patients with Hb ⩾100 g/L by centre in 2016

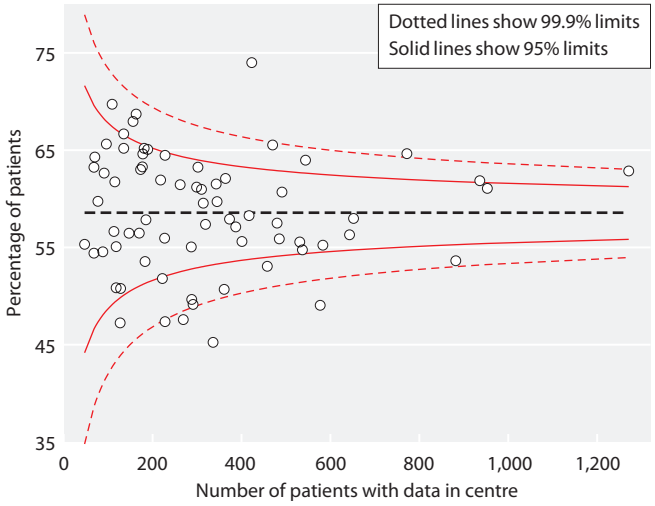

Fig. 7.11. Funnel plot of percentage of prevalent HD patients with Hb ⩾100 g/L and ⩽120 g/L by centre in 2016

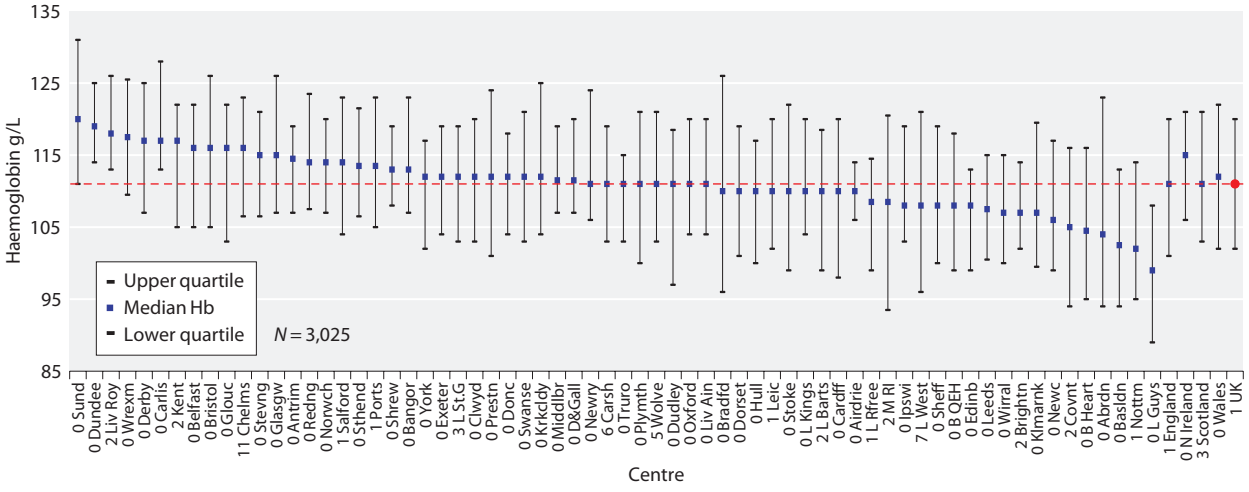

Fig. 7.12. Median haemoglobin in prevalent patients treated with PD by centre in 2016

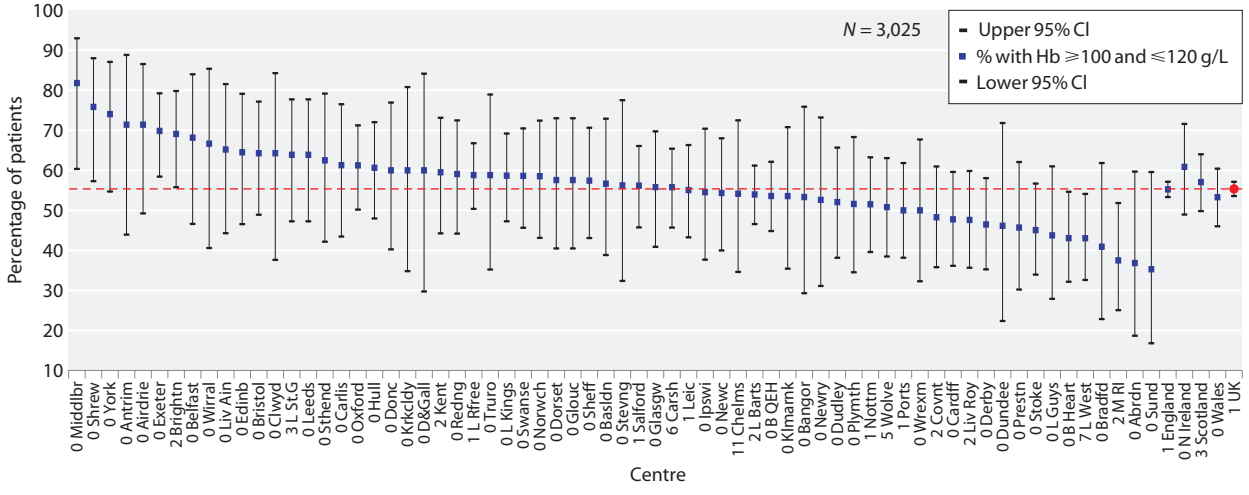

Fig. 7.13. Percentage of prevalent PD patients with Hb ⩾100 g/L and ⩽120 g/L by centre in 2016

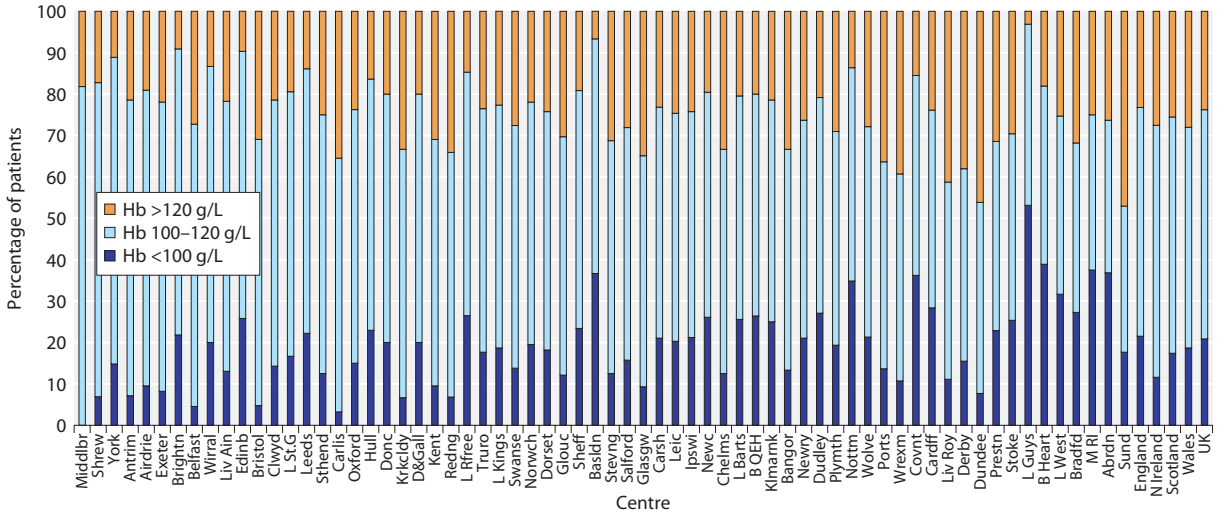

Fig. 7.14. Distribution of haemoglobin in prevalent patients treated with PD by centre in 2016

