Chapter 8 Haemoglobin and related variables

8:1 Inclusion criteria for the analysis

No laboratory harmonisation is required for haemoglobin. The data which follows are the latest relevant values of haemoglobin in the last 6 months of 1997. For these analyses, patients were only included if: -

1. They had received renal replacement therapy by dialysis for at least 3 months.
2. There had been no change of modality between haemodialysis and peritoneal dialysis in the last 3 months.
3. Patients who had transferred in to the centre in the previous 3 months.

These inclusion criteria are suggested by our later analysis (section 8:3) and are compatible with the recommendations in the Renal Association standards document.

8:2 The achievement of the recommended standard for haemoglobin

8:2.1 Achievement of the recommended standard.

The Renal Association standards document recommends ***a target haemoglobin of not less than 10 g/dl should be achieved by*** 85% of ***dialysis patients stable on therapy for 3 months. Transfusions should be avoided in patients likely to be transplanted to avoid sensitisation.***

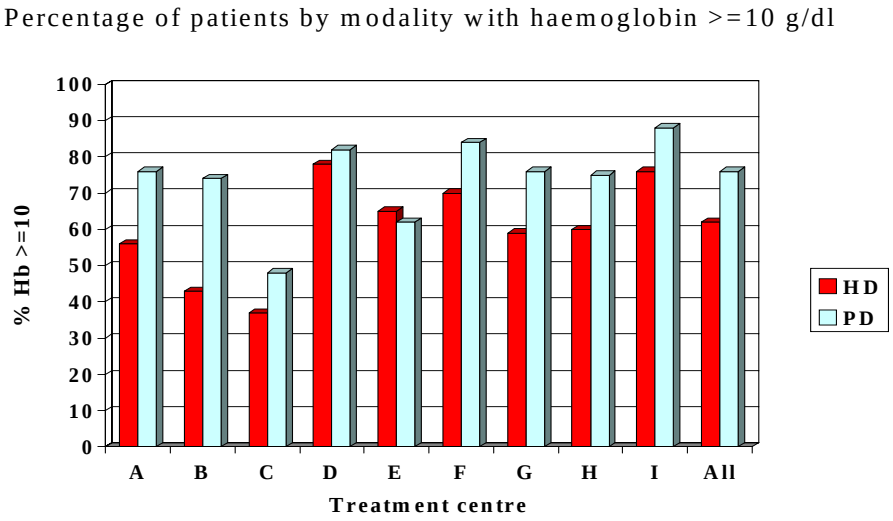


Figure 8.1 Percentage of patients on each modality of dialysis with haemoglobin ≥ 10 g/dl.

The median haemoglobin for all haemodialysis patients registered, was 10.5 g/dl, and for peritoneal dialysis patients was 11 g/dl. Figure 8.1 illustrates the percentage of patients in each renal unit on haemodialysis and peritoneal dialysis with haemoglobin above 10 g/dl. Results from centre I are difficult to interpret as the percentage return is low (tables 8.1 and 8.2)

8:2.2 Haemodialysis patients

The frequency distribution plots for haemoglobin of haemodialysis patients are shown in figure 8.2

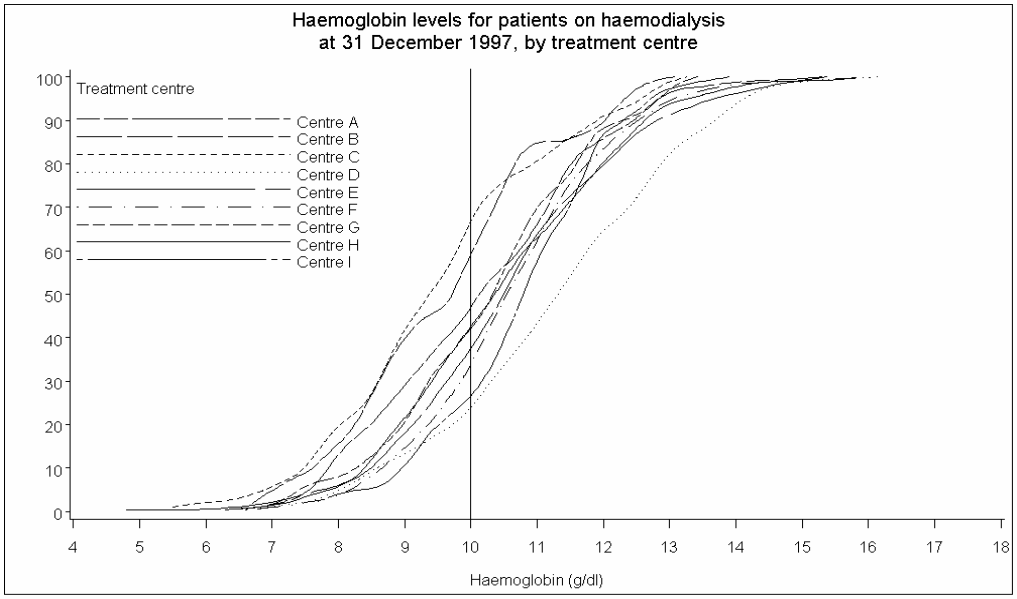


Figure 8.2 The frequency distribution plots for haemoglobin of haemodialysis patients.

The achievement of a haemoglobin of 10 g/dl varies between units from 37% to 78%, with the unit median haemoglobin ranging from 9.4 to 11.4 g/dl. The results are in table 8.1.

Centre	% ≥ 10 g/dl	% return	Median Hb g/dl	Lower quartile	Upper quartile	Quartile range
A	56	88	10.2	8.9	11.4	2.5
B	43	86	9.8	8.5	10.6	2.1
C	37	98	9.4	8.5	10.7	2.2
D	78	94	11.4	10.2	12.7	2.5
E	65	97	10.6	9.5	11.7	2.2
F	70	100	10.6	9.6	11.5	1.9
G	59	100	10.4	9.2	11.4	2.2
H	60	96	10.4	9.3	11.8	2.5
I	*76*	*59*	*10.9*	*10.0*	*11.7*	*1.7*
Total N=1449	**62**	**94**	**10.5**	**9.3**	**11.7**	**2.4**

Table 8.1 Haemoglobin attained in 1449 haemodialysis patients

To achieve adequate compliance with the standards, the data indicate that it may be necessary to achieve a median haemoglobin of 11.45 g/dl. The quartile range, where 50% of patients lie, varies between centres from 1.7 to 2.5, suggesting that local intervention policies may be able to influence this range. The first standards document recommended an upper limit for haemoglobin of 12 g/dl, but an upper limit was omitted from the second edition. Even those centres with the narrowest interquartile range could not hope to achieve a standard range as narrow as the 10 - 12 g/dl. which was originally recommended.

8:2.3 Peritoneal dialysis

The frequency distribution plots for haemoglobin of peritoneal dialysis patients are shown in figure 8.3. The results are given in table 8.2. The numbers in this group are small for some of the centres. The percentage of patients achieving an haemoglobin >= 10 g/dl ranges from 48% to 88% in different centres. The median value for each renal unit varies from 9.7 g/dl to 11.5 g/dl.

The interquartile range is lower for peritoneal dialysis patients. As with haemodialysis, a narrow target range for haemoglobin of 2 g/dl. does not appear possible.

