

Chapter 13: Performance Against Renal Association Standards by Centre and Patient Age

Summary

- Chi squared testing showed that the percentage of patients achieving the recommended Standard for all the following variables differed significantly between centres for both modalities of dialysis. The variables tested were: haemoglobin, dialysis adequacy, serum ferritin, calcium, phosphate, bicarbonate, intact parathyroid hormone and blood pressure.
- Patient age seems to be an important factor in the degree of achievement of many of the RA standards. The median age of patients on RRT varies between renal units and this may account for part of the variation in achievement of RA Standards.

Introduction

The Standards Committee of the Renal Association has identified a number of laboratory and clinical variables that may relate to quality of care or outcomes, and has recommended minimum Standards or target ranges that should be achieved in established dialysis patients. A revised document was published in autumn 2002 and these are shown in Table 13.1.

Data included on dialysis patients are from the last quarter of 2004 for all items except cholesterol and iPTH which are from the last 6 months. Patients were excluded if they had not been on renal replacement therapy (RRT) for at least 3 months or if they had transferred unit or changed dialysis modality in the 3 month period prior to data sampling. This ensured that the results for a unit reflected stable treatment patterns and were not adversely affected by new patients whom the unit had not had the chance to treat effectively.

The problems of comparing biochemical variables such as albumin, calcium and bicarbonate identified in the previous reports still apply; comparative data must be interpreted with caution. The achievement of Standards defined around the local laboratory reference range is dependent on the source of derivation for the reference range. The urea reduction ratio (URR) may be influenced by post-dialysis sampling techniques (see discussion in previous reports).

Achievement of Standards may also be affected by patient age and so an analysis of achievement by age band and modality has been included.

Table 13.1: Renal Association 3rd Standards

Standard	Haemodialysis	Peritoneal dialysis	Transplant
Albumin	≥ 35 g/L BCG ≥ 30 g/L BCP	≥ 35 g/L BCG ≥ 30 g/L BCP	
Bicarbonate	20–26 mmol/L	25–29 mmol/L	
Blood pressure	Pre-HD <140/90 mmHg Post-HD < 130/80 mmHg	<130/80 mmHg	<130/80 mmHg
Calcium adjusted for albumin	2.2–2.6 mmol/L	2.2–2.6 mmol/L	
Cholesterol – Total	<5 mmol/L	<5 mmol/L	
Dialysis adequacy	Urea reduction ratio >65%		
Ferritin	>100 µg/L	>100 µg/L	
Haemoglobin	≥ 10 g/dl	≥ 10 g/dl	
HbA1c	<7%	<7%	<7%
Parathyroid hormone	<4× upper local range	<4× upper local range	<4× upper local range
Phosphate	<1.8 mmol/L pre-HD	<1.8 mmol/L	

Overview of presentation

Results have been ranked in order of performance purely for clarity of presentation, otherwise the figures would be difficult to read. The significance of the ranking order is discussed below.

In the following section, many figures use a common modified box-plot format, data being presented separately for haemodialysis (HD) and peritoneal dialysis (PD) and transplantation.

- The figures showing the percentage of patients reaching the Renal Association

Standard include the 95% confidence interval calculated for this figure (using the Poisson approximation).

- Where medians are displayed, the 25th and 75th centiles for the unit are included.
- Data completeness is indicated by the 'percentage missing' figure before the renal unit abbreviated name (see Appendix J).

These methods are the best way the Registry has found to convey the underlying data for the larger number of centres.

Performance of Standards by modality and centre

Haemoglobin

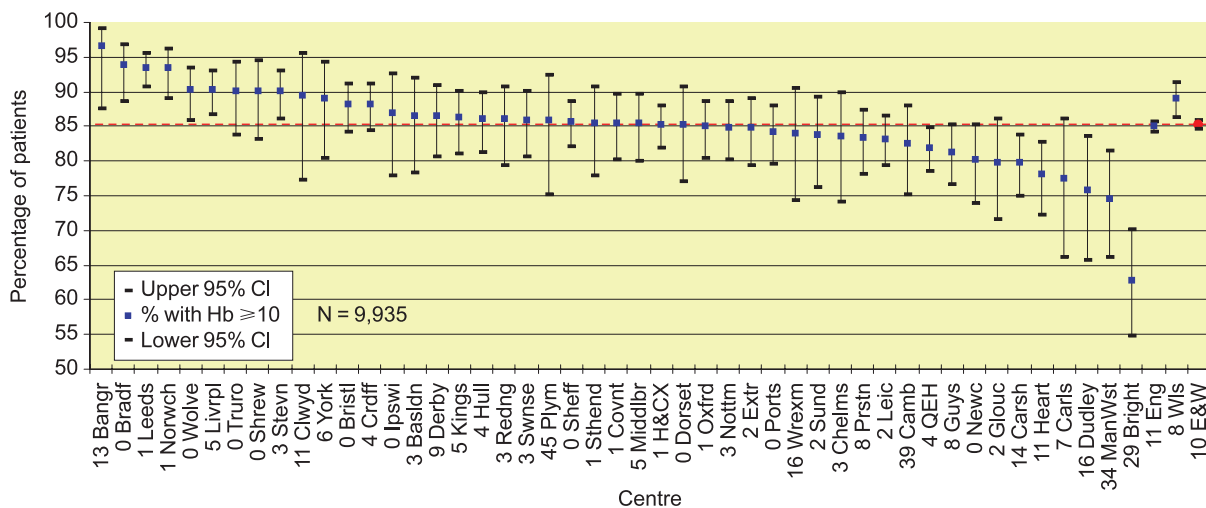


Figure 13.1: Percentage of patients achieving the RA Hb Standard by centre: HD

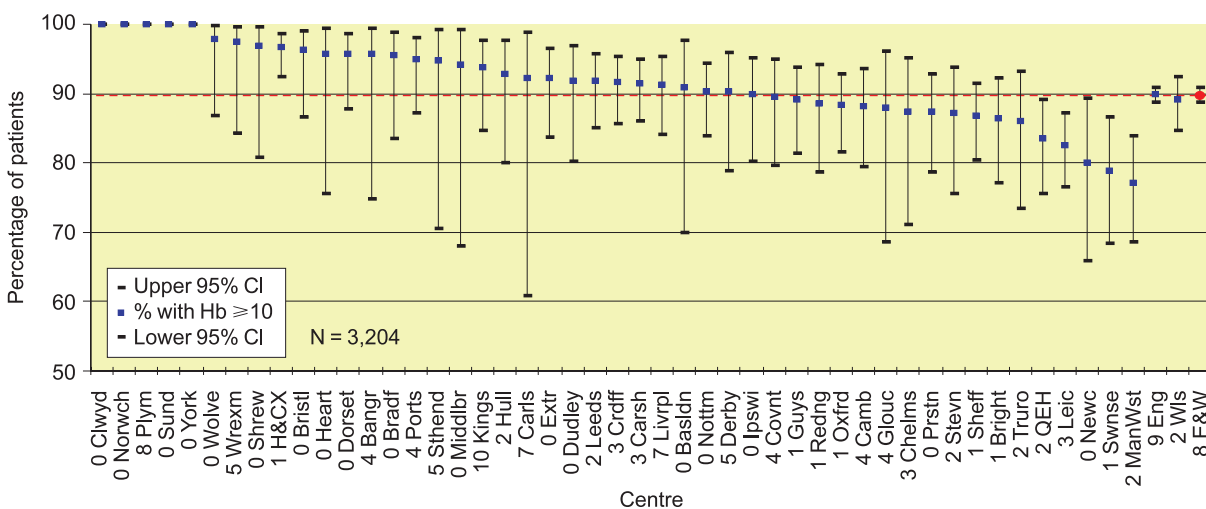


Figure 13.2: Percentage of patients achieving the RA Hb Standard by centre: PD

Serum Ferritin

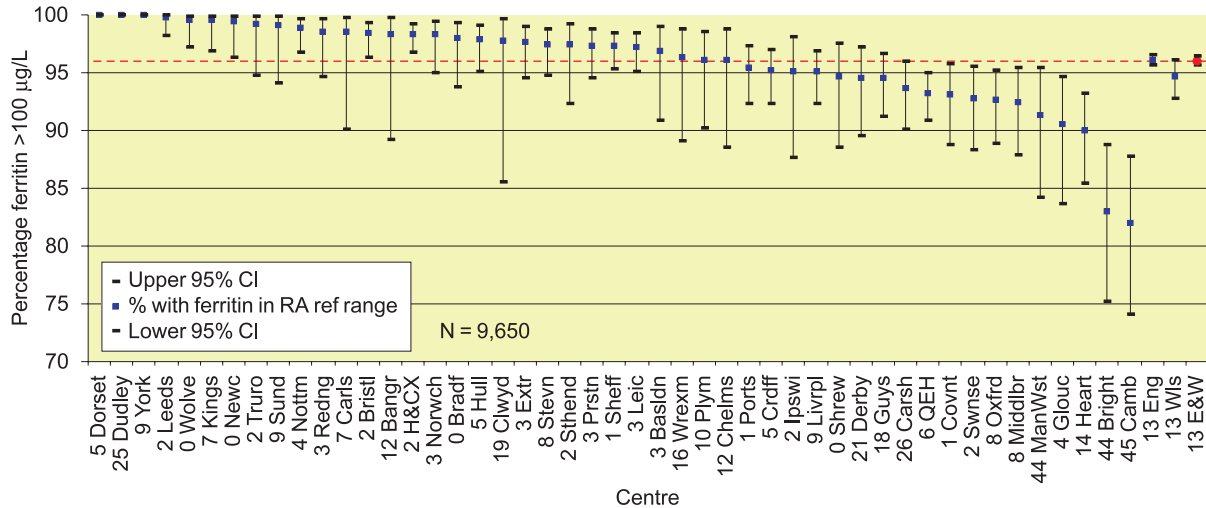


Figure 13.3: Percentage of patients achieving the RA Ferritin Standard by centre: HD

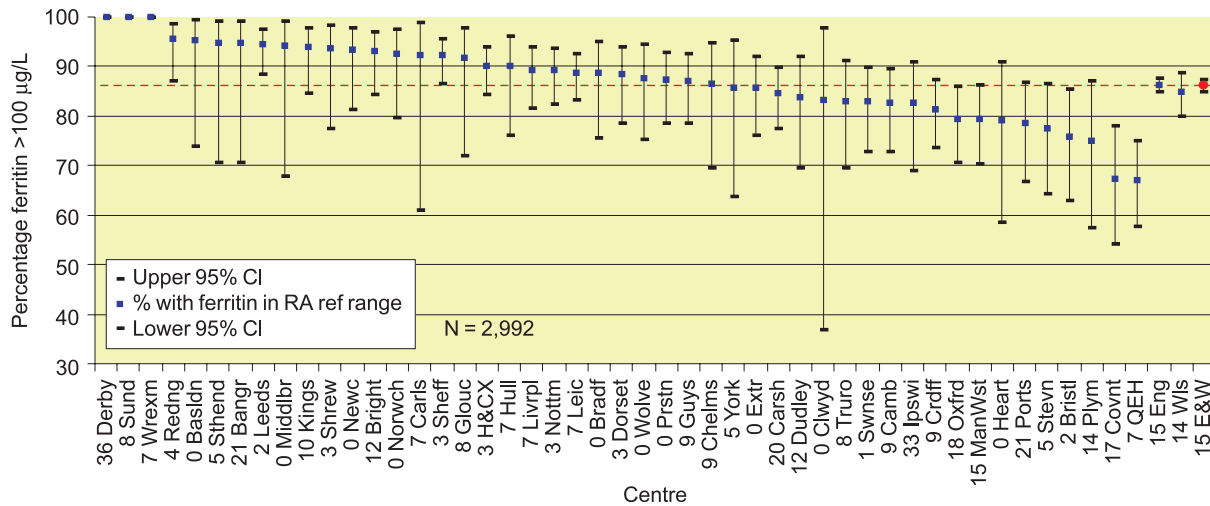


Figure 13.4: Percentage of patients achieving the RA Ferritin Standard by centre: PD

