Chapter 6: Haemoglobin and related variables

This chapter describes the position at the end of 1998 for all units from England and Wales on the Registry.

The Renal Association Standards document 1997 which recommends that ***"a target haemoglobin concentration of 10g/dl should be achieved in 85% of patients after 3 months on dialysis."***

Inclusion criteria

Patients were included in this analysis if they had been stable at the same centre, on the same modality of dialysis for 3 months. The last available haemoglobin from each patient in the last quarter of 1998 was used in the analysis.

Data from centres were only included for statistical analysis if there was more than 75% data completeness. Centres with less than 50% completeness of data were not shown on the graphs. No laboratory harmonisation is required for haemoglobin.

Haemoglobin achievement by dialysis units

The data for haemoglobin concentrations has been presented in a variety of ways. This has enabled comparison with the Renal Association Standard for haemoglobin achievement but also provides units with their median haemoglobin. The spread of haemoglobin concentrations may help determine why the Standard is not being met and is also a marker of success in targeting particular haemoglobin levels. The data for haemodialysis and peritoneal dialysis patients is presented in figures 1- 6 and tables 1 and 2.

A higher proportion of patients on peritoneal dialysis achieved the Renal Association Standard than on haemodialysis. In 1998 78% of peritoneal dialysis patients and 69% of haemodialysis patients in England and Wales had haemoglobin of 10g/dl or more (76% and 62% respectively in 1997).

Two centres achieved the Standard for patients on haemodialysis compared with none last year. For three additional centres, the 95% C.I. also included the 85% achievement Standard. Of those centres on the Registry in 1997 centre K achieved the greatest improvement in haemoglobin.

Five centres achieved the haemoglobin Standard for patients on peritoneal dialysis with an additional eight centres having a 95% C.I which includes the Standard. In 1997 for patients on peritoneal dialysis, only one of the nine centres achieved the Standard.

Units with good results for HD (I, H, B, K, M, D) also appeared to perform well for PD. This suggests that some units have haemoglobin management strategies that are effective in both dialysis modalities.

A chi-squared test was used to determine whether the percentage of patients with haemoglobin over 10g/dl differed between centres. A significant difference was found between centres in both haemodialysis (X^2 = 164.0, d.f. = 17, p<0.001) and peritoneal dialysis (X^2 = 64.5, d.f. = 18, p<0.001).

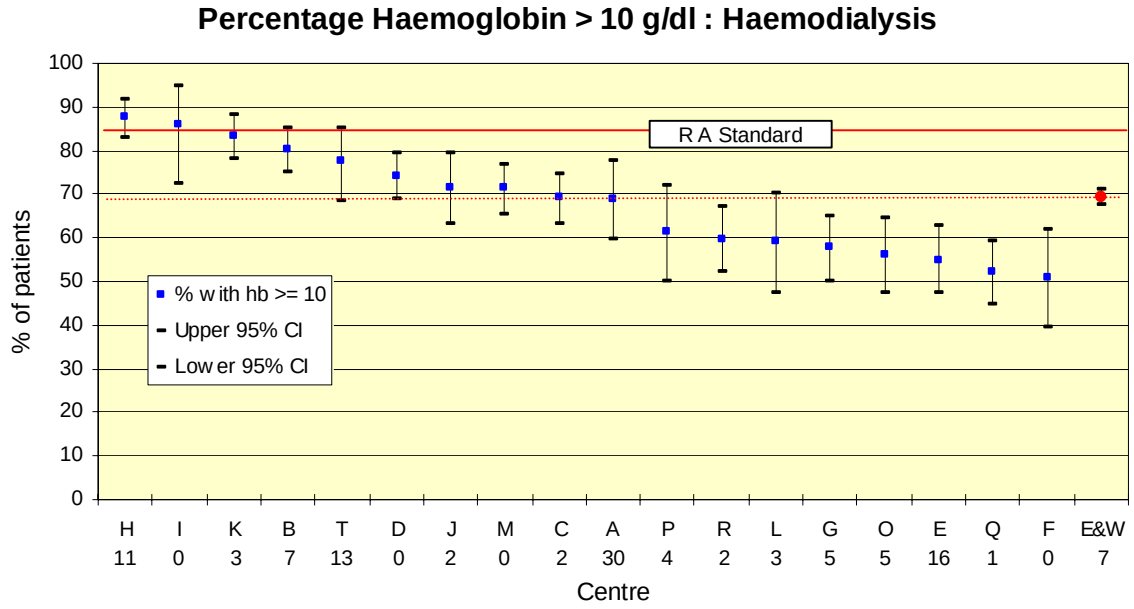


Figure 6.1 Haemoglobin Percentage of HD patients achieving the RA Standard

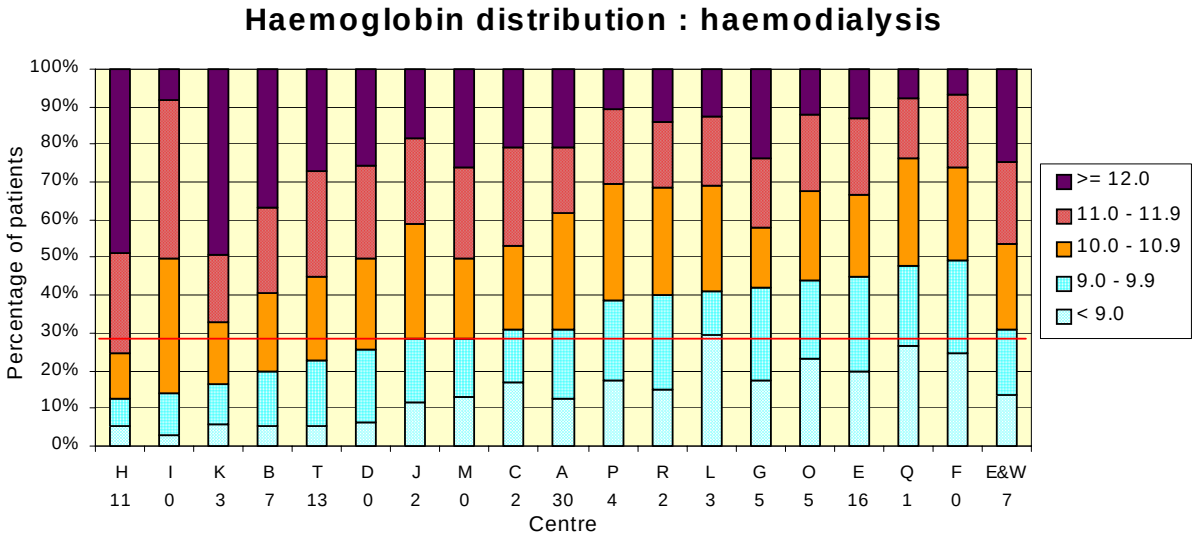


Figure 6.2 Haemoglobin for patients on HD by 1g/dl bands

Figure 6.2 shows the spread of data by 1g/dl bands. The centres are ordered by increasing percentage with a haemoglobin > 10 g/dl, with centres to the left having the highest percentage. These bands give a clearer representation of the distribution of the data by centre than the cumulative frequency distribution plots presented in the 1998 report.