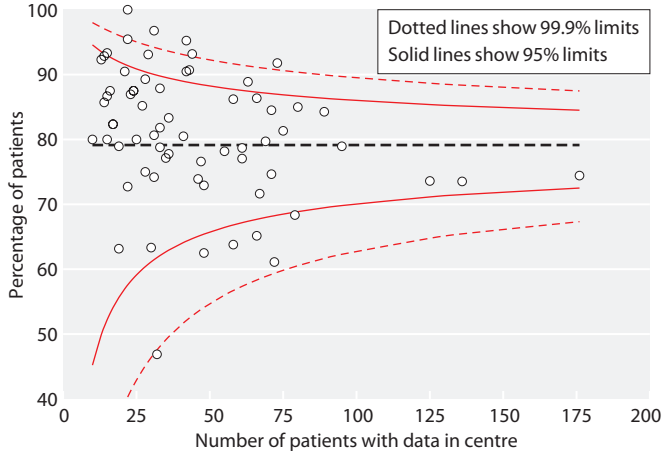

Fig. 7.15. Funnel plot of percentage of prevalent PD patients with Hb $\geqslant$100 g/L by centre in 2016

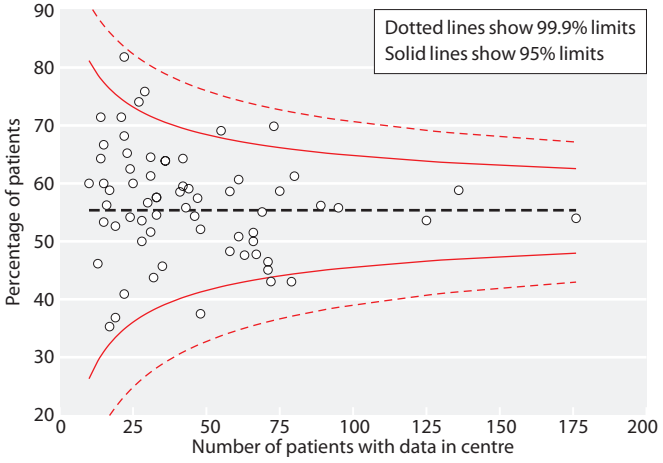

Fig. 7.16. Funnel plot of percentage of prevalent PD patients with Hb $\geqslant$100 g/L and $\leqslant$120 g/L by centre in 2016

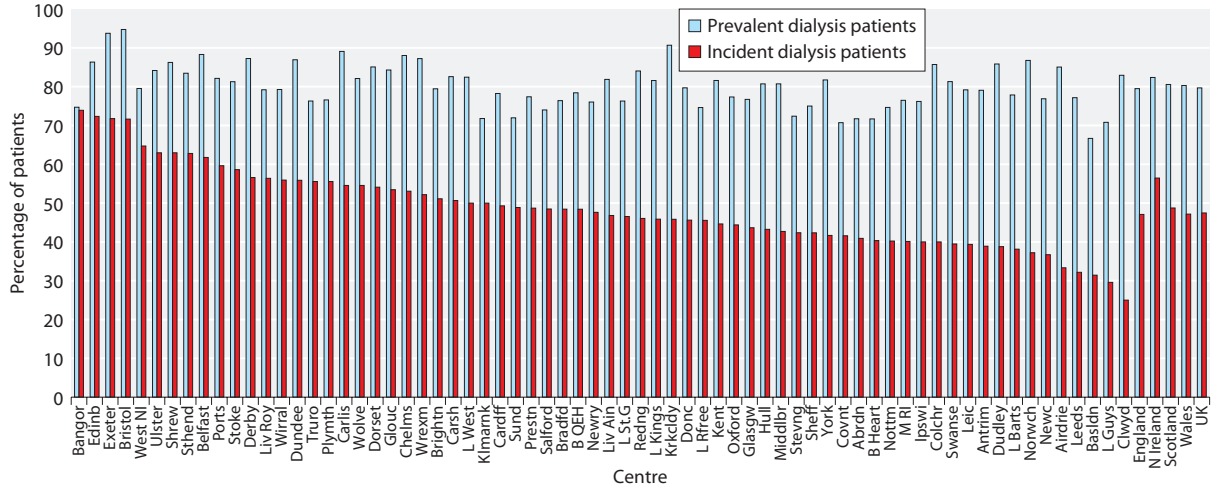

Fig. 7.17. Percentage of incident and prevalent dialysis patients with Hb $\geqslant$100 g/L by centre in 2016

Relationship between Hb in incident and prevalent dialysis patients

The relationship between the percentage of incident and prevalent patients with Hb ⩾100 g/L is shown in figure 7.17. As expected, all centres had a higher percentage of prevalent patients achieving a Hb ⩾100 g/L than of incident patients.

Changes in achievement of Hb ⩾100 g/L by year of start in both incident and prevalent patients is shown in figure 7.18. This shows a falling trend in the proportion of patients achieving a Hb ⩾100 g/L over the last decade.

Ferritin in prevalent haemodialysis patients

The median and IQR for serum ferritin for patients treated with HD are shown in figure 7.19. The percentages with serum ferritin ⩾100 μg/L, >200 μg/L to ⩽500 μg/L, and ⩾800 μg/L are shown in figures 7.20, 7.21 and 7.22 respectively. The median serum ferritin in HD patients was 410 μg/L with 94% of HD patients achieving a serum ferritin ⩾100 μg/L.

Ferritin in prevalent peritoneal dialysis patients

The median and IQR for serum ferritin for patients treated with PD are shown in figure 7.23. The percentages with serum ferritin ⩾100 μg/L, >100 μg/L to ⩽500 μg/L, and ⩾800 μg/L are shown in figures 7.24, 7.25 and 7.26 respectively. The median serum ferritin in PD patients was 306 μg/L with 88% of PD patients achieving a serum ferritin ⩾100 μg/L.