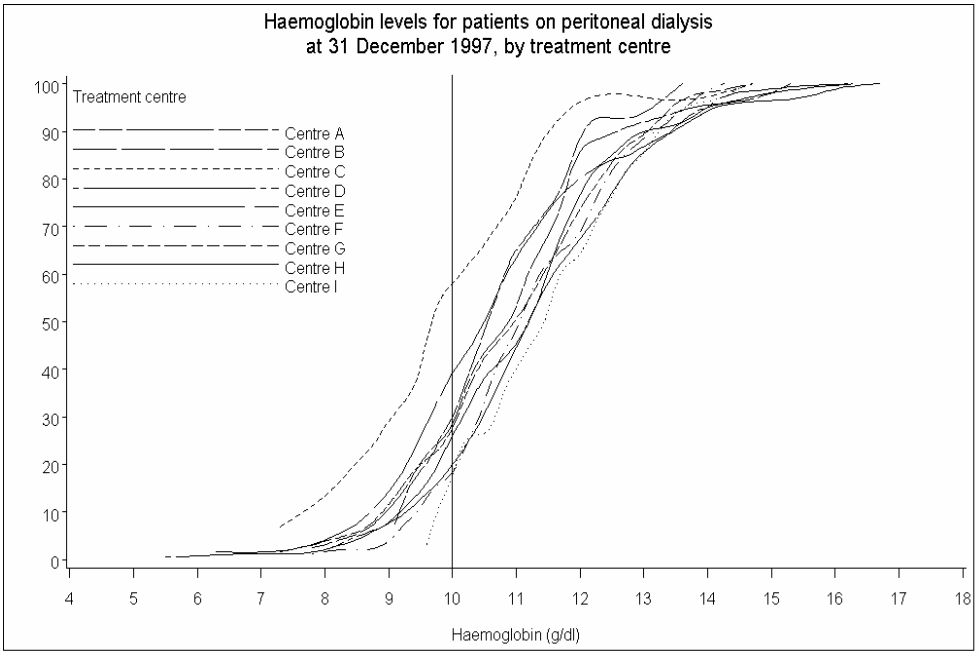


Figure 8.3 The frequency distribution plots for haemoglobin of peritoneal dialysis patients.

Centre	% >= 10 g/dl	% return	Median Hb g/dl	Lower quartile	Upper quartile	Quartile range
A	76	98	11.0	10.0	11.8	1.8
B	74	90	10.6	9.8	11.7	1.9
C	48	94	9.7	8.9	11.0	2.1
D	82	95	11.2	10.3	12.5	2.2
E	62	100	10.6	9.5	11.6	2.1
F	84	100	11.1	10.2	12.2	2.0
G	76	99	11.0	10.0	12.1	2.1
H	75	94	11.3	9.9	12.0	2.1
I	*88*	*71*	*11.5*	*10.6*	*12.5*	*1.9*
Total	**76**	**95**	**11**	**10**	**12.1**	**2.1**
N=741						

Table 8.2 Haemoglobin attained in peritoneal dialysis patients

8:2.4 The relationship between median haemoglobin and percentage patients with haemoglobin above 10g/dl.

This relationship is shown in figure 8.4

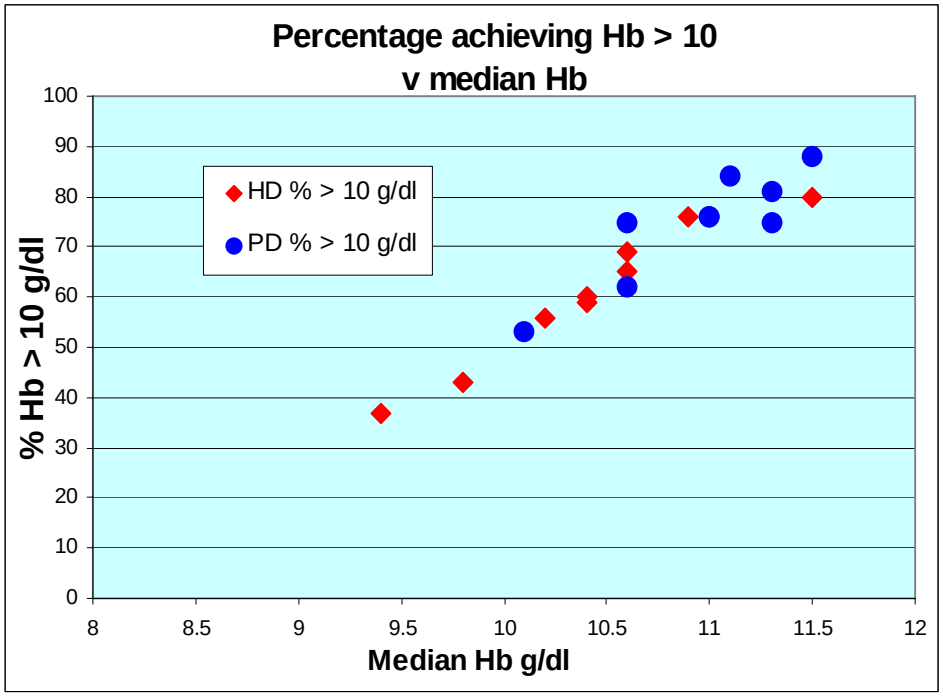


Figure 8.4 Relationship between median haemoglobin and percentage of patients with a haemoglobin above 10 g/dl.

Figure 8.4 indicates that for all the centres, there is a close association between the median haemoglobin achieved and the percentage of patients with an haemoglobin greater than 10 g/dl. The increased discrepancy for patients on peritoneal dialysis is probably caused by the smaller numbers in this patient group.

8:3 Demographic and historical factors influencing haemoglobin

Data was analysed to assess the influence of the following on haemoglobin.

1) Age
2) Gender
3) Duration of endstage renal failure
4) Recent change of dialysis modality
5) Previous transplantation

8:3.1 Age

Spearman's correlation was used to measure the degree of association between patient age and haemoglobin. Spearman's correlation was chosen rather than the Pearson correlation coefficient as patient age was not normally distributed. It also has the advantage that it detects an increasing or decreasing relationship rather than specifically a linear relationship. The results are shown in table 8.3.

Modality	Number of patients	Spearmans Correlation (r_s)	P-value
Haemodialysis	1449	-0.04	0.0918
Peritoneal dialysis	741	0.10	0.0093

Table 8.3 Spearman's correlation between patient age and haemoglobin

The results show no evidence of an association between patient age and haemoglobin for patients on haemodialysis. The very weak association between patient age and haemoglobin for patients on peritoneal dialysis is unlikely to be of practical importance.

These results will be influenced by erythropoietin therapy. The percentage of patients above and below the age of 65 who had a haemoglobin of 10 g/dl. or more without the use of erythropoietin was studied (table 8.4)

	Haemodialysis patients		Peritoneal dialysis patients	
Age	<65	>=65	<65	>=65
Number	703	407	349	203
% Hb>= 10 g/dl without EPO	20%	15%	39%	39%

Table 8.4 Attainment of haemoglobin >=10 g/dl without erythropoietin

There appears to be no notable relationship between age and haemoglobin attained without use of erythropoietin. Table 8.5 shows there is no relationship between age and the use of erythropoietin.

	Percentage on erythropoietin in each age range					
Age	18-34	35-44	45-54	55-64	65-74	75+
HD	76	73	73	69	71	76
PD	55	63	42	40	54	43

Table 8.5 Percentage on erythropoietin in each age range

There is thus no evidence that older patients are maintained with lower haemoglobin than younger patients, that they less frequently spontaneously attain a haemoglobin of 10 g/dl, or need more erythropoietin to attain the target haemoglobin. Data on use of blood transfusion is not available.

8:3.2 Gender

Two sided t-tests have been used to compare the mean haemoglobin levels of men and women. Men have a higher haemoglobin than women (tables 8.6, 8.7)

Gender	**Number of patients**	**Mean haemoglobin**	**Standard deviation**
Male	905	10.7	1.8
Female	542	10.2	1.6

T=4.8, d.f. = 1445, p<0.0001.

Table 8.6 Mean haemoglobin of haemodialysis patients on 31/12/97.