Serum calcium

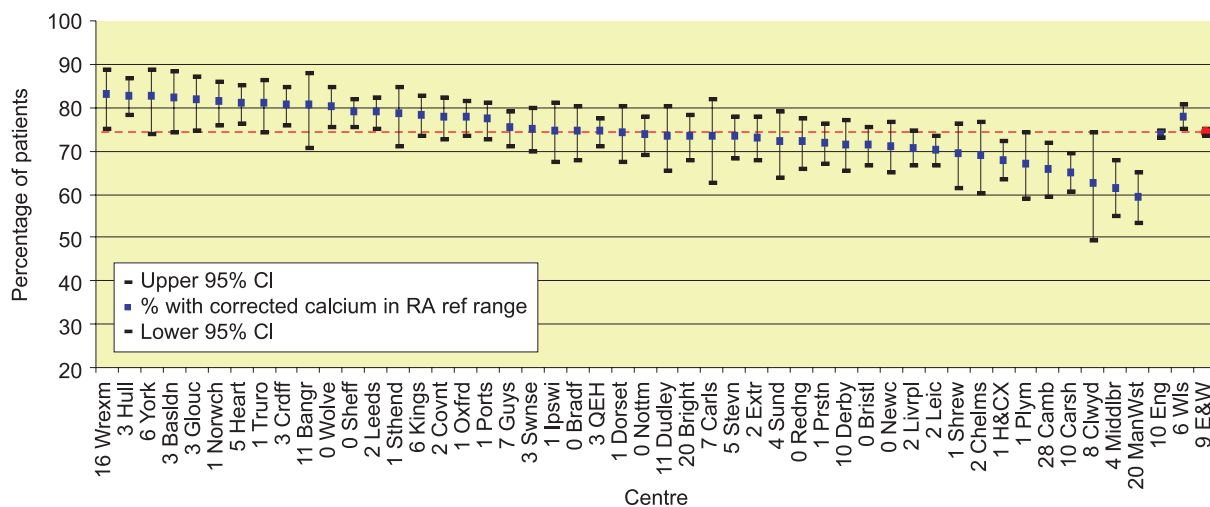


Figure 13.5: Percentage of patients achieving the RA calcium Standard by centre: Dialysis

Serum phosphate

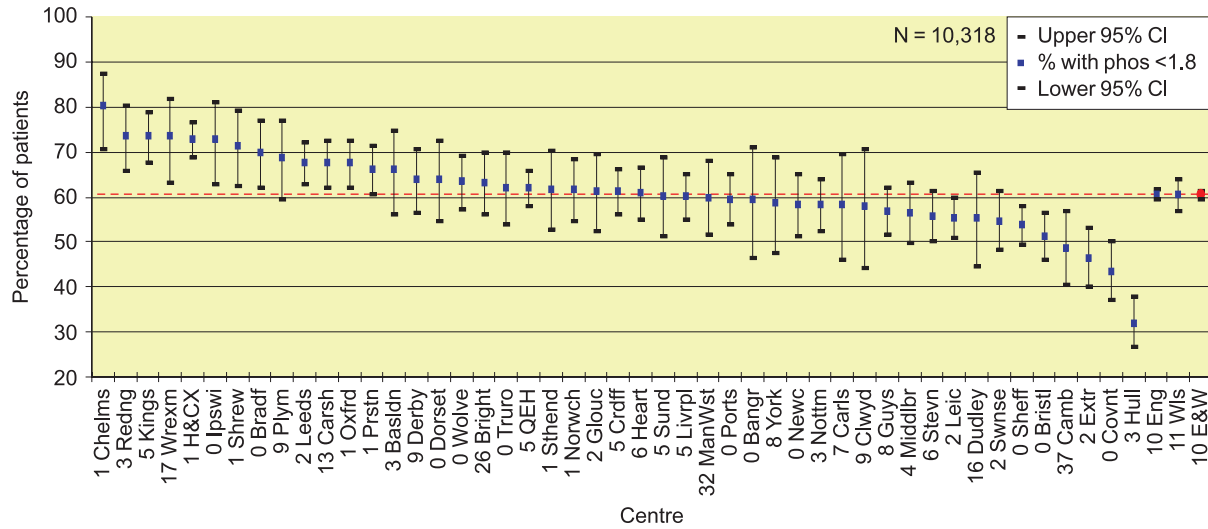


Figure 13.6: Percentage of patients achieving the RA phosphate Standard by centre: HD

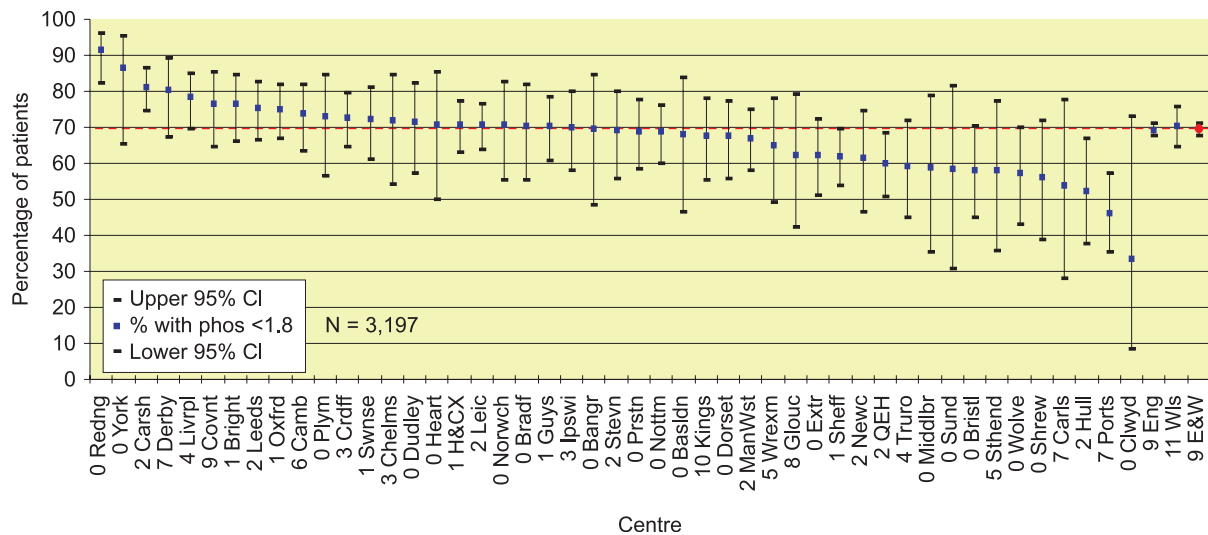


Figure 13.7: Percentage of patients achieving the RA phosphate Standard by centre: PD

Intact parathyroid hormone

As the local laboratory reference range for PTH has not been derived from a local or UK population reference range, the Registry in line

with previous years has used the average upper laboratory reference limit (8 pmol/L) and the recommended Standard of $\times 4$ this limit.

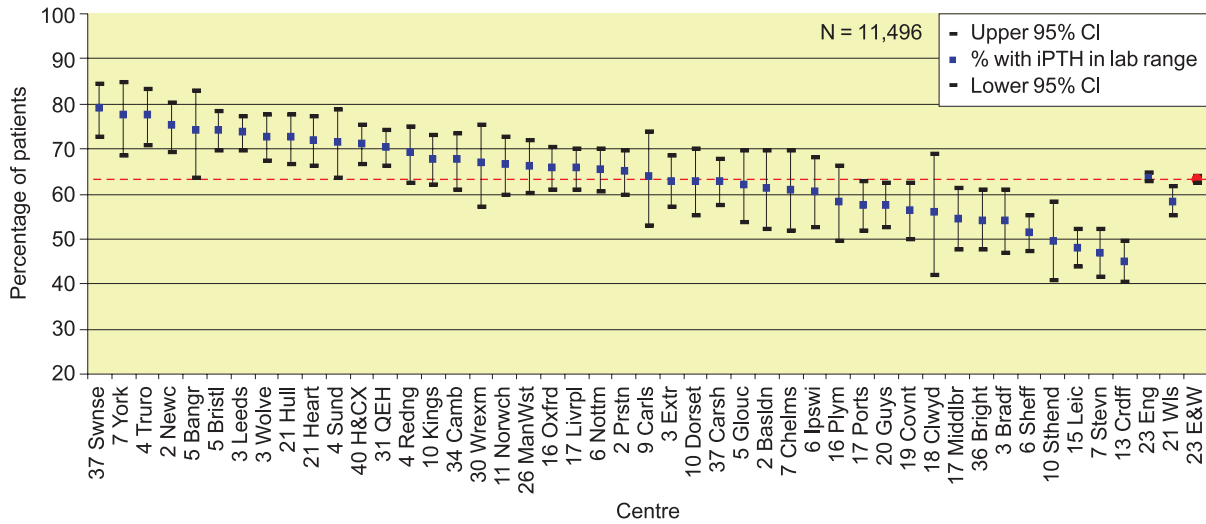


Figure 13.8: Percentage of patients achieving iPTH <32 pmol/L by centre: Dialysis