Erythropoiesis stimulating agents in prevalent haemodialysis patients

The median dose of ESA for prevalent HD patients in England, Wales and Northern Ireland was 7,750 IU/week

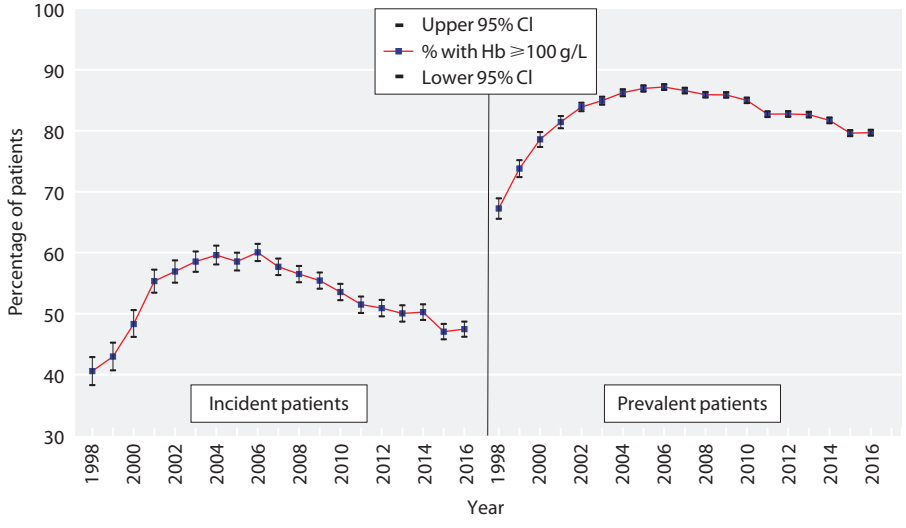

Fig. 7.18. Percentage of incident and prevalent dialysis patients (1998–2016) with Hb ⩾100 g/L

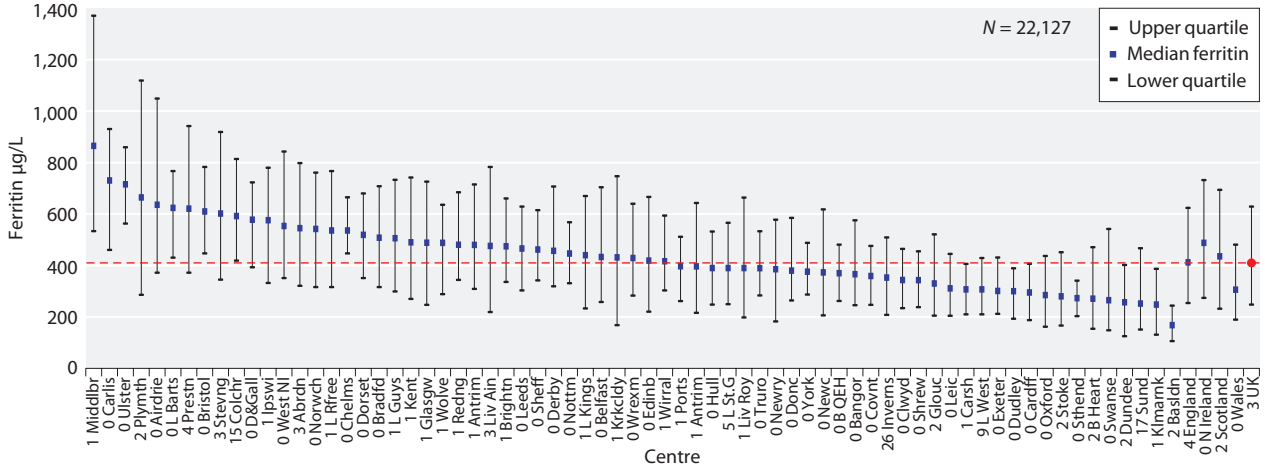

Fig. 7.19. Median ferritin in prevalent patients treated with HD by centre in 2016

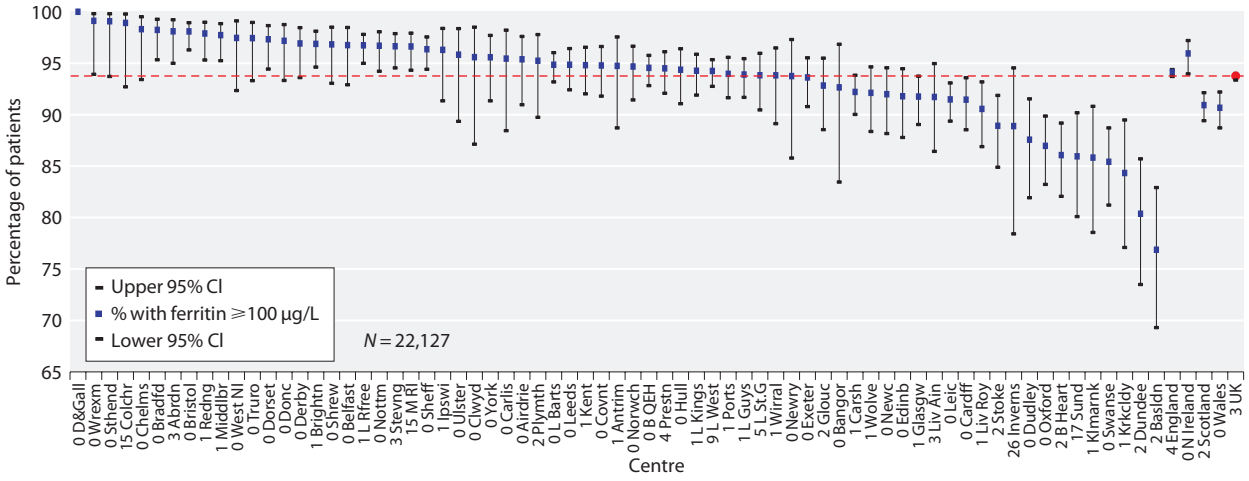

Fig. 7.20. Percentage of prevalent HD patients with ferritin ⩾100 µg/L by centre in 2016

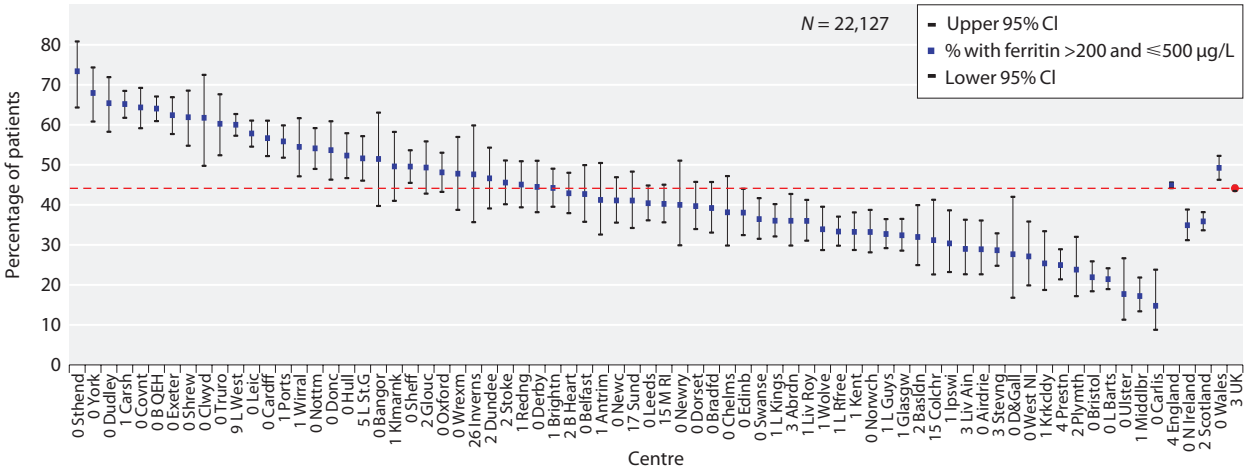

Fig. 7.21. Percentage of prevalent HD patients with ferritin > 200 and ⩽500 µg/L by centre in 2016