The results show that for patients on haemodialysis the haemoglobin of men is significantly higher than the haemoglobin of women.

Gender	Number of patients	Mean haemoglobin	Standard deviation
Male	432	11.3	1.7
Female	309	10.7	1.5

T=4.7, d.f = 739, p<0.0001.

Table 8.7 Mean haemoglobin of peritoneal dialysis patients on 31/12/97.

The results show that for patients on peritoneal dialysis the haemoglobin of men is significantly higher than the haemoglobin of women

8:3 3 Duration of renal replacement therapy

Modality	Number of patients	Spearmans Correlation (r_s)	P-value
Haemodialysis	1402	0.14	<0.0001
Peritoneal dialysis	727	-0.11	0.0044

Table 8.8 Relationship between duration of renal replacement therapy and haemoglobin.

Spearman's correlation was used to measure the degree of association between patient age and haemoglobin. Spearman's correlation was chosen rather than the Pearson correlation coefficient as patient age was not normally distributed. It also has the advantage that it detects an increasing or decreasing relationship rather than specifically a linear relationship. The results (table 8.8) show there is only a weak correlation between haemoglobin and time on renal replacement therapy in both haemodialysis and peritoneal dialysis.

	Percentage on erythropoietin by years on renal replacement therapy					
Modality	<1 year	1-2 years	2-3 years	3-5 years	5-10 years	10+ years
Haemodialysis	59	72	76	77	79	73
Peritoneal dialysis	35	43	56	45	67	65

Table 8.9 Duration of renal replacement therapy and use of erythropoietin.

The use of erythropoietin could affect these results. The percentage of patients receiving erythropoietin with regard to length of time on renal replacement therapy is shown in table 8.9. In the first year of haemodialysis, and the first 5 years of peritoneal dialysis there appears to be lower use of erythropoietin. This is probably related to retention of residual renal function.

8:3.4 Recent change of dialysis modality

The haemoglobin levels of patients who had been on the same dialysis modality (haemodialysis or peritoneal dialysis) throughout the quarter were compared with haemoglobins of patients who were previously on the alternative dialysis type in the quarter, regardless of the duration.

For this analysis haemoglobin levels have only been taken from the last 3 months.

2 sided t-tests were used to compare the mean haemoglobin levels of the two groups of patients.

Changed dialysis modality	Number of patients	Mean haemoglobin	Standard deviation
Yes	20	8.8	1.3
No	1390	10.5	1.7

T=4.4, d.f = 1408, p<0.0001.

Table 8.10 Mean haemoglobin of haemodialysis patients on 31/12/97.

The results show that the haemoglobins of patients who recently changed from peritoneal dialysis to haemodialysis are significantly lower than the haemoglobins of patients who remained on haemodialysis throughout the quarter.

Changed dialysis modality	Number of patients	Mean haemoglobin	Standard deviation
Yes	25	9.8	1.5
No	711	11.1	1.7

T=3.7, d.f = 734, p=0.0002.

Table 8.11 Mean haemoglobin of peritoneal dialysis patients on 31/12/97.

The results show that the haemoglobin of patients who recently changed from haemodialysis to peritoneal dialysis are significantly lower than the haemoglobin of patients who remained on peritoneal dialysis throughout the quarter.

Thus changes in dialysis modality in either direction between haemodialysis and peritoneal dialysis within a quarter are associated with a lower haemoglobin.

8:3.5 Previous transplantation

Two-sided t-tests were used to compare the mean haemoglobin of patients who had and had not previously had a transplant.

Previously had a transplant	Number of patients	Mean haemoglobin	Standard deviation
Yes	321	10.7	1.8
No	1095	10.5	1.7

T=2.0, d.f = 1414, p=0.0502.

Table 8.12 Previous transplantation and mean haemoglobin of haemodialysis patients on 31/12/97.

Previously had a transplant	Number of patients	Mean haemoglobin	Standard deviation
Yes	112	10.9	1.8
No	615	11.1	1.6

Results from T-test: T=1.6, d.f = 725, p=0.1022

Table 8.13 Previous transplantation and mean haemoglobin of peritoneal dialysis patients on 31/12/97

Chi-squared tests (with continuity correction) were used to compare the proportion of patients on erythropoietin for patients who had and had not previously had a transplant.

Previously had a transplant	Number of patients	Number of patients on erythropoietin	% of patients on erythropoietin
Yes	246	190	77
No	883	625	71

Results from chi-squared test: $X^2 = 3.7$, d.f = 1, p=0.0550

Table 8.14 Previous transplantation and use of erythropoietin for haemodialysis patients on 31/12/97.

Previously had a transplant	Number of patients	Number of patients on erythropoietin	% of patients on erythropoietin
Yes	77	57	74
No	486	214	44

Results from chi-squared test: $X^2 = 22.8$, d.f = 1, $p<0.0001$.

Table 8.15 Previous transplantation and use of erythropoietin for peritoneal dialysis patients on 31/12/97.

The results show some evidence for a difference in the haemoglobin of haemodialysis patients who have and have not previously been transplanted. The result did not quite reach statistical significance using the two sample t-test (T=2.0, d.f = 1414, p = 0.0502). There is also some evidence that the proportion of haemodialysis patients receiving erythropoietin is higher in those who have previously received a transplant. This did not quite reach statistical significance using the chi-squared test with continuity correction (p=0.055) (table 8.14).

There is no significant difference in the haemoglobin of peritoneal dialysis patients who have and have not previously been transplanted, but the proportion of peritoneal dialysis patients receiving erythropoietin is significantly higher in those have previously received a transplant (table 8.16).

Overall, it appears that a previous renal transplant may increase the need for erythropoietin in dialysis patients. The information on whether the transplants were left in situ or removed is not available.

8:4 Serum ferritin

The Renal Association standards document does not recommend a range for serum ferritin.

Patients with renal failure appear to have a relatively inability to utilise iron and need well-maintained iron stores to maintain haemoglobin and to respond to erythropoietin. There is argument concerning the best indicator of iron stores in end stage renal failure. Despite the fact that serum ferritin is an acute phase reactant and rises during acute inflammation it is the most widely used marker in the UK of iron status in endstage renal failure. The Registry is therefore collecting serum ferritin values as a marker of iron stores. It has been recommended that for maximum response to erythropoeitin therapy in endstage renal failure that serum ferritin be maintained at least as high as 100 µmol/l **(**ref. 12) although some authors have suggested this level is not always adequate.

Figures 8.5 and 8.6 show the cumulative frequency plots of serum ferritin in haemodialysis and peritoneal dialysis patients respectively. The details are in table 8.16. The latest result is used. If there has been no result recorded in the last 9 months the item is regarded as missing. Data from centre A are not included as this centre uses a different marker of iron stores.

