
UK Renal Registry 17th Annual Report: Chapter 8 Biochemical Variables amongst UK Adult Dialysis Patients in 2013: National and Centre-specific Analyses

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Key Words

Bicarbonate · Biochemical variables · Calcium · Dialysis · Haemodialysis · Parathyroid hormone · Peritoneal dialysis · Phosphate · Quality improvement

Summary

In 2013

- 57% of HD patients and 62% of PD patients achieved the audit measure for phosphate.
- 30% of HD and 31% of PD patients had a serum phosphate above the audit standard range.

- 78% of HD and PD patients had adjusted calcium between 2.2–2.5 mmol/L.
- 57% of HD and 63% of PD patients had a serum PTH between 16–72 pmol/L.
- 17% of HD and 13% of PD patients had a serum PTH >72 pmol/L.
- Simultaneous control of all three parameters within current audit standards was achieved by 49% of HD and 50% of PD patients.
- 59% of HD and 79% of PD patients achieved the audit measure for bicarbonate.

Introduction

The UK Renal Registry (UKRR) collects routine biochemical data from clinical information systems in renal centres in England, Wales and Northern Ireland and receives data from Scotland via the Scottish Renal Registry. Annual cross sectional analyses are undertaken on some of these variables to determine centre level performance against national (Renal Association (RA)) clinical performance measures [1]. This enables UK renal centres to compare their own performance against each other and to the UK average performance. Currently the 5th edition of the UK Renal Association clinical practice guidelines is in practice [1]. This edition commenced in a graded manner in 2009 and includes an expanded number of guideline modules compared to previous editions.

Audit measures for kidney disease increasingly include tighter specification limits in conjunction with a growing evidence base. Out of range observations (e.g. hyperphosphataemia and hypophosphataemia) need to be interpreted cautiously as they may relate to different clinical problems or population characteristics. These will therefore require different strategies to improve centre performance of clinical audit measures. Summary statistical data have been provided to enhance understanding of the population characteristics of each centre and longitudinal analyses to demonstrate changes over time.

Data are also available on the UKRR data portal at www.renalregistry.org.

Table 8.1 lists the recommended biochemical based audit measures from the RA which are relevant to the dialysis population. Several of the audit measures are not currently reported by the UKRR in its annual report; the reasons behind this are varied, but predominantly relate to a high proportion of incomplete data or that the relevant variable is not currently within the specified UKRR dataset. Over time it is hoped to work with the renal community to improve reporting across the range of recommended standards.

Methods

The analyses presented in this chapter relate to biochemical variables in the prevalent dialysis cohort in England, Wales and Northern Ireland in 2013. Scotland is also included in analyses of phosphate control. The cohort studied were patients prevalent on dialysis treatment on 31st December 2013. Patients receiving

dialysis for less than 90 days and those who had changed modality or renal centre in the last 90 days were excluded. Haemodialysis (HD) and peritoneal dialysis (PD) cohorts were analysed separately. A full definition of the cohort including inclusion and exclusion criteria is available in appendix B (www.renalreg.org).

The biochemical variables analysed in this chapter were serum phosphate, calcium, parathyroid hormone and bicarbonate. The method of data collection and validation by the UKRR has been previously described [2]. In brief, for each quarter of 2013 the UKRR extracted biochemical data electronically from clinical information systems in UK dialysis centres. The UKRR does not currently collect data regarding different assay methods mainly because a single dialysis centre may process samples in several different laboratories. Scottish centres have only been included in analyses relating to phosphate control, with data for their prevalent dialysis cohort being supplied directly by the Scottish Renal Registry. The audit measure used for serum phosphate was 1.1–1.7 mmol/L in both the HD and PD cohorts [1, 3]. For centres providing adjusted calcium values, these data were analysed directly as it is these values on which clinical decisions within centres are based. For centres providing unadjusted calcium values, a formula in widespread use was used to calculate adjusted calcium [4]. The audit measure for adjusted calcium depends on the local reference range [3]. For the purposes of these analyses, the UKRR has used the RA guideline standard of adjusted calcium between 2.2–2.5 mmol/L as the audit measure [3]. There are also a variety of methods and reference ranges in use to measure parathyroid hormone (PTH). To enable some form of comparative audit the UKRR has used 2–9 times the median upper limit of the reference range (8 pmol/L) as the audit measure in line with the 5th edition of the RA clinical practice guidelines and KDIGO 2009 guidance [3, 5]. This equates to a PTH range of 16–72 pmol/L. The audit measure used for serum bicarbonate in the HD cohort was 18–24 mmol/L as per the updated haemodialysis guidelines and in the PD cohort was 22–30 mmol/L. A summary of the current RA audit measures for these variables and conversion factors to SI units are given in table 8.2.

Quarterly values were extracted from the database for the last two quarters for calcium, phosphate and bicarbonate and the last three quarters for PTH. Patients who did not have these data were excluded from the analyses. Data completeness was analysed at centre and country level. All patients were included in analyses but centres with less than 50% completeness were excluded from plots and tables showing centre level performance. Data were also excluded from plots and tables when there were less than 20 patients with data both at centre or country level. These data were analysed to calculate summary descriptive statistics (maximum, minimum, means with the corresponding standard deviation, medians and interquartile ranges). Where applicable, the percentage achieving the Renal Association standard or other surrogate clinical performance measure was also calculated.

The simultaneous control of all three components of bone and mineral disorder (BMD) parameters were analysed in combination. The proportion of patients with control of none, one, two or three parameters are presented. For the purpose of these analyses a corrected calcium between 2.2–2.5 mmol/L, a phosphate level being maintained at or below 1.7 mmol/L and a PTH level being at or below 72 pmol/L, were evaluated in combination.

Centres report several biochemical variables with different levels of accuracy, leading to problems in comparative evaluation.

Table 8.1. Summary of Renal Association audit measures for biochemical variables [1]

RA audit measure and clinical guideline	Currently included in UKRR annual report	Reason
CKD-MBD in CKD stage 5D Guidance		
Audit measure: Serum calcium in dialysis patients (pre-dialysis for haemodialysis patients)	Yes	
Audit measure: Serum phosphate in dialysis patients (pre-dialysis for haemodialysis patients)	Yes	
Audit measure: Proportion of PTH values within range 0/4, 1/4, 2/4, 3/4, and 4/4 of the 4 annual measurements of PTH in CKD stage 5D patients	Yes	Summary measures using data from the last three quarters for PTH-based analyses are presented, rather than stratified by quarter
Audit measure: Percentage of patients with all parameters (calcium/phosphate/PTH) within target range	Yes	
Peritoneal Dialysis Guidelines		
Audit measure: cumulative frequency curves of plasma bicarbonate	Yes	Summary measures at centre and country level are presented in various formats but not as cumulative frequency curves
Haemodialysis Guidelines		
Audit measure: cumulative frequency curves of potassium concentration	No	It is hoped for the next report that data completeness will enable analysis. There are also concerns that potential delays in blood sample processing may result in over estimates of potassium concentrations
Audit measure: Cumulative frequency curves of pre-dialysis serum calcium and phosphate concentrations	Yes No	Summary measures at centre and country level are presented in various formats but not as cumulative frequency curves
Audit measure: Cumulative frequency curves of pre-dialysis serum calcium and phosphate concentrations	Yes No	Summary measures at centre and country level are presented in various formats but not as cumulative frequency curves
Cardiovascular Disease in CKD Guidance		
Audit measure: Record of HbA1c concentrations in IFCC (mmol/mol) and/or DCCT (%) units	No	Poor data completeness
Audit measure: Cholesterol concentrations in patients prescribed HMG CoA reductase inhibitors	Partially	The UKRR report summary statistics for total cholesterol. These summary data were presented in 2013 and will be presented again in 2015. Information on LDL, and changes in cholesterol are not currently available within the UKRR data or reliable information on statin prescription

Table 8.2. Summary of clinical audit measures and conversion factors from SI units

Biochemical variable	Clinical audit measure	Conversion factor from SI units
Phosphate	HD patients: 1.1–1.7 mmol/L PD patients: 1.1–1.7 mmol/L	mg/dl = mmol/L × 3.1
Calcium (adjusted)	Normal range (ideally <2.5 mmol/L)	mg/dl = mmol/L × 4
Parathyroid hormone	2–9 times upper limit of normal	ng/L = pmol/L × 9.5
Bicarbonate	HD patients: 18–24 mmol/L PD patients: 22–30 mmol/L	mg/dl = mmol/L × 6.1

For example, in the case of serum bicarbonate, data can be submitted as integer values but some centres submit data to one decimal place. All data has been rounded in an attempt to make all centres more comparable.

The number preceding the centre name in each figure indicates the percentage of missing data for that centre. Funnel plot analyses were used to identify 'outlying centres' [6]. The percentage within range for each standard was plotted against centre size along with the upper and lower 95% and 99.9% limits. Centres can be identified on these plots by looking up the number of patients treated in each centre provided in the relevant table and finding this value on the x-axis. Longitudinal analyses were performed for some data to calculate overall changes in achievement of a performance measure annually from 2003 to 2013 and were recalculated for each previous year using the rounding procedure.

All data are presented unadjusted for case-mix.

Results

Mineral and bone variables

Phosphate

In 2013 the following Renal Association clinical practice guideline regarding phosphate management was applicable:

Guideline 3.2 CKD-MBD: Serum phosphate in dialysis patients

'We suggest that serum phosphate in dialysis patients, measured before a "short-gap" dialysis session in haemodialysis patients, should be maintained between 1.1 and 1.7 mmol/L (2C)' [3].

The data completeness for serum phosphate across the UK was 97% for HD patients and 98% for PD patients although there was considerable variation between centres (tables 8.3, 8.5). The individual centre means and standard deviations are shown in tables 8.3 and 8.5. Fifty-seven percent (95% CI 56–58%) of HD patients and 62% (95% CI 60–63%) of PD patients achieved a phosphate level within the target range specified by the RA clinical audit measure (tables 8.4, 8.6). The proportion of HD patients with hyperphosphataemia was 30% and the proportion with hypophosphataemia was 13% (table 8.4, figures 8.1, 8.2). The proportion of PD patients with hyperphosphataemia was 31% and the proportion with hypophosphataemia was 7% (table 8.6, figures 8.3, 8.4). There was wide between centre variation

Table 8.3. Summary statistics for phosphate in haemodialysis patients in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	401	1.6	0.6	1.5	1.3	1.9
B QEH	97.1	859	1.6	0.5	1.5	1.3	1.8
Basldn	99.3	151	1.4	0.5	1.4	1.1	1.7
Bradfd	100.0	186	1.5	0.5	1.4	1.1	1.8
Brightn	96.2	358	1.6	0.5	1.5	1.2	1.8
Bristol	100.0	485	1.6	0.5	1.5	1.2	1.8
Camb	94.9	338	1.5	0.5	1.5	1.2	1.8
Carlisle	100.0	58	1.7	0.5	1.6	1.2	2.0
Carsh	95.3	665	1.6	0.5	1.5	1.2	1.8
Chelms	100.0	109	1.4	0.4	1.4	1.2	1.7
Colchr	92.7	101	1.5	0.4	1.5	1.3	1.7
Covnt	100.0	354	1.6	0.5	1.5	1.3	1.9
Derby	99.5	202	1.5	0.5	1.4	1.2	1.8
Donc	100.0	146	1.5	0.4	1.5	1.3	1.7
Dorset	100.0	244	1.5	0.5	1.5	1.2	1.7
Dudley	95.1	155	1.6	0.5	1.6	1.3	1.8
Exeter	100.0	376	1.6	0.5	1.5	1.3	1.8
Glouc	100.0	188	1.5	0.5	1.5	1.2	1.8
Hull	100.0	299	1.5	0.5	1.5	1.3	1.8
Ipswi	100.0	112	1.3	0.5	1.2	0.9	1.6
Kent	99.2	373	1.7	0.6	1.6	1.3	1.9
L Barts	99.9	882	1.6	0.5	1.5	1.2	1.9
L Guys	77.3	457	1.5	0.5	1.4	1.1	1.8
L Kings	99.8	465	1.5	0.4	1.4	1.2	1.7
L Rfree	99.0	681	1.5	0.5	1.5	1.2	1.8
L St.G	98.4	251	1.5	0.5	1.5	1.2	1.8