Dialysis adequacy

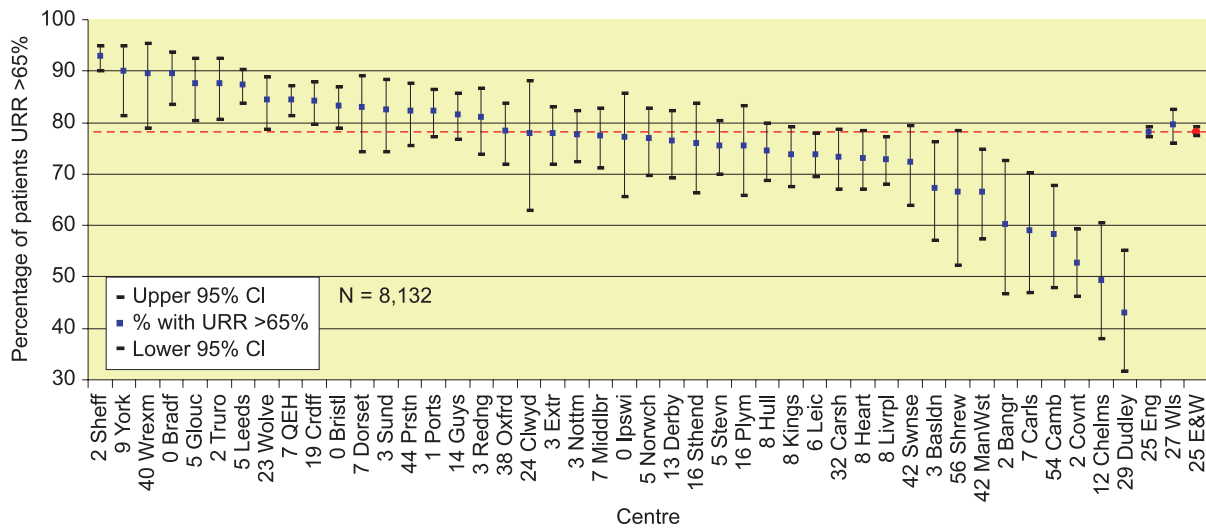


Figure 13.9: Percentage of patients with URR >=65% by centre: Haemodialysis

Serum bicarbonate

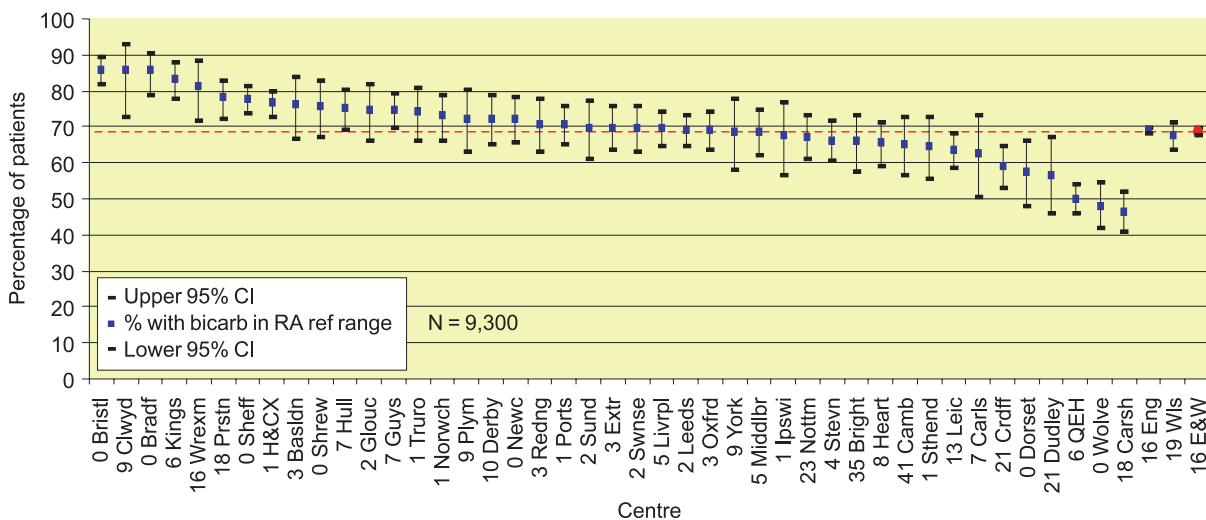


Figure 13.10: Percentage of patients achieving the RA bicarbonate Standard by centre: HD

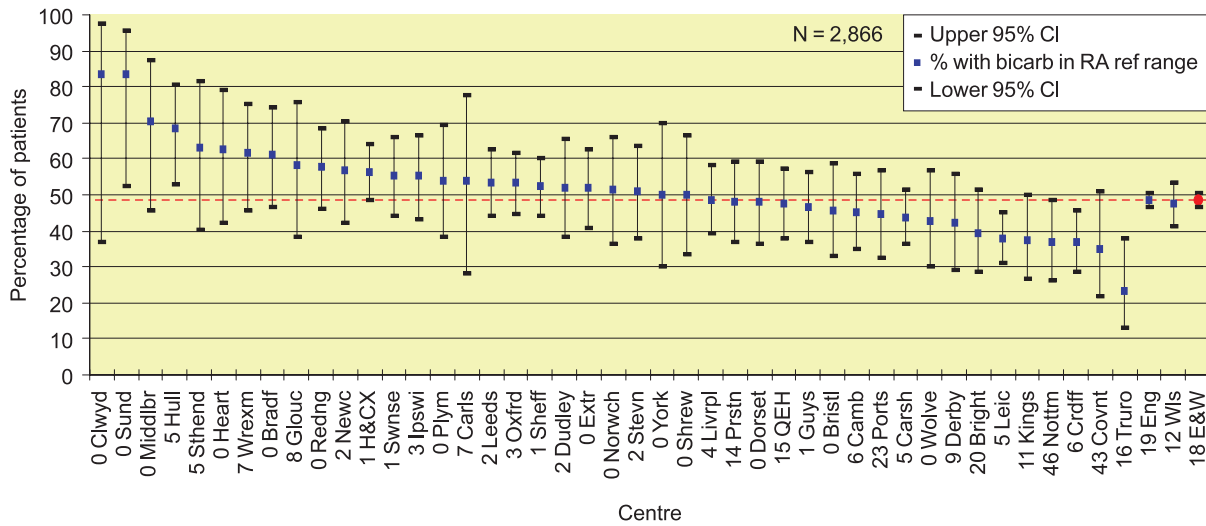


Figure 13.11: Percentage of patients achieving the RA bicarbonate Standard by centre: PD

Serum albumin

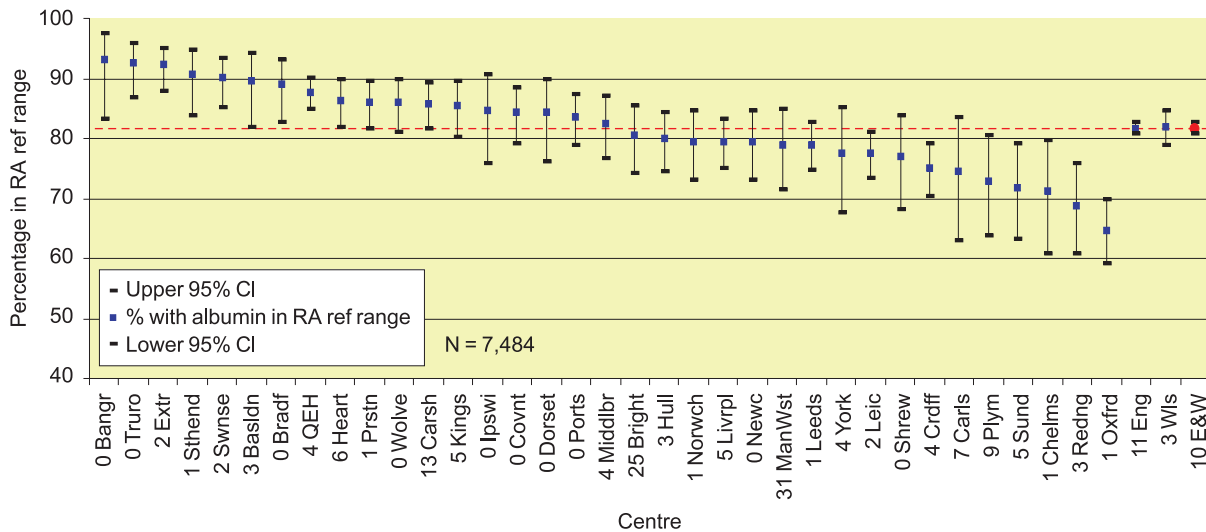


Figure 13.12: Percentage of patients achieving the RA albumin BCG Standard by centre: HD

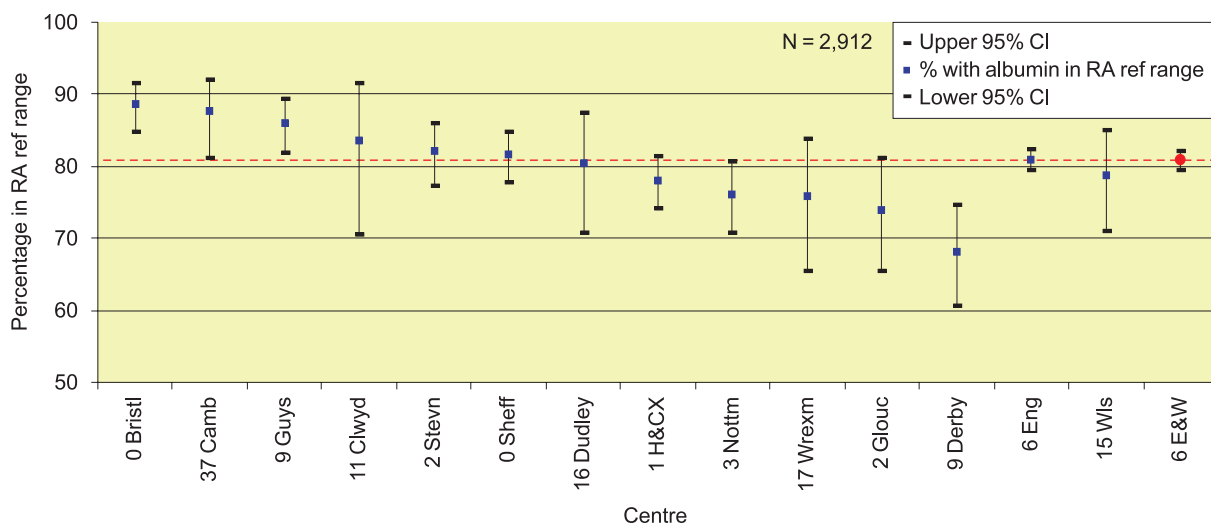


Figure 13.13: Percentage of patients achieving the RA albumin BCP Standard by centre : HD

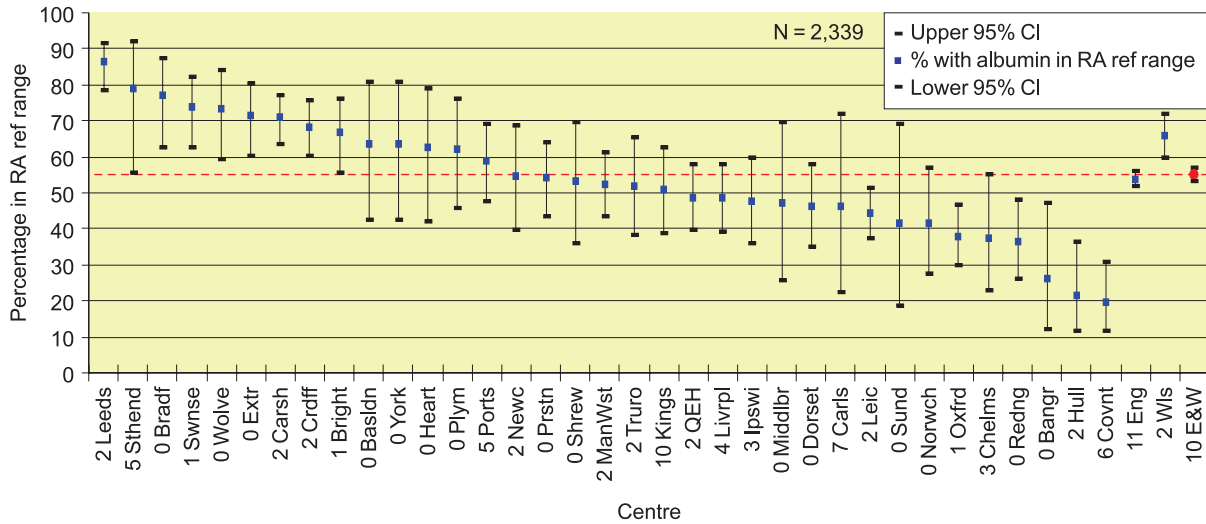


Figure 13.14: Percentage of patients achieving the RA albumin BCG Standard by centre: PD

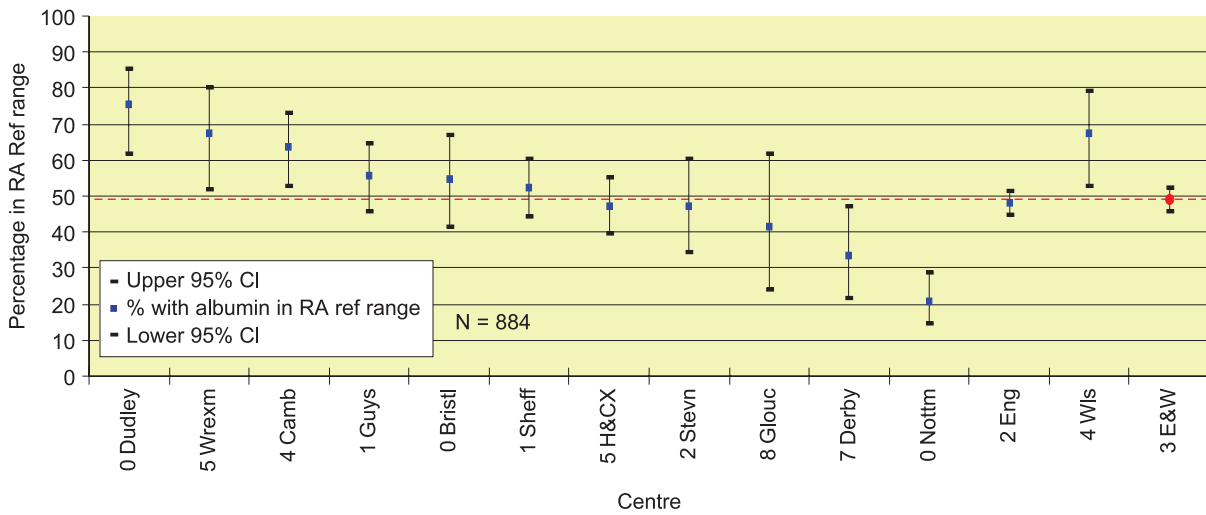


Figure 13.15: Percentage of patients achieving the RA albumin BCP Standard by centre : PD

