

## Chapter 8: Haemoglobin

### Summary

- There is continued improvement in anaemia management in centres submitting data to the Registry, 81% of haemodialysis and 86% of peritoneal dialysis patients achieving the haemoglobin Standard of over 10 g/dL (mean haemoglobin 11.3 and 11.8 g/dL respectively).
- An analysis of haemoglobin and survival indicated a significantly increased risk of death for patients with a haemoglobin level of less than 10g/dL when compared with one of 10–10.9 g/dL. Survival was also improved in patients achieving a haemoglobin greater than 11 g/dL when compared with one of 10–10.9 g/dL.
- Haemoglobin level prior to start of renal replacement therapy has been increasing over the past 3 years, possibly because of an increase in the use of erythropoietin prior to starting therapy.
- Patients who started renal replacement therapy with peritoneal dialysis had higher haemoglobin levels on starting treatment than those treated with haemodialysis, indicating a selection bias.

### Introduction

This chapter describes the position at the end of 2001 for all renal centres in England & Wales that report data to the Registry. There are Renal Association, European and US Kidney Disease Outcomes Quality Initiative (K/DOQI) guidelines established for the management of renal anaemia.

The second edition of the Renal Association Standards document, published in 1997, recommends that:

***‘a target haemoglobin concentration of 10g/dl should be achieved in 85% of patients after 3 months on dialysis’.***

European best practice guidelines recommend:

***‘the target is that ≥85% of the patient population should have a haemoglobin concentration of >11 g/dl’.***

The US K/DOQI guideline states:

***‘The target range for haemoglobin (haematocrit) should be 11 g/dl (33%) to 12 g/dl (36%).’***

The third edition of the Renal Association Standards document (SDIII), published in 2002, again recommends the target of 10 g/dL but suggests that the 85% target should apply after 6 months on dialysis.

## ***Inclusion criteria***

Patients treated with dialysis at some time during the last quarter of 2001 were included in the analysis if they had been on the same modality of dialysis in the same centre for 3 months. The last available haemoglobin reading from each patient in the last quarter of 2001 was used in the analysis.

## ***Haemoglobin achievement by dialysis units***

The data describing haemoglobin distribution in each centre are presented in Table 8.1 for haemodialysis (HD) and Table 8.2 for peritoneal dialysis (PD), and Figures 8.1–8.6. This year, the 70% quantile around the median (excluding the upper 15% and lower 15%) has been included as it is broad enough to demonstrate differences between centres but excludes outliers. It provides an additional indication of the proximity to achievement of the Renal Association Standard (85% of patients). Additional information on quartile range, 90% range, mean and standard deviation is presented in Appendix F.

<b>Centre</b>	<b>% Data return</b>	<b>Median Hb (g/dL)</b>	<b>90% Range</b>	<b>70% Quantile</b>	<b>Mean Hb (g/dL)</b>	<b>Standard deviation</b>	<b>% with Hb ≥10</b>	<b>% with Hb ≥11</b>
Bradf	100	11.8	8.9–13.9	10.3–12.6	11.5	1.7	86	65
Bristol	100	11.3	8.6–13.7	10.3–12.4	11.2	1.6	79	59
Camb	85	10.9	8.0–13.5	9.7–12.1	10.9	1.6	73	49
Carls	96	11.3	8.4–12.6	10.4–12.2	11.1	1.3	81	65
Carsh	88	11.3	9.0–14.2	10.3–12.3	11.4	1.6	83	60
Covnt	99	11.2	8.5–13.4	10.2–12.2	11.1	1.5	81	58
Crdff	96	12.1	9.5–14.4	11.0–13.1	12.0	1.6	91	77
Derby	85	10.4	7.8–13.0	9.7–11.8	10.4	1.6	67	37
Extr	100	11.5	9.2–14.0	10.6–12.3	11.5	1.4	85	64
Glouc	100	11.4	7.7–13.5	9.8–12.2	11.0	1.7	73	56
Guys	89	10.7	8.4–13.2	9.7–11.9	10.8	1.6	69	45
Heart	87	10.6	8.0–12.8	9.5–11.5	10.5	1.5	64	40
Hull	96	10.8	8.4–13.0	9.9–11.7	10.8	1.5	75	47
Leic	98	11.4	9.0–14.1	10.3–12.5	11.4	1.6	83	62
LGI	97	11.8	8.5–14.3	10.3–12.9	11.6	1.8	83	65
Livrpl	89	11.6	8.4–14.9	10.3–12.9	12.0	6.9	81	63
Notts	96	11.2	9.0–14.2	10.2–12.1	11.2	1.6	81	58
Oxford	99	11.3	8.7–13.6	10.2–12.3	11.3	1.5	80	59
Plym	91	11.5	9.1–14.6	10.6–13.0	11.7	1.6	87	67
Ports	91	11.4	8.3–14.2	10.2–12.7	11.3	1.8	80	57
Prstn	92	11.6	8.6–14.2	10.4–12.7	11.5	1.7	84	63
Redng	99	12.0	9.5–14.8	10.6–13.0	11.9	1.5	92	71
S Cleve	97	11.5	7.7–14.1	10.3–12.4	11.3	1.9	79	63
Sheff	94	10.9	8.5–13.0	10.1–11.8	10.9	1.4	76	49
Stevn	98	11.4	8.6–13.4	10.4–12.3	11.3	1.4	86	63
Sthend	100	12.0	9.7–14.0	11.15–12.8	12.0	1.3	94	81
St Jms	100	11.9	9.2–14.3	10.8–13.0	11.8	1.5	88	72
Sund	100	10.5	8.3–13.5	9.6–12.0	10.7	1.7	67	46
Swmse	86	11.1	8.7–13.6	10.1–11.9	11.1	1.5	77	54
Truro	80	11.3	9.0–12.4	10.5–11.9	11.2	1.1	91	62

Centre	% Data return	Median Hb (g/dL)	90% Range	70% Quantile	Mean Hb (g/dL)	Standard deviation	% with Hb ≥10	% with Hb ≥11
Wolve	99	11.9	9.1–14.7	10.8–12.8	11.9	1.7	88	71
Words	100	11.0	8.7–13.5	10.1–12.1	11.0	1.4	82	51
Wrex	84	11.8	8.6–13.6	10.5–12.7	11.5	1.6	84	67
York	96	12.0	10.1–14.1	11.2–13.1	12.1	1.4	95	82
Eng	94	11.3	8.6–13.9	10.2–12.3	11.3	2.3	80	59
Wls	91	11.7	8.9–14.3	10.6–12.8	11.7	1.6	85	68
E&W	94	11.3	8.6–13.9	10.3–12.4	11.3	2.3	81	60

**Table 8.1: Haemoglobin data for patients on haemodialysis**

Centre	% Data return	Median Hb (g/dL)	90% Range	Quantile range	Mean Hb (g/dL)	Standard deviation	% with Hb ≥10	% with Hb ≥11
Bradf	100	12.5	9.6–15.0	11.4–13.8	12.4	1.6	95	84
Bristol	100	12.0	9.4–14.5	11.0–13.2	12.0	1.5	93	76
Camb	98	11.4	8.7–14.2	10.4–12.6	11.4	1.6	83	64
Carls	100	11.5	9.1–13.4	10.5–13.0	11.6	1.7	79	63
Carsh	99	11.9	9.4–15.1	11.2–12.9	12.0	1.6	93	79
Covnt	94	11.3	9.2–14.0	10.3–12.4	11.4	1.6	84	60
Crdf	97	11.9	9.0–14.5	10.9–12.8	11.9	1.7	89	75
Derby	95	11.6	8.9–13.5	10.8–12.7	11.5	1.6	87	72
Extr	100	11.5	9.1–13.9	10.5–12.5	11.6	1.6	91	64
Glouc	94	11.3	8.9–13.4	10.0–12.2	11.2	1.6	77	65
Guys	99	11.8	8.9–14.2	10.8–12.8	11.7	1.7	86	70
Heart	94	11.5	8.4–13.4	10.1–12.8	11.4	1.6	75	63
Hull	97	11.0	8.3–13.9	10.0–11.8	11.0	1.7	76	51
Leic	99	11.7	9.1–14.0	10.65–12.7	11.7	1.6	86	68
LGI	96	12.9	9.4–15.4	12.0–13.6	12.7	1.7	93	87
Livrpl	93	12.2	8.4–14.6	11.0–13.0	11.9	1.8	85	76
Notts	96	11.3	9.3–13.6	10.3–12.4	11.4	1.5	82	58
Oxford	100	11.7	8.9–14.4	10.5–12.8	11.6	1.7	86	67
Plym	100	12.3	10.0–14.6	11.4–13.3	12.3	1.4	96	83
Ports	87	11.6	8.6–14.6	10.1–13.0	11.6	1.9	79	63
Prstn	99	11.7	8.9–15.1	10.35–13.1	11.8	1.9	85	65
Redng	100	11.9	8.6–14.4	10.3–13.0	11.7	1.7	83	68
SCleve	100	12.5	9.4–15.7	10.8–13.7	12.4	1.8	95	72
Sheff	98	11.3	8.8–13.9	10.1–12.3	11.3	1.8	80	56
Stevn	97	12.0	8.0–14.9	10.9–13.0	11.8	1.7	88	71
Sthend	100	11.8	9.5–15.9	11.0–12.6	12.1	1.6	93	79
StJms	100	12.3	9.7–14.5	11.9–13.1	12.4	1.3	93	88
Sund	100	11.7	9.8–15.4	10.9–12.5	11.9	1.6	93	73
Swmse	95	11.9	9.1–14.3	11.0–13.3	11.9	1.7	90	77
Truro	62	11.3	8.1–13.0	10.6–12.3	11.3	1.3	83	72
Wolve	100	12.4	9.1–14.3	11.25–13.4	12.2	1.7	88	82
Words	100	11.8	9.2–13.9	10.9–12.6	11.7	1.4	87	72
Wrex	94	12.5	11.0–14.7	11.8–13.3	12.6	1.2	98	96
York	100	12.3	9.8–14.0	11.3–13.3	12.3	1.4	91	86
Eng	97	11.8	9.0–14.4	10.6–12.9	11.7	1.7	86	69
Wls	96	12.0	9.2–14.6	11.1–13.1	12.0	1.6	91	79
E&W	97	11.8	9.0–14.4	10.7–12.9	11.8	1.7	86	70