Centre	% data return	Median Hb g/dl	90% range	Quartile range	% Hb ≥ 10g/dl	Mean Hb	Standard deviation	% Hb ≥10 without epo
A	70	10.5	8.4-13.5	9.7-11.7	69	10.7	1.5	*
B	93	11.3	8.9-14.3	10.3-12.6	80	11.4	1.7	11
C	98	10.8	8.0-13.2	9.6-11.8	69	10.7	1.6	22
D	100	11.0	8.7-13.6	9.9-12.0	74	11.0	1.6	14
E	84	10.1	8.1-13.7	9.3-11.3	55	10.3	1.6	17
F	100	10.0	7.9-12.1	9.0-11.0	51	10.0	1.3	*
G	95	10.5	7.8-13.8	9.3-11.9	58	10.6	1.8	*
H	89	11.9	8.9-14.3	11.0-12.8	88	11.8	1.6	*
I	100	11.0	9.0-12.8	10.3-11.5	86	10.9	1.1	*
J	98	10.7	8.0-13.6	9.8-11.5	72	10.7	1.6	8
K	97	11.9	8.7-14.4	10.4-12.8	83	11.7	1.8	*
L	97	10.1	7.1-12.6	8.8-11.4	59	10.0	1.7	1
M	100	11.0	8.0-13.5	9.7-12.0	71	10.9	1.8	*
N	48	*	*	*	*	*	*	*
O	95	10.2	6.9-12.8	9.0-11.2	56	10.2	1.4	5
P	96	10.2	7.8-12.6	9.2-11.1	61	9.9	1.7	*
Q	99	10.0	7.4-12.5	8.8-10.9	52	10.3	1.4	*
R	98	10.4	7.9-12.6	9.3-11.3	60	11.0	1.4	*
T	87	11.1	8.6-13.2	10.2-12.0	77	10.8	1.7	*
E & W	**93**	**10.8**	**8.0-13.7**	**9.7-11.9**	**69**	10.8	1.7	**12**