Table 8.3. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
L West	99.2	1,307	1.5	0.5	1.5	1.2	1.8
Leeds	100.0	470	1.6	0.5	1.5	1.2	1.9
Leic	99.9	827	1.6	0.5	1.6	1.3	1.9
Liv Ain	99.3	147	1.4	0.5	1.3	1.0	1.6
Liv Roy	99.7	333	1.5	0.5	1.4	1.1	1.7
M RI	94.0	457	1.6	0.5	1.5	1.2	1.9
Middlbr	99.4	320	1.6	0.5	1.5	1.3	1.8
Newc	100.0	257	1.5	0.5	1.4	1.1	1.8
Norwch	100.0	305	1.6	0.5	1.5	1.2	1.8
Nottm	100.0	354	1.5	0.5	1.5	1.2	1.8
Oxford	100.0	405	1.6	0.6	1.5	1.2	1.9
Plymth	100.0	120	1.5	0.5	1.5	1.2	1.8
Ports	99.8	544	1.6	0.5	1.6	1.3	1.9
Prestn	99.8	507	1.7	0.5	1.6	1.3	1.9
Redng	100.0	260	1.5	0.4	1.4	1.2	1.7
Salford	87.9	318	1.5	0.5	1.4	1.2	1.8
Sheff	99.8	555	1.6	0.5	1.5	1.2	1.8
Shrew	98.9	174	1.7	0.5	1.6	1.3	1.9
Stevng	97.5	420	1.6	0.5	1.5	1.2	1.9
Sthend	100.0	110	1.6	0.4	1.6	1.3	1.8
Stoke	82.6	238	1.5	0.5	1.4	1.2	1.8
Sund	0.0	0					
Truro	100.0	139	1.5	0.5	1.4	1.2	1.7
Wirral	98.5	195	1.5	0.5	1.5	1.2	1.8
Wolve	100.0	277	1.5	0.5	1.4	1.1	1.8
York	100.0	129	1.4	0.4	1.4	1.1	1.7
N Ireland							
Antrim	100.0	120	1.3	0.4	1.3	1.0	1.5
Belfast	98.0	195	1.5	0.6	1.4	1.1	1.8
Newry	100.0	84	1.6	0.5	1.6	1.3	1.8
Ulster	100.0	103	1.5	0.5	1.4	1.1	1.8
West NI	100.0	107	1.5	0.5	1.5	1.2	1.8
Scotland							
Abrdn	95.6	197	1.6	0.5	1.5	1.3	1.9
Airdrie	98.9	175	1.5	0.5	1.4	1.1	1.8
D & Gall	100.0	44	1.5	0.5	1.4	1.2	1.8
Dundee	95.7	156	1.7	0.6	1.7	1.4	2.0
Edinb	95.7	244	1.7	0.5	1.6	1.4	2.0
Glasgw	95.9	538	1.7	0.5	1.6	1.3	2.0
Inverns	85.7	54	1.7	0.5	1.6	1.3	1.9
Klmarnk	97.6	123	1.6	0.5	1.6	1.2	1.9
Krkldy	95.1	135	1.6	0.4	1.5	1.3	1.8
Wales							
Bangor	100.0	84	1.5	0.4	1.5	1.2	1.8
Cardff	100.0	460	1.6	0.5	1.6	1.3	1.9
Clwyd	100.0	72	1.6	0.5	1.6	1.3	1.9
Swanse	100.0	311	1.5	0.4	1.5	1.2	1.8
Wrexm	100.0	96	1.4	0.5	1.3	1.1	1.7
England	96.8	18,064	1.6	0.5	1.5	1.2	1.8
N Ireland	99.4	609	1.5	0.5	1.4	1.2	1.7
Scotland	95.9	1,666	1.7	0.5	1.6	1.3	1.9
Wales	100.0	1,023	1.6	0.5	1.5	1.2	1.8
UK	97.0	21,362	1.6	0.5	1.5	1.2	1.8

Blank cells: centres excluded from analyses due to low patient numbers or poor data completeness

Table 8.4. Percentage of haemodialysis patients within, below and above the range specified in the RA audit measure for phosphate (1.1–1.7 mmol/L) in 2013

Centre	N	% phos 1.1–1.7 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.7 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	401	54.9	50.0	59.7	10.2	34.9	2.5	−4.4	9.4
B QEH	859	62.9	59.6	66.0	9.3	27.8	4.8	0.1	9.4
Basldn	151	55.0	47.0	62.7	21.2	23.8	−7.8	−19.0	3.4
Bradfd	186	53.2	46.0	60.3	21.0	25.8	3.0	−7.2	13.1
Brightn	358	58.4	53.2	63.4	14.3	27.4	3.3	−4.2	10.7
Bristol	485	58.6	54.1	62.9	11.8	29.7	4.8	−1.6	11.1
Camb	338	61.2	55.9	66.3	11.8	26.9	−3.9	−11.3	3.5
Carlis	58	53.5	40.7	65.8	6.9	39.7	0.8	−17.4	19.1
Carsh	665	56.5	52.7	60.3	12.3	31.1	−2.2	−7.5	3.2
Chelms	109	67.0	57.6	75.1	16.5	16.5	1.7	−10.6	13.9
Colchr	101	70.3	60.7	78.4	6.9	22.8	−0.7	−13.3	11.9
Covnt	354	59.9	54.7	64.9	7.6	32.5	3.2	−4.2	10.5
Derby	202	62.4	55.5	68.8	12.4	25.3	6.4	−3.1	15.9
Donc	146	65.1	57.0	72.4	13.7	21.2	0.5	−10.2	11.3
Dorset	244	59.8	53.6	65.8	15.6	24.6	5.1	−3.7	13.9
Dudley	155	53.6	45.7	61.3	11.6	34.8	0.9	−10.2	12.1
Exeter	376	60.6	55.6	65.5	12.2	27.1	2.6	−4.5	9.8
Glouc	188	60.1	53.0	66.9	13.3	26.6	1.4	−8.5	11.2
Hull	299	64.2	58.6	69.5	10.0	25.8	4.9	−2.8	12.7
Ipswi	112	45.5	36.6	54.8	37.5	17.0	−14.1	−26.8	−1.5
Kent	373	53.4	48.3	58.4	9.4	37.3	−0.3	−7.6	6.9
L Barts	882	52.6	49.3	55.9	14.1	33.3	1.1	−3.6	5.8
L Guys	457	54.7	50.1	59.2	19.5	25.8	−4.4	−10.6	1.8
L Kings	465	65.4	60.9	69.6	14.4	20.2	1.5	−4.7	7.6
L Rfree	681	59.3	55.6	63.0	13.5	27.2	2.4	−3.2	7.9
L St.G	251	59.4	53.2	65.3	14.7	25.9	4.4	−4.2	12.9
L West	1,307	56.5	53.8	59.1	16.1	27.4	−1.4	−5.2	2.4
Leeds	470	51.7	47.2	56.2	14.7	33.6	−1.4	−7.8	5.1
Leic	827	53.8	50.4	57.2	10.6	35.6	1.5	−3.4	6.3
Liv Ain	147	53.7	45.7	61.6	26.5	19.7	−2.4	−13.5	8.7
Liv Roy	333	59.5	54.1	64.6	18.0	22.5	6.1	−1.4	13.6
M RI*	457	51.6	47.1	56.2	15.8	32.6	0.5	−6.1	7.0
Middlbr	320	57.2	51.7	62.5	12.8	30.0	1.8	−5.9	9.6
Newc	257	57.2	51.1	63.1	16.3	26.5	0.7	−7.8	9.2
Norwch	305	59.0	53.4	64.4	10.8	30.2	−0.5	−8.3	7.3
Nottm	354	57.1	51.9	62.1	13.8	29.1	−0.8	−8.1	6.4
Oxford	405	50.6	45.8	55.5	17.3	32.1	−3.7	−10.7	3.2
Plymth	120	57.5	48.5	66.0	13.3	29.2	−2.2	−14.6	10.3
Ports	544	50.7	46.5	54.9	14.3	34.9	−1.3	−7.4	4.7
Prestn	507	57.0	52.7	61.3	7.9	35.1	5.4	−0.8	11.5
Redng	260	62.3	56.3	68.0	13.5	24.2	4.1	−4.3	12.6
Salford*	318	53.8	48.3	59.2	19.8	26.4	0.8	−7.0	8.7
Sheff	555	60.7	56.6	64.7	9.0	30.3	1.4	−4.3	7.2
Shrew	174	57.5	50.0	64.6	6.3	36.2	3.4	−6.9	13.7
Stevng	420	54.3	49.5	59.0	11.9	33.8	−2.1	−9.0	4.8
Sthend	110	60.9	51.5	69.6	8.2	30.9	13.7	0.6	26.8
Stoke	238	62.2	55.9	68.1	10.9	26.9	4.4	−4.3	13.1
Truro	139	58.3	49.9	66.2	18.0	23.7	1.1	−10.6	12.9
Wirral	195	54.9	47.8	61.7	15.4	29.7	−1.4	−11.7	8.8
Wolve	277	52.4	46.5	58.2	21.7	26.0	−1.7	−10.1	6.6
York	129	62.8	54.2	70.7	17.8	19.4	4.1	−8.0	16.2

Table 8.4. Continued

Centre	N	% phos 1.1–1.7 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.7 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
N Ireland									
Antrim	120	60.8	51.8	69.1	30.0	9.2	4.0	−8.3	16.3
Belfast	195	51.3	44.3	58.2	20.5	28.2	−0.4	−10.2	9.4
Newry	84	58.3	47.6	68.4	10.7	31.0	7.7	−7.2	22.7
Ulster	103	54.4	44.7	63.7	18.5	27.2	−14.0	−27.2	−0.7
West NI	107	59.8	50.3	68.7	11.2	29.0	6.3	−6.3	19.0
Scotland									
Abrdn	197	55.3	48.3	62.1	11.2	33.5	−1.6	−11.3	8.1
Airdrie	175	61.1	53.7	68.1	12.6	26.3	12.1	1.5	22.6
D & Gall	44	56.8	42.0	70.5	18.2	25.0	0.3	−20.2	20.8
Dundee	156	50.0	42.2	57.8	9.0	41.0	−2.1	−12.9	8.8
Edinb	244	52.1	45.8	58.3	7.0	41.0	−2.4	−11.4	6.5
Glasgw	538	53.4	49.1	57.5	7.3	39.4	1.7	−4.3	7.8
Inverns	54	55.6	42.2	68.1	5.6	38.9	16.7	−1.9	35.2
Klmarnk	123	47.2	38.5	56.0	16.3	36.6	−5.7	−18.1	6.8
Krkldy	135	60.0	51.5	67.9	8.2	31.9	3.6	−8.2	15.4
Wales									
Bangor	84	64.3	53.5	73.8	8.3	27.4	−0.3	−14.9	14.2
Cardff	460	55.7	51.1	60.1	9.8	34.6	−2.8	−9.3	3.6
Clwyd	72	55.6	44.0	66.6	11.1	33.3	1.6	−14.4	17.7
Swanse	311	62.7	57.2	67.9	10.9	26.4	0.1	−7.5	7.7
Wrexm	96	55.2	45.2	64.8	22.9	21.9	−4.6	−18.9	9.8
England	18,064	57.2	56.4	57.9	13.6	29.2	1.0	−0.1	2.0
N Ireland	609	56.2	52.2	60.1	19.1	24.8	0.7	−4.8	6.2
Scotland	1,666	54.1	51.7	56.5	9.4	36.5	1.5	−1.9	4.9
Wales	1,023	58.5	55.4	61.4	11.3	30.2	−1.6	−5.8	2.7
UK	21,362	57.0	56.3	57.6	13.3	29.7	0.9	−0.1	1.8

*Salford and Manchester RI have been involved in the SPIRiT study – an RCT comparing low phosphate control (0.8 to 1.4 mmol/L) with high phosphate group control (1.8 to 2.4 mmol/L); HD patients only were recruited

Table 8.5. Summary statistics for phosphate in peritoneal dialysis patients in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	35	1.7	0.4	1.7	1.4	2.0
B QEH	100.0	129	1.6	0.4	1.5	1.2	1.9
Basldn	100.0	30	1.6	0.3	1.6	1.4	1.7
Bradfd	96.2	25	1.7	0.5	1.7	1.3	2.0
Brightn	100.0	66	1.6	0.5	1.5	1.2	1.8
Bristol	100.0	57	1.8	0.4	1.7	1.4	2.0
Camb	94.7	18					
Carlis	100.0	23	1.6	0.4	1.6	1.4	1.8
Carsh	97.1	102	1.6	0.4	1.5	1.3	1.7
Chelms	95.0	19					
Colchr							
Covnt	91.7	66	1.4	0.4	1.3	1.1	1.5
Derby	98.7	77	1.5	0.5	1.5	1.2	1.7
Donc	100.0	30	1.6	0.5	1.5	1.3	1.8
Dorset	89.7	35	1.6	0.4	1.6	1.4	1.8
Dudley	100.0	47	1.8	0.6	1.7	1.4	2.1
Exeter	100.0	63	1.5	0.4	1.5	1.3	1.8
Glouc	100.0	31	1.6	0.4	1.5	1.3	1.9
Hull	100.0	72	1.6	0.4	1.5	1.4	1.8
Ipswi	100.0	24	1.6	0.5	1.4	1.2	1.8
Kent	98.3	56	1.5	0.4	1.5	1.3	1.8
L Barts	98.9	176	1.5	0.4	1.5	1.2	1.8