Blood Pressure

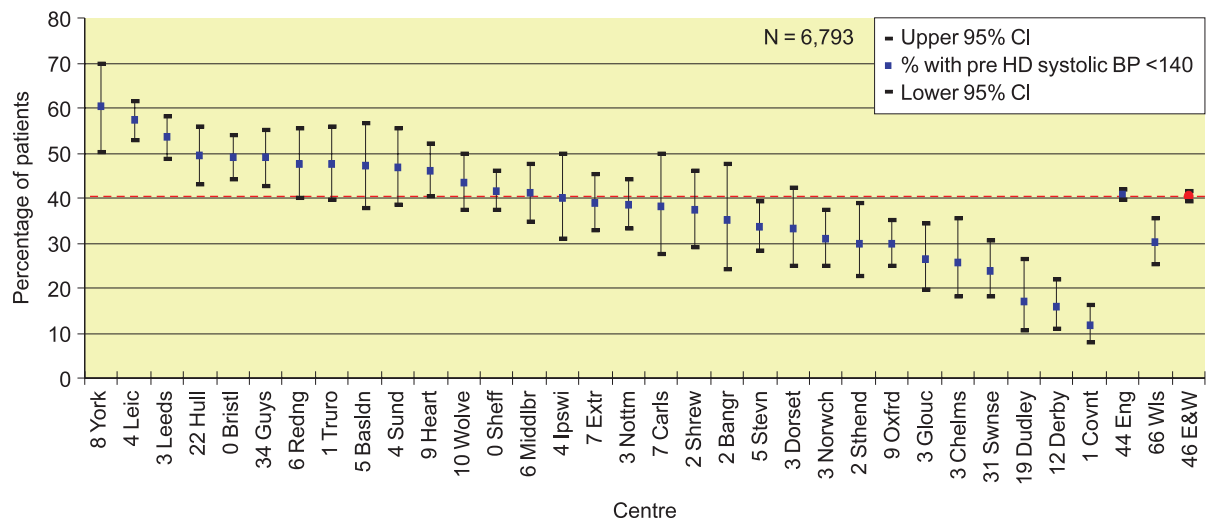


Figure 13.16: Percentage of patients achieving the RA BP Standard by centre: pre-HD

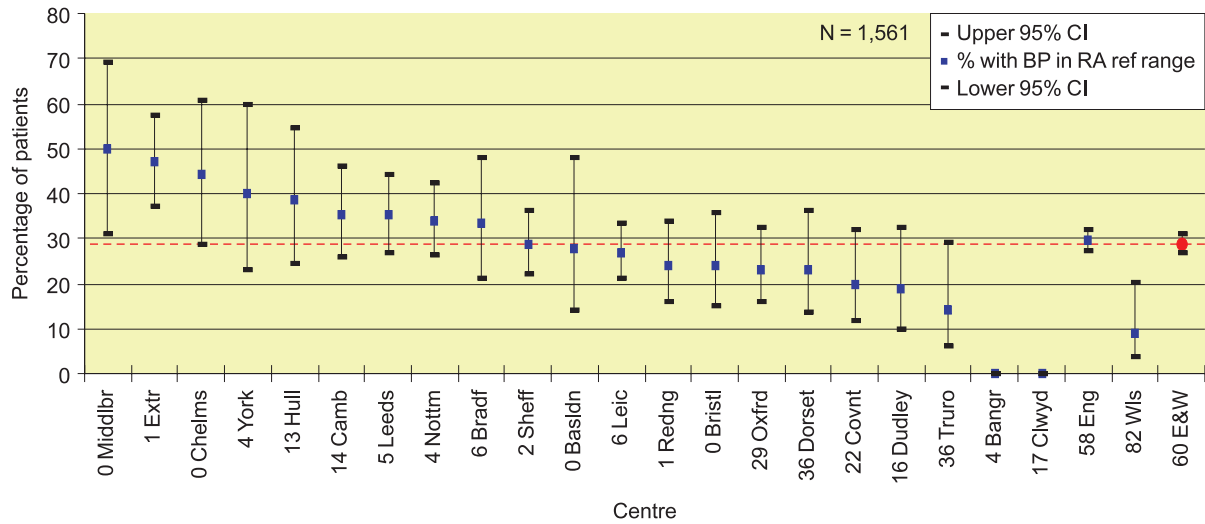


Figure 13.17: Percentage of patients achieving the RA BP Standard by centre: PD

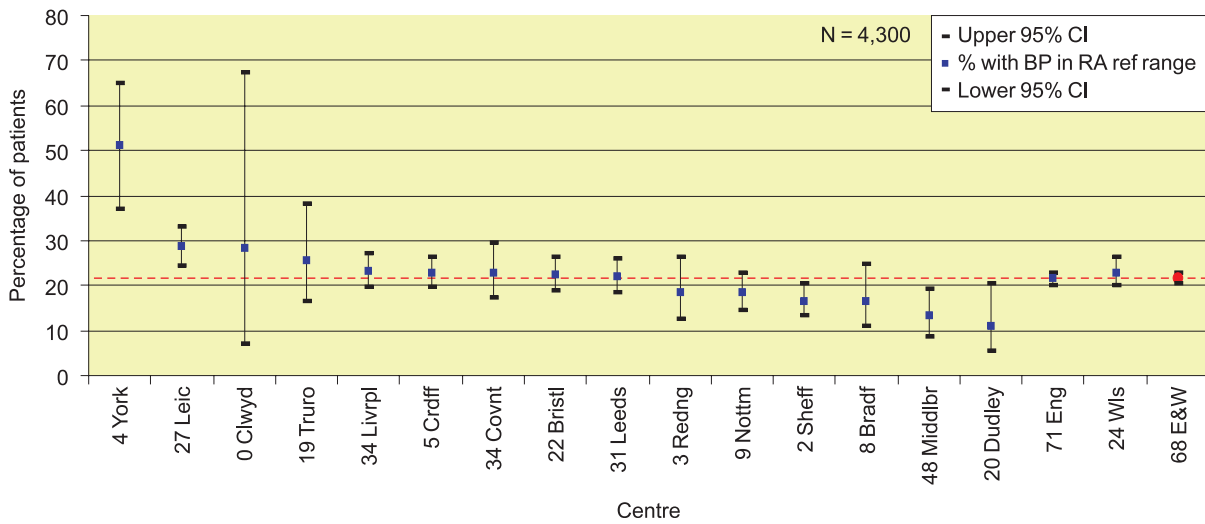


Figure 13.18: Percentage of patients achieving the RA BP Standard by centre: Transplant

Serum Cholesterol

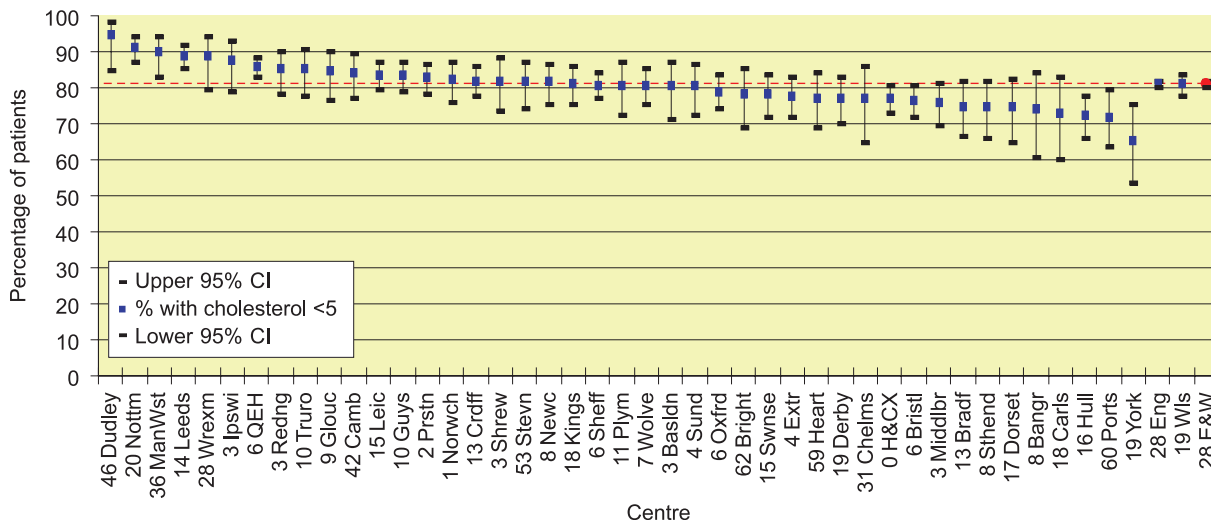


Figure 13.19: Percentage of patients achieving the RA cholesterol Standard by centre: HD

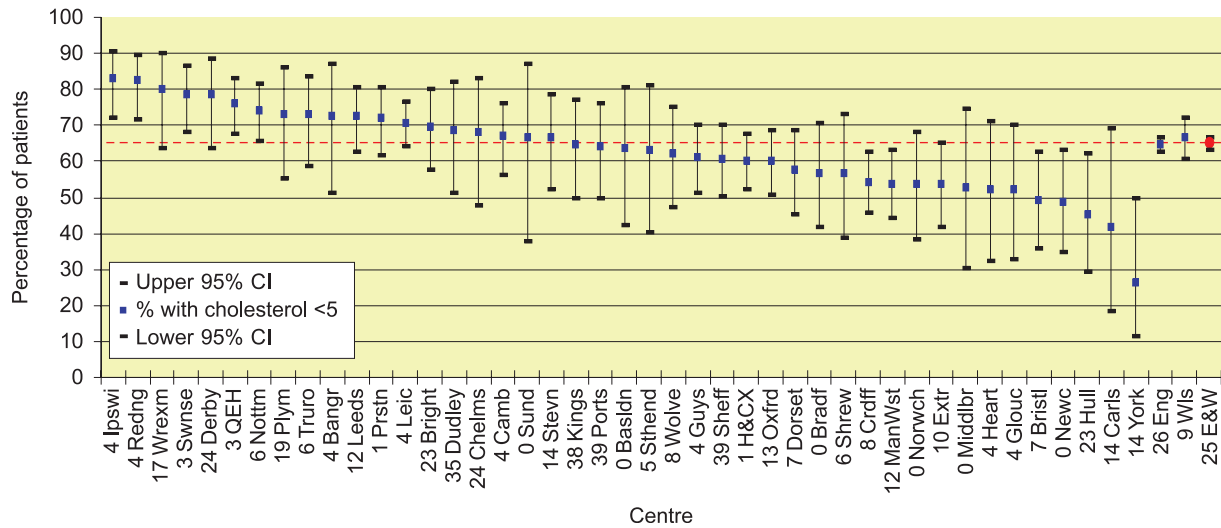


Figure 13.20: Percentage of patients achieving the RA cholesterol Standard by centre: PD

Glycated Haemoglobin

Only patients with a primary diagnosis of diabetes as the cause of ERF were included in this analysis. Patients with post transplant diabetes or who developed diabetes post ERF were excluded from the analysis. Diabetic patients who have received a pancreas transplant have not been excluded from the transplant analysis and may partially explain the lower HbA1c results seen at Guys & Liverpool (also seen in last years Report). The results for Liverpool transplant recipients are not shown due to a high percentage of missing data, which might be causing bias. Guys do not use a steroid sparing regime in transplanted patients so this cannot account for their better HbA1c results. Median

HbA1c in transplant recipients at Guys and Hammersmith was 5.6% and 7.5% respectively which compares with a median of 8.6% and 9.4% at Plymouth and Bristol respectively.