* insufficient data

Table 6.1 Haemoglobin data for patients on haemodialysis

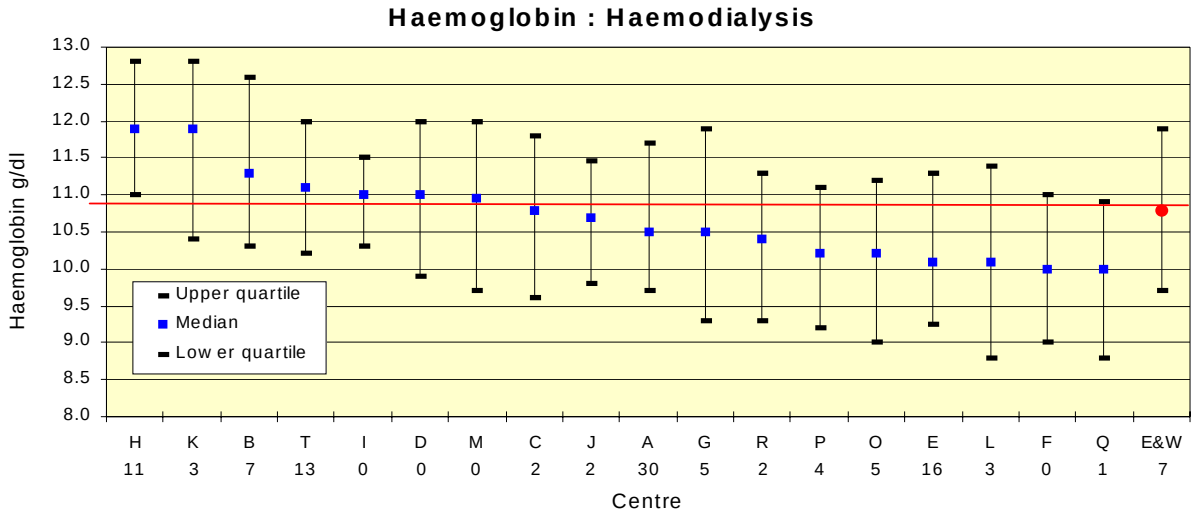


Figure 6.3 Haemoglobin median and quartile range for haemodialysis patients

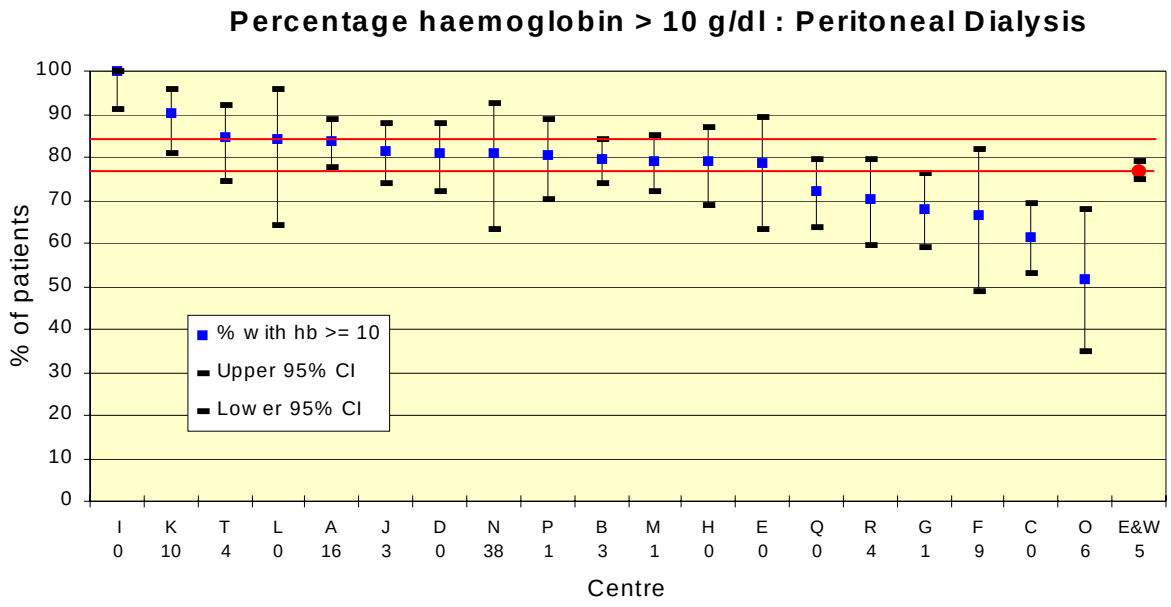


Figure 6.4 Percentage haemoglobin > 10 g/dl on peritoneal dialysis

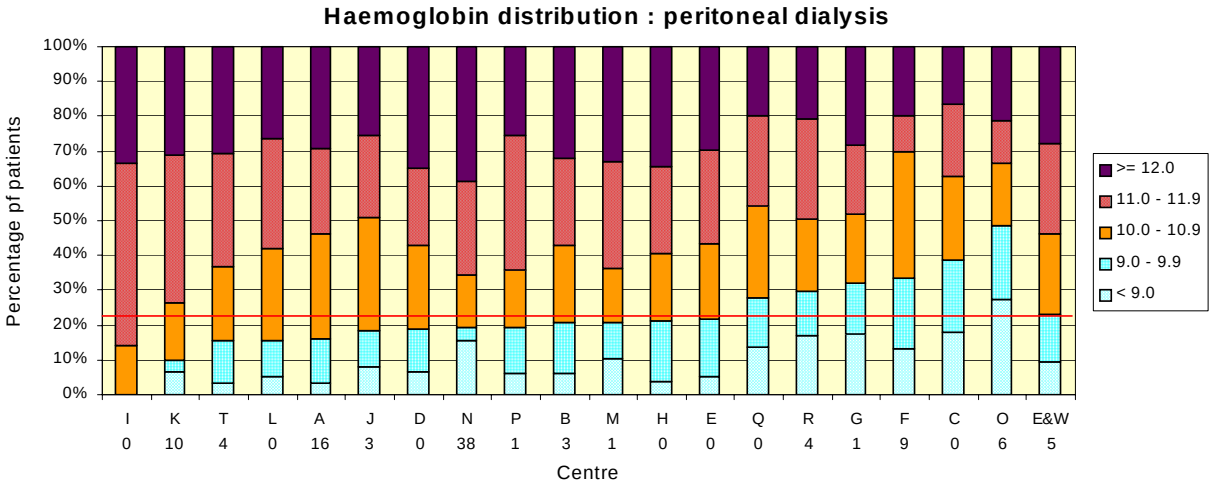


Figure 6.5 Distribution of haemoglobin for patients on PD by 1g/dl bands

Centre	% data return	Median Hb g/dl	90% range	Quartile range	% Hb ≥ 10g/dl	Mean Hb	Standard deviation	% Hb ≥10 without epo
A	84	11.2	9.3-13.8	10.3-12.1	84	11.3	1.5	*
B	97	11.2	8.6-13.8	10.2-12.3	79	11.2	1.7	25
C	100	10.4	7.6-13.1	9.3-11.5	61	10.4	1.6	43
D	100	11.2	8.9-13.8	10.1-12.2	81	11.2	1.5	34
E	100	11.6	8.8-13.2	10.1-12.2	78	11.1	1.4	*
F	91	10.5	8.0-12.1	9.6-11.2	67	10.4	1.3	40
G	99	10.8	8.0-14.1	9.6-12.3	68	10.8	1.9	*
H	100	11.3	9.0-13.6	10.1-12.3	79	11.3	1.5	*
I	100	11.5	10.4-14.2	11.0-12.3	100	11.9	1.4	*
J	97	10.9	8.6-13.5	10.2-12.0	82	11.1	1.4	33
K	90	11.4	8.8-14.2	10.9-12.1	90	11.6	1.5	*
L	100	11.7	8.9-15.4	10.5-12.4	84	11.6	1.7	16
M	99	11.4	8.2-13.8	10.5-12.4	79	11.2	1.7	*
N	62	11.6	8.0-13.0	10.7-12.2	81	11.1	1.6	*
O	94	10.1	6.8-14.1	8.9-11.4	52	10.3	2.2	27

Centre	% data return	Median Hb g/dl	90% range	Quartile range	% Hb ≥ 10g/dl	Mean Hb	Standard deviation	% Hb ≥10 without epo
P	99	11.2	8.9-13.0	10.2-12.0	81	11.2	1.3	*
Q	100	10.8	7.8-13.1	9.8-11.7	72	10.7	1.7	*
R	96	10.9	8.5-12.9	9.3-11.6	70	10.8	1.7	*
T	96	11.4	9.1-13.8	10.5-12.0	85	11.4	1.5	*
E & W	**95**	**11.1**	**8.4-13.7**	**10.0-12.0**	**77**	11.1	1.6	**32**

* insufficient data

Table 6.2 Haemoglobin data for patients on peritoneal dialysis

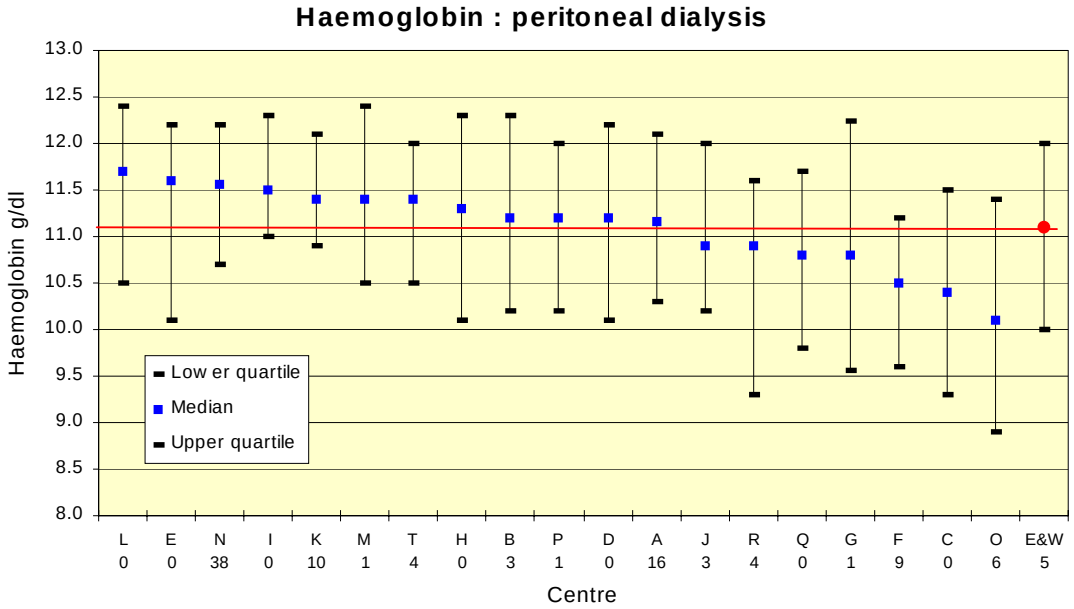


Figure 6.6 Median haemoglobin on peritoneal dialysis

Factors influencing haemoglobin

Haemoglobin concentration is influenced by several factors, for example erythropoietin prescription and iron stores. Other influences are less certain. Interpretation of factors influencing haemoglobin is rendered difficult by lack of information on prescription of erythropoietin, which is a major determining factor of haemoglobin achieved. It is important for more centres to facilitate the collection of erythropoietin data in their renal systems.

Tables 6.1 and 6.2 report (where available) the percentage of patients in each unit that achieved a haemoglobin concentration greater than 10 g/dl without the prescription of erythropoietin. This may be an indicator of whether overall management within a centre is conducive to high haemoglobin. As expected fewer patients on peritoneal dialysis require erythropoietin than haemodialysis.

Haemoglobin and serum ferritin

The Renal Association does not set a Standard for serum ferritin but it is known that individuals do not respond well to erythropoietin without adequate iron stores. Centres use different variables as measures of iron stores: Serum ferritin is the one most commonly used. For this report, serum ferritin levels have been analysed and are shown in tables 6.3 and 6.4. As with haemoglobin the distribution of serum ferritin concentrations is represented by the inter-quartile and 90% ranges. The percentage with serum ferritin over 100 mcg/l can be compared between units using 95% confidence intervals.

A chi-squared test was used to determine whether the percentage of patients with ferritin over 100 mcg/dl differed between centres. A significant difference was found between centres in both haemodialysis ($X^2 = 352.1$, d.f. = 17, $p<0.001$) and peritoneal dialysis ($X^2 = 93.7$, d.f. = 18, $p<0.001$).

Centre	% data return	Median ferritin	90% range	Quartile range	% ferritin ≥ 100µg/l	95% CI % ferritin ≥ 100
A	63	315	128-976	185-548	98	93-100
B	96	210	50-871	129-365	84	79-88
C	99	413	42-1263	255-630	92	88-95
D	99	251	32-866	114-399	78	72-82
E	83	135	26-602	68-248	65	57-72
F	100	233	32-846	130-348	90	82-96
G	90	467	116-1660	239-840	98	95-100
H	69	350	28-1188	175-570	87	81-91
I	100	373	190-1103	297-453	100	95-100
J	98	189	33-975	106-379	77	69-84
K	97	392	133-729	251-504	98	95-99
L	93	314	81-1041	182-561	93	85-97
M	93	104	20-652	56-187	53	46-59
N	49	*	*	*	*	*
O	93	292	56-1699	130-566	84	77-90
P	96	258	32-771	102-416	76	66-85
Q	98	346	117-1055	233-463	96	82-98
R	97	421	71-1080	300-556	93	88-96
T	85	225	44-976	126-444	79	70-87
E & W	**90**	**285**	**41-987**	**140-482**	**84**	**83-85**