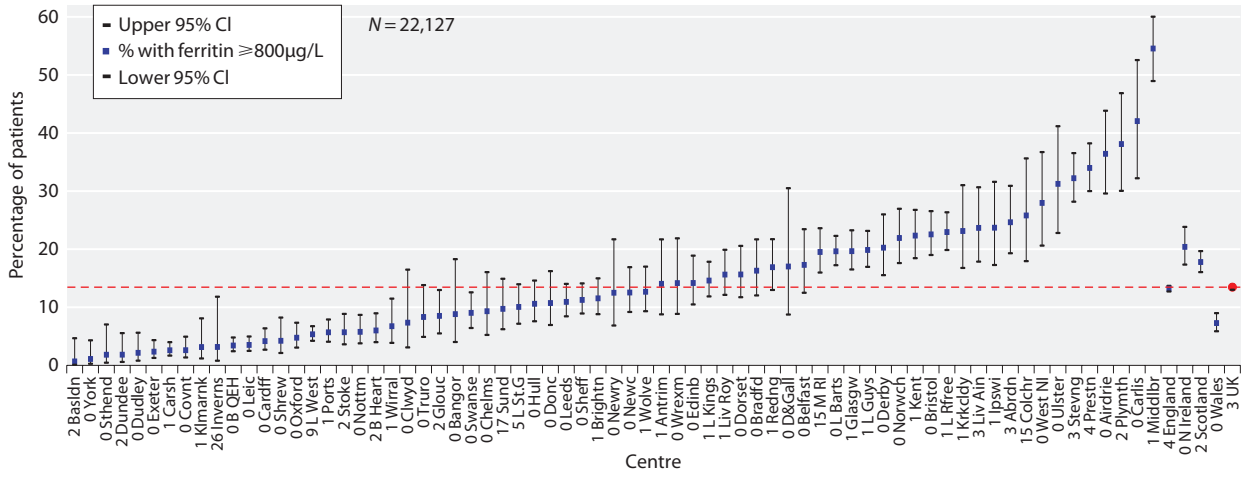

Fig. 7.22. Percentage of prevalent HD patients with ferritin ⩾800 µg/L by centre in 2016

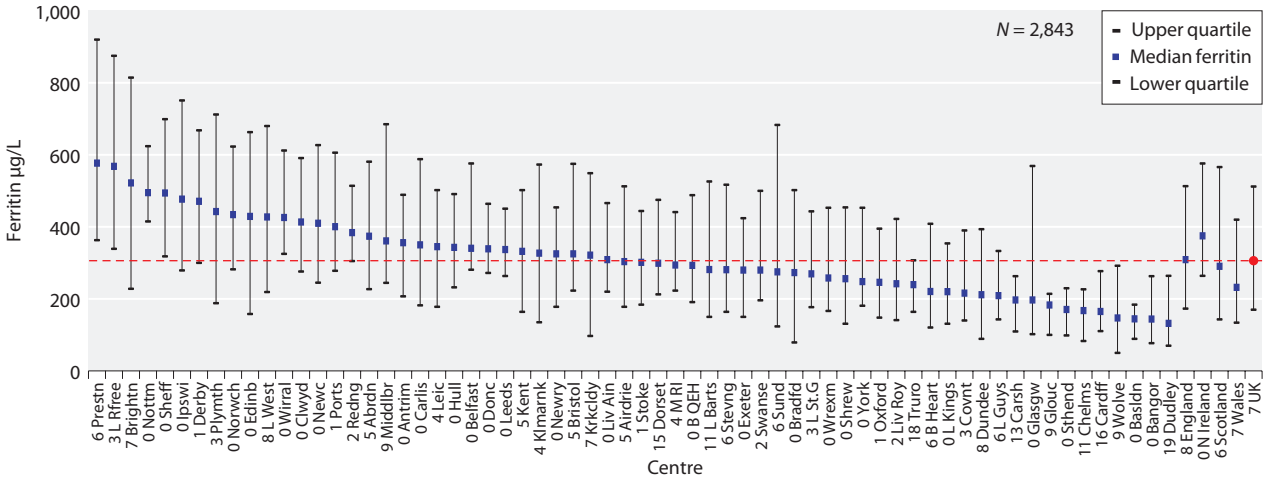

Fig. 7.23. Median ferritin in prevalent patients treated with PD by centre in 2016

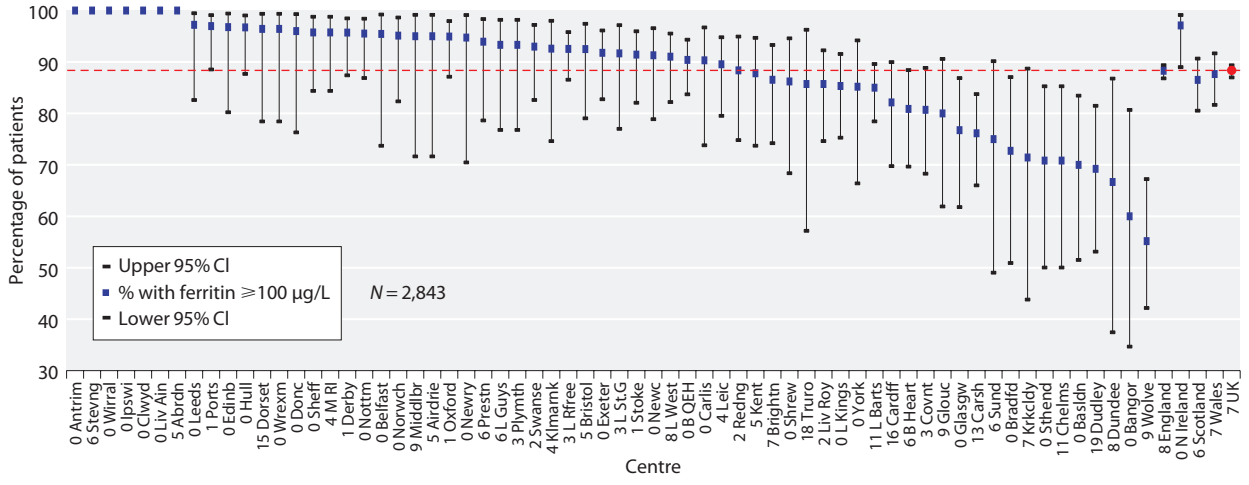

Fig. 7.24. Percentage of prevalent PD patients with ferritin ⩾100 µg/L by centre in 2016