**Table 8.2: Haemoglobin data for patients on PD**

### Haemoglobin distribution : haemodialysis

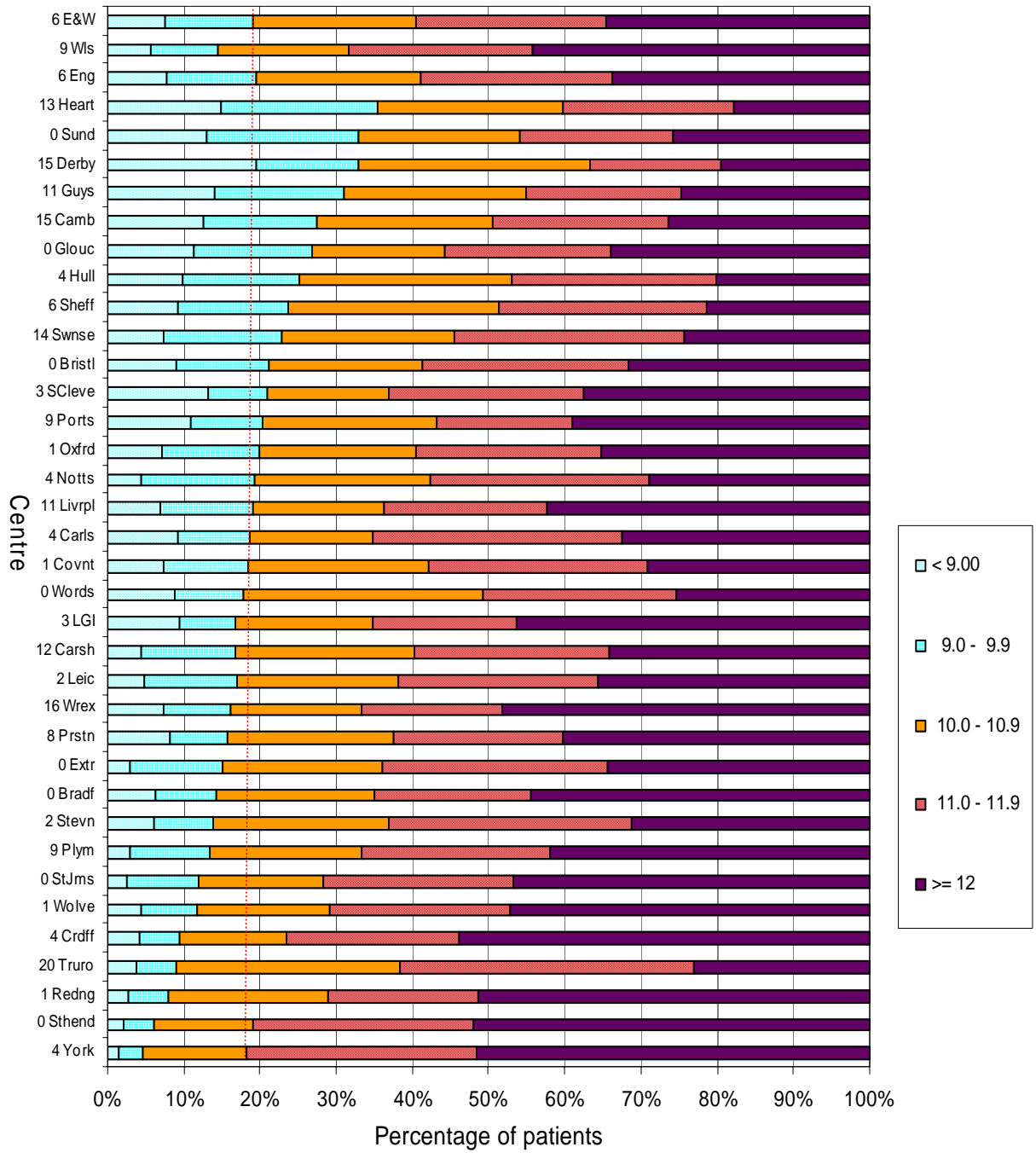
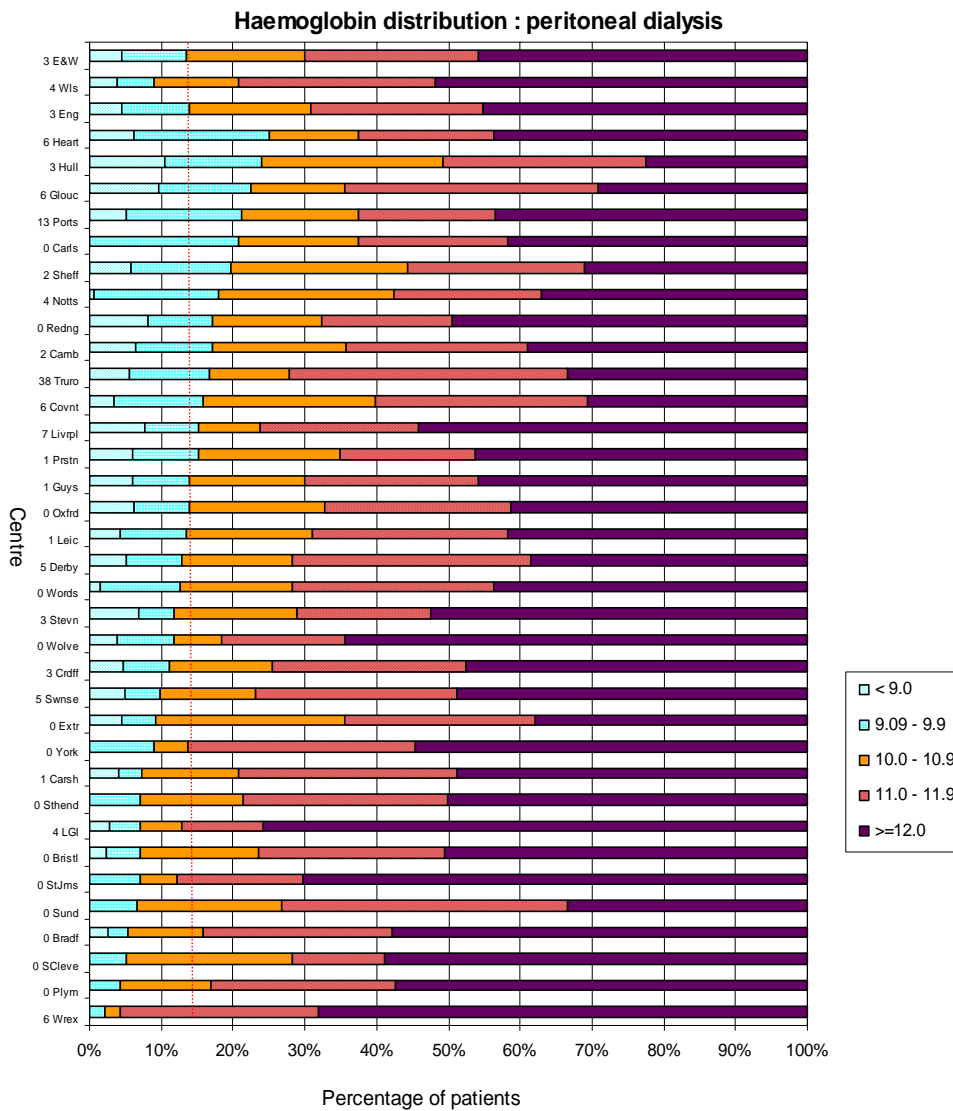


Figure 8.1: Distribution of haemoglobin in patients treated with HD



**Figure 8.2: Distribution of haemoglobin for patients on PD, by 1 g/dL bands**

The proportion of centres achieving the Renal Association Standard for haemoglobin in patients treated with HD (five centres of 27 in 2000, 13 centres of 34 in 2001) has continued to rise. In a further eight centres, the Standard falls within the 95% confidence interval. The proportion of centres achieving the Standard for PD shows little change (19 centres of 27 in 2000, 23 centres of 34 in 2001), but the 95% confidence interval included 85% of patients with a haemoglobin level of 10 g/dL or more in all centres. For HD, 81% of all patients treated in centres reporting to the Renal Registry had a haemoglobin of 10 g/dL or more, the equivalent figure for PD being 86%.