* insufficient data

Table 6.3 Ferritin concentrations in haemodialysis patients

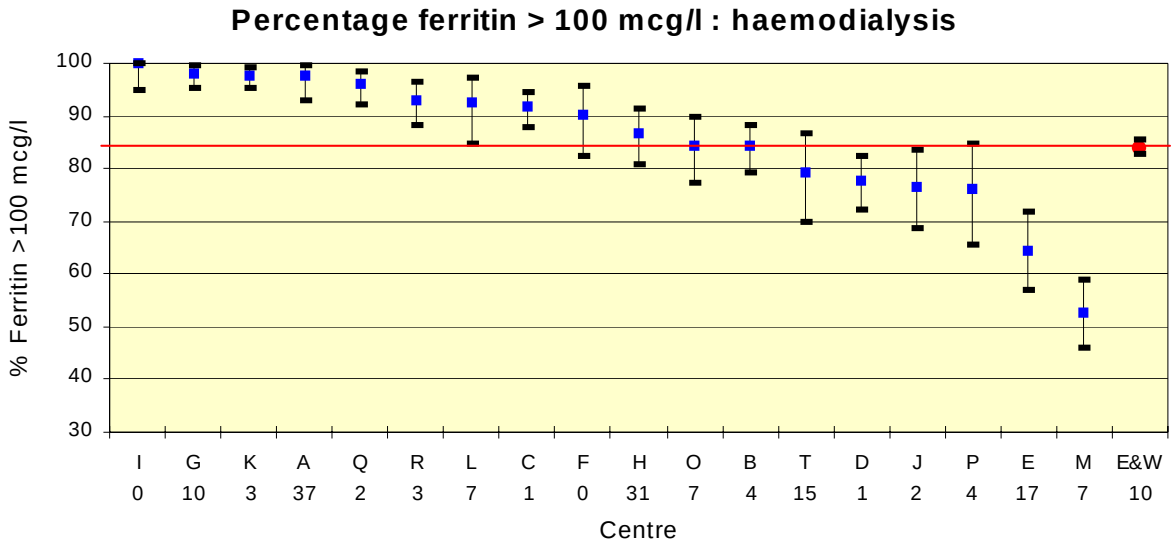


Figure 6.7 Percentage ferritin > 100 mcg/l on haemodialysis

The numbers under each centre on the graph show the percentage of missing ferritin data over 9 months, for that unit. Error bars represent 95% confidence intervals.

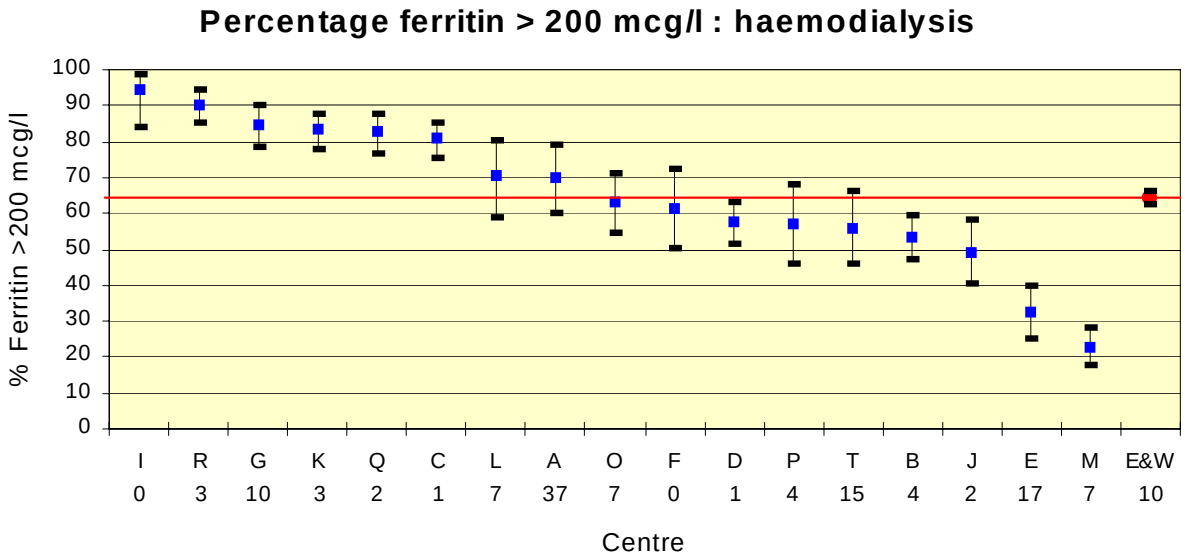
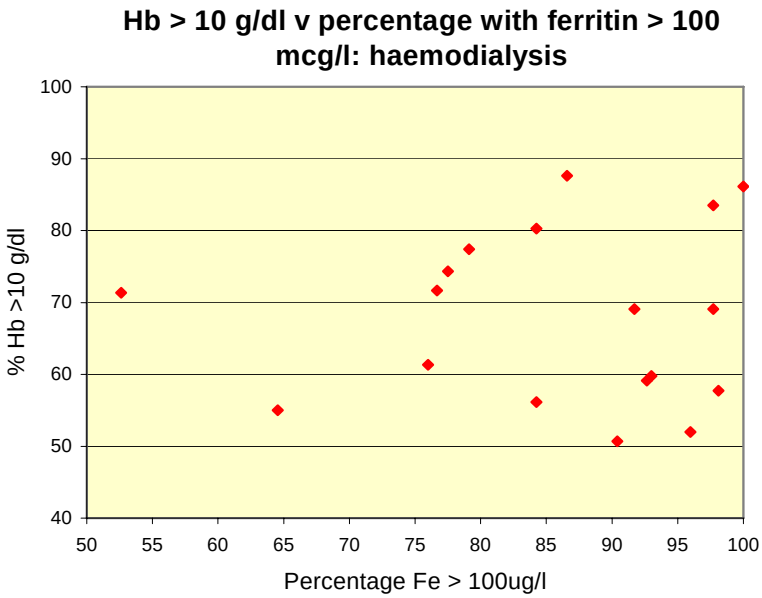


Figure 6.8 Percentage ferritin > 200 mcg/l on haemodialysis



Centre	% with ferritin ≥ 100	% with Hb ≥ 10
A	98	69
B	84	80
C	92	69
D	78	74
E	65	55
F	90	51
G	98	58
H	87	88
I	100	86
J	77	72
K	98	83
L	93	59
M	53	71
O	84	56
P	76	61
Q	96	52
R	93	60
T	79	77
E&W	**84**	**69**

Figure 6.9 Haemoglobin > 10 g/dl vs. ferritin > 100 mcg/l on haemodialysis

Centre	% data return	Median ferritin µg/l	90% range	Quartile range	% ferritin > 100µg/l	95% CI for % ferritin > 100µg/l
A	79	266	58-901	175-392	89	83-93
B	97	266	56-1330	148-468	85	80-89
C	100	322	81-1060	178-566	91	86-95
D	99	229	47-783	136-371	81	72-88
E	97	181	23-377	131-262	89	76-96
F	55	119	26-696	84-169	61	38-81
G	68	179	20-1065	99-359	75	65-84
H	89	199	57-686	104-372	76	66-85
I	100	265	65-793	147-373	81	61-94
J	74	133	27-758	75-292	60	50-70
K	88	239	58-584	174-377	87	77-94
L	100	516	101-930	240-660	100	90-100
M	88	149	32-927	78-251	64	56-72
N	64	142	41-984	69-256	59	41-76
O	86	239	50-1089	114-326	93	81-99
P	90	252	54-686	134-395	84	73-91
Q	96	216	61-722	123-387	85	78-91
R	99	222	49-696	135-350	84	74-91
T	90	257	48-532	156-382	87	77-94
E & W	**88**	**229**	**45-879**	**122-389**	**81**	**79-83**