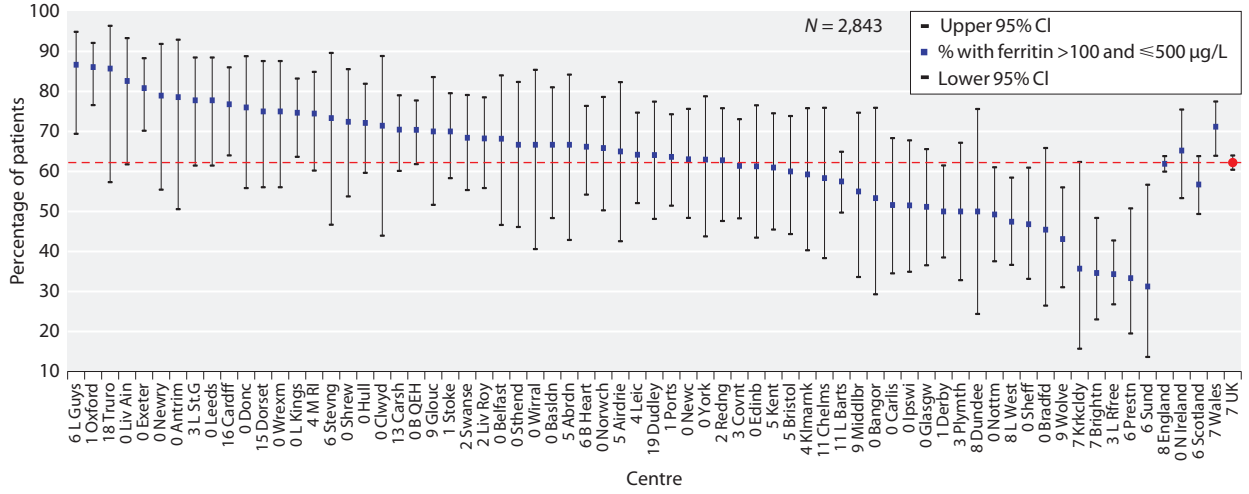

Fig. 7.25. Percentage of prevalent PD patients with ferritin > 100 and ⩽500 µg/L by centre in 2016

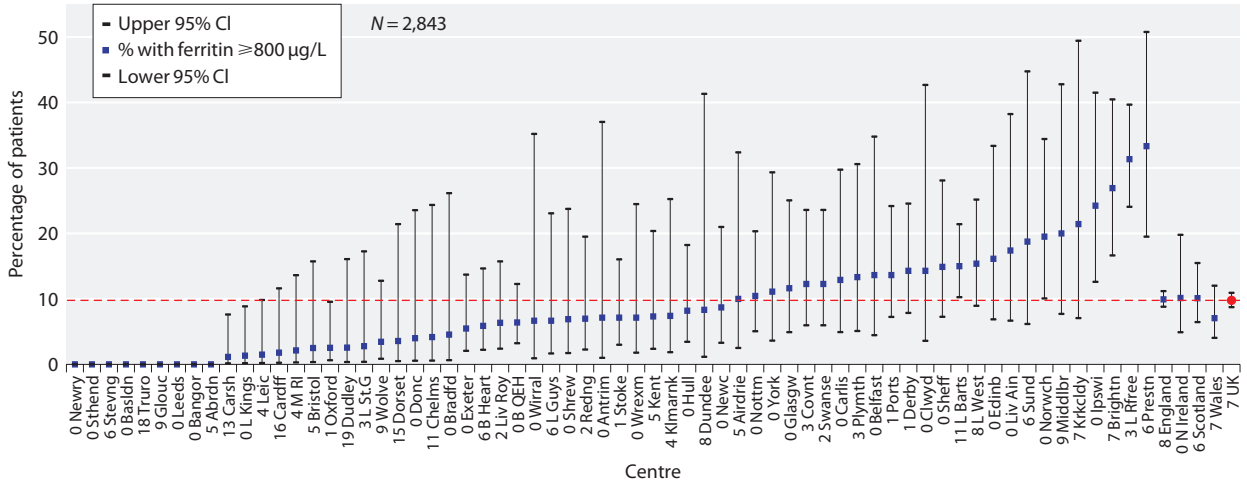

Fig. 7.26. Percentage of prevalent PD patients with ferritin ⩾800 µg/L by centre in 2016

with wide variation between centres from 4,250 IU/week (Ulster) to 13,039 IU/week (Reading) (table 7.4). There was very little correlation between median ESA dose and either median Hb (figure 7.27) or compliance with Hb 100–120 g/L (figure 7.28). For these analyses only patients with both Hb and ESA data were included.

Erythropoiesis stimulating agents in prevalent peritoneal dialysis patients

The median dose of ESA for prevalent PD patients in England, Wales and Northern Ireland was 4,500 IU/week (table 7.5).

ESA prescription and association with achieved haemoglobin

Figures 7.9 and 7.14 show the distribution of Hb concordance with the Renal Association guideline (100–120 g/L). Not all patients with Hb >120 g/L were receiving ESA. The consensus was that these patients should not be included in the group of patients not meeting this target. There are two reasons: first, the high Hb remains largely outside the control of the clinician; secondly, the trials suggesting it may be detrimental to achieve a high Hb in renal patients were based upon patients treated with ESAs [5–7]. Figures 7.29 and 7.30 therefore show the percentages of HD and PD patients in each centre whose Hb lies below, within or above the Renal Association guideline range. For those patients with Hb >120 g/L it also differentiates between those receiving, or not, ESAs. In centres with useable ESA data, 21.2% of HD patients had a Hb >120 g/L and 4.1% had a Hb >120 g/L and were not receiving ESAs. For PD patients 23.1% had a Hb >120 g/L and 12.4% had a Hb >120 g/L and were not receiving ESAs.

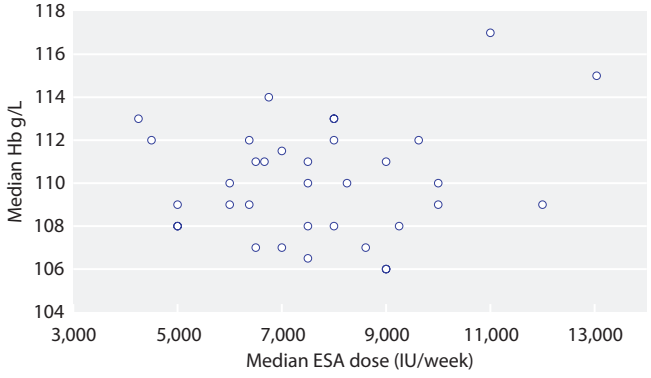

Fig. 7.27. Median Hb versus median ESA dose in prevalent HD patients on ESA, by centre in 2016

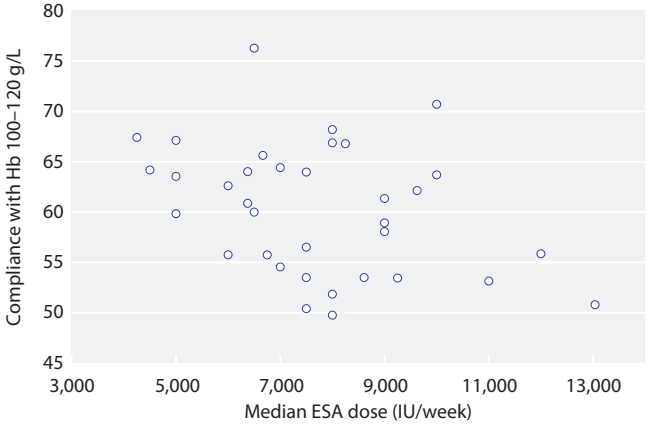

Fig. 7.28. Compliance with Hb 100–120 g/L versus median ESA dose in prevalent HD patients on ESA, by centre in 2016