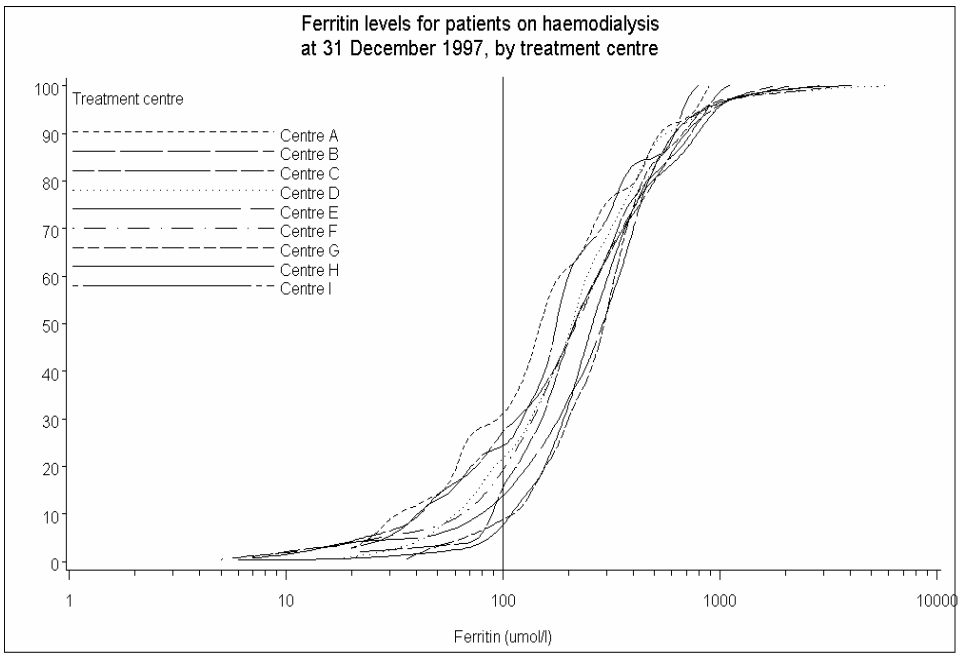


Figure 8.5 Haemodialysis patients: cumulative plots of serum ferritin levels by treatment centre –

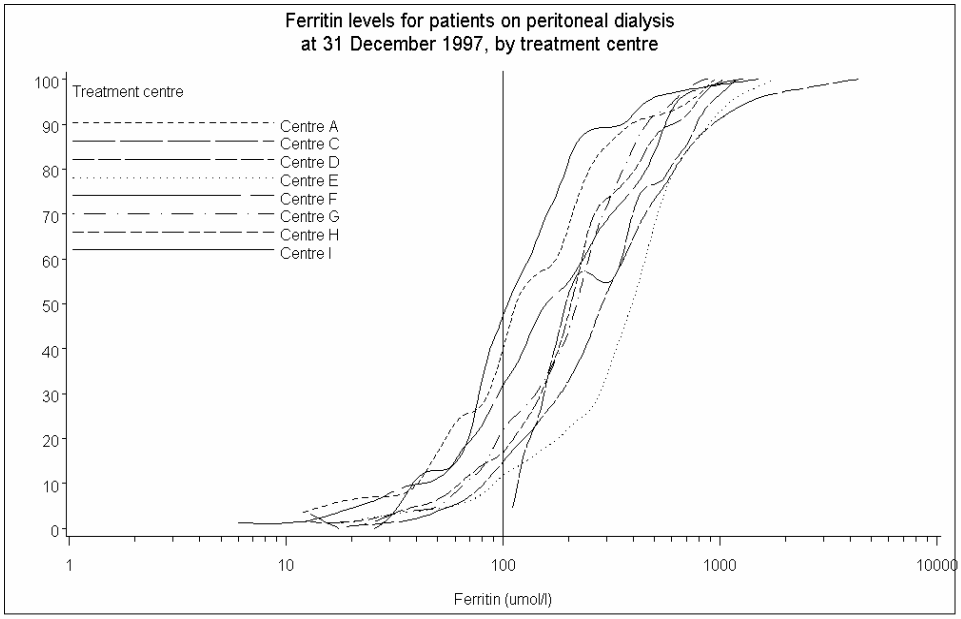


Figure 8.6 Peritoneal dialysis patients: cumulative plots of serum ferritin levels by treatment centre -.

	% ferritin ≥100		% ferritin ≥200		% return	
Unit	HD	PD	HD	PD	HD	PD
B	86	*	56	*	79	24
C	72	100	55	50	87	71
D	79	86	53	67	83	95
E	87	88	65	79	52	74
F	81	68	54	46	98	94
G	91	79	70	57	97	87
H	93	85	68	54	93	84
I	77	56	40	19	50	68
Total	**84**	**80**	**59**	**58**	**75**	**82**

For haemodialysis n=1162, peritoneal dialysis n=642
* - less than 10 patients with results, omitted

Table 8.16 Percentage of patients with serum ferritin over 100 µmol/l and 200 µmol/l

It could be argued that patients with serum ferritin between 15 and 100 µmol/l who maintain adequate serum haemoglobin without support from erythropoietin therapy do not need further iron supplementation, but that those with a serum ferritin below 100 µmol/l who do not spontaneously maintain an adequate haemoglobin do. Centres A,G,I are unable to provide data on use of erythropoietin and so cannot be included in this analysis. Figure 8.7 shows the proportion of patients in each renal unit on haemodialysis and peritoneal dialysis who appear to need further iron supplementation.

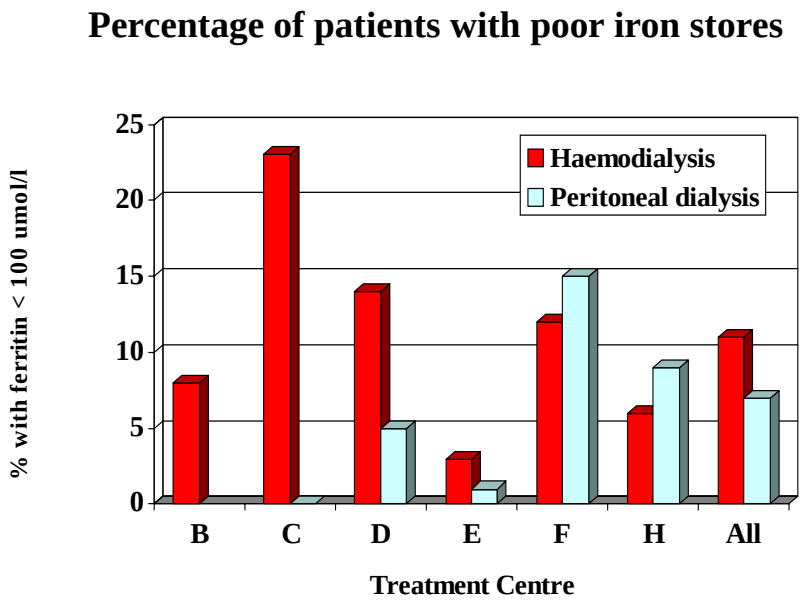


Figure 8.6 Percentage of patients anaemic or on erythropoietin with serum ferritin below 100 µmol/l.
No results are shown for peritoneal dialysis patients from centre B as there were less than 10 patients with data available.

In centre C, no peritoneal dialysis patients have low iron stores, but 23% of haemodialysis patients do. The figures for centre D are 5% and 14% respectively.

8:5 Haemoglobin and erythropoietin therapy

8:5.1 Haemoglobin, erythropoietin, serum ferritin, and adequacy of dialysis

The use of erythropoietin therapy and haemoglobin attained was studied, especially in relationship to body iron load and, in haemodialysis patients, adequacy of dialysis. Urea reduction ratio was used as a measure of adequacy of haemodialysis. The results are shown in tables 8.17 and 8.18.