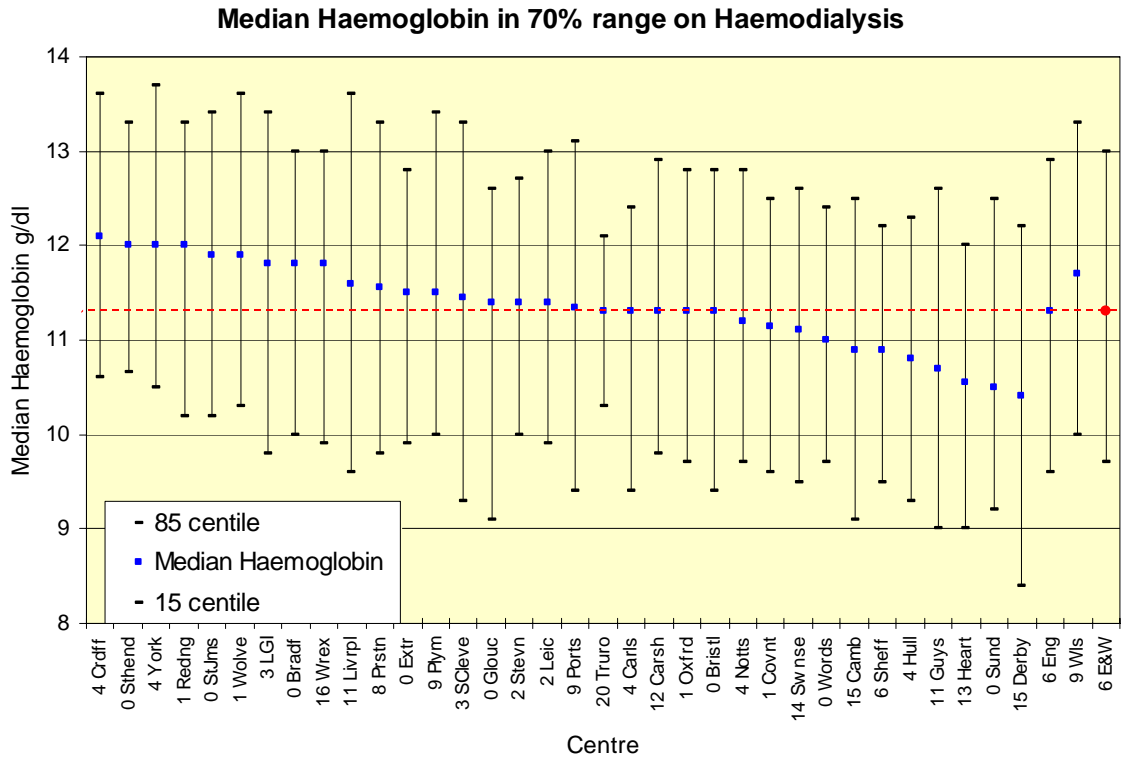


Figure 8.3: Haemoglobin median and 70% range for HD patients

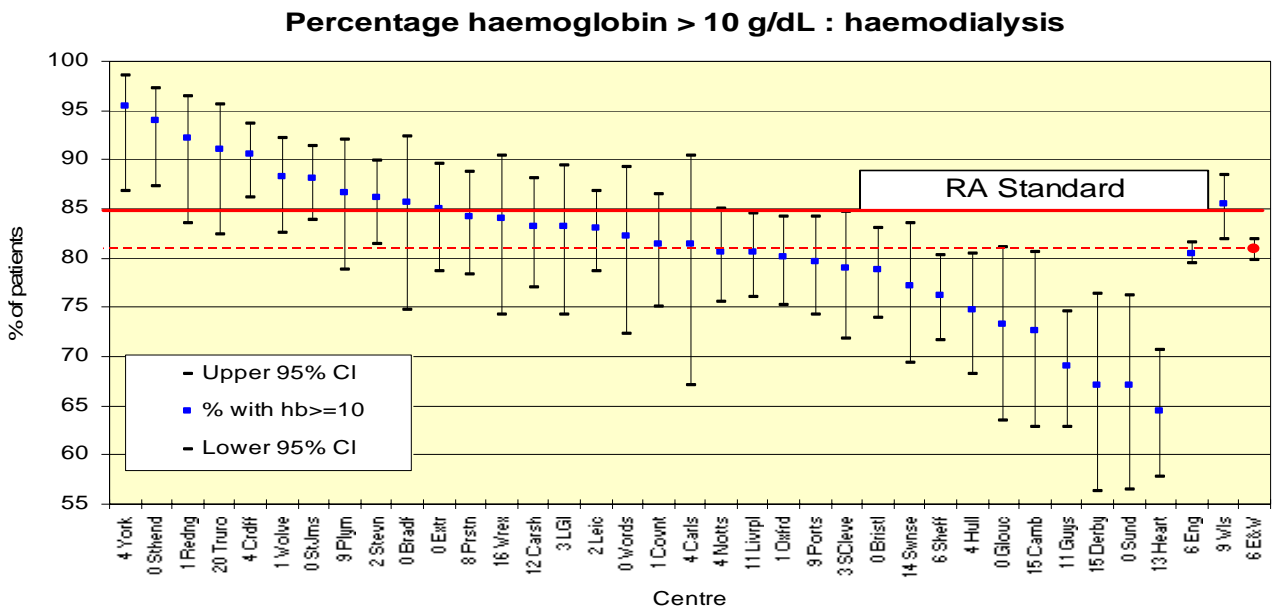


Figure 8.4: Percentage of HD patients, by centre, achieving the Renal Association Standard

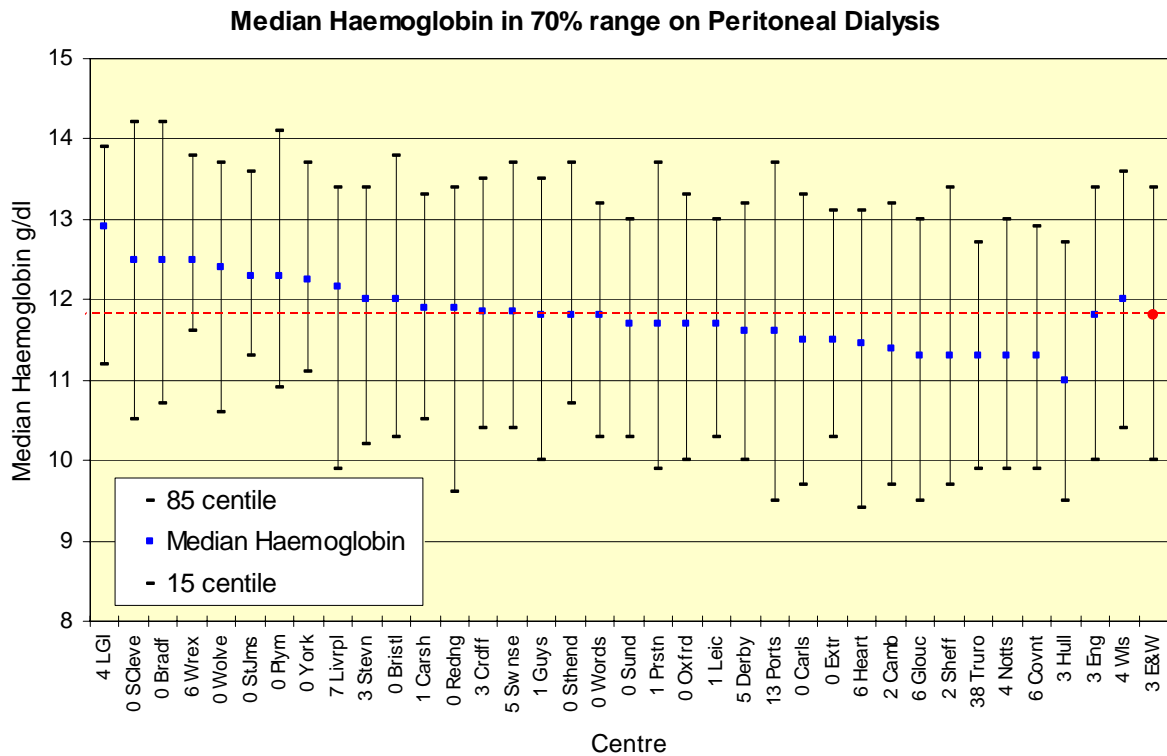


Figure 8.5: Haemoglobin median and 70% range for PD patients

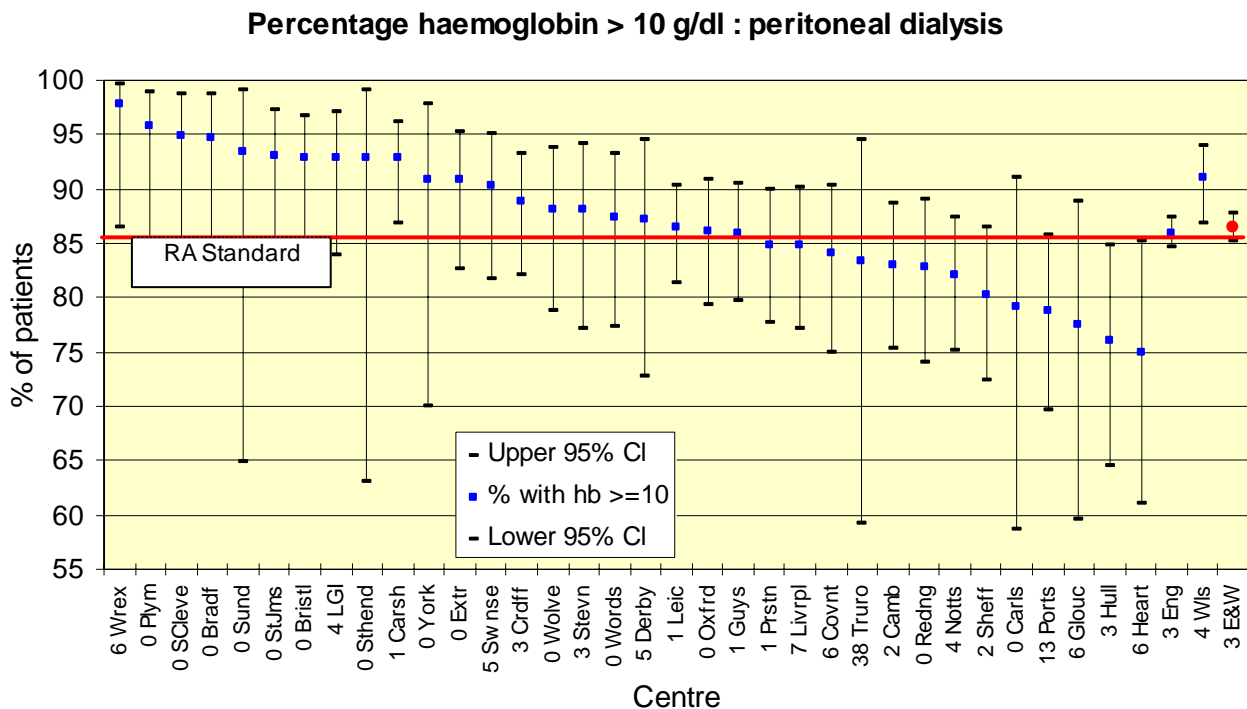


Figure 8.6: Percentage of PD patients, by centre, achieving the Renal Association Standard

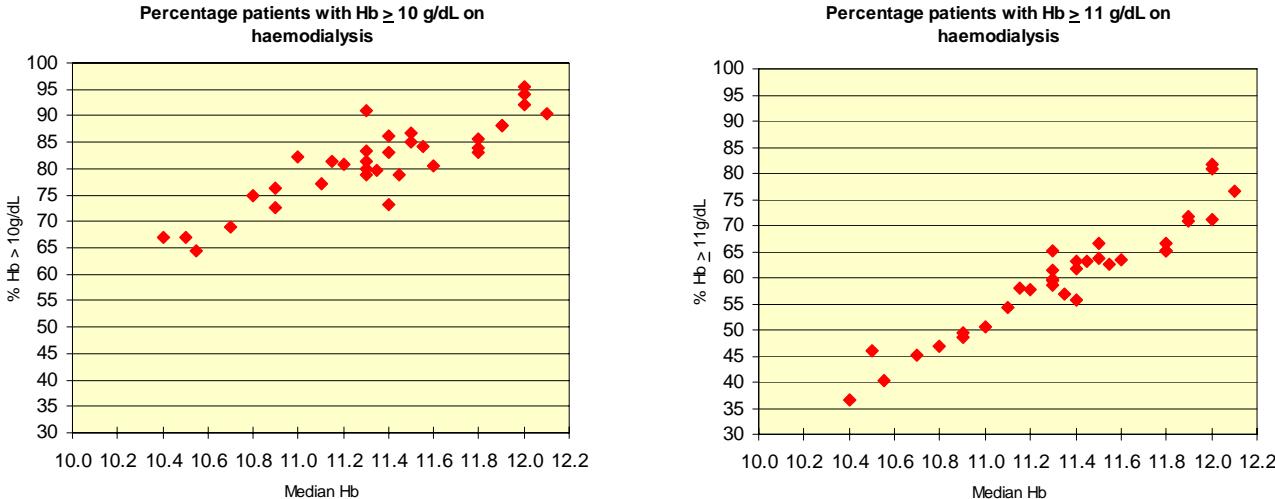
The correction of anaemia in dialysed patients has improved considerably over the past 4 years, but the extent to which this has occurred varies from one centre to another. More than

30% of HD patients in four centres have a haemoglobin level of less than 10 g/dL, and in one of these centres, PD patients also have low haemoglobin readings. In the other three centres, the distribution of haemoglobin for PD patients is closer to the overall median for England & Wales. This may reflect differences in the management of anaemia in HD and PD in these centres or patient for each mode of dialysis. In Sunderland, for example, where the majority (85%) of patients are treated with HD, 67% of HD patients and 93% of PD patients have a haemoglobin level of more than 10 g/dL. This may reflect a selection bias that ensures a good haemoglobin value in PD patients.

The optimum management of renal anaemia could be described as the achievement of target haemoglobin in the maximum number of patients with the minimum use of expensive drugs such as intravenous iron or erythropoietin. Efficient management may be inferred by a high achievement of the Renal Association target haemoglobin with a low median haemoglobin. A narrow spread of haemoglobin would be expected in those centres which have a successful targeting policy.