Table 8.5. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
L Guys	85.7	24	1.6	0.5	1.5	1.2	1.8
L Kings	98.7	78	1.5	0.4	1.5	1.2	1.7
L Rfree	100.0	108	1.6	0.4	1.5	1.3	1.8
L St.G	97.8	44	1.6	0.3	1.5	1.3	1.8
L West	100.0	52	1.6	0.4	1.5	1.2	1.8
Leeds	100.0	62	1.8	0.5	1.7	1.5	2.0
Leic	97.8	132	1.6	0.4	1.6	1.3	1.8
Liv Ain	100.0	26	1.6	0.4	1.5	1.4	1.7
Liv Roy	100.0	51	1.6	0.4	1.5	1.3	1.8
M RI	98.6	68	1.6	0.4	1.6	1.3	1.8
Middlbr	100.0	11					
Newc	88.9	32	1.6	0.4	1.6	1.2	1.9
Norwch	100.0	35	1.5	0.3	1.5	1.3	1.6
Nottm	100.0	68	1.5	0.4	1.5	1.3	1.7
Oxford	100.0	83	1.7	0.4	1.6	1.4	1.9
Plymth	100.0	29	1.5	0.4	1.4	1.2	1.8
Ports	97.4	75	1.7	0.4	1.6	1.4	1.9
Prestn	100.0	52	1.7	0.4	1.6	1.4	1.9
Redng	100.0	64	1.5	0.3	1.5	1.4	1.8
Salford	97.3	73	1.6	0.4	1.5	1.3	1.8
Sheff	100.0	61	1.6	0.4	1.5	1.3	1.9
Shrew	100.0	26	1.5	0.4	1.5	1.3	1.7
Stevng	97.3	36	1.5	0.4	1.4	1.2	1.8
Sthend	100.0	15					
Stoke	98.8	80	1.7	0.5	1.6	1.3	2.0
Sund	100.0	8					
Truro	100.0	18					
Wirral	74.1	20	1.6	0.6	1.6	1.1	2.1
Wolve	100.0	78	1.7	0.5	1.6	1.3	2.0
York	100.0	25	1.5	0.3	1.5	1.1	1.7
N Ireland							
Antrim	100.0	15					
Belfast	100.0	26	1.6	0.4	1.6	1.4	1.9
Newry	100.0	17					
Ulster	100.0	4					
West NI	100.0	14					
Scotland							
Abrdn	95.2	20	1.6	0.4	1.6	1.4	1.8
Airdrie	100.0	12					
D & Gall	100.0	11					
Dundee	94.4	17					
Edinb	100.0	25	1.5	0.4	1.5	1.2	1.9
Glasgw	100.0	39	1.7	0.4	1.6	1.4	2.0
Inverns	92.3	12					
Klmarnk	97.4	38	1.6	0.4	1.6	1.3	1.9
Krkldy	94.4	17					
Wales							
Bangor	100.0	12					
Cardff	100.0	66	1.6	0.4	1.5	1.3	1.8
Clwyd	100.0	14					
Swanse	100.0	53	1.6	0.4	1.5	1.3	1.8
Wrexm	94.7	18					
England	98.3	2,715	1.6	0.4	1.5	1.3	1.8
N Ireland	100.0	76	1.5	0.4	1.6	1.2	1.8
Scotland	97.5	191	1.6	0.4	1.6	1.4	1.9
Wales	99.4	163	1.6	0.4	1.5	1.3	1.8
UK	98.3	3,145	1.6	0.4	1.5	1.3	1.8

Blank cells: centres excluded from analyses due to low patient numbers or poor data completeness

Table 8.6. Percentage of peritoneal dialysis patients within, below and above the range specified in the RA audit measure for phosphate (1.1–1.7 mmol/L) in 2013

Centre	N	% phos 1.1–1.7 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.7 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	35	48.6	32.7	64.7	5.7	45.7	5.7	−16.6	28.0
B QEH	129	58.1	49.5	66.3	8.5	33.3	−9.7	−21.1	1.7
Basldn	30	76.7	58.5	88.5	3.3	20.0	17.4	−6.5	41.3
Bradfd	25	48.0	29.6	66.9	8.0	44.0	−10.3	−38.1	17.5
Brightn	66	51.5	39.6	63.3	12.1	36.4	2.3	−14.8	19.4
Bristol	57	54.4	41.5	66.8	0.0	45.6	0.8	−17.6	19.2
Carlis	23	65.2	44.3	81.6	8.7	26.1	−11.0	−37.6	15.7
Carsh	102	69.6	60.0	77.7	6.9	23.5	5.4	−7.7	18.5
Covnt	66	60.6	48.4	71.6	19.7	19.7	−15.7	−30.9	−0.5
Derby	77	61.0	49.8	71.2	14.3	24.7	−2.1	−17.1	12.9
Donc	30	63.3	45.1	78.4	6.7	30.0	6.8	−19.8	33.4
Dorset	35	62.9	46.0	77.1	5.7	31.4	−1.8	−24.5	20.8
Dudley	47	46.8	33.2	61.0	4.3	48.9	3.4	−16.1	22.9
Exeter	63	65.1	52.6	75.8	7.9	27.0	1.8	−14.6	18.3
Glouc	31	64.5	46.6	79.1	0.0	35.5	0.0	−23.8	23.8
Hull	72	68.1	56.5	77.8	4.2	27.8	6.2	−9.1	21.6
Ipswi	24	75.0	54.4	88.3	0.0	25.0	11.7	−12.8	36.1
Kent	56	62.5	49.3	74.1	8.9	28.6	8.8	−9.6	27.2
L Barts	176	61.4	54.0	68.3	10.2	28.4	3.2	−7.2	13.6
L Guys	24	62.5	42.2	79.2	12.5	25.0	−10.6	−36.4	15.2
L Kings	78	71.8	60.9	80.7	6.4	21.8	9.5	−5.3	24.2
L Rfree	108	64.8	55.4	73.2	8.3	26.9	2.4	−10.6	15.5
L St.G	44	70.5	55.5	82.0	2.3	27.3	−3.5	−22.0	15.1
L West	52	71.2	57.5	81.8	1.9	26.9	0.9	−17.0	18.9
Leeds	62	46.8	34.8	59.1	6.5	46.8	−11.7	−28.3	4.9
Leic	132	65.2	56.7	72.8	6.1	28.8	1.6	−9.8	13.0
Liv Ain	26	69.2	49.5	83.8	7.7	23.1			
Liv Roy	51	70.6	56.8	81.4	5.9	23.5	−1.1	−18.5	16.3
M RI	68	60.3	48.3	71.2	10.3	29.4	7.7	−8.5	23.8
Newc	32	59.4	41.9	74.7	3.1	37.5	3.1	−21.1	27.3
Norwch	35	74.3	57.5	86.0	8.6	17.1	13.9	−6.2	33.9
Nottm	68	72.1	60.3	81.4	4.4	23.5	19.3	3.6	35.0
Oxford	83	55.4	44.6	65.7	4.8	39.8	−2.2	−18.2	13.9
Plymth	29	51.7	34.1	68.9	20.7	27.6	−10.4	−35.7	15.0
Ports	75	58.7	47.3	69.2	6.7	34.7	−6.7	−22.1	8.6
Prestn	52	59.6	45.9	72.0	7.7	32.7	1.0	−17.4	19.4
Redng	64	71.9	59.7	81.5	3.1	25.0	5.7	−10.2	21.7
Salford	73	56.2	44.7	67.0	12.3	31.5	0.7	−14.9	16.4
Sheff	61	62.3	49.6	73.5	6.6	31.2	3.2	−13.8	20.2
Shrew	26	69.2	49.5	83.8	7.7	23.1	6.7	−17.7	31.1
Stevng	36	58.3	41.9	73.1	16.7	25.0	−23.2	−44.9	−1.4
Stoke	80	57.5	46.5	67.8	5.0	37.5	1.3	−14.4	17.1
Wirral	20	45.0	25.3	66.4	10.0	45.0	−31.2	−59.6	−2.8
Wolve	78	56.4	45.3	66.9	3.9	39.7	−2.6	−18.1	12.9
York	25	72.0	51.8	86.0	12.0	16.0	16.4	−9.3	42.2
N Ireland									
Belfast	26	53.9	35.1	71.6	7.7	38.5	1.7	−26.3	29.7
Scotland									
Abrdn	20	50.0	29.4	70.6	10.0	40.0	0.0	−31.0	31.0
Edinb	25	56.0	36.6	73.7	8.0	36.0	11.6	−13.8	36.9
Glasgw	39	59.0	43.2	73.1	0.0	41.0	6.5	−15.4	28.3
Klmarnk	38	63.2	47.0	76.8	2.6	34.2	−1.8	−23.1	19.5

Table 8.6. Continued

Centre	N	% phos 1.1–1.7 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	% phos >1.7 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
Wales									
Cardff	66	68.2	56.1	78.3	6.1	25.8	3.9	-12.0	19.8
Swanse	53	67.9	54.3	79.0	5.7	26.4	-1.9	-19.5	15.7
England	2,715	62.0	60.1	63.8	7.7	30.4	1.1	-1.5	3.6
N Ireland	76	59.2	47.9	69.6	7.9	32.9	-5.5	-21.3	10.3
Scotland	191	56.5	49.4	63.4	4.7	38.7	2.5	-7.3	12.2
Wales	163	65.0	57.4	72.0	6.1	28.8	-1.6	-11.8	8.5
UK	3,145	61.7	60.0	63.4	7.4	30.9	0.9	-1.5	3.3

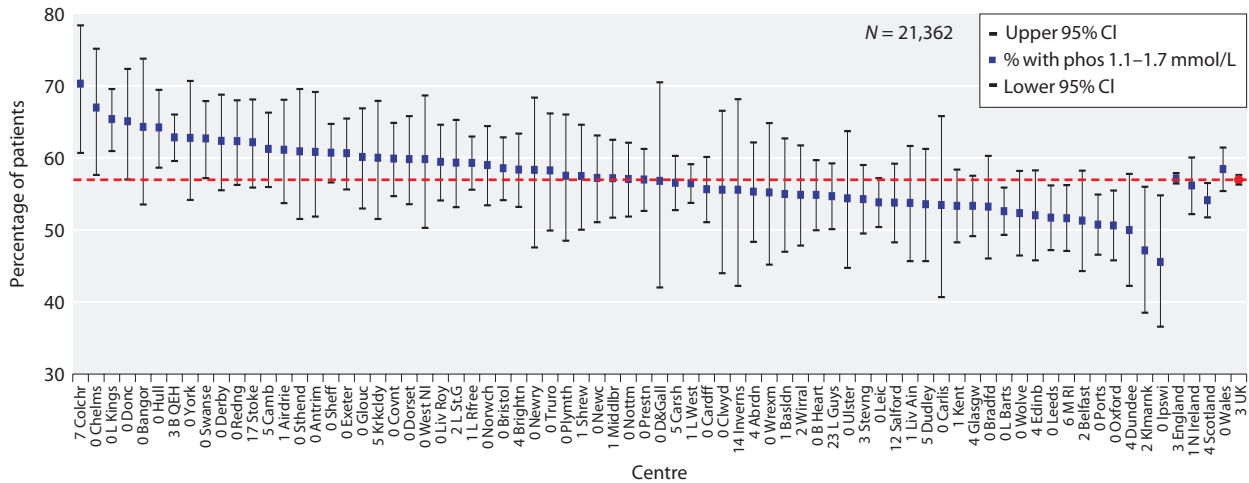


Fig. 8.1. Percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2013

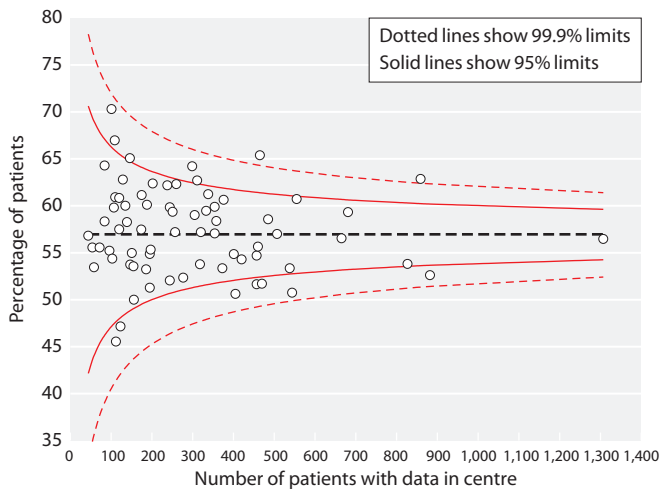


Fig. 8.2. Funnel plot of percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2013

in the proportion of patients below, within and above the phosphate range specified by the clinical performance measure (figures 8.1–8.4).

Longitudinal analysis showed a trend towards improved phosphate control across England, Northern Ireland and Wales combined between 2003 and 2013 that has plateaued in more recent years (figure 8.5). However, this overall plateau masks substantial deterioration in a few centres achieving the standard this year (Ipswich, Ulster for HD patients; Coventry, Stevenage, Wirral for PD patients) that has been countered by improvements in other centres.