Unit	% Hb ≥ 10 g/dl	% patients Hb≥10 without EPO	% ferritin ≥100 µmol/l	% ferritin ≥200 µmol/l	% 0n EPO	URR ≥60 %	URR ≥65 %
A	56	na	-	-	na	80	58
B	43	26	86	56	33	95	90
C	37	9	72	55	74	72	43
D	78	20	79	53	77	76	52
E	65	28	87	65	61	85	70
F	70	20	81	54	76	84	61
G	59	na	91	70	na	79	53
H	60	8	93	68	86	76	53
I	76	na	77	40	na	*	*
All patients	62	18	84	59	73	79	58

na = not available. - = not applicable * = numbers too small

Table 8.17 Haemoglobin, use of erythropoietin, serum ferritin, and urea reduction ratio in haemodialysis patients

Unit	% Hb ≥ 10 g/dl	% patients Hb>=10 without EPO	% ferritin ≥100 µmol/l	% ferritin ≥200 µmol/l	% on erythropoietin
A	76	na	-	-	na
B	74	74	*	*	*
C	48	21	100	50	48
D	82	35	86	67	59
E	62	46	88	79	33
F	84	45	68	46	47
G	76	na	79	57	na
H	75	27	85	54	61
I	88	na	56	19	na
All patients	76	39	80	58	48

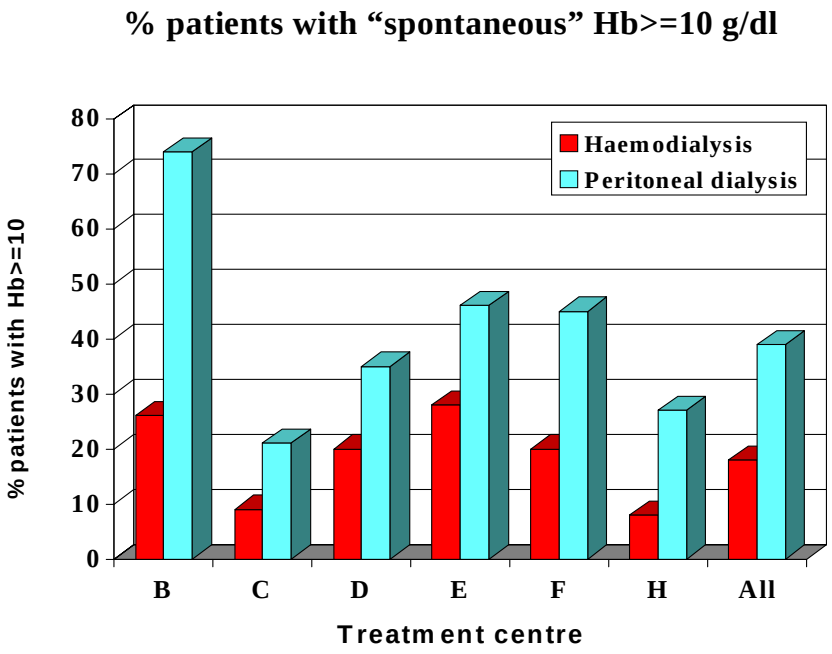
na = not available. - = not applicable * = numbers to small too include

Table 8.18 Haemoglobin, use of erythropoietin, and serum ferritin in peritoneal dialysis patients

8:5.2 "Spontaneous" haemoglobin

The use of erythropoietin makes the relationship between haemoglobin and serum ferritin and urea reduction ratio difficult to interpret, especially as the prescription of erythropoietin is often influenced by financial restrictions and is not always decided on strictly clinical grounds. In an attempt to eliminate the effect of erythropoietin prescription, the patients not using erythropoietin were studied.

As an indicator of optimal background renal replacement therapy the percentage of patients achieving a haemoglobin above 10 g/dl without the use of erythropoietin was assessed (figure 8.7). For haemodialysis the range is from 8% to 28%, for peritoneal dialysis from 21% to74%.



For haemodialysis n=1110 patients, for peritoneal dialysis n=552 patients.

Figure 8.7 Percentage of patients in each treatment centre with "spontaneous" haemoglobin of 10 g/dl. or more.

8:5.3 The prescription of erythropoietin and serum ferritin

The prescription of erythropoietin was analysed in relationship to haemoglobin attained and serum ferritin. The results are in tables 8.20 and 8.21

Treatment centre		**Haemoglobin <10**		**Haemoglobin ≥10**	
		Fe<100	Fe ≥100	Fe<100	Fe≥100
B	No EPO	5	27.5	5	22.5
	On EPO	2.5	17.5	0	20
C	No EPO	6	10	5	4
	On EPO	8	38	9	21
D	No EPO	1	1	7	12
	On EPO	2	20	11	47
E	No EPO	1	8	10	20
	On EPO	. 0	25	2	34
F	No EPO	0	3	7	12
	On EPO	3	24	8	42
H	No EPO	0	3	1	6
	On EPO	0	37	5	48

Table 8.20 Use of erythropoietin therapy, serum ferritin, and haemoglobin attained in haemodialysis patients.

Treatment centre		**Haemoglobin <10**		**Haemoglobin ≥10**	
		Fe<100	Fe ≥100	Fe<100	Fe ≥100
B *					
C	No EPO	0	36	0	23
	On EPO	0	23	0	18
D	No EPO	1	5	10	24
	On EPO	1	10	3	45
E	No EPO	1	17	11	38
	On EPO	0	16	0	17
F	No EPO	2	6	27	24
	On EPO	0	9	12	29
H	No EPO	0	9	6	19
	On EPO	3	15	6	42

- - numbers too small to include.
-

Table 8.21 Use of erythropoietin therapy, serum ferritin, and haemoglobin attained in peritoneal dialysis patients

The data indicate a difference of approach between units with regard to iron replenishment and erythropoietin usage (tables 8.20, 8.21). These tables show that some units rarely give erythropoietin to patients without replenishing iron stores such that serum ferritin is above 100, whereas others are giving erythropoietin to relatively iron deficient patients in whom a less efficient response is to be expected. The percentage of haemodialysis patients with serum ferritin below 100 μmol/l and who receive erythropoietin ranges between units from 2% to 17%, for peritoneal dialysis patients it ranges from 0% to 17%.

8:5.4 Access to erythropoietin therapy

Although peritoneal dialysis patients maintain better haemoglobin levels than haemodialysis patients, they are less likely to receive erythropoietin therapy when anaemic (figure 8.8)

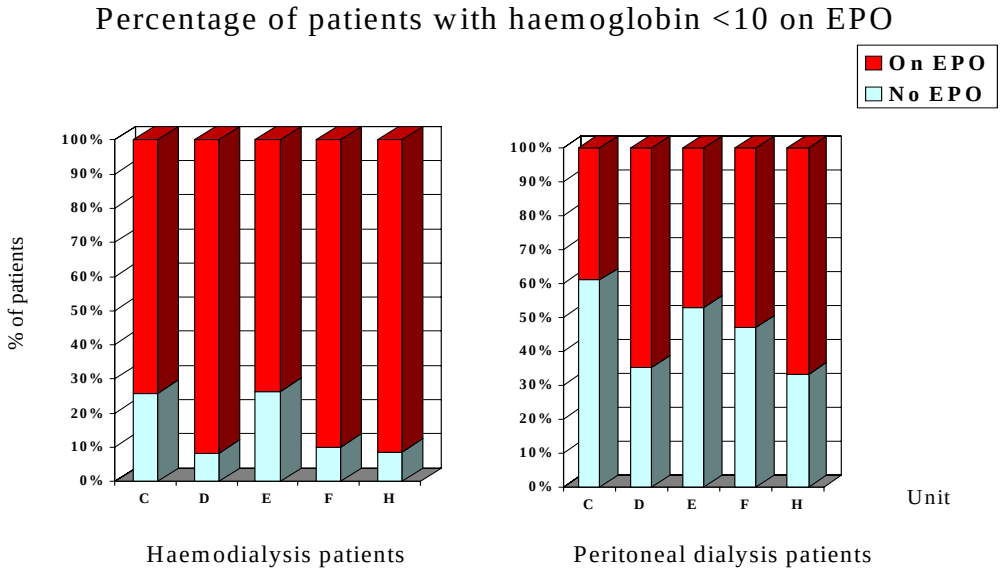


Figure 8.8, 8.9 Percentage of patients with haemoglobin <10 g/dl receiving erythropoietin therapy

The variation between units in the proportion of haemodialysis patients receiving erythropoietin was from 33% to 86%, and for peritoneal dialysis patients from 31% to 61% (tables 8.17, 8.18). Whether the prescription rate is appropriate can only be interpreted when the proportion attaining a haemoglobin of 10 g/dl is also considered.