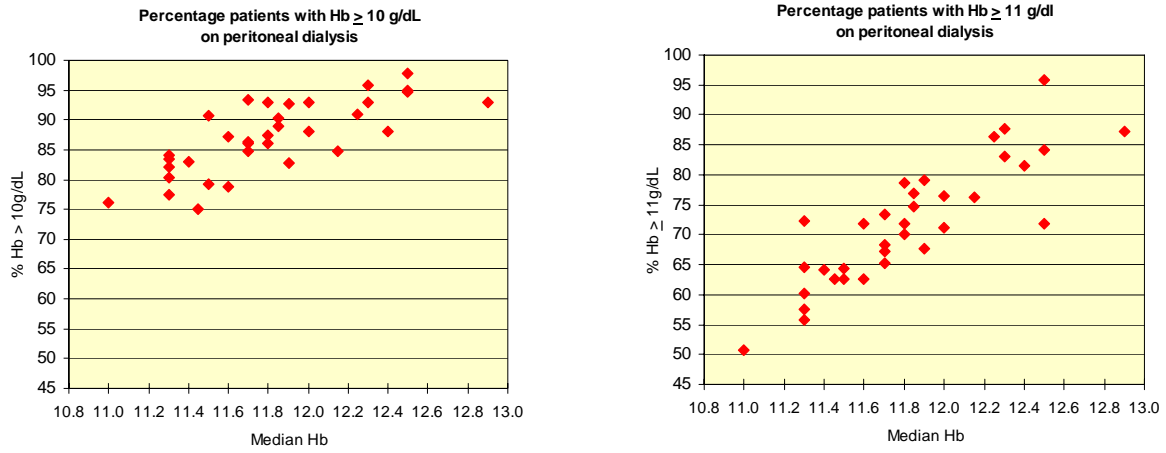
For example, among the six centres with a median haemoglobin concentration of 11.4 g/dL for HD, achievement of the Renal Association target ranges from 73% to 88%. Those centres with the lowest degree of spread have the greater proportion with a haemoglobin over 10 g/dL, suggesting better targeting. The ability to manage anaemia efficiently does not appear to be dependent upon the size of the unit. Both Stevenage (260 HD patients) and Truro (78 HD patients), for example, achieve the Renal Association target with a narrow spread of data.

Overall, there is still a close relationship between the median haemoglobin concentration in a centre and the percentage of patients with a haemoglobin reading of 10 g/dL or more (Figures 8.7 and 8.8).



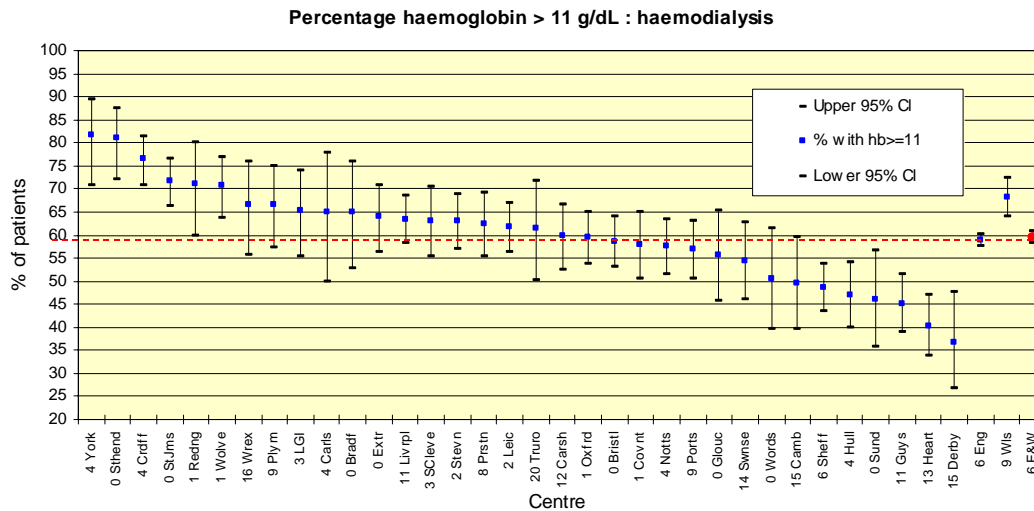
**Figure 8.7: Percentage patients with (left) Hb ≥10 g/dL and (right) Hb>11 g/dL plotted against median Hb for HD patients**



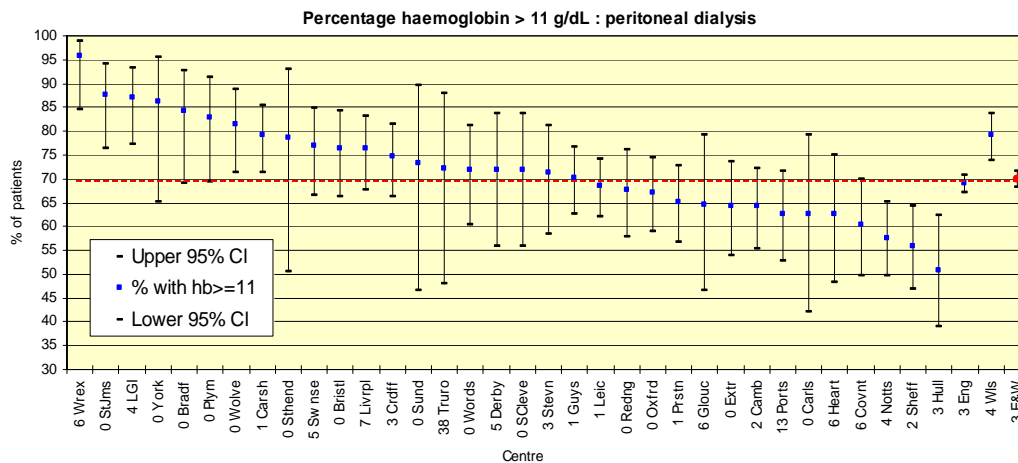


**Figure 8.8: Percentage patients with (left) Hb ≥10 g/dL and (right) Hb>11 g/dL plotted against median Hb for PD patients**

Some centres may have taken the view that a target of 11 g/dL, as recommended in Europe and the USA, is more appropriate than the UK figure of 10 g/dL; these data are shown in Figures 8.9 and 8.10.



**Figure 8.9: Percentage of HD patients with haemoglobin ≥11 g/dL**



**Figure 8.10: Percentage of PD patients with haemoglobin ≥11 g/dL**

Four centres achieved 85% of patients with a haemoglobin concentration of 11 g/dL or more with PD. No centres achieved the European target for HD patients, although both York and Southend achieved a haemoglobin value of 11 g/dL or more in over 80% of patients, and 85% fell within the 95% confidence interval. Sixty per cent of HD patients and 70% of PD patients in the registry had a haemoglobin of 11 g/dL or more. Most centres, however, fall well short of the European target of 11 g/dL, suggesting that they are concentrating on the Renal Association Standard. Nevertheless, within the European arm of the International Dialysis Outcomes and Practice Patterns Study of HD patients, the mean haemoglobin level from the UK (11.1 g/dL, compared with a Registry mean of 11.3 g/dL) was higher than that from the other countries.

### ***Haemoglobin concentrations of recently started patients***

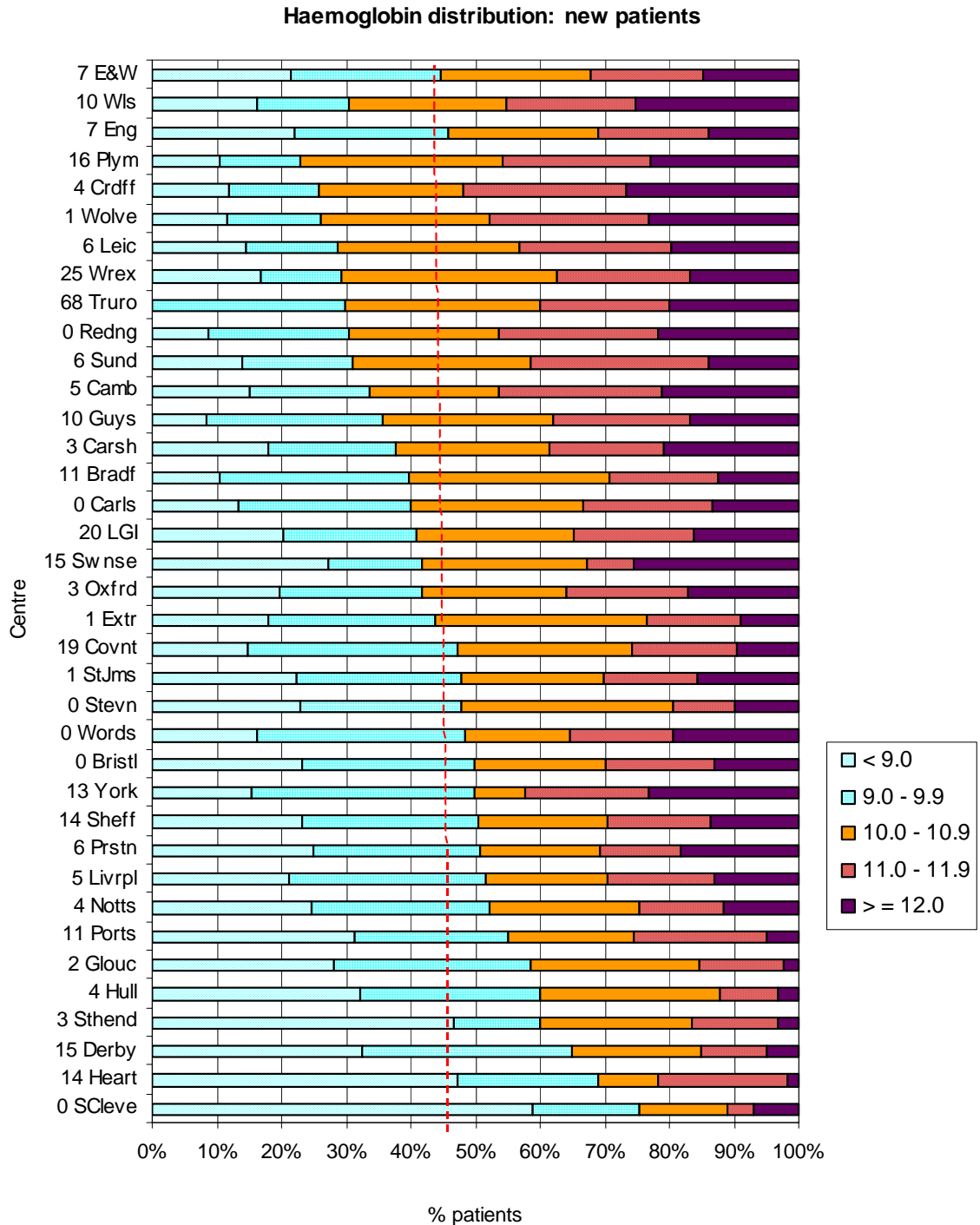
Haemoglobin concentrations within the first 3 months of starting dialysis have been analysed, data being shown in Table 8.3 and Figures 8.11–8.13. The haemoglobin data were extracted locally as the latest value in the quarter. The haemoglobin levels of these ‘new’ patients may be influenced by the management of anaemia prior to starting dialysis, the basis on which the decision to start dialysis is made and the proportion of patients who start dialysis following late referral or on presentation as uraemic emergencies.