Adjusted calcium

In 2013, the following Renal Association clinical practice guideline regarding calcium management was applicable:

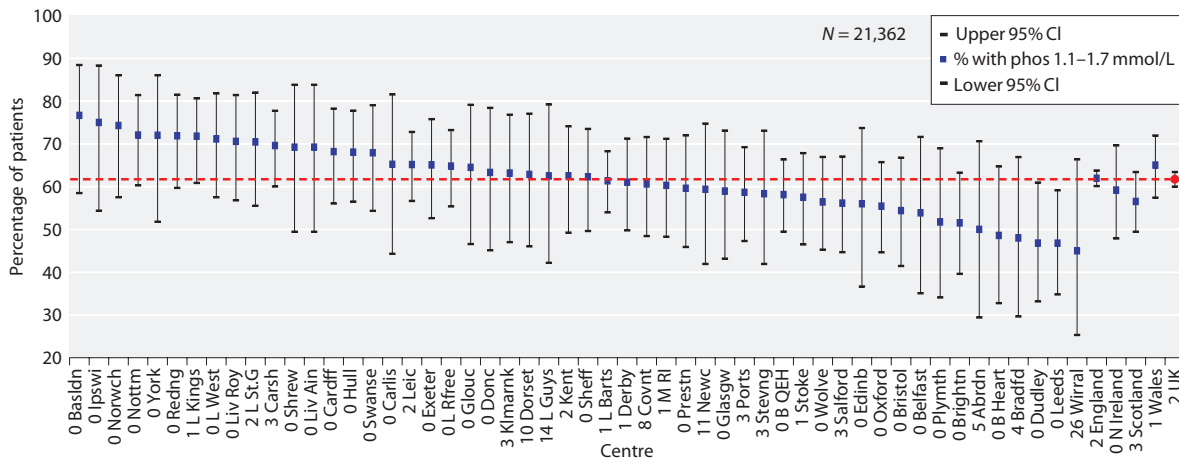


Fig. 8.3. Percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2013

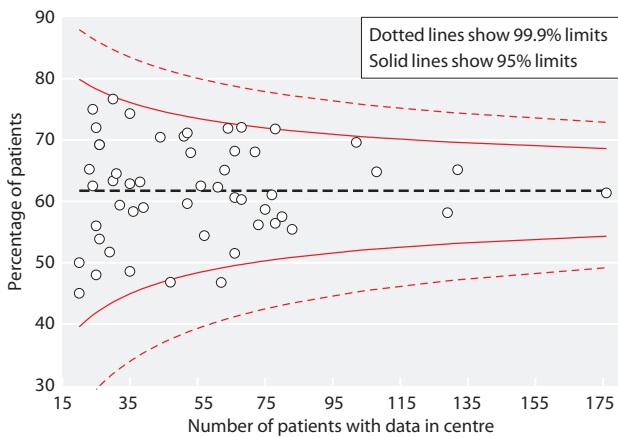


Fig. 8.4. Funnel plot of percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2013

Guideline 2.2 CKD-MBD: Serum calcium in dialysis patients (stage 5D)

‘We suggest that serum calcium, adjusted for albumin concentration, should be maintained within the normal reference range for the laboratory used, measured before a “short-gap” dialysis session in haemodialysis patients. Ideally, adjusted serum calcium should be maintained between 2.2 and 2.5 mmol/L, with avoidance of hypercalcaemic episodes (2D)’ [3].

In 2013, the data for adjusted calcium was 97% complete for HD patients and 98% complete for PD patients overall, although there was between centre variation (tables 8.7, 8.9). Seventy-eight percent (95% CI 78–79%) of HD patients and 78% of PD (95% CI

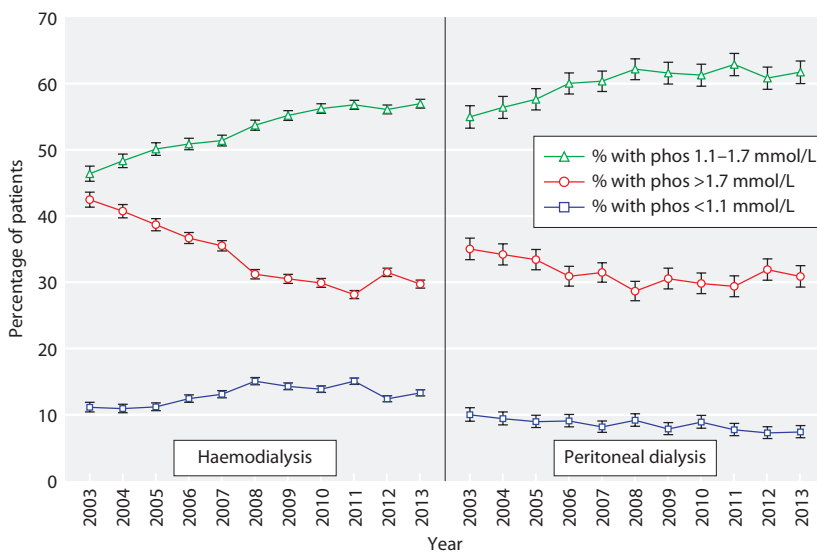


Fig. 8.5. Longitudinal change in percentage of patients with phosphate below, within and above the 2010 RA standard by dialysis modality 2003–2013

Table 8.7. Summary statistics for adjusted calcium in haemodialysis patients in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart ^a	100.0	401	2.5	0.2	2.5	2.3	2.6
B QEH	99.6	881	2.3	0.2	2.3	2.2	2.4
Basldn	99.3	151	2.4	0.2	2.4	2.3	2.4
Bradfd	100.0	186	2.4	0.2	2.4	2.3	2.5
Brightn ^b	78.5	292	2.3	0.2	2.3	2.2	2.4
Bristol	100.0	485	2.4	0.1	2.4	2.3	2.5
Camb	94.7	337	2.3	0.2	2.3	2.2	2.4
Carlis	100.0	58	2.3	0.2	2.3	2.2	2.4
Carsh	95.4	666	2.3	0.2	2.3	2.2	2.4
Chelms	100.0	109	2.3	0.2	2.3	2.2	2.4
Colchr	91.7	100	2.4	0.1	2.4	2.3	2.4
Covnt ^b	100.0	354	2.3	0.2	2.3	2.2	2.5
Derby	100.0	203	2.5	0.1	2.5	2.4	2.5
Donc	100.0	146	2.3	0.1	2.3	2.2	2.4
Dorset ^b	100.0	244	2.3	0.2	2.3	2.2	2.4
Dudley	95.1	155	2.4	0.2	2.4	2.3	2.5
Exeter	100.0	376	2.3	0.1	2.3	2.2	2.4
Glouc	100.0	188	2.4	0.2	2.4	2.3	2.5
Hull	100.0	299	2.4	0.2	2.4	2.3	2.5
Ipswi	100.0	112	2.4	0.2	2.4	2.3	2.5
Kent	98.4	370	2.4	0.2	2.4	2.3	2.6
L Barts	99.9	882	2.3	0.2	2.3	2.2	2.4
L Guys	77.3	457	2.3	0.2	2.3	2.2	2.4
L Kings	99.8	465	2.3	0.1	2.3	2.2	2.4
L Rfree	99.0	681	2.3	0.2	2.3	2.2	2.4
L St.G	98.4	251	2.3	0.2	2.3	2.2	2.4
L West ^b	90.7	1,194	2.4	0.2	2.4	2.2	2.5
Leeds	100.0	470	2.4	0.2	2.4	2.3	2.5
Leic	99.9	827	2.4	0.2	2.4	2.3	2.5
Liv Ain	99.3	147	2.4	0.2	2.3	2.2	2.4
Liv Roy	99.7	333	2.4	0.2	2.4	2.3	2.5
M RI	94.0	457	2.4	0.2	2.4	2.3	2.5
Middlbr	99.4	320	2.3	0.2	2.3	2.1	2.4
Newc ^a	100.0	257	2.3	0.2	2.3	2.3	2.4
Norwch	99.3	303	2.5	0.2	2.5	2.3	2.5
Nottm	100.0	354	2.4	0.2	2.4	2.3	2.5
Oxford	100.0	405	2.4	0.2	2.4	2.3	2.5
Plymth	99.2	119	2.4	0.2	2.4	2.3	2.4
Ports	99.6	543	2.4	0.2	2.4	2.3	2.5
Prestn	95.5	485	2.3	0.0	2.3	2.2	2.4
Redng	100.0	260	2.4	0.2	2.3	2.3	2.4
Salford	87.9	318	2.4	0.2	2.4	2.3	2.5
Sheff	99.8	555	2.3	0.2	2.3	2.2	2.4
Shrew	98.9	174	2.4	0.2	2.4	2.3	2.5
Stevng	97.5	420	2.3	0.2	2.3	2.2	2.4
Sthend	100.0	110	2.4	0.2	2.4	2.3	2.5
Stoke	79.2	228	2.4	0.2	2.4	2.3	2.5
Sund ^b	100.0	177	2.3	0.2	2.3	2.2	2.4
Truro	100.0	139	2.4	0.2	2.4	2.3	2.5
Wirral	98.5	195	2.3	0.2	2.3	2.2	2.4
Wolve	100.0	277	2.4	0.2	2.4	2.3	2.5
York	100.0	129	2.4	0.1	2.4	2.3	2.4

Table 8.7. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
N Ireland							
Antrim	100.0	120	2.5	0.1	2.5	2.4	2.6
Belfast ^b	99.5	198	2.4	0.2	2.4	2.3	2.5
Newry	97.6	82	2.3	0.2	2.3	2.2	2.4
Ulster	100.0	103	2.4	0.2	2.4	2.3	2.5
West NI	100.0	107	2.3	0.2	2.3	2.2	2.4
Wales							
Bangor	100.0	84	2.3	0.1	2.3	2.2	2.4
Cardiff	100.0	460	2.4	0.2	2.4	2.3	2.5
Clwyd	100.0	72	2.3	0.2	2.3	2.2	2.4
Swansea	100.0	311	2.3	0.2	2.3	2.2	2.4
Wrexham	100.0	96	2.4	0.2	2.4	2.3	2.5
England	96.7	18,045	2.4	0.2	2.3	2.2	2.5
N Ireland	99.5	610	2.4	0.2	2.4	2.3	2.5
Wales	100.0	1,023	2.4	0.2	2.4	2.3	2.5
E, W & NI	97.0	19,678	2.4	0.2	2.4	2.2	2.5

^aNewcastle had a change in calcium assay in April 2013; Birmingham Heartlands had a change in calcium assay in 2012

^bThese centres supplied uncorrected calcium and were corrected using the formula: adjusted calcium = unadjusted calcium + [(40-albumin) × 0.02]

77–80%) patients had an adjusted calcium between 2.2–2.5 mmol/L (tables 8.8, 8.10). The proportion of HD patients with hypercalcaemia was 12% and the proportion with hypocalcaemia was 10%. For PD patients the proportion of patients with hypercalcaemia was 15% and the proportion with hypocalcaemia was 7% (tables 8.8, 8.10, figures 8.6–8.9). Interestingly there was quite a large shift in the proportion of individuals on HD with an adjusted calcium greater than the target range in Northern Ireland when reviewed at aggregate level, with an increase from 9% to 14% between 2012 and 2013; corresponding changes in the proportion of patients with calcium >2.5 mmol/L in Antrim and Belfast centres were observed. A reversal of this pattern was observed in the PD population with the suggestion of a fall in the proportion of patients in Northern Ireland with hypercalcaemia from 20% in 2012 to 13% in 2013. In Wales, there was an increase in the proportion of the PD population with hypercalcaemia from 10% in 2012 to 20% in 2013.

Similar to that seen in the earlier presented phosphate analyses, there was significant between centre variation in unadjusted analyses for the proportion of patients below, within and above the range specified by the clinical performance measure (figures 8.6–8.10). There was greater variation in the proportion of patients within range for adjusted calcium than phosphate, most notably for HD patients. The funnel plot shows a greater number

of centres outlying the three standard deviation limit indicating over dispersion in the data, possibly due to differences in calcium adjustment factors between centres.

The changes in the percentages above, below and within range for the period 2003 to 2013 for England, Northern Ireland and Wales combined are shown in figure 8.10. The percentage of patients achieving the audit standard for calcium appears to have plateaued for both HD and PD patients in recent years. As with the phosphate data, this overall plateau masks substantial deterioration in a few centres achieving the standard this year (Carlisle, Antrim, Wrexham for HD patients; London West, Newcastle, Cardiff for PD patients) that has been countered by improvements in other centres.

Parathyroid hormone

At the beginning of 2013 the following RA guideline for PTH applied:

Guideline 4.2.1 CKD-MBD: Target range of serum PTH in patients on dialysis

‘We suggest that the target range for parathyroid hormone measured using an intact PTH assay should be between 2 and 9 times the upper limit of normal for the assay used (2C)’ [3].