Table 8.22 shows the difference in erythropoietin prescription between the sexes. Although men attain higher haemoglobin than women (section 8:3.2) they are significantly less frequently prescribed erythropoietin.

	% patients on erythropoietin	
Modality	Men	Women
Haemodialysis	69.5	77.9
Peritoneal dialysis	43.4	555.4

For haemodialysis: $X^2 = 9.1$, d.f. = 1, p = 0.003
For peritoneal dialysis: $X^2 = 7.6$, d.f. = 1, P = 0.006
Table 8.22 Prescription of erythropoietin by gender

8:5.5 Factors determining haemoglobin attained and erythropoietin prescription.

In neither haemodialysis nor peritoneal dialysis is there any apparent relationship between haemoglobin attained and use of erythropoietin (tables 8.20, 8.21, figure 8.10).

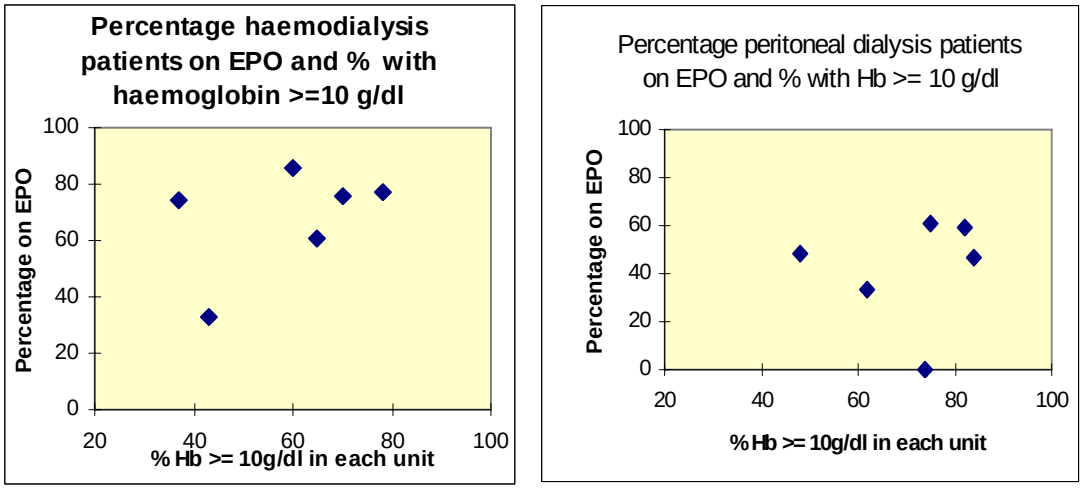


Figure 8.10 Relationship between erythropoietin therapy and haemoglobin.

Neither is there any apparent relationship between adequate iron stores and haemoglobin (figures 8.11,8.12).

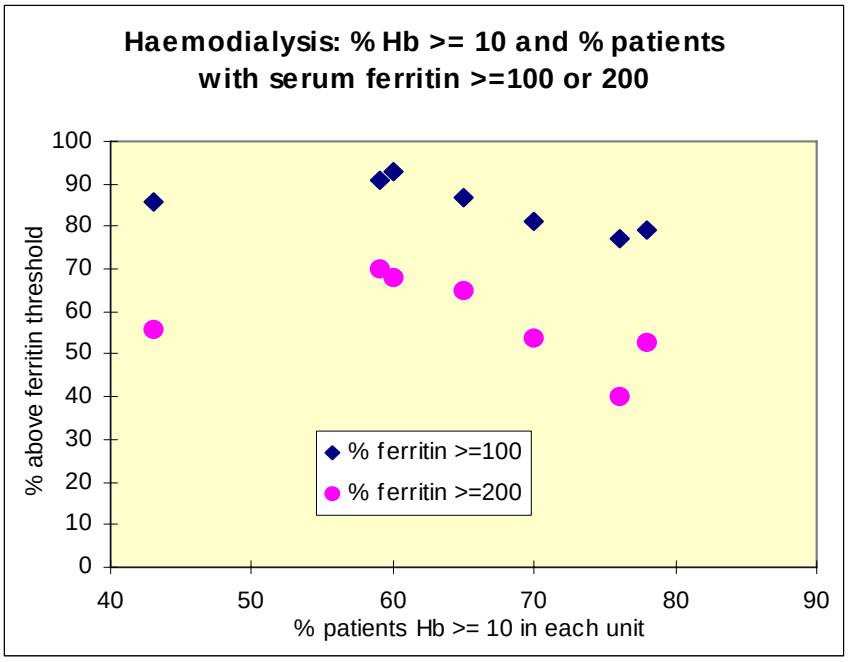


Figure 8.11 Relationship between serum ferritin and haemoglobin in haemodialysis patients

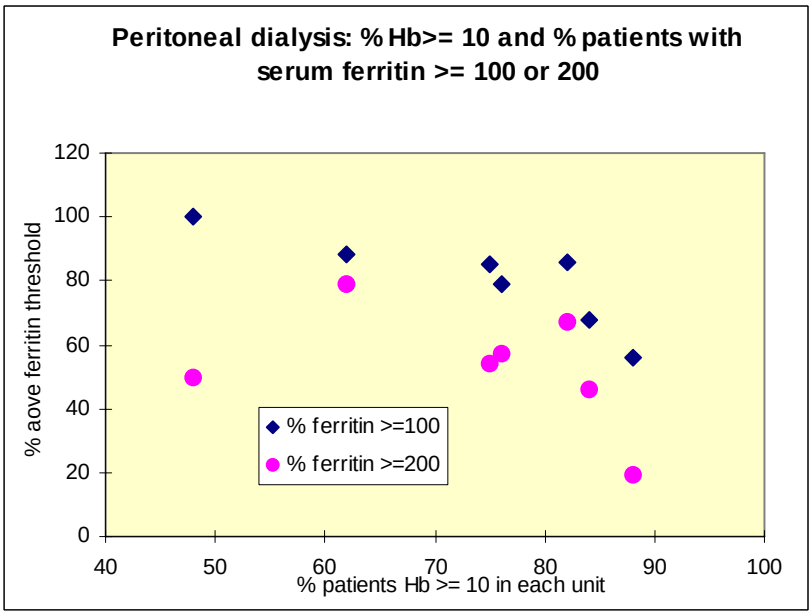


Figure 8.12 Relationship between serum ferritin and centre haemoglobin in peritoneal dialysis patients

In haemodialysis patients the use of erythropoietin and haemoglobin obtained was studied in relationship to dialysis adequacy as indicated by the urea reduction ratio. This is illustrated in figures 8.13 and 8.14. The unit with the highest proportion of patients with a urea reduction ratio above 65% (B) had a low proportion of patients with haemoglobin >= 10 g/dl, but had a very low prescription rate of erythropoietin. The data gives some support to the possibility that in a treatment centre a high proportion of patients with a urea reduction ratio >=65% is associated with lower use of erythropoietin and possibly better haemoglobin levels .