### ***Haemoglobin at start of dialysis***

<b>Centre</b>	<b>% Data return</b>	<b>Median Hb (g/dL)</b>	<b>90% Range</b>	<b>Quartile range</b>	<b>% Hb &gt; 10 g/dL</b>
Bradf	87	10.4	8.8–12.6	9.35–11.25	60.4
Bristl	99	10.1	7.6–13.0	9.0–11.3	50.0
Camb	95	10.7	8.1–12.85	9.5–11.85	66.3
Carls	96	10.4	8.1–12.3	9.4–11.3	60.0
Carsh	96	10.5	8.0–13.5	9.3–11.7	62.3
Covnt	82	10.1	8.0–13.3	9.2–11.0	52.7
Crdff	95	11.0	8.2–13.8	9.9–12.0	74.1
Derby	86	9.5	7.65–11.8	8.5–10.5	35.0
Extr	99	10.1	8.0–12.8	9.3–10.8	56.2
Glouc	98	9.6	7.3–11.5	8.7–10.6	41.3
Guys	90	10.6	8.6–13.3	9.5–11.5	64.2
Heart	68	9.4	6.8–11.7	8.4–10.4	30.9
Hull	95	9.5	6.9–11.6	8.6–10.5	40.0
Leic	93	10.7	8.1–13.2	9.7–11.7	71.3
LGI	81	10.4	7.8–13.1	9.2–11.1	59.2
Livrpl	93	10.2	7.9–12.9	9.1–11.1	48.4
Notts	96	10.0	7.6–13.0	9.0–10.9	47.8
Oxfrd	96	10.4	7.9–13.4	9.3–11.5	58.2
Plym	81	10.7	8.5–12.8	10.0–11.65	77.1
Ports	89	9.8	7.6–11.9	8.9–11.0	44.8
Prstn	94	10.2	7.15–13.45	8.95–11.5	49.2
Redng	99	10.9	8.4–13.4	9.7–11.9	69.6
S Cleve	100	9.0	7.2–12.4	7.8–9.9	24.7
Sheff	87	10.1	7.6–12.5	9.0–11.2	49.6
Stevn	100	9.9	7.2–12.4	9.1–10.7	52.2
Sthend	91	9.4	7.6–11.5	8.1–10.6	40.0
St Jms	98	10.3	7.7–13.8	9.1–11.3	52.2
Sund	76	10.5	7.7–12.8	9.8–11.4	69.0
Swmse	55	10.2	7.0–13.4	8.8–12.0	58.2
Truro	34	11.0	9.5–14.4	9.9–11.6	70.0

Centre	% Data return	Median Hb (g/dL)	90% Range	Quartile range	% Hb > 10 g/dL
Wolve	95	10.8	7.7–13.5	9.9–11.9	73.9
Words	100	10.4	8.1–13.6	9.1–11.8	51.6
Wrex	72	10.8	8.5–14.1	9.45–11.6	70.8
York	83	10.3	8.1–12.6	9.2–11.9	50.0
E&W	90	10.2	7.7–13.1	9.1–11.3	55.3

**Table 8.3: Haemoglobin levels for new patients starting renal replacement therapy**



**Figure 8.11: Distribution of haemoglobin for new patients, by 1 g/dL bands**

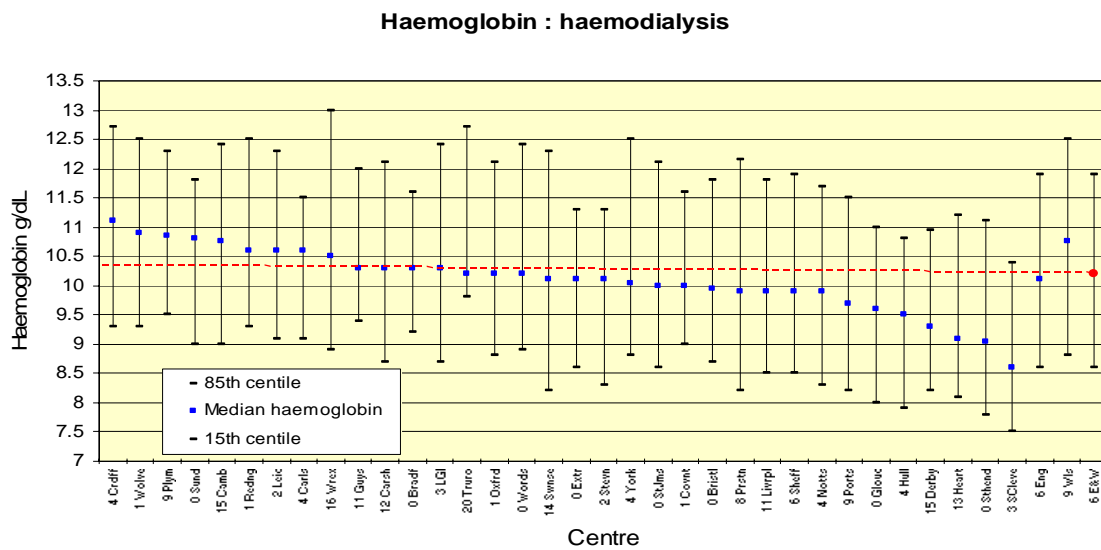


Figure 8.12: Haemoglobin median and 70% range for new patients

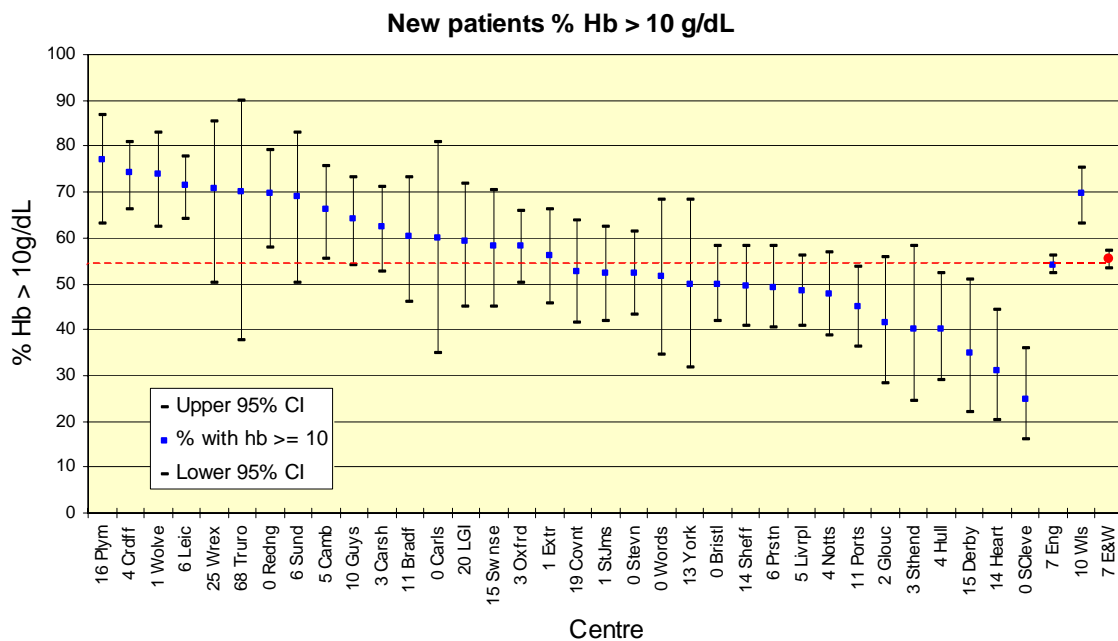


Figure 8.13: Percentage of new patients, by centre, achieving the RA Standard

There is wide variation in new patient haemoglobin concentration between centres. In Plymouth, 77% have readings greater than 10 g/dL, and 10% have a haemoglobin of less than 9.0 g/dL. In South Cleveland, 15% have haemoglobin level greater than 10 g/dL, and 59% have values less than 9 g/dL. One of the factors that may contribute to this discrepancy is the extent to which erythropoietin is used to treat patients before they start dialysis. The difference in haemoglobin level between new and prevalent patients is shown in Figure 8.14.

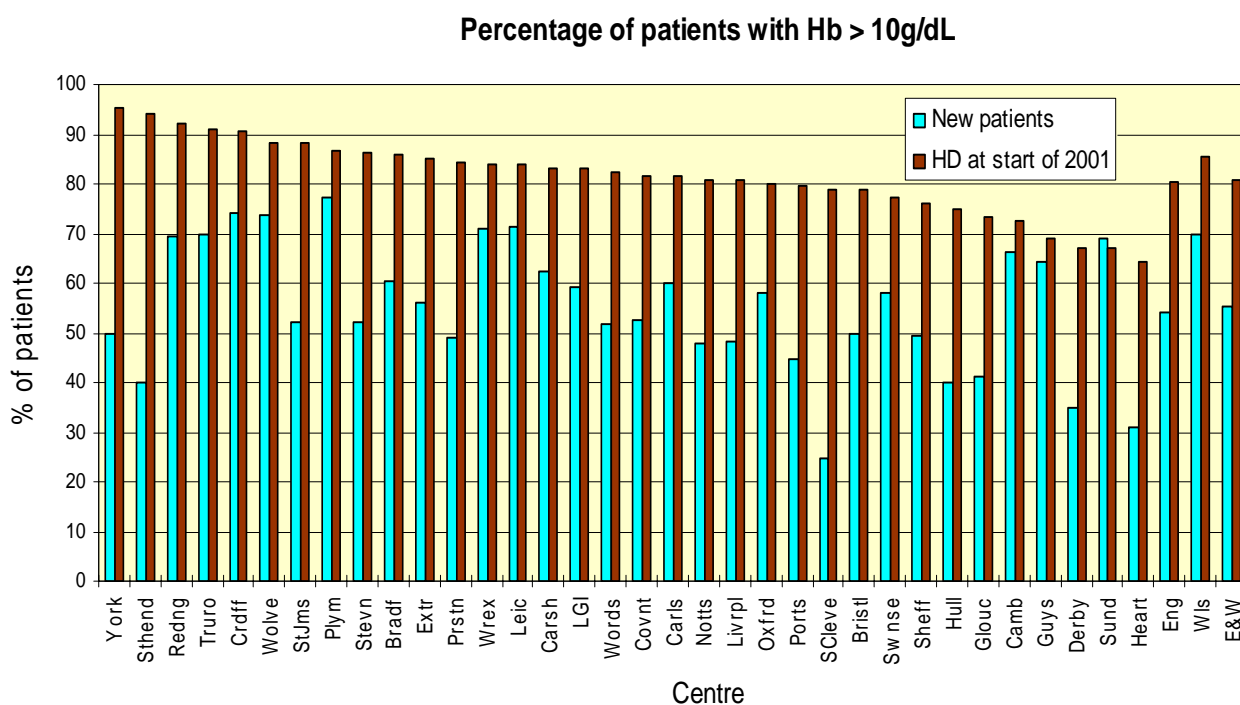


Figure 8.14: Percentage of patients with haemoglobin >10 g/dL: new and prevalent patients