The data for parathyroid hormone were 93% complete for HD patients and 90% for PD patients overall,

Table 8.8. Percentage of haemodialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2013

Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	% adjusted Ca >2.5 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart ^a	401	65.3	60.5	69.8	4.0	30.7	7.6	0.9	14.3
B QEH	881	77.1	74.2	79.7	20.7	2.3	6.4	2.3	10.6
Basldn	151	84.1	77.4	89.1	8.6	7.3	2.0	–6.5	10.6
Bradfd	186	81.2	74.9	86.2	5.4	13.4	8.2	–0.3	16.7
Brightn ^b	292	70.6	65.1	75.5	16.8	12.7	–7.4	–14.9	0.1
Bristol	485	86.4	83.0	89.2	1.7	12.0	9.8	4.9	14.7
Camb	337	82.2	77.7	85.9	11.0	6.8	–4.8	–10.4	0.7
Carlis	58	65.5	52.5	76.6	24.1	10.3	–13.4	–29.6	2.7
Carsh	666	80.9	77.8	83.7	11.9	7.2	–0.6	–4.8	3.7
Chelms	109	88.1	80.5	93.0	5.5	6.4	3.8	–5.1	12.7
Colchr	100	93.0	86.0	96.6	0.0	7.0	6.0	–2.3	14.3
Covnt ^b	354	75.7	71.0	79.9	12.2	12.2	–1.6	–7.9	4.7
Derby	203	74.9	68.5	80.4	2.0	23.2	–2.6	–10.9	5.6
Donc	146	91.1	85.3	94.8	8.2	0.7	4.4	–2.6	11.4
Dorset ^b	244	82.4	77.1	86.7	8.6	9.0	–2.4	–9.0	4.2
Dudley	155	80.7	73.7	86.1	8.4	11.0	2.4	–6.7	11.4
Exeter	376	88.3	84.6	91.2	3.2	8.5	12.6	7.0	18.1
Glouc	188	81.9	75.8	86.8	5.3	12.8	–4.7	–12.0	2.6
Hull	299	79.6	74.7	83.8	6.0	14.4	3.4	–3.2	10.1
Ipswi	112	76.8	68.1	83.7	6.3	17.0	–3.1	–13.6	7.5
Kent	370	70.8	66.0	75.2	4.1	25.1	0.6	–6.0	7.2
L Barts	882	71.0	67.9	73.9	22.8	6.2	4.2	–0.1	8.6
L Guys	457	76.6	72.5	80.2	12.9	10.5	2.6	–2.8	8.0
L Kings	465	88.4	85.1	91.0	8.0	3.7	6.4	1.9	11.0
L Rfree	681	85.8	82.9	88.2	9.5	4.7	9.2	4.8	13.6
L St.G	251	78.9	73.4	83.5	13.2	8.0	–2.0	–8.9	5.0
L West ^b	1,194	67.8	65.1	70.4	12.0	20.3	–3.6	–7.3	0.1
Leeds	470	81.1	77.3	84.4	6.4	12.6	0.0	–5.1	5.1
Leic	827	78.4	75.4	81.0	8.5	13.2	–0.5	–4.5	3.5
Liv Ain	147	82.3	75.3	87.7	6.8	10.9	2.7	–6.1	11.4
Liv Roy	333	77.8	73.0	81.9	6.3	15.9	–2.9	–9.0	3.3
M RI	457	77.9	73.9	81.5	5.7	16.4	3.1	–2.4	8.7
Middlbr	320	68.8	63.5	73.6	27.5	3.8	–7.5	–14.4	–0.5
Newc ^a	257	87.9	83.4	91.4	7.8	4.3	12.8	6.2	19.3
Norwch	303	72.3	67.0	77.0	3.3	24.4	2.5	–4.7	9.8
Nottm	354	78.0	73.4	82.0	5.7	16.4	–5.1	–10.9	0.7
Oxford	405	80.3	76.1	83.8	8.2	11.6	1.3	–4.3	6.9
Plymth	119	77.3	68.9	84.0	10.9	11.8	–10.1	–19.7	–0.5
Ports	543	78.6	75.0	81.9	7.0	14.4	–1.3	–6.2	3.6
Prestn	485	79.0	75.1	82.4	17.1	3.9	3.9	–1.4	9.1
Redng	260	84.2	79.3	88.2	7.3	8.5	3.8	–2.9	10.4
Salford	318	79.9	75.1	83.9	8.2	12.0	8.4	1.7	15.1
Sheff	555	79.8	76.3	83.0	15.3	4.9	2.1	–2.7	6.9
Shrew	174	82.2	75.8	87.2	7.5	10.3	10.4	1.8	19.1
Stevng	420	81.9	77.9	85.3	10.7	7.4	1.9	–3.6	7.3
Sthend	110	71.8	62.7	79.4	7.3	20.9	–5.0	–16.6	6.5
Stoke	228	83.3	77.9	87.6	4.8	11.8	5.1	–2.0	12.2
Sund ^b	177	74.6	67.7	80.5	16.4	9.0	–2.5	–11.3	6.4
Truro	139	81.3	73.9	86.9	5.0	13.7	7.6	–2.3	17.5
Wirral	195	84.1	78.3	88.6	10.8	5.1	2.7	–5.2	10.5
Wolve	277	77.3	72.0	81.8	6.5	16.3	0.8	–6.3	7.8
York	129	92.3	86.2	95.8	1.6	6.2	1.3	–5.6	8.2

Table 8.8. Continued

Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	% adjusted Ca >2.5 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
N Ireland									
Antrim	120	69.2	60.4	76.8	1.7	29.2	−14.8	−25.3	−4.4
Belfast ^b	198	76.8	70.4	82.1	9.6	13.6	−5.7	−13.5	2.2
Newry	82	84.2	74.6	90.6	12.2	3.7	−0.6	−11.6	10.4
Ulster	103	82.5	74.0	88.7	2.9	14.6	1.3	−9.2	11.9
West NI	107	81.3	72.8	87.6	12.2	6.5	−2.4	−12.2	7.3
Wales									
Bangor	84	85.7	76.5	91.7	11.9	2.4	2.8	−8.3	13.8
Cardff	460	71.1	66.8	75.1	8.5	20.4	−2.1	−7.9	3.8
Clwyd	72	83.3	72.9	90.3	15.3	1.4	9.6	−3.5	22.8
Swansea	311	72.4	67.1	77.0	14.5	13.2	−3.1	−10.0	3.8
Wrexms	96	75.0	65.4	82.6	5.2	19.8	−13.5	−24.5	−2.6
England	18,045	78.5	77.9	79.1	10.3	11.2	2.0	1.1	2.8
N Ireland	610	78.0	74.6	81.1	7.7	14.3	−5.1	−9.4	−0.7
Wales	1,023	73.9	71.1	76.5	10.8	15.4	−2.1	−5.9	1.6
E, W & NI	19,678	78.2	77.7	78.8	10.2	11.6	1.5	0.7	2.3

^aNewcastle had a change in calcium assay in April 2013; Birmingham Heartlands had a change in calcium assay in 2012

^bThese centres supplied uncorrected calcium and were corrected using the formula: adjusted calcium = unadjusted calcium + [(40−albumin) × 0.02]

Table 8.9. Summary statistics for adjusted calcium in peritoneal dialysis patients in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart ^a	100.0	35	2.4	0.2	2.4	2.3	2.5
B QEH	100.0	129	2.3	0.2	2.3	2.2	2.4
Basldn	100.0	30	2.4	0.1	2.4	2.3	2.5
Bradfd	96.2	25	2.5	0.1	2.4	2.4	2.5
Brightn ^b	100.0	66	2.4	0.2	2.4	2.3	2.4
Bristol	100.0	57	2.4	0.2	2.4	2.3	2.5
Camb	94.7	18					
Carlis	100.0	23	2.3	0.2	2.3	2.2	2.4
Carsh	97.1	102	2.4	0.2	2.4	2.3	2.5
Chelms	95.0	19					
Colchr ^c							
Covnt ^b	98.6	71	2.3	0.2	2.3	2.2	2.4
Derby	100.0	78	2.5	0.2	2.5	2.4	2.6
Donc	100.0	30	2.4	0.1	2.4	2.3	2.4
Dorset ^b	92.3	36	2.3	0.1	2.3	2.3	2.4
Dudley	100.0	47	2.4	0.2	2.4	2.3	2.5
Exeter	100.0	63	2.4	0.1	2.4	2.3	2.4
Glouc	100.0	31	2.4	0.1	2.4	2.3	2.4
Hull	100.0	72	2.4	0.2	2.4	2.3	2.5
Ipswi	100.0	24	2.3	0.2	2.4	2.2	2.4
Kent	98.3	56	2.5	0.2	2.5	2.4	2.6
L Barts	98.9	176	2.3	0.2	2.3	2.2	2.5

Table 8.9. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
L Guys	85.7	24	2.3	0.2	2.3	2.3	2.4
L Kings	98.7	78	2.3	0.1	2.3	2.2	2.4
L Rfree	100.0	108	2.4	0.2	2.3	2.3	2.5
L St.G	100.0	45	2.5	0.1	2.5	2.4	2.5
L West ^b	100.0	52	2.5	0.2	2.6	2.5	2.7
Leeds	100.0	62	2.4	0.2	2.4	2.3	2.5
Leic	97.8	132	2.4	0.2	2.4	2.3	2.5
Liv Ain	100.0	26	2.4	0.2	2.3	2.2	2.4
Liv Roy	100.0	51	2.4	0.1	2.4	2.3	2.5
M RI	98.6	68	2.4	0.2	2.4	2.3	2.5
Middlbr	100.0	11					
Newc ^a	88.9	32	2.4	0.2	2.4	2.3	2.5
Norwch	100.0	35	2.5	0.1	2.5	2.5	2.6
Nottm	100.0	68	2.4	0.2	2.4	2.3	2.5
Oxford	100.0	83	2.4	0.2	2.4	2.3	2.5
Plymth	100.0	29	2.4	0.1	2.4	2.4	2.5
Ports	97.4	75	2.4	0.1	2.4	2.3	2.5
Prestn	100.0	52	2.3	0.2	2.3	2.2	2.4
Redng	100.0	64	2.4	0.1	2.4	2.3	2.5
Salford	97.3	73	2.4	0.2	2.4	2.3	2.5
Sheff	100.0	61	2.3	0.2	2.3	2.2	2.4
Shrew	100.0	26	2.4	0.2	2.4	2.3	2.5
Stevng	100.0	37	2.4	0.1	2.4	2.3	2.4
Sthend	100.0	15					
Stoke	87.7	71	2.4	0.2	2.4	2.3	2.6
Sund ^b	100.0	8					
Truro	100.0	18					
Wirral	74.1	20	2.3	0.2	2.3	2.2	2.4
Wolve	100.0	78	2.4	0.2	2.4	2.2	2.5
York	100.0	25	2.4	0.1	2.4	2.4	2.5
N Ireland							
Antrim	93.3	14					
Belfast ^b	100.0	26	2.4	0.2	2.3	2.2	2.5
Newry	100.0	17					
Ulster	100.0	4					
West NI	100.0	14					
Wales							
Bangor	100.0	12					
Cardff	100.0	66	2.5	0.2	2.5	2.4	2.6
Clwyd	100.0	14					
Swanse	100.0	53	2.3	0.2	2.3	2.2	2.4
Wrexm	94.7	18					
England	98.3	2,715	2.4	0.2	2.4	2.3	2.5
N Ireland	98.7	75	2.4	0.2	2.3	2.3	2.5
Wales	99.4	163	2.4	0.2	2.4	2.3	2.5
E, W & NI	98.4	2,953	2.4	0.2	2.4	2.3	2.5

Blank cells: centres excluded from the analysis due to low patient numbers

^aNewcastle had a change in calcium assay in April 2013; Birmingham Heartlands had a change in calcium assay in 2012

^bThese centres supplied uncorrected calcium and were corrected using the formula: adjusted calcium = unadjusted calcium + [(40-albumin) × 0.02]

^cNo PD patients

Table 8.10. Percentage of peritoneal dialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2013

Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	% adjusted Ca >2.5 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	35	85.7	70.0	93.9	5.7	8.6	14.3	−3.6	32.2
B QEH	129	77.5	69.5	83.9	14.0	8.5	−2.1	−11.8	7.6
Basldn	30	76.7	58.5	88.5	6.7	16.7	10.0	−13.3	33.3
Bradfd	25	76.0	55.8	88.8	0.0	24.0	−4.0	−26.9	18.9
Brightn*	66	86.4	75.8	92.8	4.6	9.1	4.8	−7.7	17.4
Bristol	57	84.2	72.4	91.6	0.0	15.8	7.4	−7.1	22.0
Carlis	23	82.6	61.8	93.3	8.7	8.7	1.7	−21.2	24.5
Carsh	102	78.4	69.4	85.4	7.8	13.7	−1.6	−12.9	9.8
Covnt*	71	87.3	77.4	93.3	9.9	2.8	5.0	−6.4	16.5
Derby	78	69.2	58.2	78.4	1.3	29.5	3.8	−10.7	18.2
Donc	30	86.7	69.4	94.9	6.7	6.7	4.1	−15.6	23.8
Dorset*	36	91.7	77.1	97.3	5.6	2.8	2.8	−12.1	17.7
Dudley	47	83.0	69.5	91.3	6.4	10.6	1.9	−13.2	16.9
Exeter	63	88.9	78.5	94.6	3.2	7.9	6.5	−5.4	18.5
Glouc	31	87.1	70.3	95.1	6.5	6.5	0.0	−16.7	16.7
Hull	72	77.8	66.8	85.9	5.6	16.7	1.5	−12.1	15.0
Ipswi	24	66.7	46.1	82.4	20.8	12.5	−10.0	−34.2	14.2
Kent	56	58.9	45.7	71.0	0.0	41.1	3.4	−15.1	21.9
L Barts	176	70.5	63.3	76.7	15.9	13.6	−5.3	−14.7	4.1
L Guys	24	79.2	58.7	91.1	8.3	12.5	−9.3	−29.7	11.1
L Kings	78	85.9	76.3	92.0	11.5	2.6	9.3	−2.9	21.5
L Rfree	108	85.2	77.2	90.7	7.4	7.4	11.9	1.0	22.8
L St.G	45	75.6	61.0	85.9	0.0	24.4	−11.4	−27.3	4.5
L West*	52	46.2	33.2	59.7	3.9	50.0	−17.7	−37.0	1.6
Leeds	62	75.8	63.7	84.9	3.2	21.0	−9.9	−23.1	3.3
Leic	132	81.1	73.5	86.9	3.0	15.9	3.2	−6.4	12.8
Liv Ain	26	80.8	61.3	91.8	7.7	11.5			
Liv Roy	51	86.3	73.9	93.3	2.0	11.8	7.0	−7.4	21.5
M RI	68	75.0	63.4	83.9	4.4	20.6	9.2	−5.6	24.0
Newc	32	71.9	54.2	84.7	12.5	15.6	−12.5	−32.5	7.5
Norwch	35	62.9	46.0	77.1	0.0	37.1	−1.7	−22.7	19.2
Nottm	68	80.9	69.8	88.6	4.4	14.7	−1.1	−14.0	11.8
Oxford	83	74.7	64.3	82.9	3.6	21.7	−2.6	−16.3	11.2
Plymth	29	72.4	53.8	85.6	3.5	24.1	−10.9	−32.0	10.1
Ports	75	85.3	75.4	91.7	2.7	12.0	7.1	−5.0	19.3
Prestn	52	75.0	61.6	84.9	13.5	11.5	−7.8	−23.0	7.5
Redng	64	87.5	76.9	93.6	3.1	9.4	−6.3	−16.3	3.6
Salford	73	76.7	65.7	85.0	2.7	20.6	11.7	−2.5	25.8
Sheff	61	82.0	70.3	89.7	9.8	8.2	−10.5	−22.0	1.1
Shrew	26	69.2	49.5	83.8	15.4	15.4	−2.6	−26.3	21.0
Stevng	37	86.5	71.4	94.3	2.7	10.8	1.3	−16.0	18.6
Stoke	71	69.0	57.4	78.7	5.6	25.4	−4.4	−19.7	10.8
Wirral	20	80.0	57.2	92.3	10.0	10.0	3.8	−21.5	29.1
Wolve	78	84.6	74.8	91.1	6.4	9.0	2.3	−9.3	14.0
York	25	84.0	64.3	93.9	0.0	16.0	−1.2	−20.8	18.5
N Ireland									
Belfast*	26	84.6	65.5	94.1	3.9	11.5	19.4	−4.5	43.3
Wales									
Cardff	66	56.1	44.0	67.5	3.0	40.9	−23.9	−39.1	−8.7
Swanse	53	84.9	72.6	92.3	11.3	3.8	3.8	−10.5	18.1
England	2,715	78.5	76.9	80.0	6.6	15.0	0.5	−1.7	2.6
N Ireland	75	78.7	68.0	86.5	8.0	13.3	6.6	−7.5	20.7
Wales	163	71.2	63.8	77.6	8.6	20.3	−10.1	−19.2	−1.0
E, W & NI	2,953	78.1	76.6	79.6	6.7	15.2	0.0	−2.1	2.1