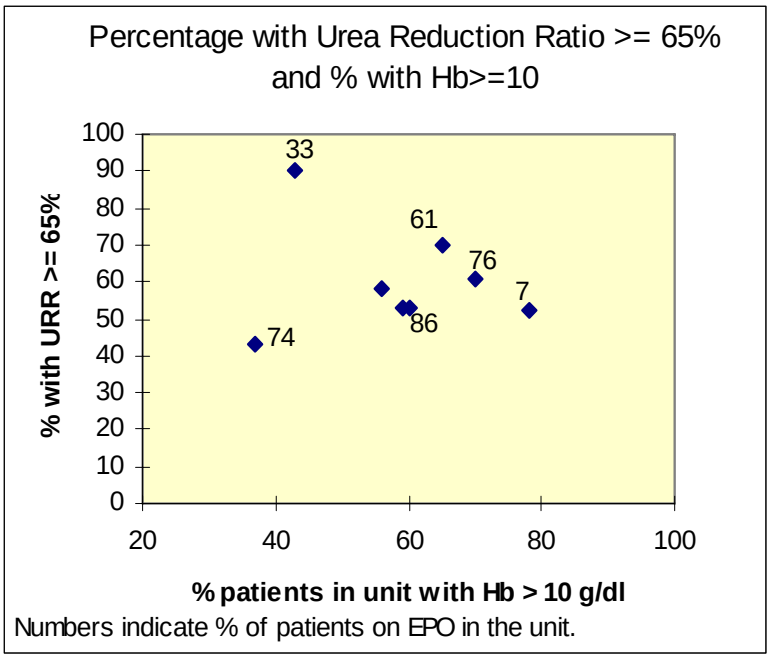


Figure 8.13 Urea reduction ratio and haemoglobin

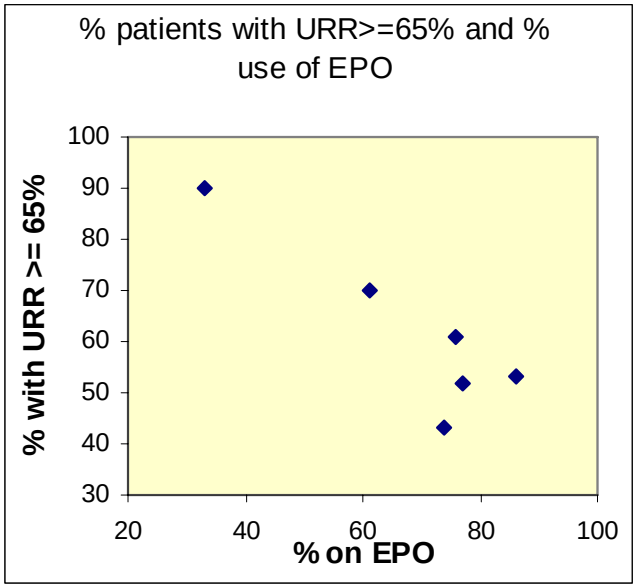


Figure 8.14 Urea reduction ratio and use of erythropoietin

The prescription of erythropoietin is often partly determined by non-clinical factors such as financial restriction: this renders the above relationships difficult to interpret. To try to eliminate this problem the proportion of patients with a "spontaneous" (i.e. not supported by erythropoietin) haemoglobin >= 10g/dl was studied in relationship to serum ferritin and to urea reduction ratio. There is no apparent relationship with serum ferritin (figures 8.15,8.16), but a strong suggestion of a relationship with urea reduction ratio (figure 8.17).

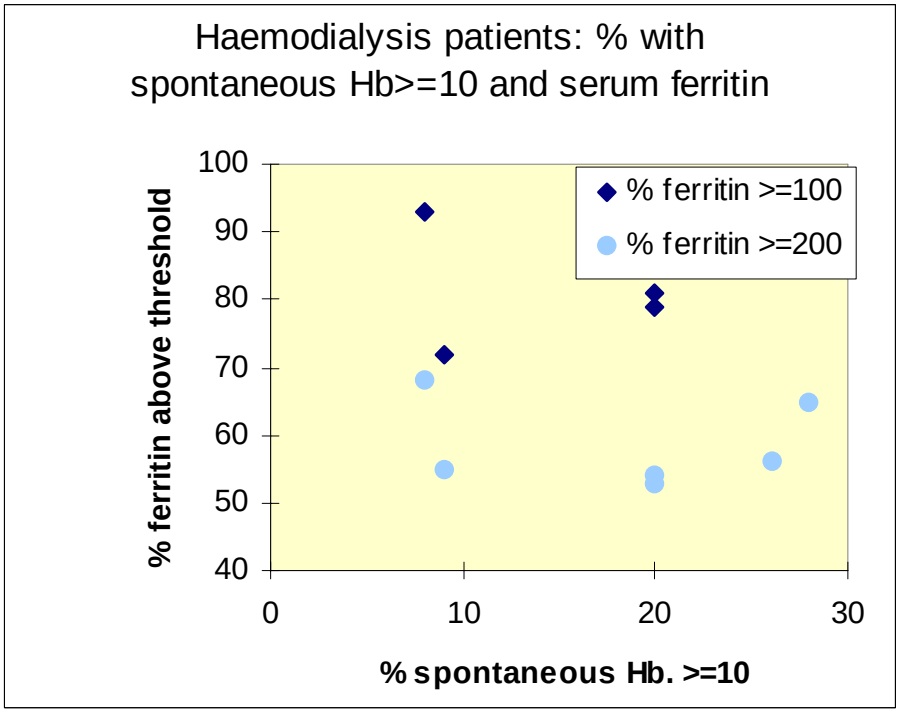


Figure 8.15 "Spontaneous" haemoglobin and serum ferritin of haemodialysis patients

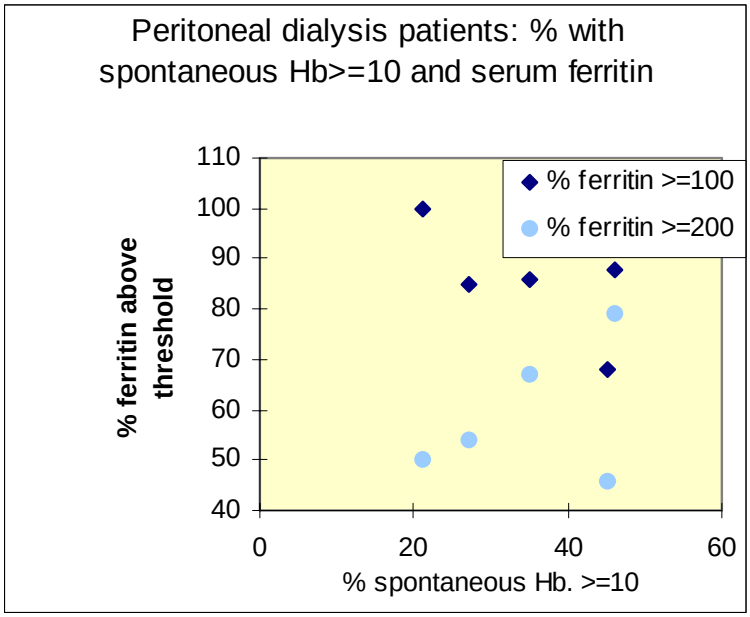


Figure 8.16 "Spontaneous" haemoglobin and serum ferritin of peritoneal dialysis patients

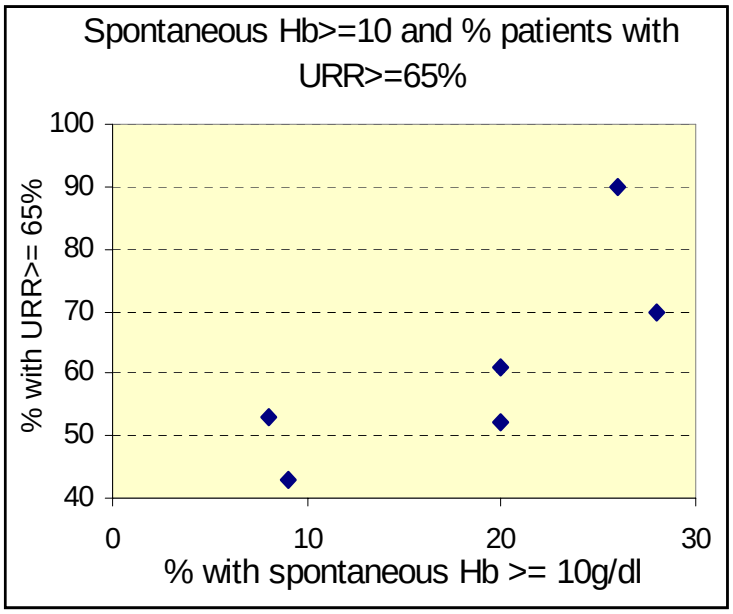


Figure 8.17 "Spontaneous" haemoglobin and urea reduction ratio

8:5.6 Sequential changes in haemoglobin

As the Registry has collected sequential quarterly data for only 1 year very little analysis has been performed on changes over time. There do seem to be changes in the percentage haemoglobin >= 10 g/dl between the first and last quarters of 1997. Details from units returning sufficient data to analyse in both quarters are given in table 8.23.