### Changes in anaemia management over time

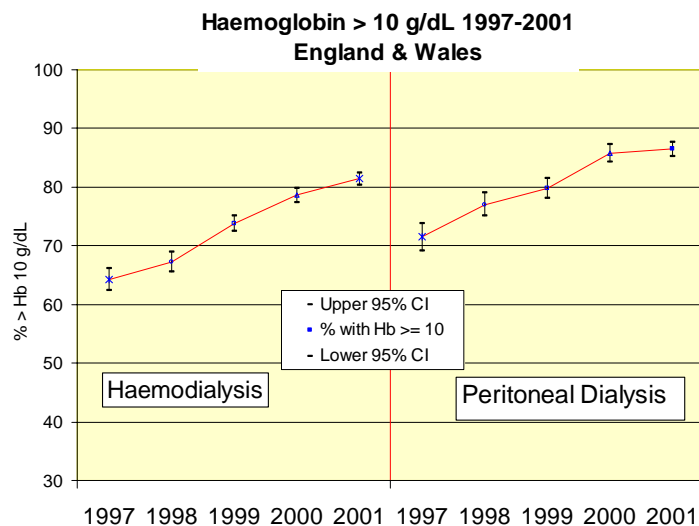


Figure 8.15: Change in the % of patients with Hb ≥10 g/dL in England & Wales, 1997–2001

The cumulative data for all units in England & Wales that contribute to the Renal Registry (Figure 8.15) demonstrate a continued improvement in the management of anaemia in HD. The percentage of PD patients with a haemoglobin of 10 g/dL or more has not changed over the past year, although the mean haemoglobin has risen slightly. Many centres still do not reach the Renal Association Standard.

Figure 8.16 is a cross-sectional analysis of median haemoglobin by length of time on renal replacement therapy (RRT). The median haemoglobin of HD patients who have been on dialysis less than 6 months showed little change between 2000 and 2001. Whereas in 2000, the haemoglobin continued to rise up to the 1–2 year cohort, there was in 2001 little difference between the 6 months – 1 year cohort and patients who had been dialysing for longer. The haemoglobin of PD patients declined with a longer time on dialysis. In 1999 and 2000, the 6 month – 1 year cohort of PD patients had the highest median haemoglobin level. In 2001, the less than 6 month cohort had the highest median haemoglobin. The earlier peaks in 2001 for both HD and PD could reflect a more aggressive early treatment of anaemia or an increased use of pre-dialysis erythropoietin.

	Mean	SD	Median	90% Range	Quartile range	% Hb $\geq 10$ g/dL
Haemodialysis						
1999	10.7	1.7	10.7	7.9–13.6	9.6–11.8	67
2000	11.2	1.6	11.2	8.3–13.8	10.1–12.2	79
2001	11.3	1.6	11.4	8.6–14.0	10.3–12.4	81
Peritoneal dialysis						
1999	11.1	1.7	11.0	8.3–13.9	10.0–12.1	76
2000	11.6	1.6	11.6	9.0–14.3	10.6–12.7	86
2001	11.8	2.6	11.8	9.0–14.4	10.7–12.9	86

Table 8.4: Change in haemoglobin for all centres in 1999, 2000 and 2001

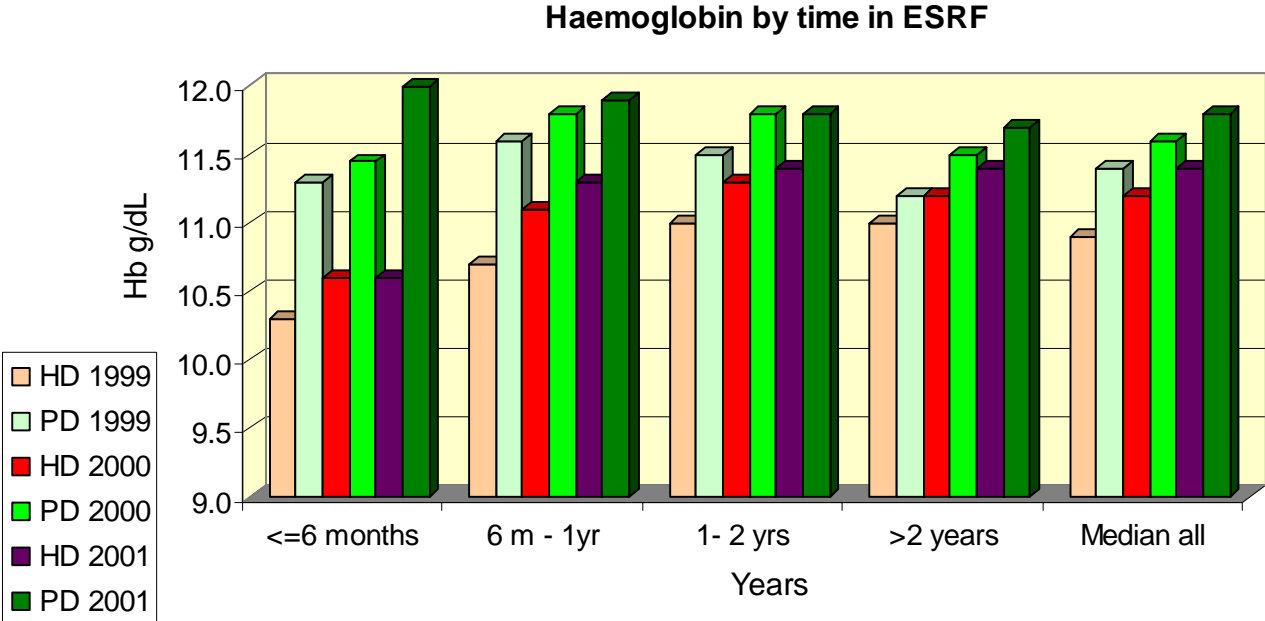
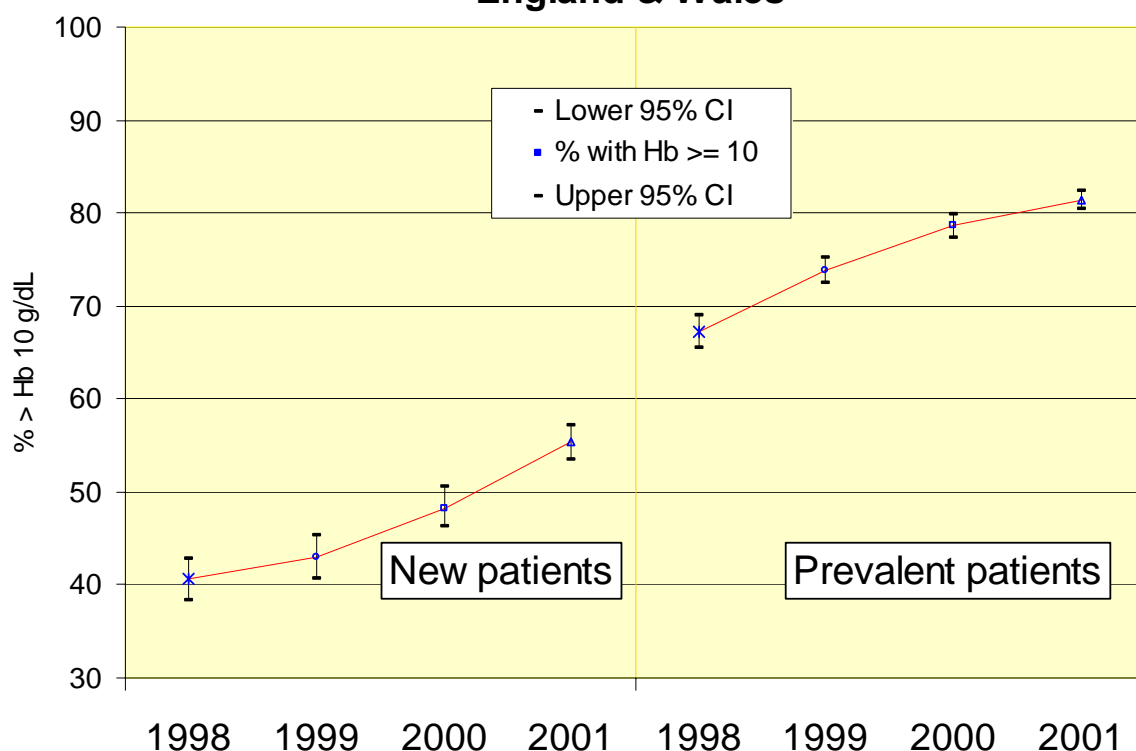


Figure 8.16: Median haemoglobin vs against time patients have been treated with RRT

An analysis of pre-dialysis haemoglobin level and modality of treatment is provided at the end of this chapter.

### Haemoglobin > 10 g/dL new patients 1998-2001 England & Wales



**Figure 8.17: Change in haemoglobin  $\geq 10$  g/dL, new and prevalent patients 1998– 2001**

In the years 2000 and 2001, the attainment of haemoglobin targets in patients commencing RRT has continued to improve (Figure 8.18), although haemoglobin levels are lower than in those patients already treated with dialysis.

#### ***Temporal changes in haemoglobin in the different renal units***

Serial data are shown for all centres. Figures 8.18 and 8.19 show the percentage of HD and PD patients with a haemoglobin of 10 g/dL or more in the first and fourth quarters of 2001 from those centres reporting for the first time this year.

For the centres that have more than have contributed to the Registry for more than 1 year, the percentage of patients with a haemoglobin concentration of 10 g/dL or above in the final quarter of each year that the centre has reported data is shown in Figures 8.20 and 8.21.