Centres with less than 10 patients or <50% completeness of data are not shown in the figures. Although some centres have a high percentage of missing data it cannot be inferred that HbA1c is not being measured. The test may have been taken at a diabetic clinic in the same hospital or elsewhere and the result not transferred to the renal IT system.

Most centres use assays that are DCCT aligned.

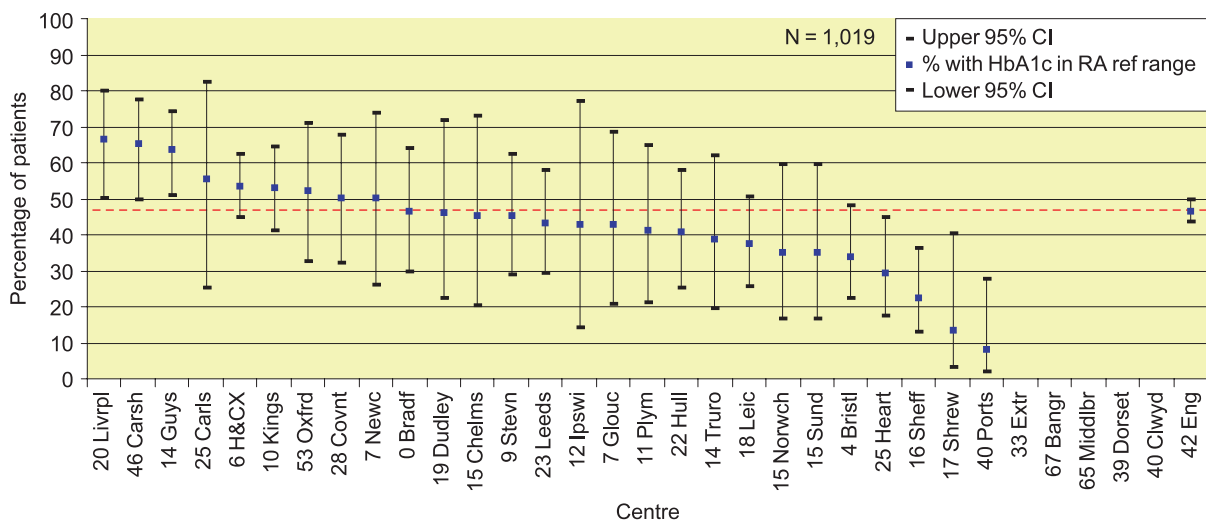


Figure 13.21: Percentage of diabetic patients achieving the RA HbA1c Standard by centre: HD

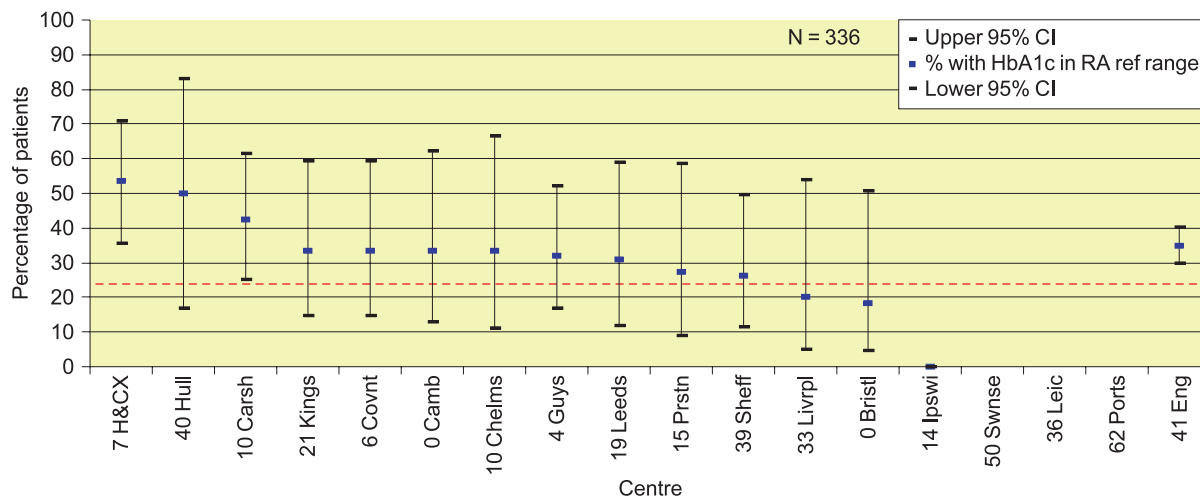


Figure 13.22: Percentage of diabetic patients achieving the RA HbA1c Standard by centre: PD

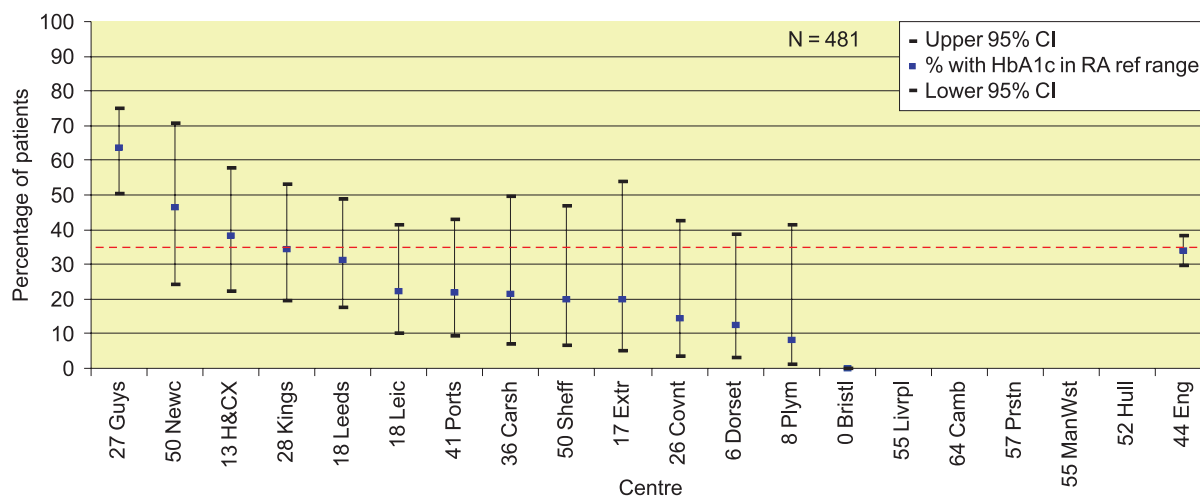


Figure 13.23: Percentage of diabetic patients achieving the RA HbA1c Standard by centre: Transplant

Statistical analysis

Methodology

Chi squared tests were used to see whether the percentage of patients with data in a given range varied significantly between centres. Degrees of freedom are equal to the number of centres with over 50% completeness of data (who were included in the analysis) minus 1.

Due to the large number of statistical tests undertaken, the significance level used was $p < 0.01$ level.

Results

Haemoglobin

A chi squared test was used to determine whether the percentage of patients with a

haemoglobin level of 10 g/dl or more differed between centres.

For patients on HD, the percentage of patients with a haemoglobin of 10 g/dl or more was found to differ significantly between centres ($\chi^2 = 198.4$, d.f. = 47, $p < 0.001$).

For patients on PD, the percentage of patients with a haemoglobin of 10 g/dl or more was found to differ significantly between centres ($\chi^2 = 96.9$, d.f. = 47, $p < 0.001$).

Ferritin

A chi squared test was used to determine whether the percentage of patients with a ferritin level of 100 µg/L or more differed between centres.

For patients on HD, the percentage of patients with a ferritin of 100 µg/L or over was found to differ significantly between centres ($\chi^2 = 289.3$, d.f. = 47, $p < 0.001$).

For patients on PD, the percentage of patients with a ferritin of 100 µg/L or over was found to differ significantly between centres ($\chi^2 = 132.4$, d.f. = 47, $p < 0.001$).

Corrected Calcium

A chi squared test was used to determine whether the percentage of patients with a calcium level of 2.2 to 2.6 mmol/L differed between centres.

For patients on HD, the percentage of patients with a serum calcium of 2.2 to 2.6 mmol/L differed significantly between centres ($\chi^2 = 167$, d.f. = 47, $p < 0.001$).

For patients on PD, the percentage of patients with a serum calcium of 2.2 to 2.6 mmol/L differed significantly between centres ($\chi^2 = 93$, d.f. = 47, $p < 0.001$).

Phosphate

A chi squared test was used to determine whether the percentage of patients with a phosphate level of 1.8 mmol/L or less differed between centres.

For patients on HD, the percentage of patients with a serum phosphate of 1.8 mmol/L or less differed significantly between centres ($\chi^2 = 310.6$, d.f. = 47, $p < 0.001$).

For patients on PD, the percentage of patients with a serum phosphate of 1.8 mmol/L or less differed significantly between centres ($\chi^2 = 105.9$, d.f. = 46, $p < 0.001$).

PTH

A chi squared test was used to determine whether the percentage of patients with a PTH of 32 pmol/L or below differed between centres. Note this is slightly different from the RA Standard.

For patients on HD, the percentage of patients with a PTH value of 32 pmol/L or

less differed significantly between centres ($\chi^2 = 459.1$, d.f. = 46, $p < 0.001$).

For patients on PD, the percentage of patients with a PTH of 32 pmol/L or less differed significantly between centres ($\chi^2 = 154.1$, d.f. = 46, $p < 0.001$).

URR

A chi squared test was used to determine whether the percentage of patients with a URR of 65% or more differed between centres.

The percentage of patients with a URR of 65% or above was found to vary significantly between centres ($\chi^2 = 390.6$, d.f. = 43, $p < 0.001$).

Bicarbonate

A chi squared test was used to determine whether the percentage of patients with bicarbonate values within 20–26 mmol/L or 25–29 mmol/L respectively for HD and PD varied significantly between centres.

For patients on HD, the percentage of patients with a bicarbonate within 20–26 mmol/L differed significantly between centres ($\chi^2 = 418.3$, d.f. = 46, $p < 0.001$).

For patients on PD, the percentage of patients with a bicarbonate within 25–29 mmol/L differed significantly between centres ($\chi^2 = 90.3$, d.f. = 44, $p < 0.001$).

Albumin

A chi squared test was used to determine whether the percentage of patients with a serum albumin 35 g/L or more measured using a BCG assay or 30 g/L or more measured using a BCP assay varied between centres.

For patients on HD, the percentage of patients with a serum albumin ≥ 35 g/L measured by BCG differed significantly between centres ($\chi^2 = 220$, d.f. = 35, $p < 0.001$) and > 30 g/L measured by BCP differed significantly between centres ($\chi^2 = 54.9$, d.f. = 11, $p < 0.001$).

For patients on PD, the percentage of patients with a serum albumin ≥ 35 g/L measured by BCG differed significantly between centres ($\chi^2 = 228$, d.f. = 35, $p < 0.001$) and

>30 g/L measured by BCP differed significantly between centres ($\chi^2 = 75.8$, d.f. = 11, $p < 0.001$).

Blood Pressure

A chi-squared test was used to determine whether the percentage of patients with both systolic and diastolic blood pressure within range differed between centres.