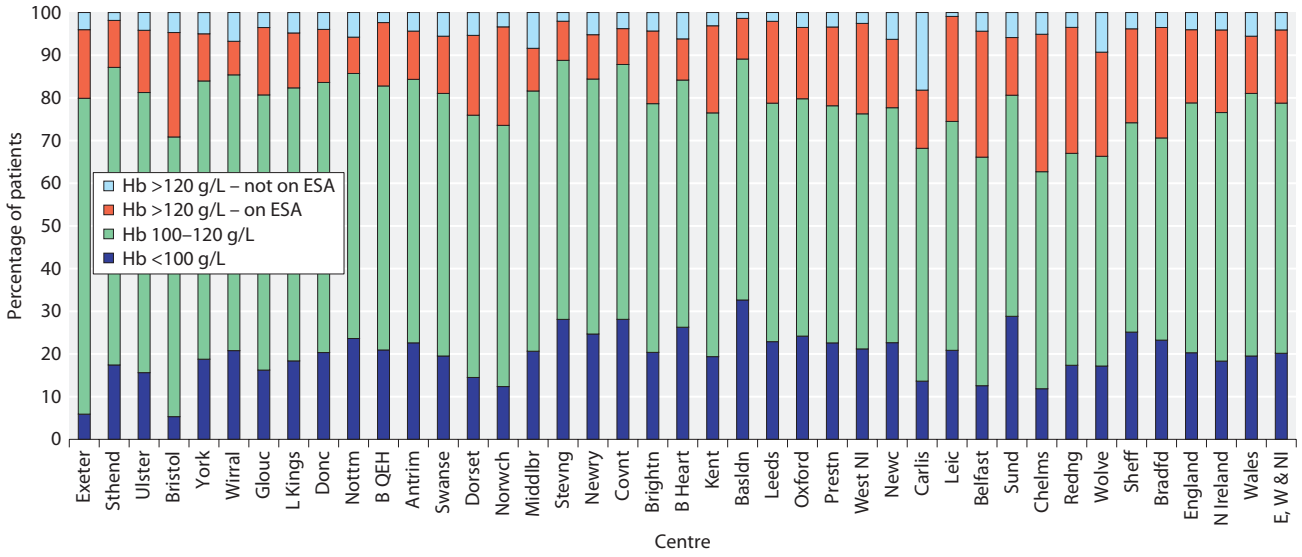

Fig. 7.29. Distribution of haemoglobin in prevalent patients treated with HD and the proportion of patients with Hb >120 g/L receiving ESA by centre in 2016

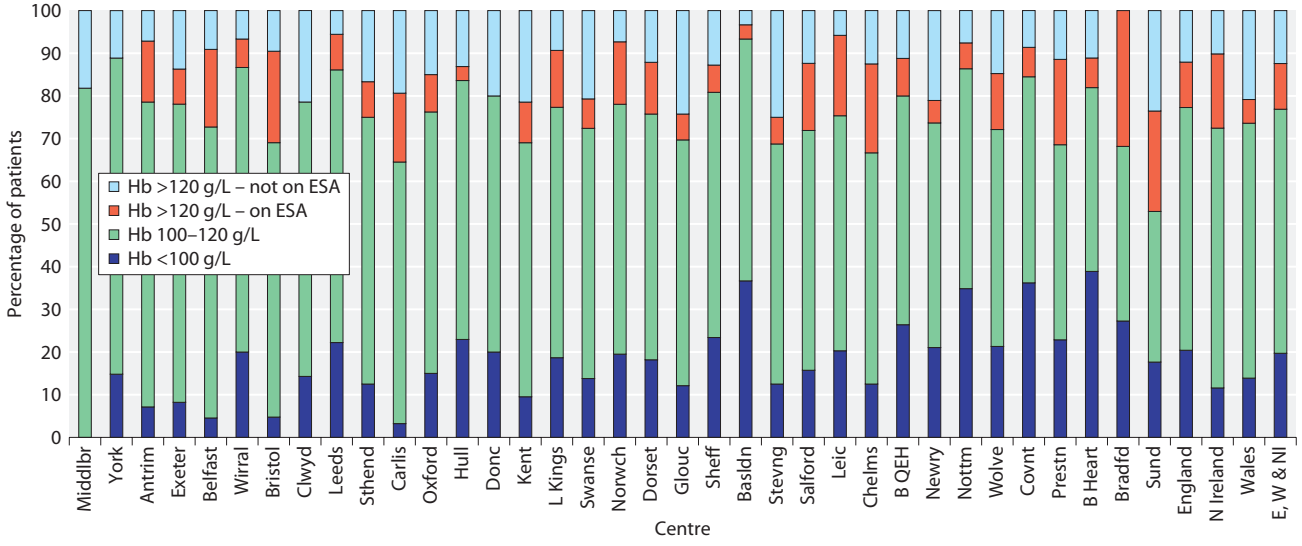

Fig. 7.30. Distribution of haemoglobin in prevalent patients treated with PD and the proportion of patients with Hb >120 g/L receiving ESA by centre in 2016

ESA prescription: age and modality associations

The proportion of patients on ESA was higher for HD (90%) than for PD (70%). This difference was maintained across all age groups (figure 7.31). The proportion of patients with Hb ⩾100 g/L without requiring an ESA is shown (by age group and modality) in figure 7.32.

ESAs and time on renal replacement therapy

The percentage of patients on ESA by time on RRT and dialysis modality is shown in figure 7.33. This is a cross-sectional analysis of patients at the end of 2016. Patients who had previously changed RRT modality were included in the analysis. The proportion of PD patients receiving ESA rises with duration of RRT from 70% after 3–12 months to 78% after ten or more years.

Resistance to ESA therapy

The Renal Association 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***' [1]. Figure 7.34 shows the frequency distribution

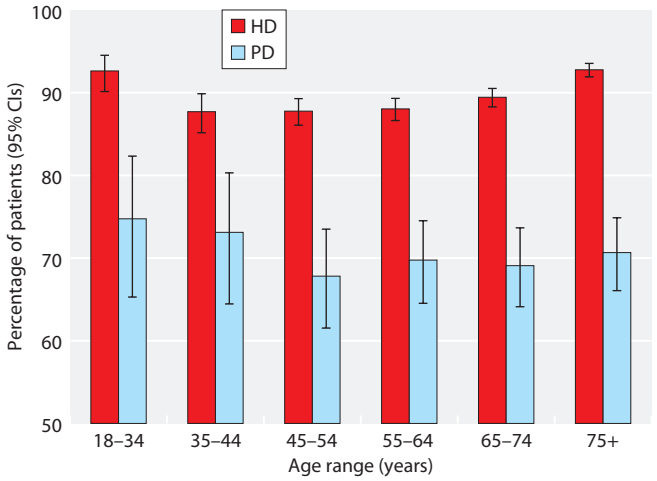

Fig. 7.31. Percentage of dialysis patients on ESA, by age group and treatment modality in 2016