Table 6.4 Ferritin concentrations in peritoneal dialysis patients

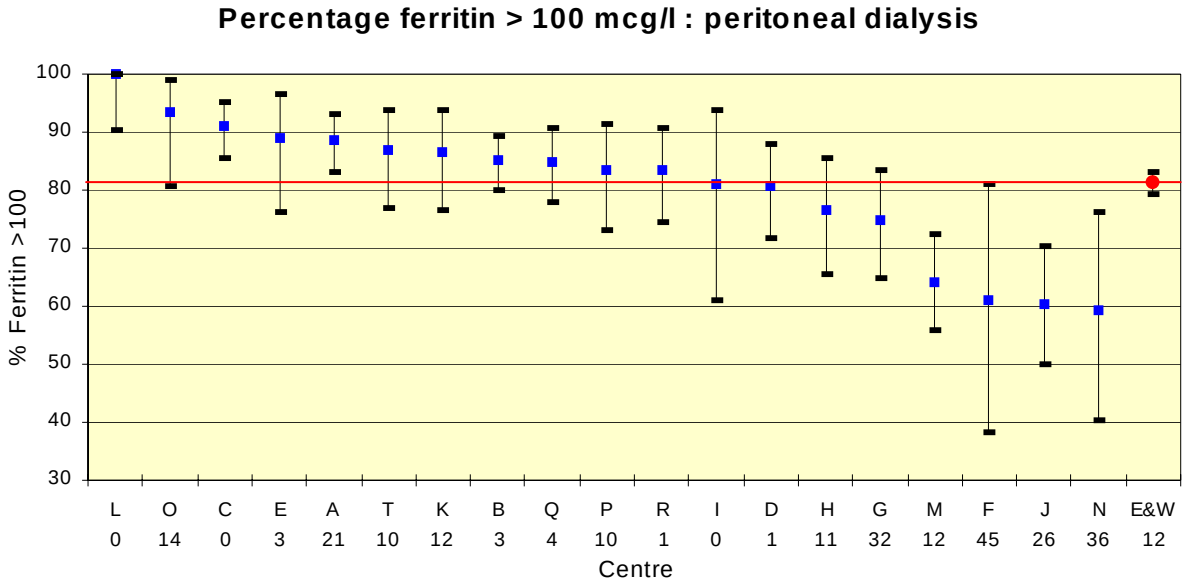


Figure 6.10 Percentage ferritin > 100 mcg/l on peritoneal dialysis

The numbers under each centre on the graph show the percentage of missing ferritin data over 9 months, for that unit. Error bars represent 95% confidence intervals.

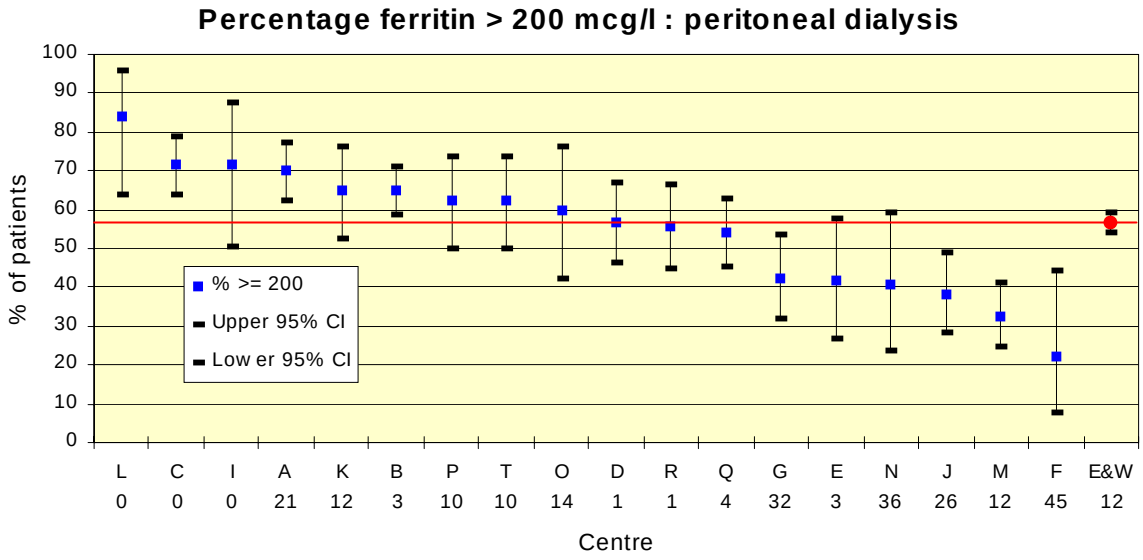
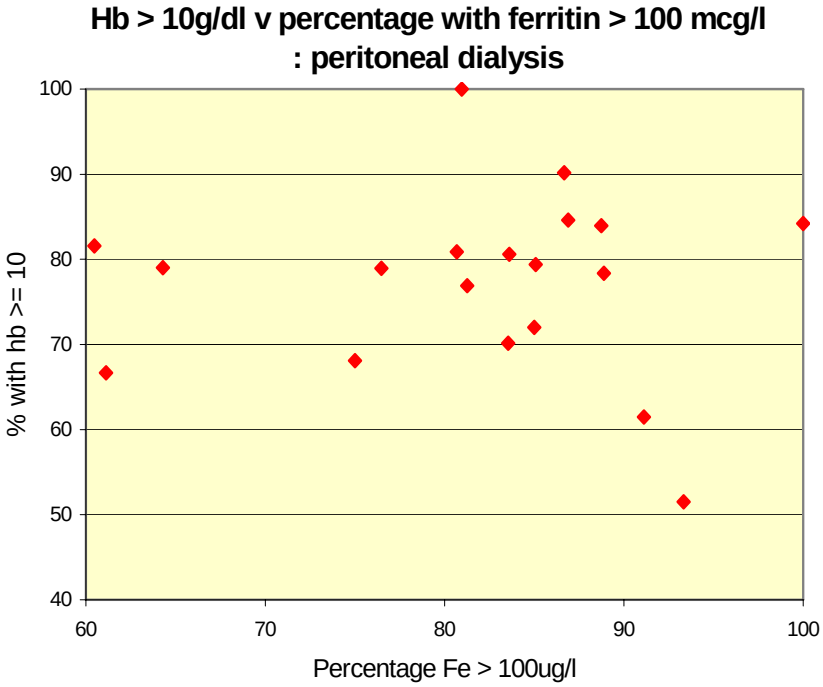


Figure 6.11 Percentage ferritin > 200 mcg/l on peritoneal dialysis

The numbers under each centre on the graph show the percentage of missing ferritin data over 9 months, for that unit. Error bars represent 95% confidence intervals.



Centre	% with ferritin ≥ 100	% with Hb ≥ 10
A	89	84
B	85	79
C	91	61
D	81	81
E	89	78
F	61	67
G	75	68
H	76	79
I	81	100
J	60	82
K	87	90
L	100	84
M	64	79
N	59	81
O	93	52
P	84	81
Q	85	72
R	84	70
T	87	85
E&W	**81**	**77**

Figure 6.12 Haemoglobin > 10 g/dl vs. ferritin > 100 mcg/l on peritoneal dialysis

There was no clear correlation between the percentage of patients with serum ferritin over 100 mcg/l and achievement of the Standard haemoglobin in either haemodialysis or peritoneal dialysis patients (figures 6.6 and 6.9). This suggests that variations in iron stores are not a major determinant of the differences in haemoglobin achieved between units.

Intravenous iron usage

Syner-Med collect data on intravenous iron used in centres which exclusively use their preparation. The company made available to the Registry data from some of the centres on calculated intravenous iron usage per dialysis patient. The centres have been classed as high, medium or low users of intravenous iron to preserve confidentiality.

Intravenous iron use	Centre
Low	B,M,T
Medium	C,R
High	G, I, L,O

Low usage of intravenous iron is correlated with a lower percentage of patients having a serum ferritin above 200 mcg/L. Usage of intravenous iron is not correlated with achievement of the haemoglobin Standard. Centre B, a low user has 80% of haemodialysis patients with a haemoglobin above 10 g/dl. Centres G, L, and O are high users although only 58, 59 and 56% of their haemodialysis patients have haemoglobins above 10 g/dl. The iron usage by these centres has not changed in the last 1- 2 years.

Haemoglobin and erythropoietin

Although the Registry is able to accurately collect laboratory data from centres, many renal units do not record erythropoietin usage on their renal IT systems. Some centres only record partial erythropoietin data and this has been identified during the analysis, confirmed with the centre and excluded from the erythropoietin analysis. This limits conclusions that can be drawn from this data. Most centres only record whether an individual was prescribed erythropoietin and failure to record is assumed to mean that erythropoietin has not been prescribed. The rates of prescription of erythropoietin are shown in table 6.5.