For patients on HD, the percentage of patients with a pre-dialysis blood pressure of $\leq 140/90$ mmHg differed significantly between centres ($\chi^2 = 397.6$, d.f. = 44, $p < 0.001$).

For patients on PD, the percentage of patients with a blood pressure of $\leq 130/80$ mmHg differed significantly between centres ($\chi^2 = 96.9$, d.f. = 34, $p < 0.001$).

For patients with a transplant, the percentage of patients with a blood pressure of $\leq 130/80$ mmHg differed significantly between centres ($\chi^2 = 118.8$, d.f. = 35, $p < 0.001$).

Cholesterol

A chi squared test was used to determine whether the percentage of patients with a serum cholesterol level of 5 mmol/L or less differed between centres.

For patients on HD, the percentage of patients with a serum cholesterol of 5 mmol/L or less differed significantly between centres ($\chi^2 = 136.5$, d.f. = 47, $p < 0.001$).

For patients on PD, the percentage of patients with a serum cholesterol of 5 mmol/L or less differed significantly between centres ($\chi^2 = 121$, d.f. = 45, $p < 0.001$).

HbA1c

A chi squared test was used to determine whether the percentage of patients with a

glycated haemoglobin level of less than 7% differed between centres.

For patients on HD, the percentage of patients with an HbA1c of <7% differed significantly between centres ($\chi^2 = 144$, d.f. = 39, $p < 0.001$).

For patients on PD, the percentage of patients with an HbA1c of <7% differed significantly between centres ($\chi^2 = 91$, d.f. = 35, $p < 0.001$).

For patients with a transplant, the percentage of patients with an HbA1c of <7% differed significantly between centres ($\chi^2 = 127$, d.f. = 36, $p < 0.001$).

Performance against Standards by Modality and Age Band

The performance against the RA standards are shown below by age band and modality. Transplantation has been included for most of the variables as the 'control' group. The variation of serum albumin with age in the general non-RRT population (lower in older patients) is well known, and highlights the difficulty in interpreting albumin in the dialysis population.

Serum cholesterol achievement in transplant recipients appears to take a V shaped curve, with a maximum cholesterol level in patients aged 45. It is not known how much this is an influence of immuno-suppressive therapy. The median age of transplantation in the UK is 42 years and the Registry has previously shown in analysis of modality change in the 2004 Report (Chapter 10) that serum cholesterol increases in the first year post transplantation but by the end of 1 year has fallen to pre-transplant levels.

Haemoglobin

Figure 13.24 and Figure 13.25 show that haemoglobin achievement has a non-linear relationship with age (lower in younger patients) which plateaus at age 45. Previous Registry analyses (in the haemoglobin chapter) and other international studies have only tested for linear affects with age and therefore reported this to be negative. An element of this non-linear effect may be due to younger patients having a longer ‘vintage’ on RRT.

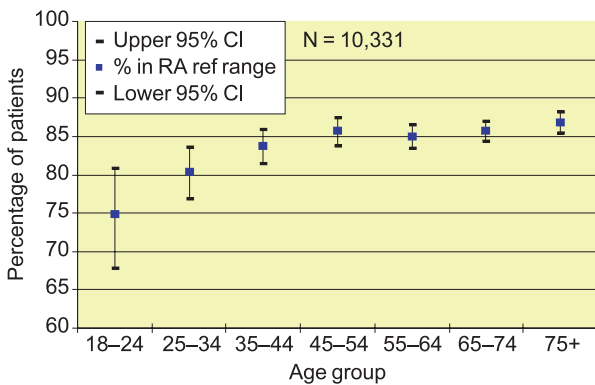


Figure 13.24: Percentage of patients with Hb >10 g/dl by age: HD

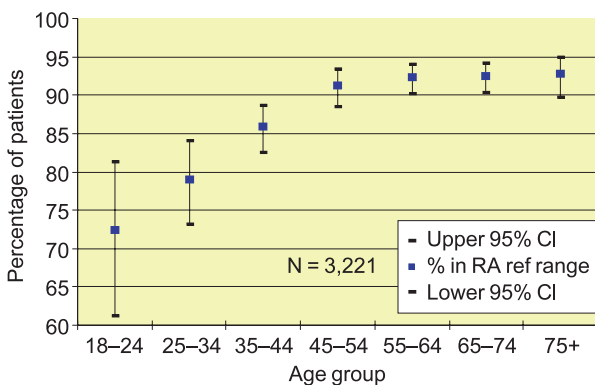


Figure 13.25: Percentage of patients with Hb >10 g/dl by age: PD

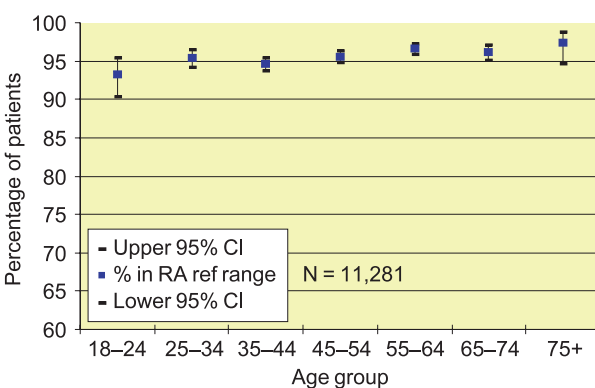


Figure 13.26: Percentage of patients with Hb >10 g/dl by age: Transplant

Serum Ferritin

Patients on PD show an increasing serum ferritin with increasing age. The picture is less clear with HD patients.

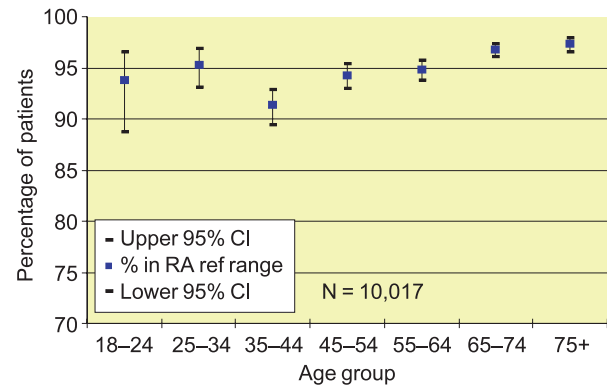


Figure 13.27: Percentage of patients achieving the RA Ferritin Standard by age: HD

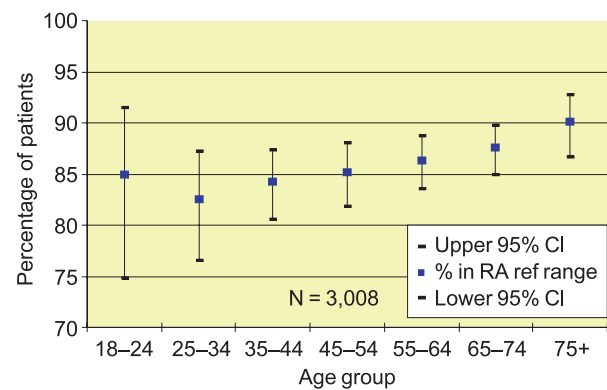


Figure 13.28: Percentage of patients achieving the RA Ferritin Standard by age: PD

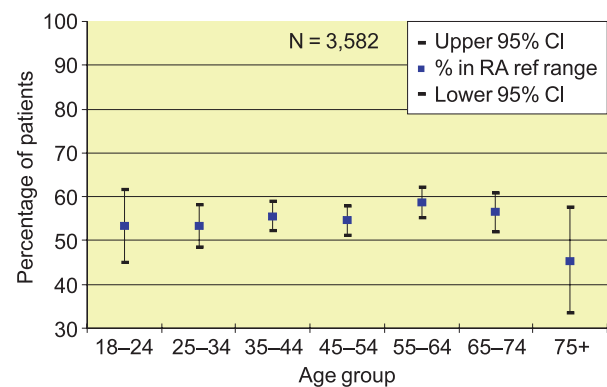


Figure 13.29: Percentage of patients achieving the RA Ferritin Standard by age: Transplant

Serum calcium

Serum calcium in HD patients shows a lower achievement of the Standard (2.2–2.6 mmol/L) with younger age. Analysis of the median, and quartile data show that this is due to lower serum calciums in younger patients. This may be a positive affect from trying to reduce arterial calcification in younger patients. No such affect is seen in PD patients. The non-linear affect seen in transplant patients (lower achievement which plateaus at 45 years) is due to a higher upper range of serum calcium in these patients.

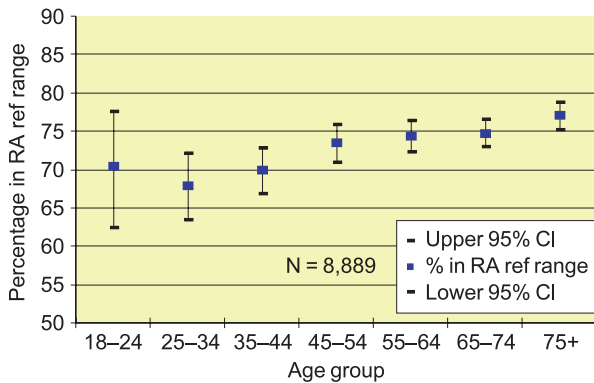


Figure 13.30: Percentage of patients achieving the RA calcium Standard by age: HD

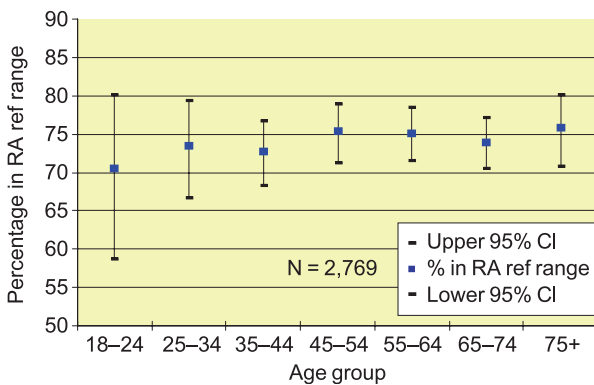


Figure 13.31: Percentage of patients achieving the RA calcium Standard by age: PD

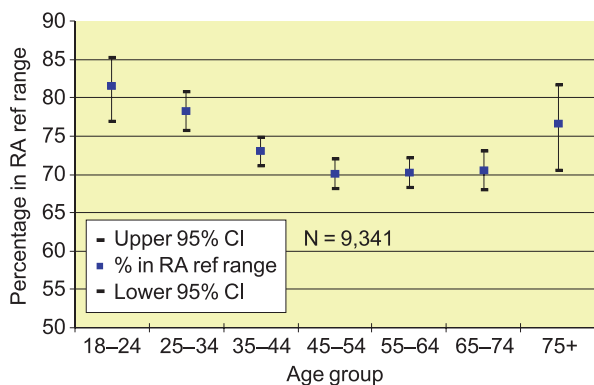


Figure 13.32: Percentage of patients achieving the RA calcium Standard by age: Transplant

Serum phosphate

Only 40% of HD patients compared with 70% of older patients achieve serum phosphate within the target range. A similar affect is seen in patients on PD. This may partly be due to better dietary intake in younger patients (see discussion in Chapter 10). No affect of age is seen in transplant recipients.