	Haemodialysis		Peritoneal dialysis	
Unit	1st quarter	4th quarter	1st quarter	4th quarter
A	45	58	81	74
C	39	37	40	48
D	66	78	69	81
E	58	64	70	63
F	56	70	68	84
G	56	59	64	76
H	49	60	83	75
Total	**54**	**62**	**69**	**75**
N =	1227	1390	676	711

Table 8.23 Changes through 1997 in % patients with haemoglobin >=10 g/dl.

As can be seen from figure 8.18, there has been a rise in all the units, with the exception of unit C, in the proportion of haemodialysis patients with haemoglobin >= 10 g/dl over the year. Although the proportion in the whole Registry of peritoneal dialysis patients with haemoglobin >=10 g/dl has risen, there is considerable variation between treatment centres (figure 8.19). This is partly due to the fact that haemoglobin is higher in peritoneal dialysis patients leaving little opportunity for improvement in some centres.

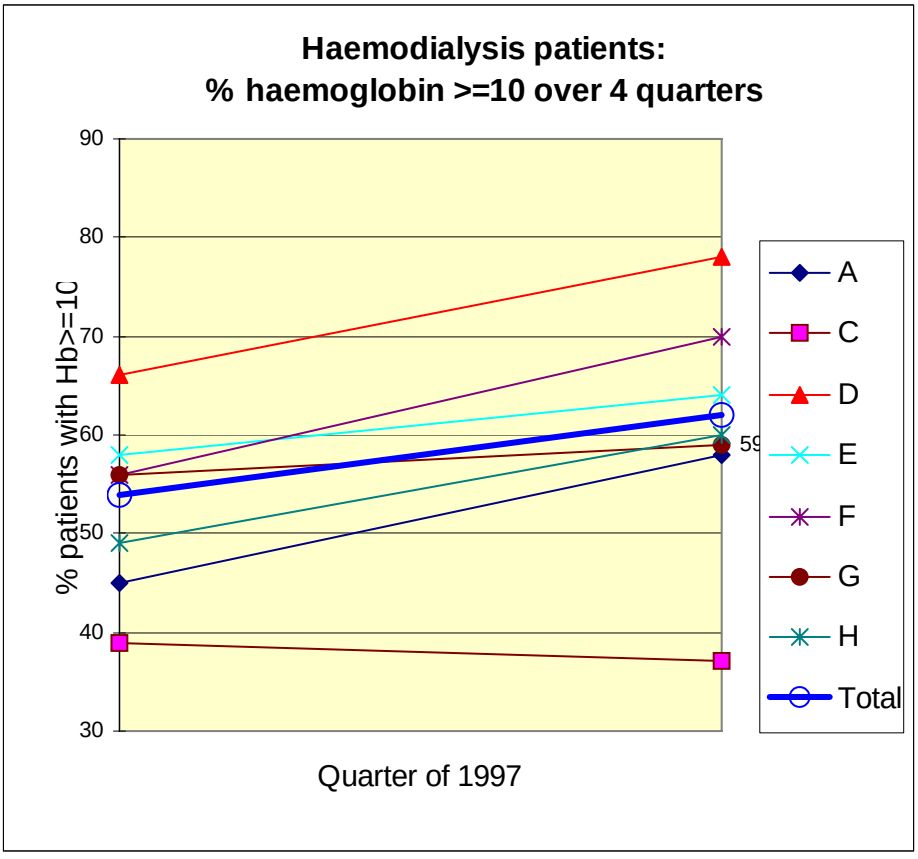


Figure 8.18 Haemodialysis patients: changes in % haemoglobin ≥ 10 g/dl through 1997 by centre.

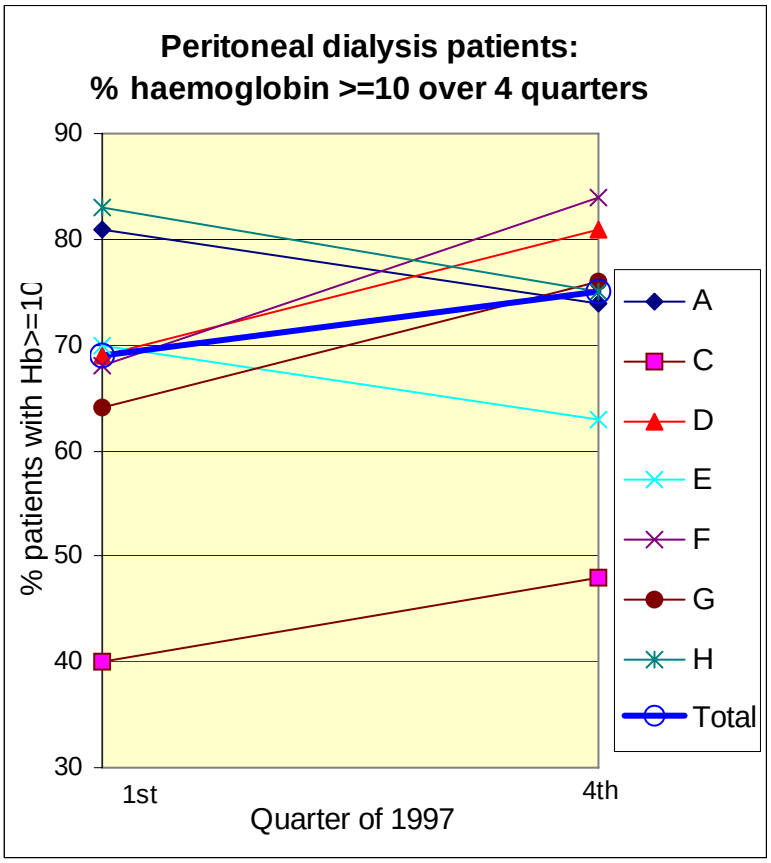


Figure 8.19 Peritoneal dialysis patients: changes in % haemoglobin ≥ 10 g/dl through 1997 by centre

8:5.7 Conclusion

As some units were unable to return data on use of erythropoietin and some could not returned data on serum ferritin, only a small number of treatment centres are included in these analyses, and the data must not be over-interpreted. There are however important pointers to further studies the Registry will undertake which will be more instructive with time as sequential data becomes available, data returns improve, and more units participate. Even with this preliminary data it is clear that there is wide variation in practice between treatment centres with regard to the availability of erythropoietin therapy and policy with regard to erythropoietin treatment and iron replenishment. Peritoneal dialysis patients may be less likely than haemodialysis patients to be given erythropoietin if anaemic. In haemodialysis dialysis adequacy may be a major determinant of haemoglobin and need for erythropoietin. Through 1997 patients in the participating units had an overall improvement in haemoglobin.