Data from the Health Care Finance Association in the USA shows a much higher usage, with 96% of haemodialysis patients on erythropoietin. The importance of erythropoietin is illustrated by centre Q in which 48% of HD patients have haemoglobin < 10g/dl as this centre is not adequately funded for erythropoietin treatment. If centres work to a minimum haemoglobin of 10g/dl then it might be presumed that patients with a haemoglobin less than this level will be prescribed erythropoietin. Rates of erythropoietin prescription to patients with haemoglobin less than 10g/dl are reported in table 5 and may be useful in determining whether there are specific groups to which there is a relative reluctance to prescribe erythropoietin. For example although patients on peritoneal dialysis have higher haemoglobins and lower erythropoietin requirements than haemodialysis patients, there is a smaller proportion of those with haemoglobin less than 10 g/dl that are prescribed erythropoietin.

	Haemodialysis				**Peritoneal dialysis**			
Centre	**% on EPO**	**Mean dose for pats on EPO**	**Median dose pats on EPO**	**Hb<10g/dl % on EPO**	**% on EPO**	**Mean dose pats on EPO**	**Median dose pats on EPO**	**Hb<10g/dl % on EPO**
B	88	6791	6000	98	69	4762	4000	74
C	70	6126	6000	72	36	5885	6000	46
D	83	6389	6000	71	61	4444	4000	71
F	85	6121	6000	92	45	3467	4000	70
J	86	6962	6000	82	57	5716	6000	57
L	97	6958	8000	97	84	3438	3000	100
N	*			*	79			
O	81			77	51			63
E & W	**81**			**84**	**59**			**62**

* insufficient data

Table 6.5 Erythropoietin prescribing in dialysis patients

Despite the known importance of erythropoietin and iron stores the measured variables do not fully explain the differences in haemoglobin achievement between units. In centre F 49% of HD patients did not achieve the Standard although 85% of patients were treated with EPO and 92% of patients with a haemoglobin of < 10 g/dl were on EPO. Serum ferritins were high in this centre.

Influence of demographics on haemoglobin concentration

Regression analysis adjusted for treatment centre effect, has been used to describe the relationship between haemoglobin and continuous variables. Statistical significance has been defined as $p<0.05$.

Haemoglobin and age

Patients' age on 31/12/98 was analysed against latest haemoglobin in the previous 6 months.

Haemodialysis

Data from 2694 patients was analysed from a total of 2823 patients in the centres with more than 75% data return. A significant negative association was found between age and haemoglobin. A 10-year increase in age was associated with a 0.047g/dl decrease in haemoglobin (95% CI: 0.008-0.087, F=5.5, p=0.0187). Data for erythropoietin prescribing is shown in table 6 indicating no consistent effect of age on spontaneous haemoglobin over 10g/dl without erythropoietin or on rates of erythropoietin prescription.

Age group (years)	18-34	35-44	45-54	55-64	65-74	75+
% on EPO	89 (106)	81 (129)	69 (134)	77 (202)	85 (271)	83 (182)
% Hb >10 no EPO	8 (9)	13 (19)	23 (42)	15 (36)	8 (22)	8 (15)
% Hb <10 on EPO	97 (30)	86 (37)	78 (39)	79 (57)	86 (85)	85 (47)

Brackets indicate total numbers.

Table 6.6 Erythropoietin prescription by age in haemodialysis patients

Peritoneal dialysis

Data from 1598 patients on peritoneal dialysis was analysed from a total of 1660 patients in the centres with more than 75% data return. A significant positive association was found between age and haemoglobin. A 10-year increase in age was associated with a 0.096g/dl increase in haemoglobin (95% CI: 0.043 – 0.148, F=12.9, p=0.0003). Data in table 6.7 suggests a relative reluctance to prescribe erythropoietin to elderly anaemic patients on peritoneal dialysis although numbers are too small for formal analysis.

Age group (years)	18-34	35-44	45-54	55-64	65-74	75+
% on EPO	63 (47)	65 (57)	62 (84)	59 (97)	53 (83)	56 (48)
% Hb>10 no EPO	24 (7)	26 (21)	32 (41)	36 (54)	33 (49)	36 (25)
% Hb<10 on EPO	70 (19)	75 (24)	76 (22)	64 (18)	36 (13)	50 (7)

Brackets indicate total numbers

Table 6.7 Erythropoietin prescription by age in peritoneal dialysis patients

Haemoglobin and time on renal replacement therapy

The number of days on renal replacement therapy on 31/12/98 was analysed. Since the time distribution was skewed the data was log transformed for regression analysis. The data is shown in table 6.8.

	no of patients with data	total patients in included centres	change in Hb for 10 fold increase in days on dialysis	95% CI	F
Haemodialysis	2463	2632	+0.33 g/dl	+0.19 to +0.47	21.4 (p<0.0001)
Peritoneal dialysis	1417	1468	- 0.12 g/dl	- 0.31 to +0.07	1.6 (p=0.2117)

Table 6.8 Haemoglobin and time on dialysis

No significant relationship was found between haemoglobin and time on renal replacement therapy in peritoneal dialysis patients. For haemodialysis patients there was a significant relationship between haemoglobin and time on dialysis. The cross section of patients who had been on dialysis for a short time had lower haemoglobin than those who had been dialysed for some years. One interpretation of this would be that patients with low haemoglobins have increased mortality and therefore drop out from data on the long-term survivors. The relationship is most easily demonstrated graphically. Figure 6.10 shows the relationship for one particular centre. The regression line is derived from the relationship described for the whole population in table 6.8 and the haemoglobin distribution in that centre. The data suggest that centres with a high proportion of new patients will find it difficult to achieve the Renal Association Standard at three months. Data from the USA also show early anaemia reaching a plateau by about one year. The characteristics of patients early in their treatment history may be difficult for a centre to influence if referrals are received late. The rapid increase in haemoglobin during the first year suggest that it would be more appropriate to judge a centre's performance by haemoglobin levels at a later time point after starting renal replacement therapy.

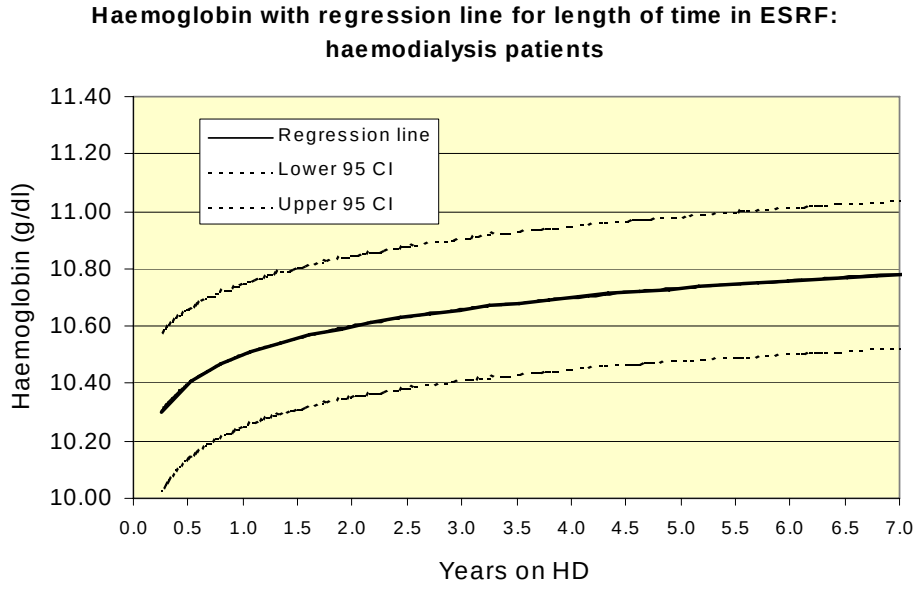


Figure 6.13 Haemoglobin regression line by length of time in ESRF

Haemoglobin and gender

The mean haemoglobin of men and women was compared by analysis of variance and adjusted for treatment centre effect.

Haemodialysis

Haemoglobin data was available for 2692 patients (1702 males and 990 females) from a total of 2823 in the included centres. Data on erythropoietin prescribing was available for 800 males and 468 females in the included centres.