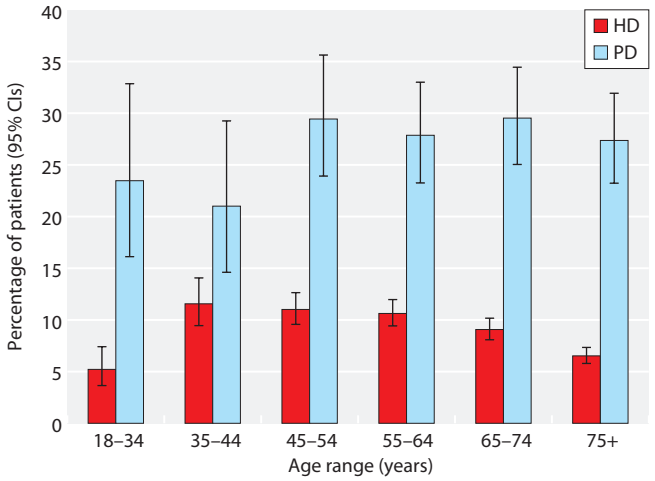

Fig. 7.32. Percentage of whole cohort (2016) who were not on ESA and had Hb ⩾100 g/L, by age group and treatment modality

of weekly ESA dose adjusted for weight by treatment modality. Centres included in this analysis were restricted to those with good completeness for weight (>75%) and ESA data. Thirty two centres were included for HD data and 16 centres for PD. The prevalence of PD patients receiving over 300 IU/kg/week was 3.0% with 5.7% of HD patients receiving more than 300 IU/kg/week and 1.2% more than 450 IU/kg/week.

Success with guideline compliance

The percentage of prevalent dialysis patients achieving a Hb ⩾100 g/L by year (1998–2016) is shown in figure 7.35. This has shown a gradual fall in achievement of this guideline over the last decade.

Table 7.6 shows that the percentage of all patients treated with an ESA and having Hb >120 g/L ranged between 8–32% for HD and between 0–32% for PD.

Table 7.7 shows the percentage completeness for ESA type, dose, route and frequency for centres reporting ESA data. Even for this group of centres which is already restricted to those with useable ESA data, completeness of frequency and administration route averaged below 50%. Roughly half of the centres had very good completeness for these items and the other half did not submit at all.

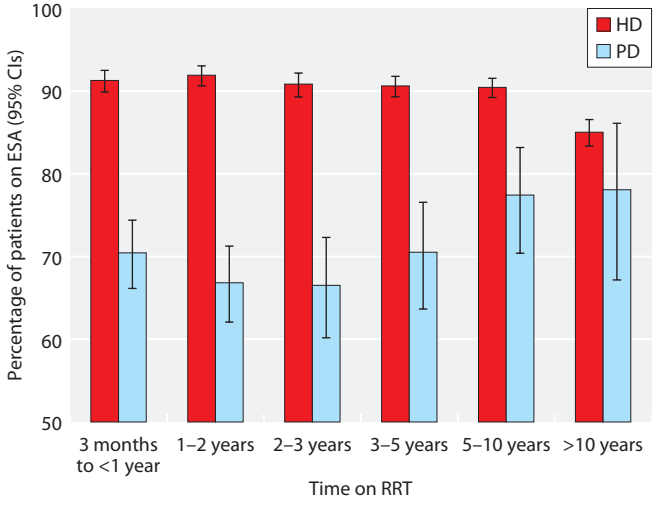

Fig. 7.33. Percentage of patients on ESA by time on RRT in 2016

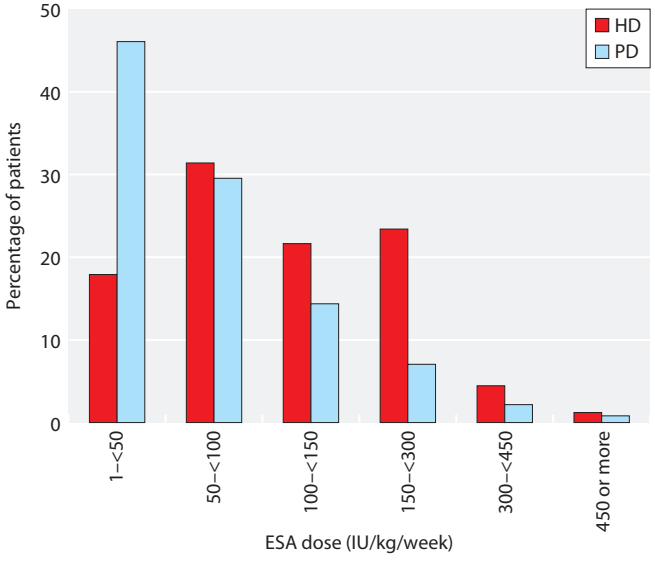

Fig. 7.34. Frequency distribution of mean weekly ESA dose corrected for weight in 2016

Table 7.6. Percentage of prevalent patients with Hb >120 g/L and on ESA and percentage of patients with serum ferritin <100 μg/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	10	10	7	10
B QEH	15	4	9	2
Basldn	10	21	3	27
Bradfd	26	1	32	16
Brightn	17	2		
Bristol	24	2	21	3
Carlis	14	2	16	9
Chelms	32	0	21	10
Covnt	8	2	7	14
Donc	12	3	0	0
Dorset	19	2	12	0
Exeter	16	5	8	0
Glouc	16	5	6	9
Hull			3	2
Kent	20	4	10	3
L Kings	13	5	13	7
Leeds	19	3	8	0
Leic	25	8	19	3
Middlbr	10	1	0	0
Newc	16	4		
Norwch	23	3	15	3
Nottm	9	1	6	0
Oxford	17	11	9	4
Prestn	18	4	20	3
Redng	30	1		
Salford			16	0
Sheff	22	2	6	0
Stevng	9	2	6	0
Sthend	11	1	8	8
Sund	14	10	24	20
Wirral	8	1	7	0
Wolve	24	5	13	29
York	11	1	0	4
N Ireland				
Antrim	11	4	14	0
Belfast	30	2	18	0
Newry	10	6	5	0
Ulster	15	1		
West NI	21	2		
Wales				
Clwyd			0	0
Swanse	13	10	7	0
England	**17**	**4**	**11**	**5**
N Ireland	**19**	**3**	**17**	**0**
Wales	**13**	**10**	**6**	**0**
E, W & NI	**17**	**4**	**11**	**5**

Blank cells – centres excluded from analyses due to poor data completeness, small numbers with data or incomplete ESA data