*These centres supplied uncorrected calcium and were corrected using the formula: adjusted calcium = unadjusted calcium + [(40−albumin) × 0.02]

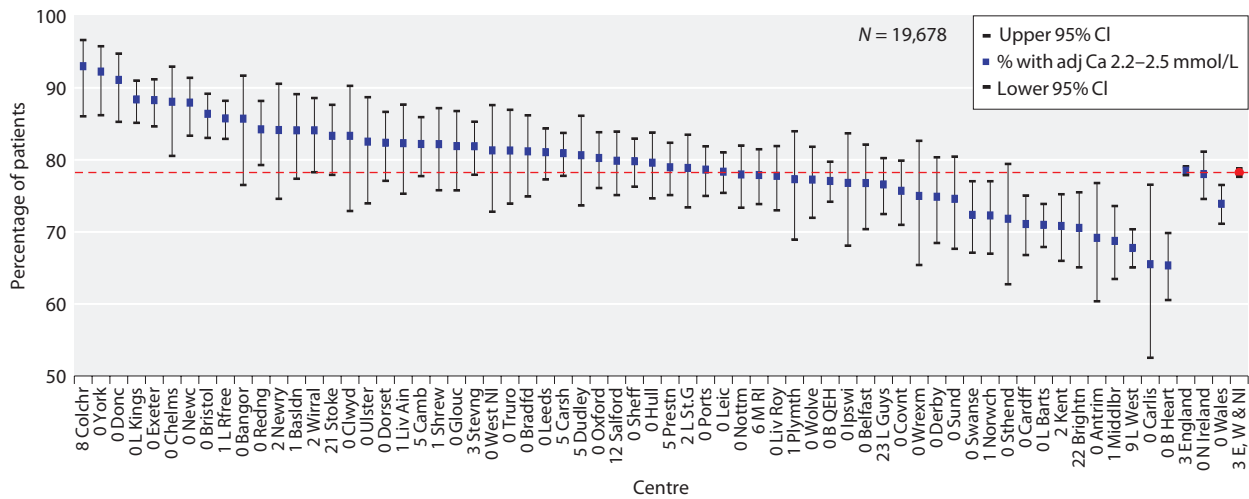


Fig. 8.6. Percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2013

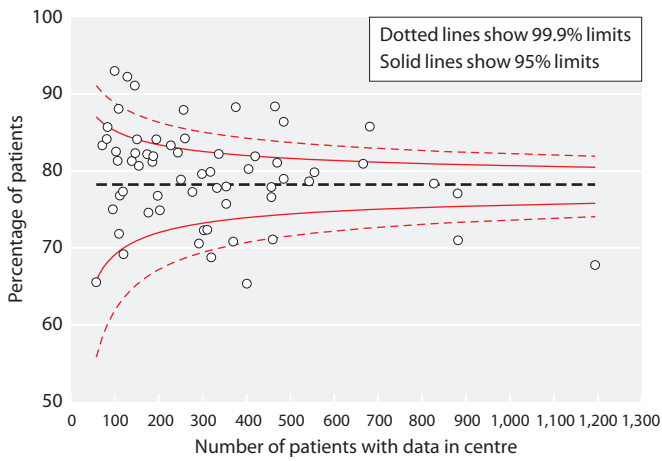


Fig. 8.7. Funnel plot of percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2013

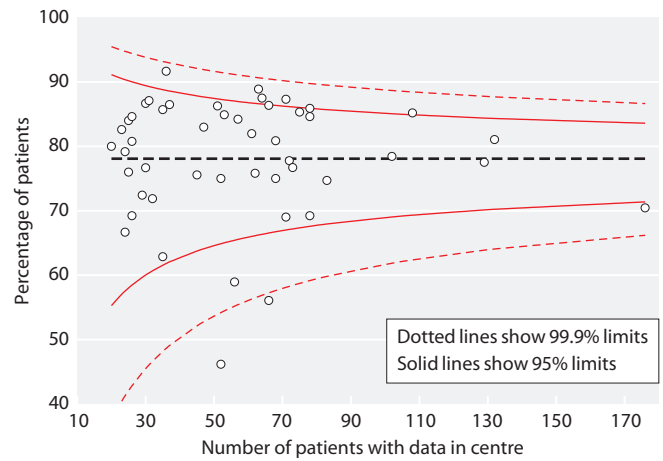


Fig. 8.9. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2013

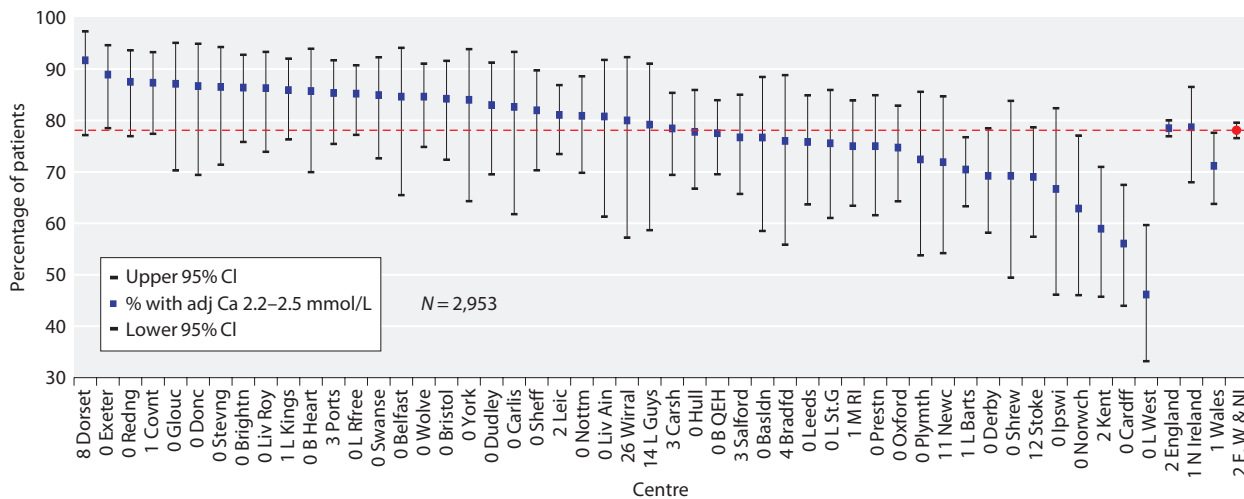


Fig. 8.8. Percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2013

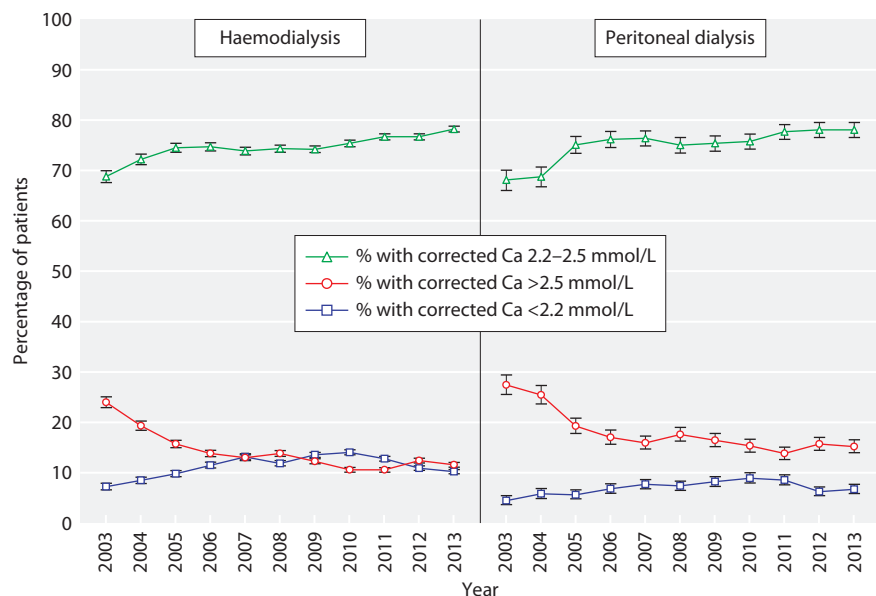


Fig. 8.10. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.5 mmol/L and >2.5 mmol/L by dialysis modality 2003–2013

although there was between centre variation (tables 8.11, 8.13). Fifty-seven percent (95% CI 56–58%) of HD patients and 63% (95% CI 61–65%) of PD patients achieved a parathyroid hormone between 16–72 pmol/L (tables 8.12, 8.14).

In 2013, the proportion of HD patients with a parathyroid hormone above the upper limit of the range (>72 pmol/L) was 17% and the proportion with parathyroid hormone below the lower limit of the range was 26%, very similar to aggregate level results in 2012. The proportion of PD patients with parathyroid hormone

above the upper limit of the range was 13% and the proportion below the lower limit of the range was 24% (tables 8.12, 8.14, figures 8.11–8.14). Again there was significant between centre variation in unadjusted analyses for the proportion of patients below, within and above the range specified by the clinical performance measure.

There was no substantial variation in attainment of the standard for HD patients but there was deterioration for some PD centres (Birmingham Heartlands, Basildon, Newcastle, Portsmouth) where increases in patients both below and above the audit range were seen.