Gender	mean Hb g/dl	Standard deviation	% on EPO	% Hb < 10 g/dl on EPO	% Hb>10g/dl without EPO
Male	10.9	1.78	77 (617)	80 (173)	15 (108)
Female	10.6	1.62	87 (406)	91 (122)	8 (35)

Numbers in brackets are the total number of patients

Table 6.9 Haemoglobin and gender in HD patients

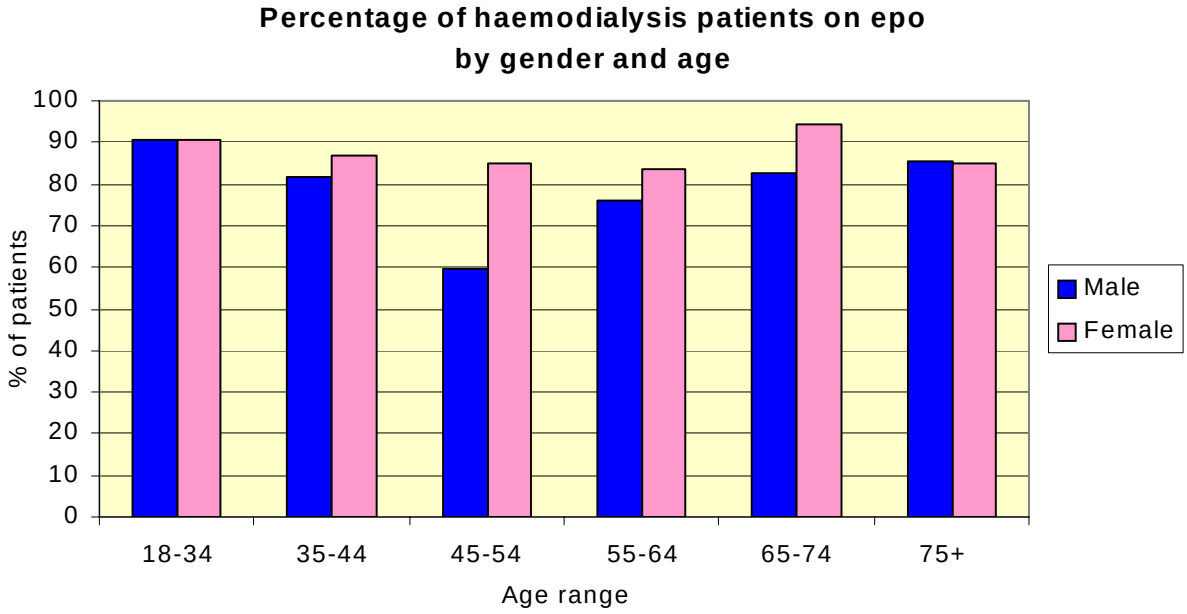


Figure 6.14 Percentage of haemodialysis patients on EPO by age

The mean haemoglobin of men on haemodialysis was significantly higher than women (Difference 0.25g/dl, 95% CI 0.13-0.38g/dl, F=15.1, p<0.0001).

Peritoneal dialysis

Haemoglobin data was available for 1598 patients (960 males and 635 females) from a total of 1660 in the included centres. Data on erythropoietin prescribing was available for 430 males and 276 females in the included centres.

Gender	mean Hb g/dl	s.d.	% on EPO	Hb < 10 g/dl % on EPO	% Hb>10g/dl without EPO
Male	11.2	1.65	56 (240)	66 (57)	37 (146)
Female	10.8	1.61	64 (176)	58 (46)	24 (61)

Numbers in brackets are the total number of patients

Table 6.10 Haemoglobin and gender in peritoneal dialysis patients

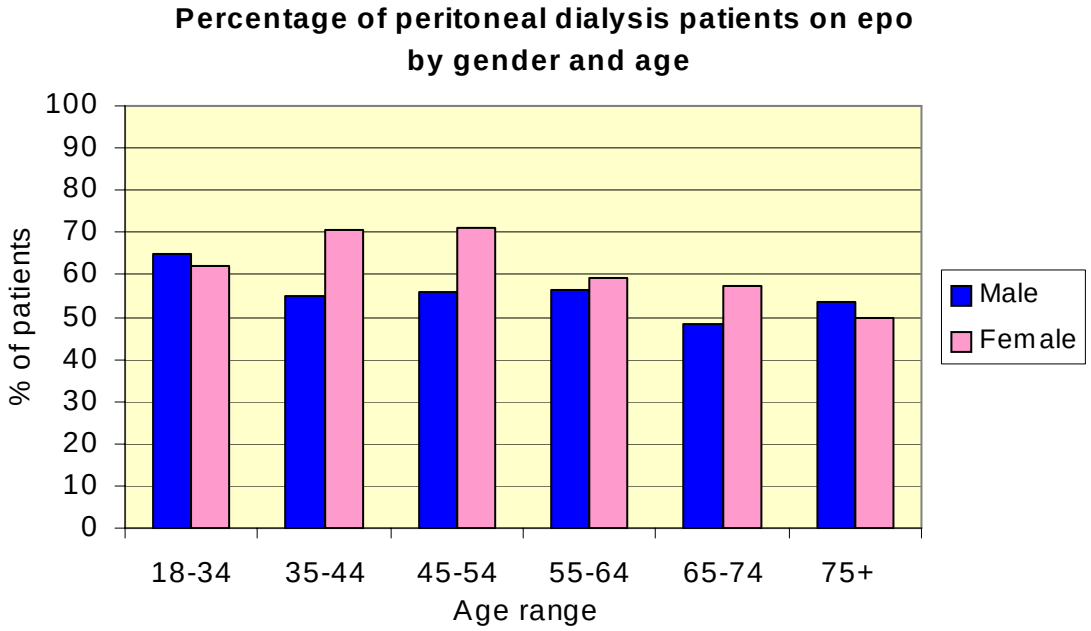


Figure 6.15 Percentage of peritoneal dialysis patients on EPO by age

The mean haemoglobin of men on peritoneal dialysis was significantly higher than women (Difference = 0.36g/dl, 95% CI 0.20-0.52, F=19, p<0.0001)

The percentage of patients with haemoglobin greater than 10g/dl, without requiring erythropoietin, was higher in men than women in both dialysis modalities. Despite their lower mean haemoglobin, a higher proportion of women were being treated with erythropoietin. Amongst patients on haemodialysis with a haemoglobin less than 10 g/dl men were less likely to be on erythropoietin than women (p=0.011). For patients on peritoneal dialysis there was no significant difference in erythropoietin prescribing to men and women with haemoglobin less than 10 g/dl (p=0.43) although numbers were small.

Haemoglobin and hyperparathyroidism

The most recent PTH value from the last three-quarters of 1998 was used for analysis. The PTH value was accepted even if the patient had subsequently changed modality. PTH follows a skewed distribution and hence the log of PTH was used for regression analysis.

Haemodialysis

Sufficient data on PTH was only available from 8 centres. 1209 patients were included from a total of 1300 in the analysed centres. No significant association between log

PTH and haemoglobin was found in haemodialysis patients. There was a non-significant decrease in haemoglobin of 0.14g/dl (95% CI –0.01 to 0.29g/dl, F=3.4, p=0.0637) for a ten-fold increase in PTH. This significance may change with increased patient numbers.

Peritoneal dialysis

Data was analysed for 846 patients out of a total of 944 from the 10 centres with sufficient data return. No significant association between log PTH and haemoglobin was found in peritoneal dialysis patients (decrease in haemoglobin for a ten-fold increase in PTH =0.15g/dl 95% CI –0.05 to 0.35g/dl, F=2.1, p=0.1447).

Haemoglobin and URR in haemodialysis patients

Haemoglobin and URR data were taken paired from the same quarter in the last 6 months of 1998. Patients on home haemodialysis or those known to be on twice or four times weekly dialysis were excluded. Data were available from 1868 patients from the total of 2075 patients in the centres with adequate data return. URR was significantly associated with a linear increase in haemoglobin (p=0.0143). The increase though, was only small with a 10% increase in URR from 60% to 70% associated with an increase in haemoglobin of 0.10g/dl (95% CI: 0.02-0.18g/dl).