Haemoglobin > 10 g/dL at start and end of 2001 by centre : haemodialysis

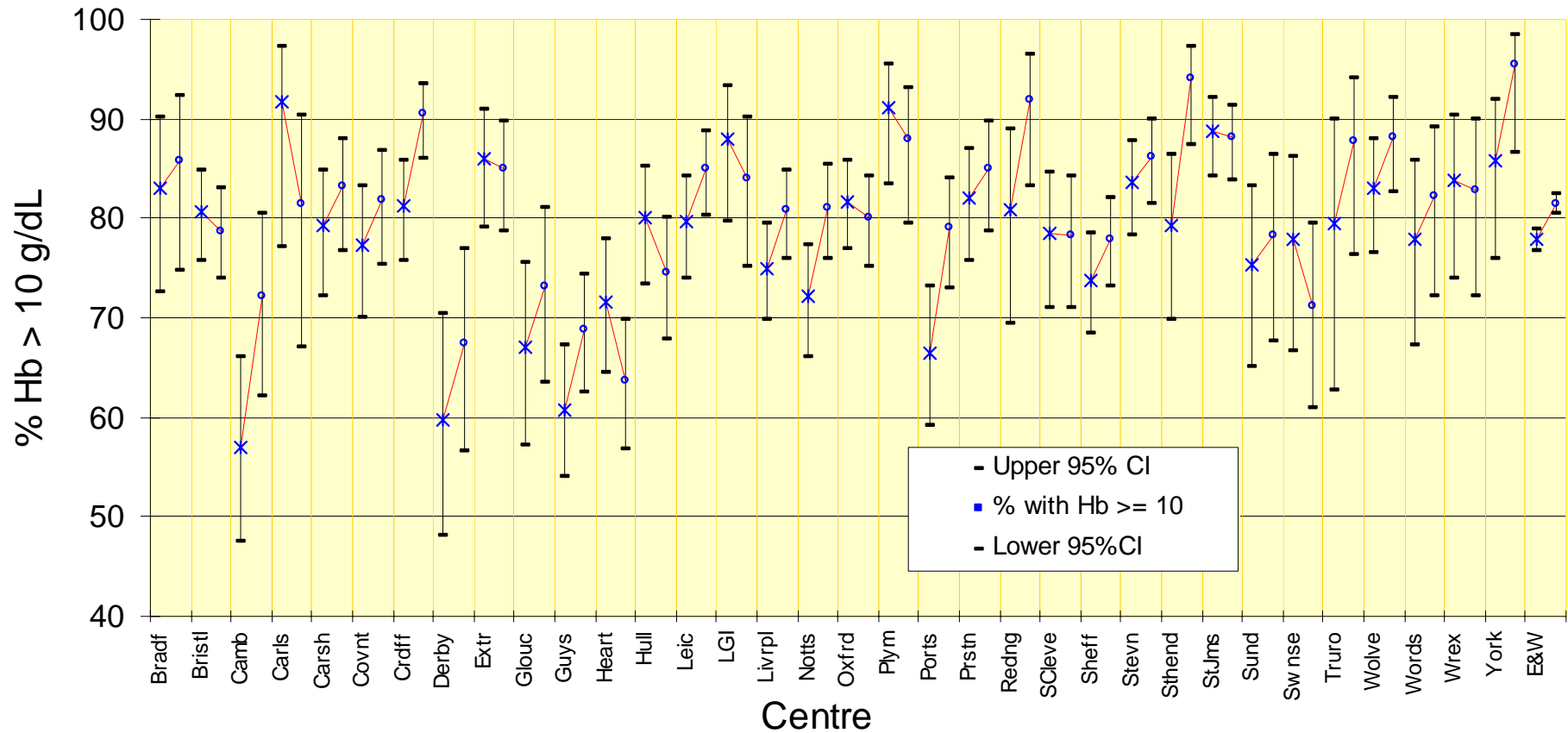


Figure 8.18: Percentage of HD patients with Hb ≥10 g/dL in the 1<sup>st</sup> and 4<sup>th</sup> quarters of 2001 by centre



**Haemoglobin > 10 g/dL at start and end of 2001 by centre :  
peritoneal dialysis**

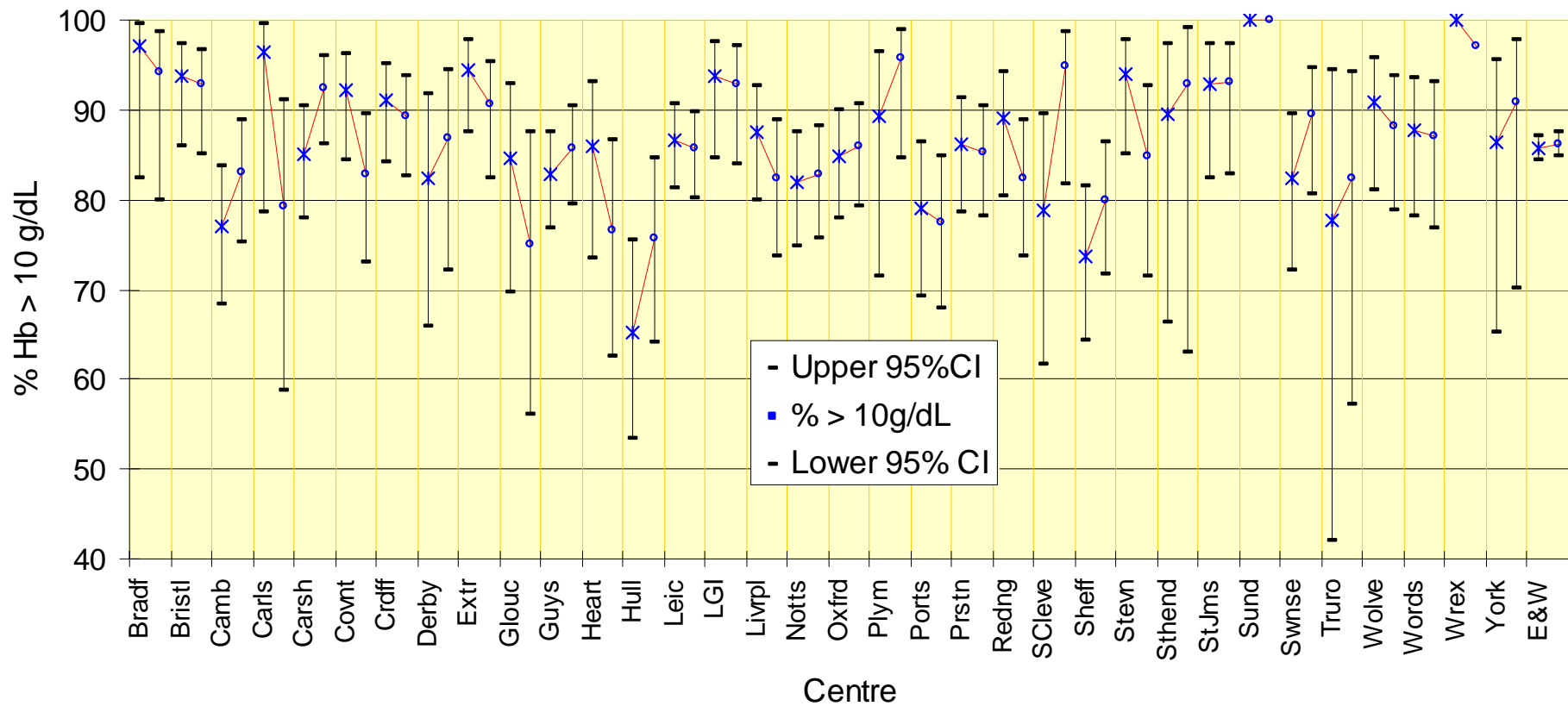


Figure 8.19: Percentage of PD patients with Hb  $\geq 10$  g/dL in the 1<sup>st</sup> and 4<sup>th</sup> quarters of 2001 by centre

**Haemoglobin > 10 g/dl at start 2000 to end of 2001 by centre :  
haemodialysis**

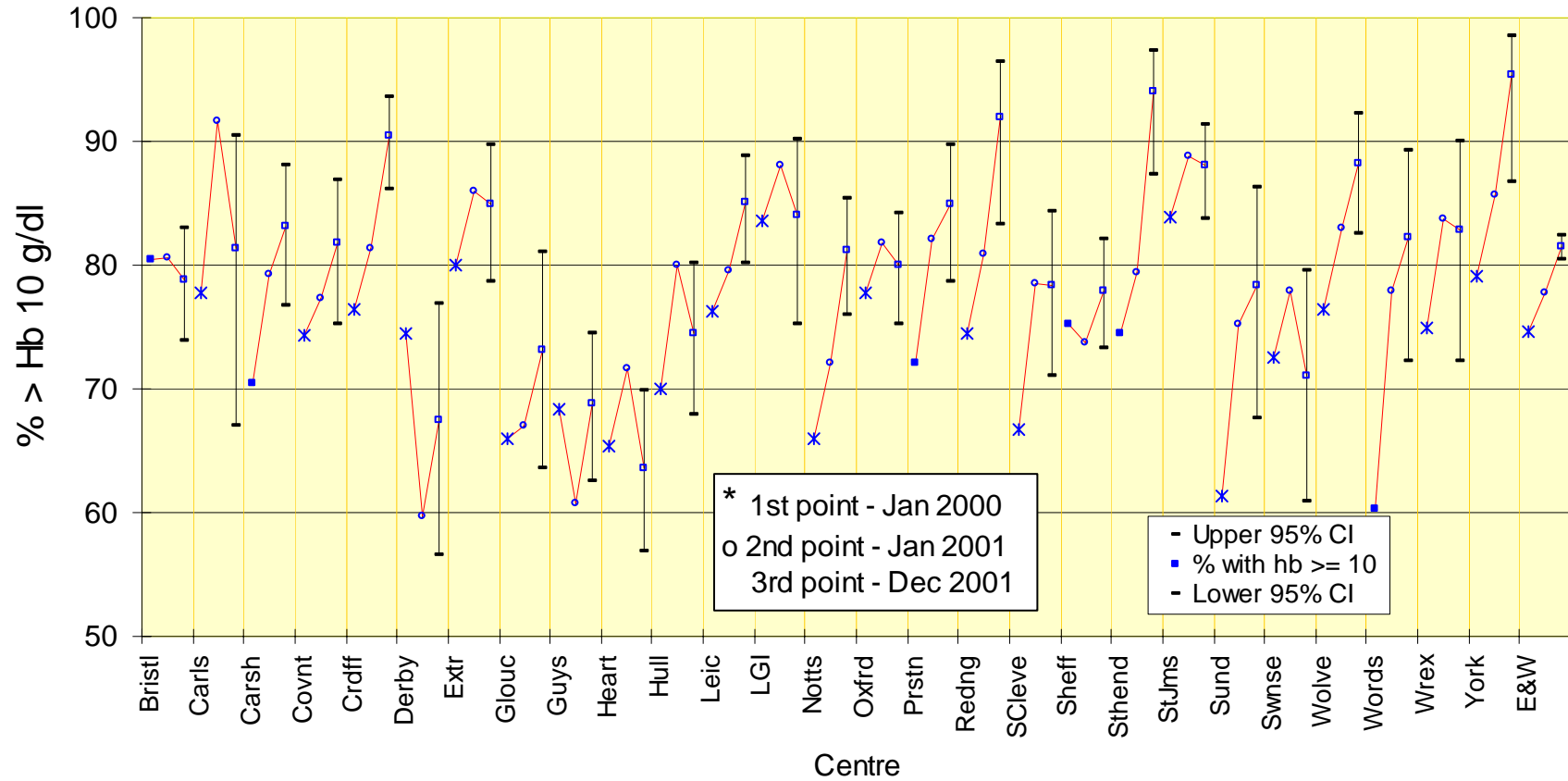


Figure 8.21: Haemoglobin >10 g/dL at start of 2000 and end of 2001, on HD

Haemoglobin > 10 g/dl at start 2000 to end of 2001 by centre :  
peritoneal dialysis