Table 8.11. Summary statistics for PTH in haemodialysis patients in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	401	61.8	51.9	49	26	80
B QEH	93.6	828	43.8	51.3	29	15	53
Basldn	98.0	149	38.0	31.9	30	17	49
Bradfd	98.9	184	35.3	37.5	21	12	48
Brightn	81.2	302	39.0	45.8	26	13	49
Bristol	98.6	478	37.7	44.2	26	12	45
Camb	73.9	263	28.1	29.2	23	11	36
Carlis	98.3	57	29.9	30.3	22	12	32
Carsh	74.6	521	60.4	58.2	41	23	77
Chelms	100.0	109	42.0	29.7	33	20	52
Colchr	89.9	98	25.6	28.4	18	9	27
Covnt	98.0	347	43.9	46.0	28	15	56
Derby	99.5	202	30.5	24.4	24	16	39
Donc	100.0	146	49.3	39.9	40	26	63
Dorset	98.8	241	28.3	28.3	19	10	37
Dudley	90.2	147	37.5	40.0	27	13	46
Exeter	98.9	372	22.6	25.3	15	7	28

Table 8.11. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Glouc	99.5	187	34.3	34.1	27	14	45
Hull	97.3	291	49.4	53.9	31	15	65
Ipswi	100.0	112	30.5	38.0	19	12	32
Kent	98.9	372	48.4	40.1	38	19	57
L Barts	99.1	875	51.7	52.9	37	18	67
L Guys	72.8	430	50.8	51.3	36	15	73
L Kings	98.7	460	44.9	45.1	31	13	59
L Rfree	98.4	677	45.7	45.0	34	17	59
L St.G	94.9	242	55.5	53.3	40	20	72
L West	81.4	1,072	64.0	63.5	44	21	83
Leeds	96.8	455	40.4	40.3	27	13	54
Leic	98.6	816	40.9	41.8	27	11	59
Liv Ain	98.0	145	23.4	26.6	14	6	34
Liv Roy	99.7	333	38.0	39.2	25	12	48
M RI	83.7	407	50.1	45.6	38	19	66
Middlbr	94.4	304	50.5	47.4	38	20	64
Newc	99.6	256	41.5	36.4	31	16	55
Norwch	97.7	298	38.2	33.4	30	15	51
Nottm	100.0	354	43.9	51.6	30	15	52
Oxford	99.0	401	44.4	38.4	34	16	60
Plymth	96.7	116	35.4	46.5	24	12	39
Ports	84.8	462	45.9	46.5	32	16	57
Prestn	99.4	505	42.4	42.6	28	15	55
Redng	100.0	260	38.5	35.2	32	16	49
Salford	82.9	300	29.9	28.4	21	10	40
Sheff	99.1	551	44.0	43.7	32	16	56
Shrew	99.4	175	30.5	33.2	19	10	38
Stevng	95.4	411	42.1	31.9	38	19	57
Sthend	90.0	99	44.5	40.7	31	19	56
Stoke	76.7	221	44.0	35.3	35	19	59
Sund	99.4	176	41.0	39.3	29	12	60
Truro	99.3	138	22.4	28.0	14	6	29
Wirral	98.5	195	31.5	28.6	26	14	43
Wolve	93.9	260	45.1	46.9	32	15	57
York	95.4	123	28.0	32.9	18	7	40
N Ireland							
Antrim	100.0	120	28.2	29.6	20	14	35
Belfast	98.5	196	36.1	39.4	23	12	47
Newry	100.0	84	28.6	21.9	22	12	42
Ulster	99.0	102	23.7	22.0	16	8	32
West NI	100.0	107	33.4	22.3	30	18	41
Wales							
Bangor	98.8	83	26.3	20.3	23	14	33
Cardff	98.0	451	43.9	38.0	34	19	56
Clwyd	100.0	72	40.4	39.8	30	13	54
Swanse	74.0	230	39.3	37.5	32	16	53
Wrexm	96.9	93	21.7	18.2	19	10	29
England	92.9	17,324	43.9	45.7	30	15	57
N Ireland	99.4	609	30.9	30.4	22	12	39
Wales	90.8	929	38.7	36.0	30	16	51
E, W & NI	93.0	18,862	43.2	44.9	30	15	56

Table 8.12. Percentage of haemodialysis patients within, below and above the range for PTH (16–72 pmol/L) in 2013

Centre	N	% PTH 16–72 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% phos >72 pmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	401	56.1	51.2	60.9	12.5	31.4	-7.9	-14.7	-1.1
B QEH	828	59.4	56.0	62.7	25.9	14.7			
Basldn	149	67.8	59.9	74.8	22.2	10.1	6.0	-4.9	16.9
Bradfd	184	51.6	44.4	58.8	35.3	13.0	8.2	-2.0	18.3
Brightn	302	56.0	50.3	61.5	31.5	12.6	2.5	-5.7	10.6
Bristol	478	57.3	52.8	61.7	30.8	11.9	-0.1	-6.4	6.3
Camb	263	59.3	53.3	65.1	35.7	4.9	-4.1	-12.8	4.5
Carlisle	57	59.7	46.6	71.5	33.3	7.0	1.8	-16.3	19.8
Carsh	521	57.8	53.5	62.0	14.6	27.6			
Chelms	109	67.0	57.6	75.1	16.5	16.5	-1.4	-13.5	10.8
Colchr	98	46.9	37.3	56.8	43.9	9.2	-3.6	-17.4	10.3
Covnt	347	55.6	50.4	60.8	26.5	17.9	-5.8	-13.2	1.6
Derby	202	72.3	65.7	78.0	23.3	4.5	3.7	-5.2	12.5
Donc	146	71.9	64.1	78.6	8.9	19.2	0.6	-9.6	10.7
Dorset	241	50.2	43.9	56.5	41.1	8.7	-1.9	-10.8	7.1
Dudley	147	59.2	51.1	66.8	29.9	10.9	13.7	2.3	25.1
Exeter	372	42.5	37.5	47.6	52.7	4.8	0.7	-6.5	7.9
Glouc	187	64.7	57.6	71.2	27.8	7.5	0.6	-9.0	10.3
Hull	291	53.3	47.5	58.9	26.8	19.9	-4.1	-12.1	3.9
Ipswi	112	49.1	40.0	58.3	41.1	9.8	-10.6	-23.2	2.1
Kent	372	66.7	61.7	71.3	14.3	19.1	-0.6	-7.4	6.3
L Barts	875	57.0	53.7	60.3	20.0	23.0	-2.3	-7.0	2.4
L Guys	430	49.3	44.6	54.0	25.6	25.1	-6.1	-12.7	0.5
L Kings	460	49.8	45.2	54.3	29.1	21.1	-3.7	-10.2	2.8
L Rfree	677	60.6	56.8	64.2	22.0	17.4	0.4	-5.1	6.0
L St.G	242	55.0	48.6	61.1	20.7	24.4	-1.3	-10.1	7.5
L West	1,072	50.9	47.9	53.9	18.4	30.7	0.4	-3.9	4.7
Leeds	455	54.5	49.9	59.0	29.5	16.0	-1.3	-7.8	5.2
Leic	816	47.7	44.3	51.1	33.1	19.2	-2.7	-7.5	2.2
Liv Ain	145	43.5	35.6	51.6	52.4	4.1	-6.9	-18.1	4.4
Liv Roy	333	53.8	48.4	59.1	32.7	13.5	-1.8	-9.4	5.8
M RI	407	58.7	53.9	63.4	19.7	21.6	7.1	0.3	13.8
Middlbr	304	61.8	56.3	67.1	16.8	21.4	-0.2	-8.0	7.6
Newc	256	59.8	53.6	65.6	22.7	17.6	-0.8	-9.2	7.7
Norwch	298	62.8	57.1	68.1	25.2	12.1	1.5	-6.4	9.4
Nottm	354	60.5	55.3	65.4	25.7	13.8	0.4	-6.8	7.6
Oxford	401	56.1	51.2	60.9	24.7	19.2	-2.2	-9.1	4.7
Plymth	116	56.9	47.8	65.6	33.6	9.5	4.7	-8.1	17.6
Ports	462	56.3	51.7	60.7	24.9	18.8	4.1	-2.4	10.6
Prestn	505	56.6	52.3	60.9	26.9	16.4			
Redng	260	67.7	61.8	73.1	21.5	10.8	2.0	-6.2	10.1
Salford	300	55.3	49.7	60.9	37.0	7.7	0.0	-8.0	8.0
Sheff	551	61.0	56.8	65.0	24.0	15.1	-2.6	-8.3	3.2
Shrew	175	49.1	41.8	56.5	41.1	9.7	-0.6	-11.0	9.8
Stevng	411	69.3	64.7	73.6	16.8	13.9	3.4	-3.2	9.9
Sthend	99	63.6	53.8	72.5	18.2	18.2	-1.7	-15.0	11.7
Stoke	221	67.4	61.0	73.3	18.1	14.5	0.2	-8.2	8.7
Sund	176	51.7	44.3	59.0	30.1	18.2	-2.7	-13.1	7.6
Truro	138	42.0	34.1	50.4	54.4	3.6	-3.0	-14.9	8.8
Wirral	195	66.7	59.8	72.9	28.7	4.6	0.6	-9.2	10.4
Wolve	260	56.9	50.8	62.8	25.8	17.3	4.1	-4.4	12.6
York	123	49.6	40.9	58.4	43.9	6.5	0.9	-11.8	13.5

Table 8.12. Continued

Centre	N	% PTH 16–72 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% phos >72 pmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
N Ireland									
Antrim	120	62.5	53.5	70.7	34.2	3.3	−4.7	−16.6	7.2
Belfast	196	52.6	45.6	59.5	35.7	11.7	−5.1	−14.8	4.7
Newry	84	59.5	48.8	69.5	34.5	6.0	13.6	−1.3	28.6
Ulster	102	46.1	36.7	55.8	49.0	4.9	−1.4	−15.2	12.3
West NI	107	71.0	61.8	78.8	21.5	7.5	4.4	−7.5	16.2
Wales									
Bangor	83	67.5	56.7	76.7	30.1	2.4	10.7	−4.1	25.4
Cardff	451	65.9	61.4	70.1	18.6	15.5	−5.5	−11.6	0.7
Clwyd	72	54.2	42.6	65.3	27.8	18.1	−7.7	−23.5	8.2
Swanse	230	61.7	55.3	67.8	24.4	13.9	−1.1	−10.0	7.8
Wrexm	93	53.8	43.6	63.6	45.2	1.1	−5.8	−20.4	8.8
England	17,324	56.7	56.0	57.5	26.1	17.1	−0.4	−1.4	0.7
N Ireland	609	57.6	53.7	61.5	35.0	7.4	−0.5	−6.0	5.0
Wales	929	62.9	59.7	65.9	24.4	12.7	−3.1	−7.5	1.3
E, W & NI	18,862	57.1	56.4	57.8	26.3	16.6	−0.5	−1.6	0.5

Blank cells: no data available for 2012

Table 8.13. Summary statistics for PTH in peritoneal dialysis patients in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	88.6	31	51.8	42.9	38	26	79
B QEH	97.7	126	39.0	40.2	25	14	42
Basldn	100.0	30	39.8	29.3	30	18	57
Bradfd	88.5	23	39.2	49.9	25	4	47
Brightn	97.0	64	32.2	25.2	23	12	49
Bristol	96.5	55	37.1	28.1	32	17	46
Camb	100.0	19					
Carlis	87.0	20	40.6	25.6	28	26	54
Carsh	48.6	51					
Chelms	95.0	19					
Colchr*							
Covnt	91.7	66	22.9	19.9	18	11	28
Derby	97.4	76	29.5	19.6	26	16	35
Donc	96.7	29	54.4	33.7	40	33	63
Dorset	89.7	35	27.7	18.5	24	13	40
Dudley	87.2	41	34.7	40.8	18	10	41
Exeter	100.0	63	24.8	19.3	18	12	35
Glouc	83.9	26	35.7	22.8	26	18	47
Hull	55.6	40	25.5	23.0	22	8	34
Ipswi	91.7	22	56.9	52.1	32	16	87
Kent	96.5	55	41.2	32.4	29	19	57
L Barts	95.5	170	36.0	35.3	27	12	48

Table 8.13. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
L Guys	57.1	16					
L Kings	96.2	76	47.4	41.3	32	17	70
L Rfree	84.3	91	46.1	47.3	35	17	58
L St.G	91.1	41	31.7	27.3	22	16	41
L West	100.0	52	49.5	46.9	34	26	64
Leeds	100.0	62	42.4	34.4	32	18	54
Leic	89.6	121	42.2	35.7	33	16	59
Liv Ain	92.3	24	17.0	12.7	13	10	20
Liv Roy	94.1	48	30.7	23.1	24	13	40
M RI	94.2	65	37.6	22.1	37	21	50
Middlbr	90.9	10					
Newc	83.3	30	30.0	24.9	22	14	38
Norwch	100.0	35	40.0	25.9	33	20	60
Nottm	97.1	66	51.2	54.3	41	19	62
Oxford	95.2	79	44.1	37.6	35	18	57
Plymth	75.9	22	23.6	24.1	18	10	33
Ports	87.0	67	43.6	34.8	33	15	68
Prestn	100.0	52	42.2	28.5	38	24	54
Redng	95.3	61	31.1	18.7	27	17	41
Salford	94.7	71	39.9	39.7	25	13	47
Sheff	86.9	53	34.0	24.0	29	18	46
Shrew	100.0	26	42.6	42.0	24	19	57
Stevng	86.5	32	37.1	21.9	38	19	52
Sthend	60.0	9					
Stoke	87.7	71	52.8	46.0	36	23	67
Sund	100.0	8					
Truro	88.9	16					
Wirral	66.7	18					
Wolve	98.7	77	40.3	29.2	32	19	54
York	100.0	25	33.2	27.5	26	14	52
N Ireland							
Antrim	100.0	15					
Belfast	100.0	26	27.7	20.3	23	10	37
Newry	100.0	17					
Ulster	100.0	4					
West NI	100.0	14					
Wales							
Bangor	91.7	11					
Cardff	92.4	61	49.6	30.9	45	28	71
Clwyd	92.9	13					
Swanse	88.7	47	38.3	28.1	33	17	46
Wrexm	100.0	19					
England	90.0	2,485	39.1	35.9	29	16	51
N Ireland	100.0	76	25.9	19.6	22	12	34
Wales	92.1	151	42.2	27.9	38	19	57
E, W & NI	90.3	2,712	38.9	35.2	29	16	51

Blank cells: centres excluded from analyses due to small numbers or poor data completeness

* No PD patients

Table 8.14. Percentage of peritoneal dialysis patients within, below and above the range for PTH (16–72 pmol/L) in 2013