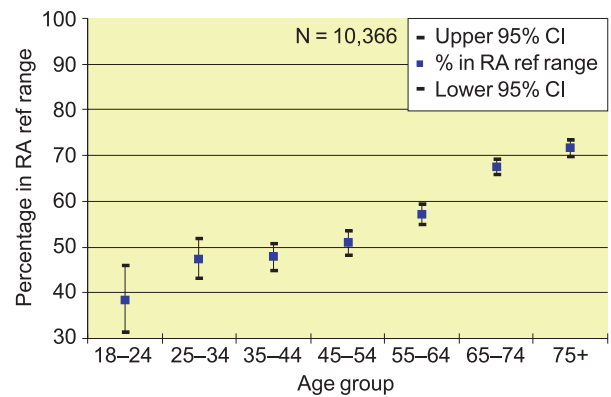


Figure 13.33: Percentage of patients achieving the RA phosphate Standard by age: HD

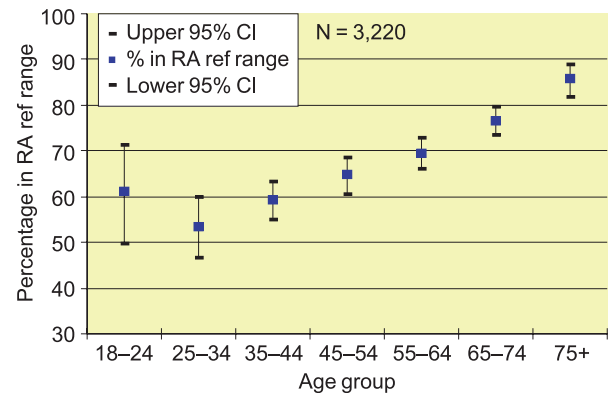


Figure 13.34: Percentage of patients achieving the RA phosphate Standard by age: PD

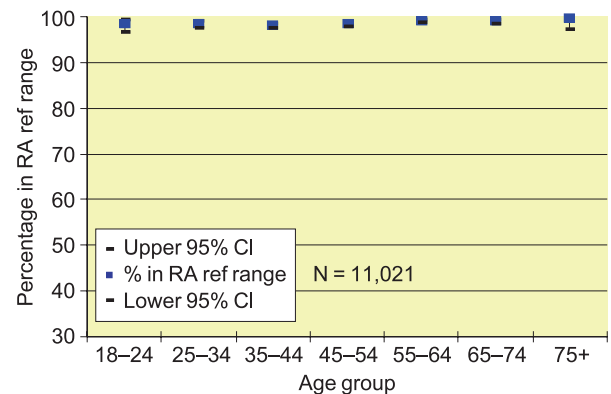


Figure 13.35: Percentage of patients achieving the RA phosphate Standard by age: Transplant

Intact parathyroid hormone

Marked variation in achievement of iPTH with age is seen both in HD and PD patients, although not in transplant recipients. This may reflect serum phosphate control (see discussion in Chapter 10).

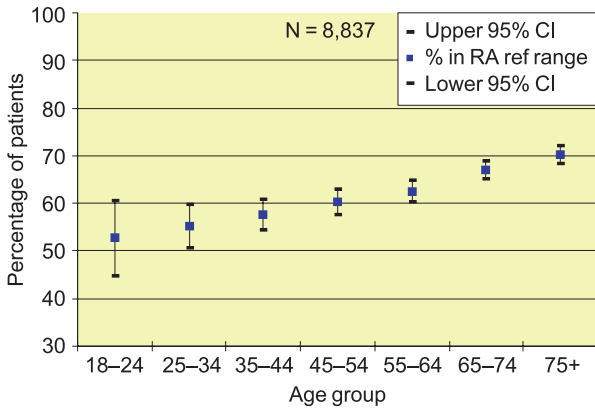


Figure 13.36: Percentage of patients achieving iPTH <32 pmol/L by age: HD

Serum albumin

Both BCG and BCP methods show a falling albumin achievement with patient age, for those on HD and PD. A similar affect is noted in BCG albumin levels in transplant recipients.

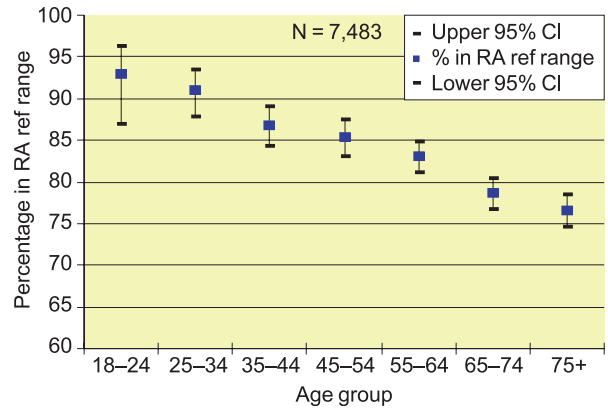


Figure 13.39: Percentage of patients achieving the RA albumin BCG Standard by age: HD

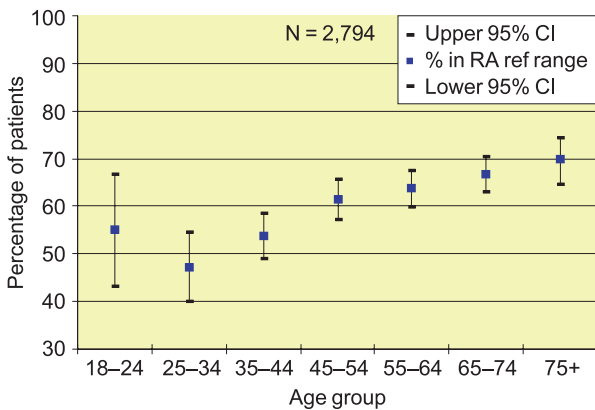


Figure 13.37: Percentage of patients achieving iPTH <32 pmol/L by age: PD

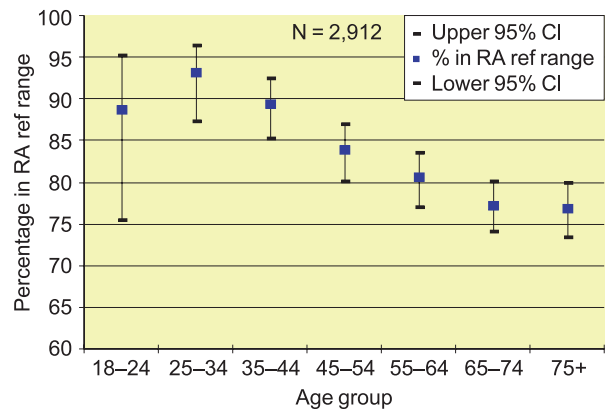


Figure 13.40: Percentage of patients achieving the RA albumin BCP Standard by age: HD

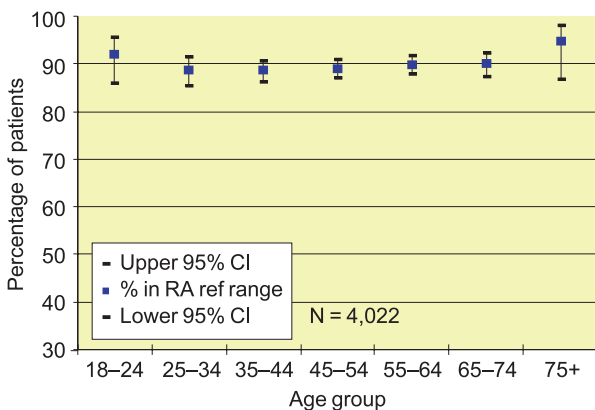


Figure 13.38: Percentage of patients achieving iPTH <32 pmol/L by age: Transplant

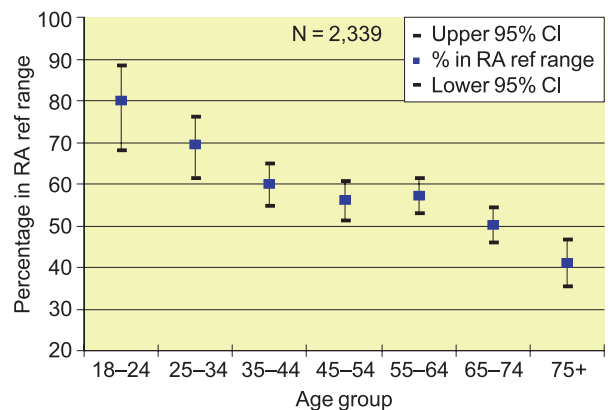


Figure 13.41: Percentage of patients achieving the RA albumin BCG Standard by age: PD

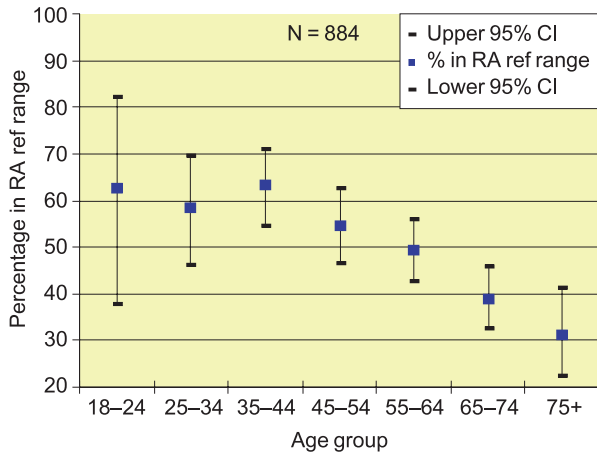


Figure 13.42: Percentage of patients achieving the RA albumin BCP Standard by age: PD

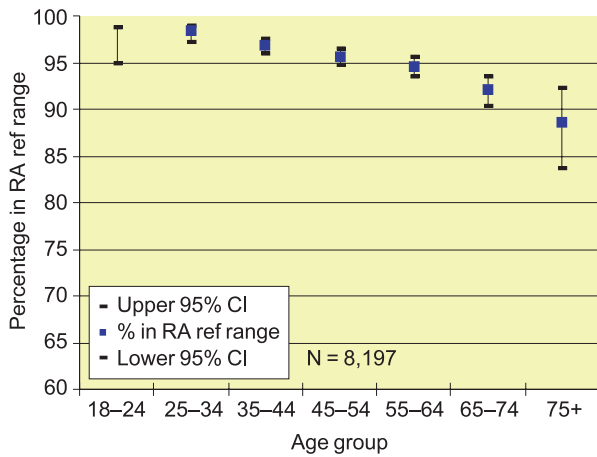


Figure 13.43: Percentage of patients achieving the RA albumin BCG Standard by age: Transplant

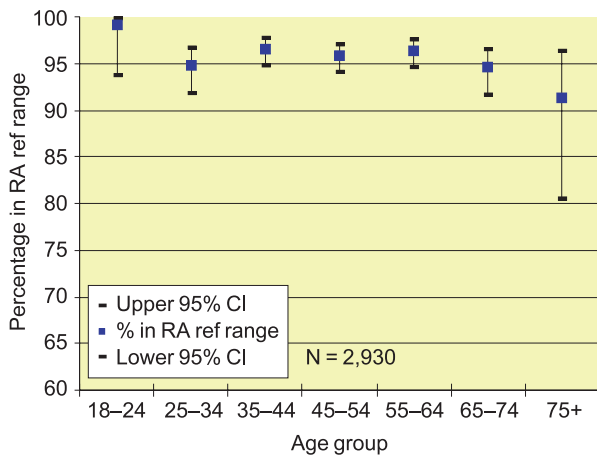


Figure 13.44: Percentage of patients achieving the RA albumin BCP Standard by age: Transplant

Blood Pressure

In HD and PD patients systolic BP achievement remains unchanged with age. Diastolic BP falls with age resulting in increasing pulse pressure, but increasing achievement of the RA Standard. In contrast transplant recipients follow the pattern seen in the general population with increasing systolic BP seen with age and hence poorer achievement of the Standard.