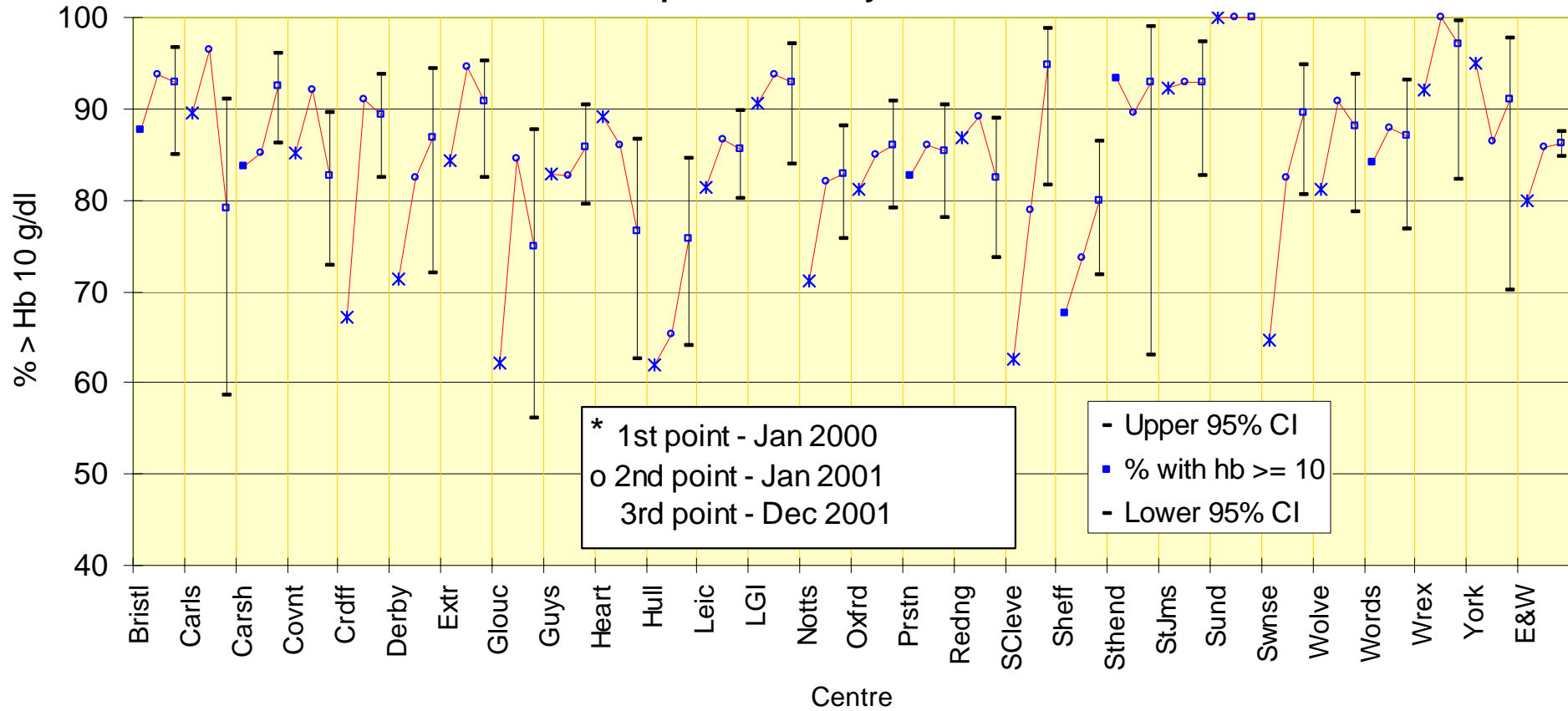
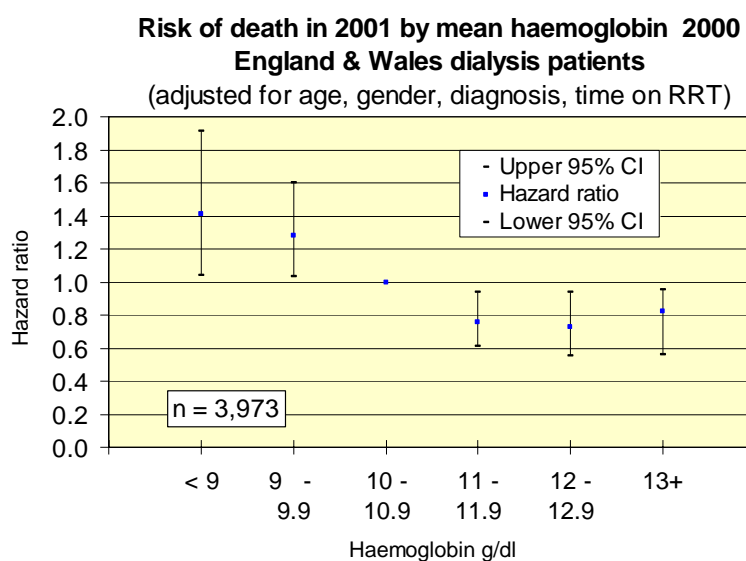


Figure 8.20: Haemoglobin >10 g/dL at start of 2000 and end of 2001, on PD

	Mean	SD	Median	90% Range	Quartile range	% Hb $\geq 10$ g/dLl
Haemodialysis						
Qtr 1 2001	11.1	1.6	11.2	8.4–13.8	10.1–12.2	81
Qtr 4 2001	11.3	1.6	11.4	8.6–14.0	10.3–12.4	81
Peritoneal dialysis						
Qtr 1 2001	11.7	1.7	11.6	8.9–14.5	10.6–12.7	86
Qtr 4 2001	11.8	2.6	11.8	9.0–14.4	10.7–12.9	86

**Table 8.5: Change in haemoglobin - all centres returning data, 1<sup>st</sup> and 4<sup>th</sup> quarters of 2001**

## Haemoglobin and survival



**Figure 8.22: Haemoglobin and hazard ratio for death**

Figure 8.22 shows the mean haemoglobin achieved through 2000 for patients alive on 31 December 2000 and their hazard ratio for death in 2001. All patients included in the analysis had haemoglobin data from three or more quarters of 2000.

When compared with those with a haemoglobin level of 10–10.9 g/dL, patients with lower haemoglobins had a significantly increased hazard of death. Patients with a haemoglobin of 11–11.9 g/dL had a significantly better survival than those with a haemoglobin of 10–10.9 g/dL (Renal Association Standard), indicating support for the European best practice guideline of a haemoglobin concentration of over 11 g/dL. There was no improvement in survival to be gained from increasing the haemoglobin concentration beyond this level.

## Haemoglobin level before start of RRT and first treatment modality

The Registry collects electronically the last haemoglobin reading before start of RRT and the date on which this was measured. Data were only included in this analysis if the haemoglobin had been measured within 3 months prior to the start of RRT.

This analysis included incident patients starting in 1999 through to end of 2001.

Centres were excluded if they had less than 50% completeness of the pre-RRT haemoglobin for incident patients. All the centres remaining in the analysis were using automated laboratory links.

The data were analysed by the year of start of RRT and by first treatment modality of HD or PD. Patients with a pre-emptive transplant were excluded.

## Results

Year	HD	PD	All
Hb (g/dL) 1999	9.4	9.9	9.6
95% CI	[9.3–9.5]	[9.8–10.0]	[9.5–9.7]
Median days before RRT	3	6	4
Hb (g/dL) 2000	9.7	10.2	9.9
95% CI	[9.6–9.8]	[10.1–10.3]	[9.8–9.9]
Median days before RRT	2	5	4
Hb (g/dL) 2001	9.8	10.6	10.1
95% CI	[9.7–9.9]	[10.5–10.7]	[10.0–10.1]
Median days before RRT	2	6	3
Hb (g/dL) all	9.7	10.3	9.9

**Table 8.6: Haemoglobin prior to the start of RRT 1999–2001**

Table 8.6 shows that the haemoglobin level prior to start of RRT has been rising successively from 9.6 g/dL to 10.1 g/dL over the past 3 years.

Patients starting on HD had significantly lower haemoglobins than those starting on PD (Table 8.7), this gap being largest in 2001.

Age	HD	PD
Hb age <65	9.6	10.2
95% CI	[9.55–9.71]	[10.16–10.32]
n	(n=1729)	(n=1349)
Hb age 65+	9.7	10.3
95% CI	[9.64–9.78]	[10.18–10.40]
n	(n=2079)	(n=740)
n	9.7 (n=3808)	10.3 (n=2089)

**Table 8.7: Haemoglobin prior to the start of RRT, by first modality of RRT**

In Table 8.7, the haemoglobin prior to the start of RRT was not significantly different between the two age groups (under-65 and 65+).

When analysed by age, patients starting RRT on PD had significantly higher haemoglobin concentrations than those starting on HD ( $p < 0.0001$  ANOVA) in both patients aged under 65 and over 65 years.

## ***Discussion***

Haemoglobin levels prior to the start of RRT have risen progressively over the past 3 years. This in part probably reflects the increasing prescription of erythropoietin for patients before they reach established renal failure, although over 50% of patients remain anaemic at the start of RRT. In some renal units, the use of pre-dialysis erythropoietin is prevented or very restricted by inadequate funding. SDIII mandates the use of erythropoietin in anaemic patients prior to the start of RRT.

The Registry has shown in previous reports that haemoglobin levels within the first 3 months of starting RRT have been significantly lower in patients starting on HD than on PD. These results show that pre-dialysis haemoglobin values are also lower in those patients starting HD than those starting PD. The haemoglobin result was taken a median of 2 days prior to starting HD. Most of the patients presenting acutely or late, who are more likely to require HD and are unlikely to receive pre-dialysis erythropoietin, will have had results that have been included in the above analysis. These results indicate that patients starting on PD and HD are two differently selected groups. This highlights the problems of studies trying to assess differences between the techniques of PD and HD. The Registry plans to analyse this in more detail by obtaining haemoglobin data 1 week and 1 month prior to the start of RRT, which would exclude these patients presenting acutely.

## ***Conclusion***

There has been a continued improvement in anaemia management in centres submitting data to the Registry, the improvement being most marked for HD patients.

Several centres are now achieving the Renal Association Standard for haemoglobin in both PD and H, although some centres are still falling significantly short of the Standard.

It is interesting to note that centres with the same median haemoglobin may have a quite varying achievement of the Renal Association target, although there is overall still a close relationship between median haemoglobin and percentage achievement of the Renal Association Standard.

There is little evidence to suggest that centres have adopted the European Standard for haemoglobin. There is a significant gap between current practice and the achievement of a haemoglobin level of over 11 g/dL in 85% of patients.