Table 7.7. 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	98	0	0	49	100	100	0	0
B QEH	866	100	100	100	0	84	100	100	100	0
Basldn	138	100	100	100	100	26	100	100	100	100
Bradfd	214	100	99	100	100	21	100	95	100	95
Brightn	367	100	100	0	0					
Bristol	435	100	100	0	0	33	100	100	0	0
Carlis	67	100	100	0	0	20	100	100	0	0
Chelms	111	100	100	99	100	17	100	100	100	100
Covnt	281	100	100	0	0	40	100	100	0	0
Donc	160	100	100	100	100	15	100	100	93	100
Dorset	240	100	100	95	100	23	100	100	74	100
Exeter	389	100	100	0	0	53	100	100	0	0
Glouc	199	100	0	0	0	15	100	0	0	0
Hull						40	100	85	93	98
Kent	360	100	100	99	100	23	100	100	96	100
L Kings	498	100	100	0	0	59	100	100	0	0
Leeds	457	100	95	100	100	27	100	81	100	100
Leic	858	100	100	0	0	53	100	100	0	0
Middlbr	214	100	100	0	0	12	100	100	0	0
Newc	232	100	100	0	0					
Norwch	282	100	100	99	100	32	100	100	66	100
Nottm	322	100	100	97	100	52	100	100	98	100
Oxford	367	100	100	0	0	63	100	100	0	0
Prestn	499	100	18	0	0	28	100	4	0	0
Redng	250	100	100	0	0					
Salford						65	100	100	100	0
Sheff	519	100	93	0	0	29	100	100	0	0
Stevng	458	100	100	100	100	9	100	100	100	100
Sthend	104	100	95	0	0	14	100	86	0	0
Sund	200	100	100	0	0	10	100	100	0	0
Wirral	155	100	100	100	100	13	100	100	100	100
Wolve	243	100	100	97	100	41	100	100	100	100
York	158	100	91	100	99	18	100	89	94	100
N Ireland										
Antrim	104	100	100	100	100	11	100	100	100	100
Belfast	176	100	100	99	100	19	100	100	95	100
Newry	72	100	100	99	100	13	100	100	92	100
Ulster	89	100	100	100	100					
West NI	110	100	100	97	100					
Wales										
Clwyd						8	100	0	0	0
Swanse	304	100	100	100	100	35	100	100	100	100

Blank cells – data not useable or not available

Discussion

Anaemia is one of the major comorbidities associated with CKD. It can lead to a debilitating reduction in exercise capacity and quality of life as well as left ventricular dysfunction and heart failure. While the degree of renal impairment affects the likelihood of any patient developing anaemia [8], all patients should be carefully

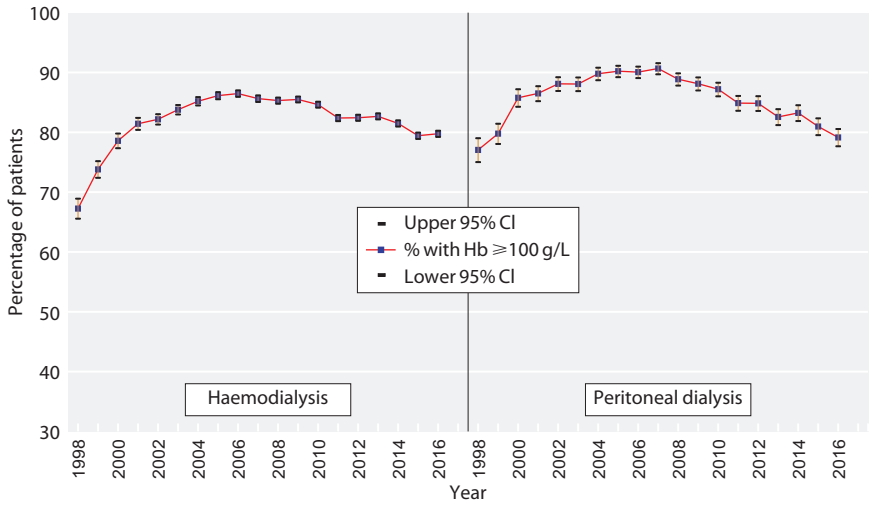

Fig. 7.35. Percentage of prevalent HD and PD patients (1998–2016) with Hb ⩾100 g/L

investigated for an underlying cause particularly prior to the initiation of any therapy. The anaemia of chronic kidney disease, often an isolated normocytic anaemia, is multifactorial but primarily due to a reduction (absolute or relative) in erythropoietin production often with an associated (absolute or relative) iron deficiency. Inflammatory processes related to underlying kidney disease or other comorbidities, inflammatory processes related to dialysis, blood loss (CKD-associated platelet dysfunction, frequent phlebotomy, dialysis-associated blood loss), hyperparathyroidism and dialysis inadequacy may all further contribute to the anaemia and may do so variably over time, resulting in a need for regular monitoring.

The goal of anaemia management in CKD is the maintenance of acceptable Hb concentrations. Prior to the development of ESAs, severe anaemia with intermittent blood transfusions were the norm. Unexpectedly, several studies subsequently showed adverse outcomes with physiological correction of Hb with ESAs [5–7], resulting in clinical guidelines advocating a target Hb of 100–120 g/L for patients receiving ESA therapy. This evolution in understanding of optimal Hb targets is reflected in historic analyses in figures 7.18 and 7.35. Guidelines continue to underline the importance of individualising therapy taking into account the time it takes for ESA therapy to work and the small but significant risk associated with ESA therapy.

Haemoglobin outcomes were similar for both HD and PD patients with proportions of prevalent patients compliant with Hb 100–120 g/L of 59% and 55% respectively. Prevalent HD patients had a higher median serum ferritin (410 μg/L vs 306 μg/L), a higher proportion of patients requiring ESAs (90% vs 70%) and a higher median ESA dose in those receiving ESAs (7,750 IU/week vs 4,500 IU/week) compared with prevalent PD patients.

As expected, a greater proportion of prevalent dialysis patients than incident patients attained a Hb ⩾100 g/L (80% vs 47%). Only 34% of late presenters achieved a Hb ⩾100 g/L suggesting that part of this difference was because there was less opportunity for anaemia to be treated with iron or ESAs. The fact that even in the early presenting incident group of patients only 50% achieved Hb ⩾100 g/L suggests that opportunity is only part of the explanation for incident patients. Alternative explanations include the fact that a number of patients commenced dialysis at the time of an acute illness when acute anaemia is common.

The proportion of patients achieving a serum ferritin of ⩾100 μg/L was 94% of HD patients and 88% of PD patients. It is recommended that patients be iron replete to achieve and maintain optimal target Hb, while avoiding iron overload and potential toxicity as reflected in the guideline audit measures. Iron repletion helps to minimise both the need to initiate ESA therapy and the dose of ESA subsequently required. The revised Renal Association anaemia guideline published midway through the 2017 data collection period [2] recommends that percentage hypochromic red blood cells or reticulocyte haemoglobin are preferable markers of iron deficiency than serum ferritin or transferrin saturation. Renal centres will need to consider the incorporation of these changes into local guidelines. The UKRR will continue to work in collaboration with renal centres to report these new data items as well as improve data completeness for ESA and iron therapy. As of 2016, the analysis of ESA usage continued to be limited by incomplete

data returns. From the available data, 90% of HD patients and 70% of PD patients were receiving ESAs. The attainment of Hb targets correlated poorly with median ferritin and ESA usage.

There continued to be variation in concordance with anaemia guidelines between UK renal centres.

Conflicts of interest: the authors declare no conflicts of interest

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