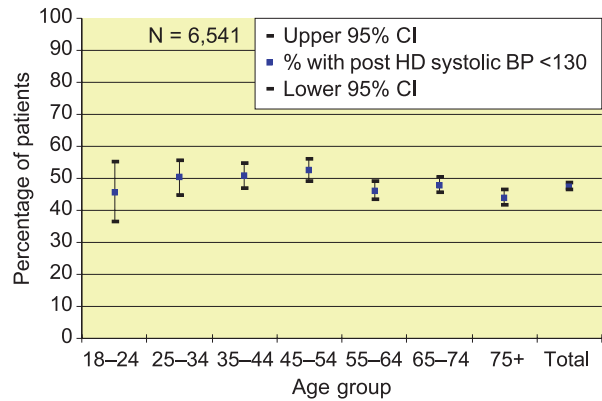


Figure 13.45: Percentage of patients achieving the RA SBP Standard by age: post-HD

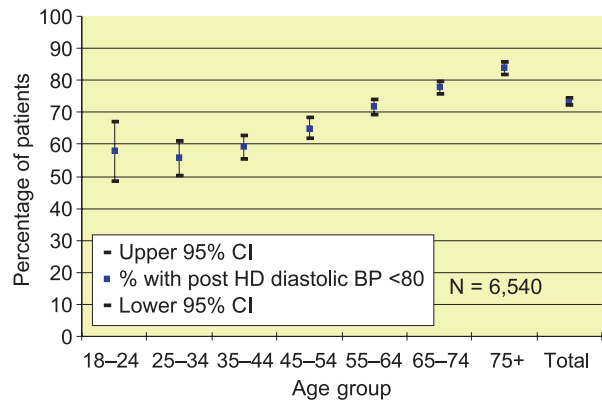


Figure 13.46: Percentage of patients achieving the RA DBP Standard by age: post-HD

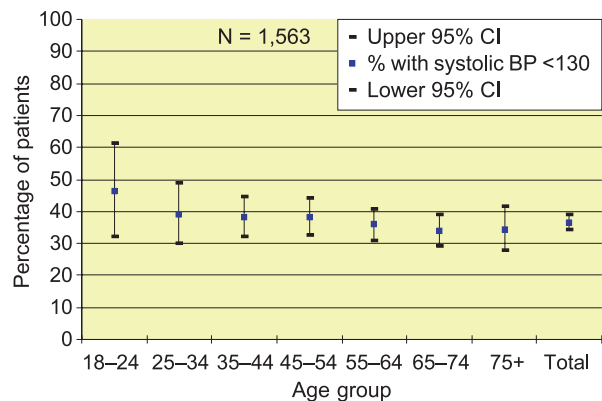


Figure 13.47: Percentage of patients achieving the RA SBP Standard by age: PD

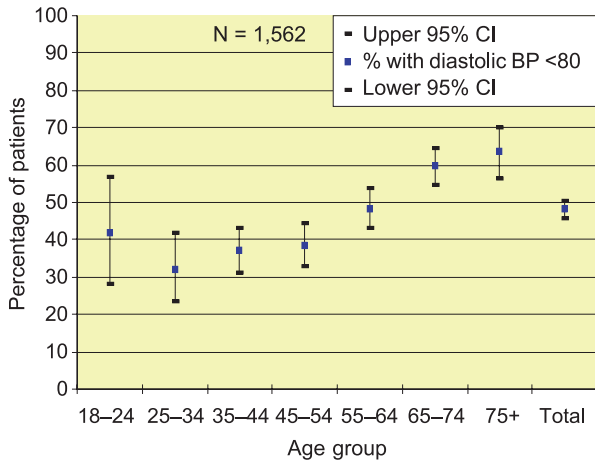


Figure 13.48: Percentage of patients achieving the RA DBP Standard by age: PD

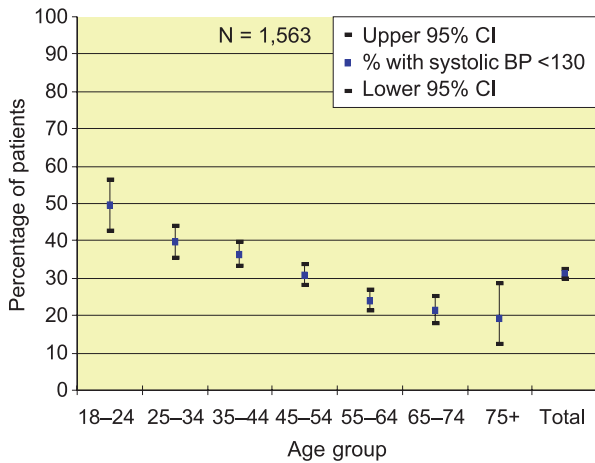


Figure 13.49: Percentage of patients achieving the RA SBP Standard by age: Transplant

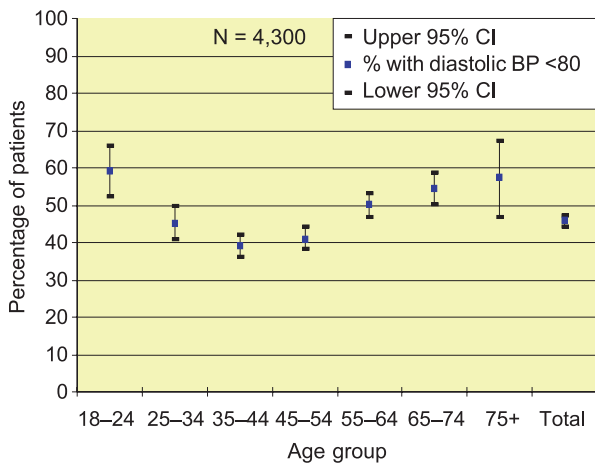


Figure 13.50: Percentage of patients achieving the RA DBP Standard by age: Transplant

Serum Cholesterol

There is no variation of serum cholesterol achievement with age for HD patients. In contrast, achievement of serum cholesterol is slightly better in PD patients aged >55 years. Transplant recipients show a V shaped curve with highest cholesterol in the 45–55 age group. How much this reflects immuno-suppressive regimes or clinical practice in treating perceived 10 year risk of myocardial infarction in these patients is not known.

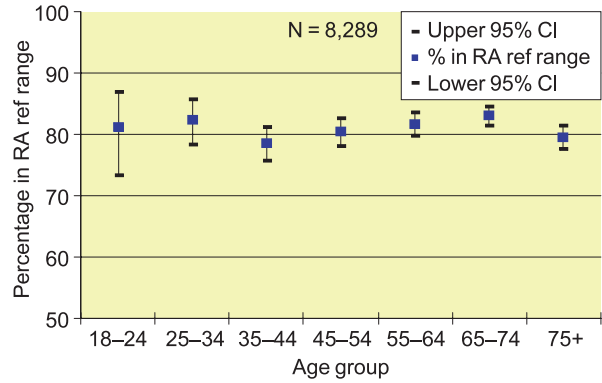


Figure 13.51: Percentage of patients achieving the RA cholesterol Standard by age: HD

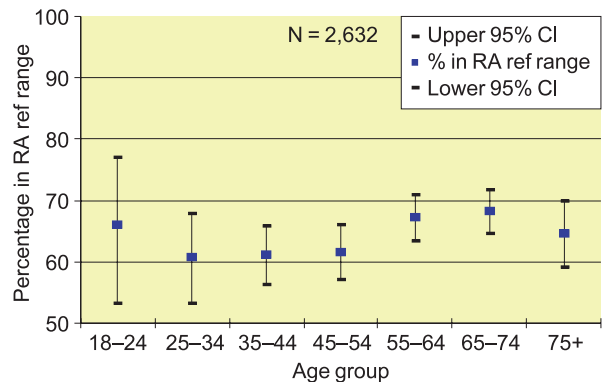


Figure 13.52: Percentage of patients achieving the RA cholesterol Standard by age: PD

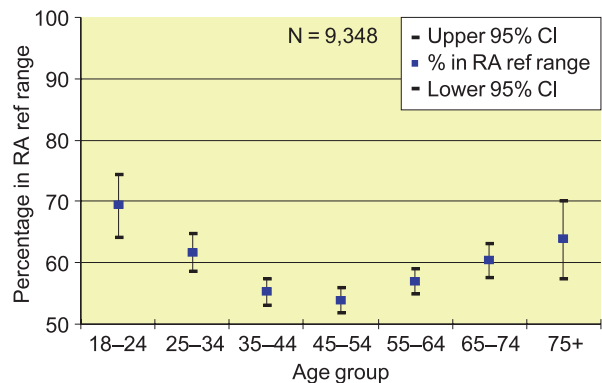


Figure 13.53: Percentage of patients achieving the RA cholesterol Standard by age: Transplant

Glycated Haemoglobin

Only patients with a primary diagnosis of diabetes as the cause of ERF were included in this analysis. Patients with post transplant diabetes or who developed diabetes post ERF were excluded from the analysis.

HD patients with diabetes show a marked trend to lower HbA1c with increasing age although this may partly be accounted for by the different proportions of Type 1 and Type 2 diabetics within the age bands. PD and transplant recipients do not show the same trend with age.

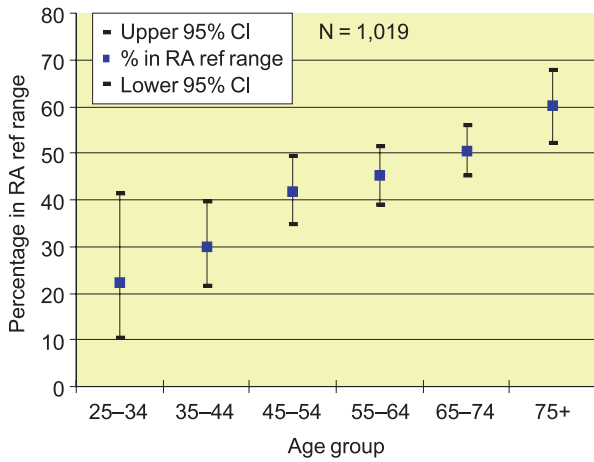


Figure 13.54: Percentage of diabetic patients achieving the RA HbA1c Standard by age: HD

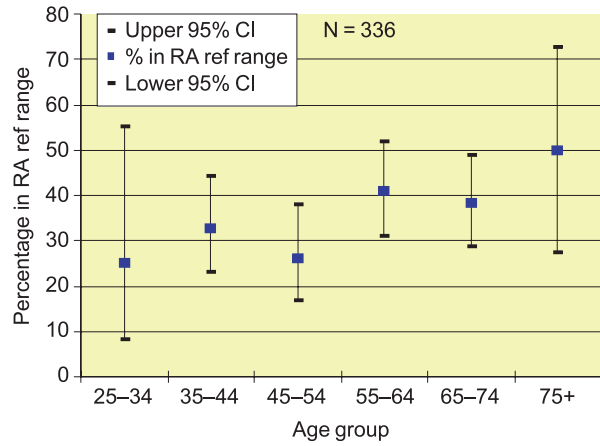


Figure 13.55: Percentage of diabetic patients achieving the RA HbA1c Standard by age: PD

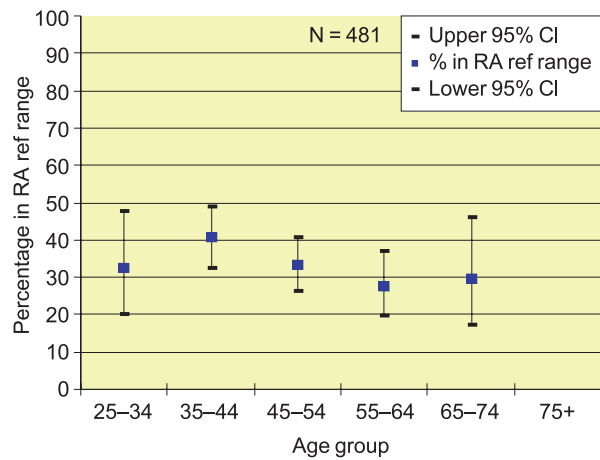


Figure 13.56: Percentage of diabetic patients achieving the RA HbA1c Standard by age: Transplant