Haemoglobin and cause of renal failure

In both haemodialysis and peritoneal dialysis the diagnosis of polycystic kidney disease was associated with higher haemoglobin than other causes of renal failure. The mean haemoglobin of haemodialysis patients with a diagnosis of polycystic kidney disease was 0.5g/dl higher than patients with other diagnoses (ANOVA 95% CI: 0.27-0.74g/dl, F=18, p<0.0001). The mean haemoglobin of peritoneal dialysis patients with a diagnosis of polycystic kidney disease was 0.7g/dl higher than patients with other diagnoses (95% CI: 0.36-1.04g/dl, F=16.2, p<0.0001).

Compliance with Renal Association recommendations and Renal Unit Median Haemoglobin

The current data confirm the linear relationship of median centre Haemoglobin and percent compliance with a minimum value of 10g/dl demonstrated in the 1998 Report, for both forms of dialysis (Figs 6.16/6.17). This association depends on the uniformity of the range of results (Standard Deviation, shown in Tables 6.1 and 6.2). Because of the apparently inevitable spread of outcome values a considerable over-achievement is necessary for compliance with the Standard.

It would be expected that a successful policy of targeting a particular haemoglobin concentration would result in narrowing of the spread of haemoglobins as shown by the standard deviation from the mean. This would indicate economic use of erythropoietin, with little wastage stimulating excessive haemoglobin concentrations, and may protect patients from the possible risks to vascular access of high haemoglobin. It is difficult

from a single year's data to comment on the targeting policy of individual centres, but the spread of data in most centres is similar regardless of median haemoglobin achieved. Some differences between centres are noted. For instance 86% of haemodialysis patients in Centre I achieved a haemoglobin > 10 g/dl with a median haemoglobin of 11.0 g/dl whilst centre H with 88% above 10 g/dl had median haemoglobin of 11.9 g/d, and many patients with high haemoglobin. The standard deviation for Centre I was 1.1 compared with 1.6 for Centre H, though the smaller number of patients in Centre I would have been expected to increase the standard deviation. The influence of explicit treatment strategies (e.g. 'Target' values) is uncertain from these data but will be reviewed with individual centres as part of the evaluation exercises undertaken by the Registry.

It is only by comparing data in subsequent years that it will become clear whether these differences are consistent or are a statistical anomaly of the 1998 data.

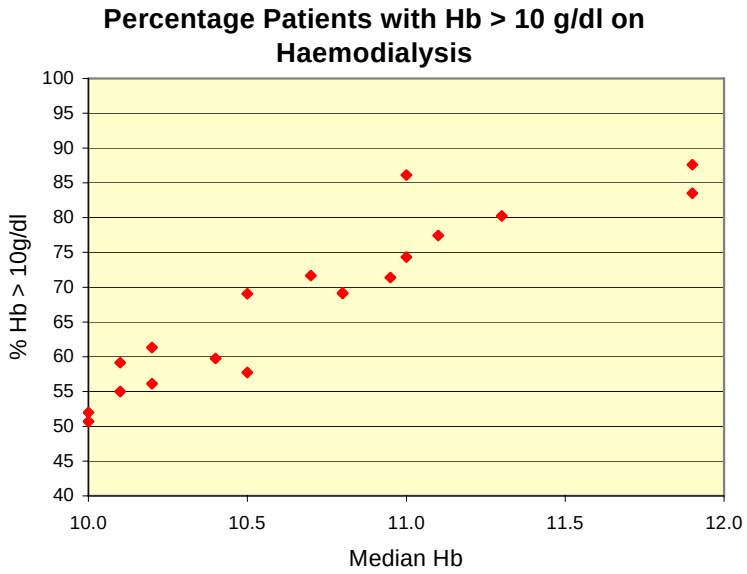


Figure 6.16 Individual centres achievement and median haemoglobin on HD

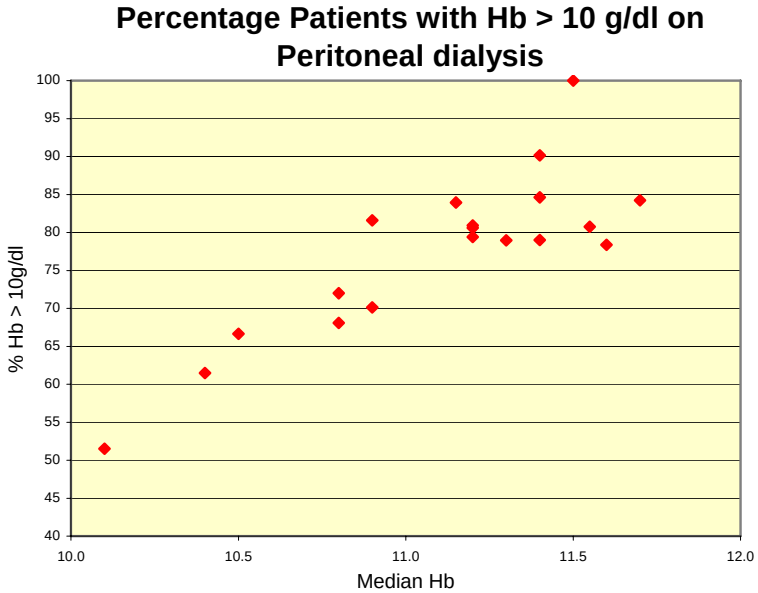


Figure 6.17 Individual centres achievement and median haemoglobin on PD

	Haemodialysis		Peritoneal Dialysis	
Centre	**Median Hb**	**% with Hb ≥ 10**	**Median Hb**	**% with Hb ≥ 10**
A	10.5	69	11.2	84
B	11.3	80	11.2	79
C	10.8	69	10.4	61
D	11.0	74	11.2	81
E	10.1	55	11.6	78
F	10.0	51	10.5	67
G	10.5	58	10.8	68
H	11.9	88	11.3	79
I	11.0	86	11.5	100
J	10.7	72	10.9	82
K	11.9	83	11.4	90
L	10.1	59	11.7	84
M	11.0	71	11.4	79
O	10.2	56	10.1	52
P	10.2	61	11.2	81
Q	10.0	52	10.8	72
R	10.4	60	10.9	70
T	11.1	77	11.4	85
E&W	**10.8**	**69**	**11.1**	**77**

Table 6.11 Percentage patients with Hb ≥ 10 g/dl on haemodialysis and peritoneal dialysis

Conclusion

More than 75 % return of haemoglobin data was achieved in all but 2 centres for haemodialysis and all but 1 centre for peritoneal dialysis. High rates of return were also achieved in the majority of centres for serum ferritin. The data for erythropoietin prescribing was only available from 8 centres and was less robust since failure to record prescription was assumed to mean that no prescription was made rather than as a failure to return the data. There was a wide range of median haemoglobin in the different centres and a wide range of achievement of the Renal Association Standard. The linear relationship of compliance with Standard and Median Haemoglobin was confirmed, although less consistent at higher values.

Haemodialysis patients in the first few months of renal replacement therapy have a higher rate of anaemia. It may be more appropriate to address the current standard to those on renal replacement therapy for at least six months or possibly one year.

There were different practices between centres with respect to prescribing erythropoietin and iron. As noted in the 1997 report anaemic patients on peritoneal dialysis were less likely than those on haemodialysis to be prescribed erythropoietin. The adequacy of haemodialysis appeared to be related to the achieved haemoglobin. The proportion of women on haemodialysis prescribed erythropoietin is higher than men, for a haemoglobin outcome that is less satisfactory. From the variables that have been measured it is often not possible to determine the reasons for differences in haemoglobin achieved in different centres.

These data show a progressive improvement in the haemoglobin of dialysis patients for England & Wales through 1997 to 1999.