Centre	N	% PTH 16–72 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% phos >72 pmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	31	61.3	43.5	76.5	12.9	25.8	−13.7	−36.5	9.1
B QEH	126	61.9	53.1	70.0	26.2	11.9	−4.5	−16.0	7.0
Basldn	30	66.7	48.4	81.0	20.0	13.3	−14.8	−37.2	7.5
Bradfd	23	47.8	28.8	67.5	39.1	13.0	−6.7	−35.9	22.4
Brightn	64	59.4	47.0	70.7	34.4	6.3	−4.6	−21.6	12.5
Bristol	55	67.3	53.9	78.3	20.0	12.7	6.9	−11.2	25.0
Carlis	20	80.0	57.2	92.3	5.0	15.0	20.0	−7.7	47.7
Covnt	66	59.1	46.9	70.2	37.9	3.0	−2.0	−18.1	14.2
Derby	76	72.4	61.3	81.2	22.4	5.3	−1.1	−14.9	12.7
Donc	29	72.4	53.8	85.6	6.9	20.7	7.2	−18.2	32.6
Dorset	35	71.4	54.6	83.9	28.6	0.0	4.8	−18.5	28.0
Dudley	41	48.8	34.1	63.7	41.5	9.8	−3.4	−24.4	17.6
Exeter	63	57.1	44.7	68.7	39.7	3.2	7.1	−9.9	24.2
Glouc	26	76.9	57.2	89.3	15.4	7.7	19.2	−5.7	44.2
Hull	40	57.5	42.0	71.7	37.5	5.0	3.2	−16.0	22.5
Ipswi	22	54.6	34.1	73.5	18.2	27.3	−4.1	−31.5	23.4
Kent	55	63.6	50.3	75.2	18.2	18.2	−0.4	−18.8	18.0
L Barts	170	56.5	48.9	63.7	32.4	11.2	−7.0	−17.8	3.7
L Kings	76	56.6	45.3	67.2	19.7	23.7	−1.3	−17.0	14.4
L Rfree	91	61.5	51.2	70.9	22.0	16.5	−6.1	−20.8	8.7
L St.G	41	65.9	50.3	78.6	24.4	9.8	−5.6	−25.5	14.4
L West	52	61.5	47.8	73.7	19.2	19.2	−8.0	−26.8	10.7
Leeds	62	64.5	51.9	75.4	19.4	16.1	−1.7	−17.6	14.2
Leic	121	61.2	52.2	69.4	23.1	15.7	1.3	−10.6	13.3
Liv Ain	24	29.2	14.6	49.8	70.8	0.0			
Liv Roy	48	62.5	48.2	74.9	29.2	8.3	−1.0	−19.9	18.0
M RI	65	73.9	61.9	83.1	15.4	10.8	0.9	−13.8	15.6
Newc	30	53.3	35.8	70.1	36.7	10.0	−21.7	−45.0	1.6
Norwch	35	71.4	54.6	83.9	14.3	14.3	20.3	−0.9	41.4
Nottm	66	66.7	54.5	76.9	15.2	18.2	3.3	−12.7	19.3
Oxford	79	59.5	48.4	69.7	21.5	19.0	−5.6	−21.6	10.4
Plymth	22	50.0	30.2	69.8	45.5	4.6	10.7	−16.9	38.3
Ports	67	49.3	37.6	61.0	28.4	22.4	−18.3	−34.2	−2.4
Prestn	52	69.2	55.5	80.2	17.3	13.5			
Redng	61	75.4	63.1	84.6	19.7	4.9	7.2	−8.6	22.9
Salford	71	54.9	43.3	66.1	26.8	18.3	−6.5	−22.1	9.1
Sheff	53	67.9	54.3	79.0	22.6	9.4	−5.2	−22.6	12.3
Shrew	26	69.2	49.5	83.8	15.4	15.4	1.5	−22.7	25.7
Stevng	32	75.0	57.4	87.0	18.8	6.3	23.0	−1.7	47.7
Stoke	71	70.4	58.9	79.9	9.9	19.7	2.3	−13.0	17.6
Wolve	77	68.8	57.7	78.2	19.5	11.7	−3.2	−17.7	11.3
York	25	64.0	44.0	80.1	32.0	4.0	0.0	−26.6	26.6
N Ireland									
Belfast	26	57.7	38.5	74.8	38.5	3.9	−7.5	−34.7	19.7
Wales									
Cardff	61	60.7	48.0	72.0	16.4	23.0	−5.1	−21.6	11.5
Swanse	47	68.1	53.6	79.8	21.3	10.6	−3.9	−22.1	14.3
England	2,485	62.9	60.9	64.7	24.0	13.2	−1.7	−4.3	1.0
N Ireland	76	60.5	49.2	70.8	36.8	2.6	−4.2	−20.0	11.6
Wales	151	68.9	61.1	75.7	16.6	14.6	0.6	−9.7	10.8
E, W & NI	2,712	63.1	61.3	64.9	23.9	12.9	−1.6	−4.2	0.9

Blank cells: no data available for 2012

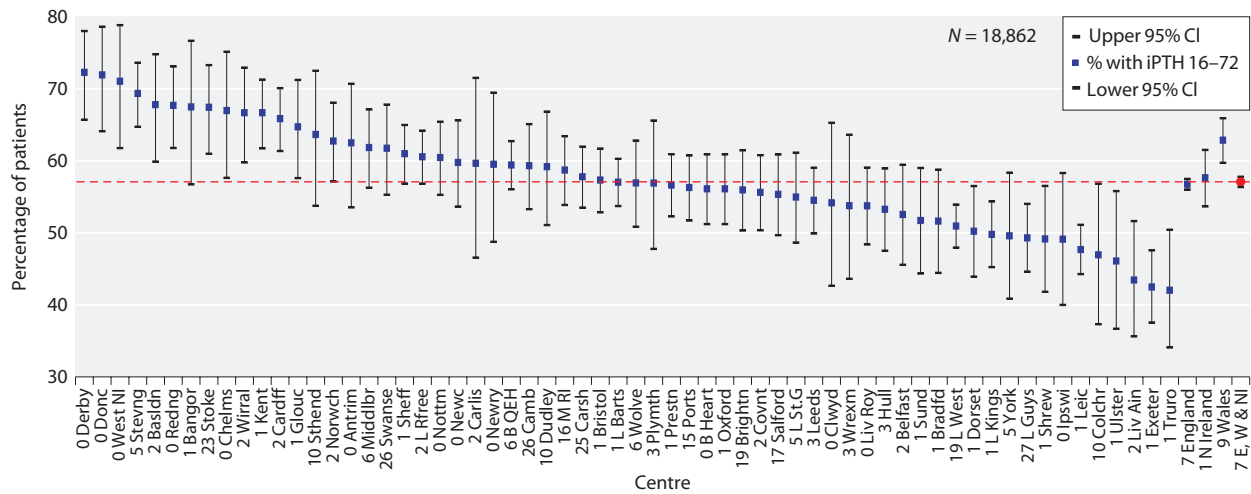


Fig. 8.11. Percentage of haemodialysis patients with PTH within range (16–72 pmol/L) by centre in 2013

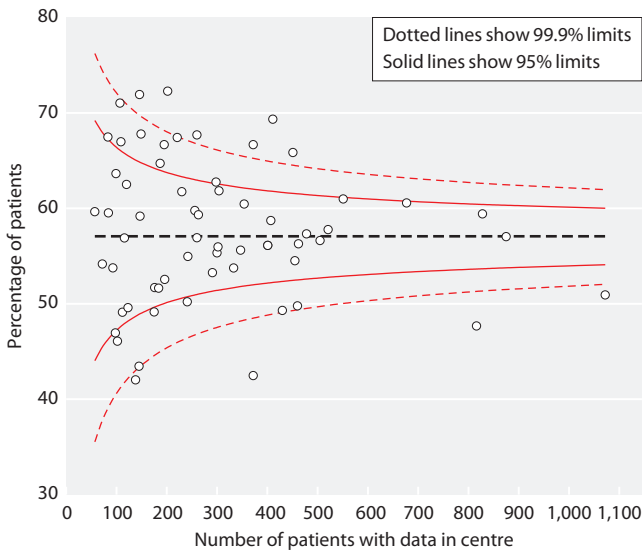


Fig. 8.12. Funnel plot of percentage of haemodialysis patients with PTH within range (16–72 pmol/L) by centre in 2013

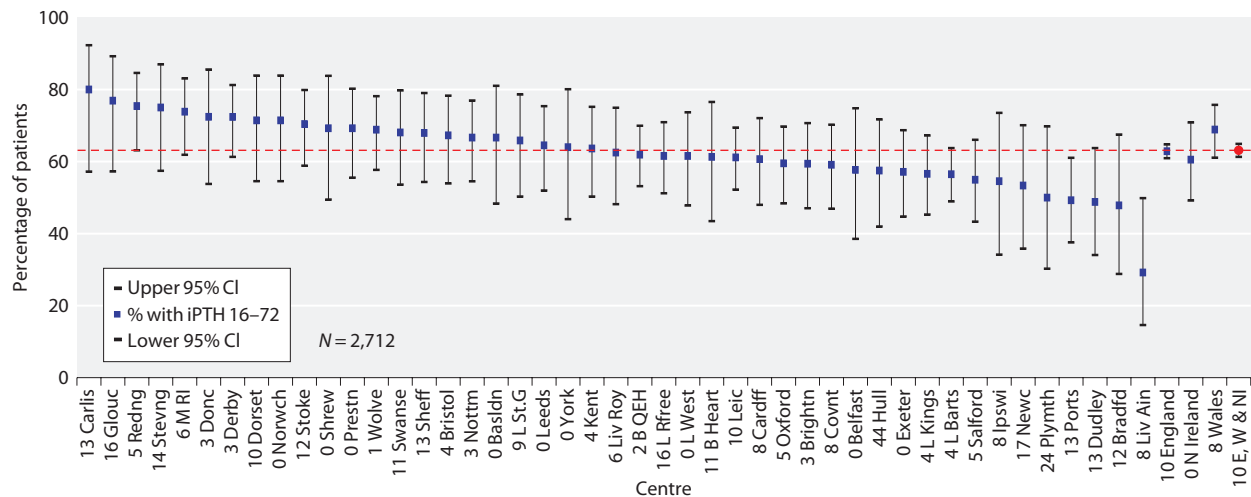


Fig. 8.13. Percentage of peritoneal dialysis patients with PTH within range (16–72 pmol/L) by centre in 2013

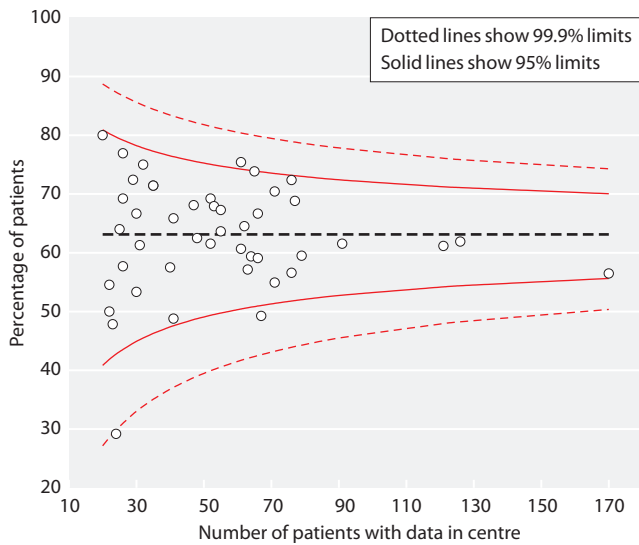


Fig. 8.14. Funnel plot of percentage of peritoneal dialysis patients with PTH within range (16–72 pmol/L) by centre in 2013

Changes in PTH control between 2003 and 2013 stratified by dialysis modality are shown in figure 8.15.

Simultaneous control of corrected calcium, phosphate and PTH in preventing severe hyperparathyroidism

Data points to perform the bone mineral disease (BMD) combination analyses were available from 61 HD and 45 PD centres, covering 18,428 HD and 2,433 PD patients, from England, Wales and Northern Ireland.

Tables 8.15 and 8.16 identify each centre and detail the numbers of patients who had received HD and PD and the results of the BMD combination analyses.

Figures 8.16 and 8.17 demonstrate the caterpillar plots of all centres and the percentage achievement of

simultaneous control of all three BMD parameters for HD and PD patients respectively.

Control of none of the parameters of BMD was found in 1.9% of HD patients and 1.6% of PD patients across England, Wales and Northern Ireland cumulatively. Control of one parameter was reported in 13.0% of HD and 12.5% of PD patients; of two parameters in 35.9% of HD and 35.8% of PD patients; and of all three parameters in 49.3% of HD and 50.1% of PD patients (tables 8.15, 8.16).

Figures 8.18 and 8.19 are funnel plots of all centres who contributed data to these analyses based on the size of the centre and the percentage of patients achieving the control of all three BMD parameters. In HD patients, there was a negative trend observed between centre size and the simultaneous control of all three BMD parameters as identified in this analysis. No such trend was observed in PD patients, perhaps because PD centres are all of a small size.

Bicarbonate

In 2013 the following Renal Association clinical practice guidelines regarding bicarbonate management were applicable:

Haemodialysis Guideline 6.3: Pre-dialysis serum bicarbonate concentrations

‘We suggest that pre-dialysis serum bicarbonate concentrations, measured with minimum delay after venepuncture, should be between 18 and 24 mmol/l [7].

Peritoneal Dialysis Guideline 6.2 – PD: Metabolic factors

‘We recommend that plasma bicarbonate should be maintained within the normal range’ [8].

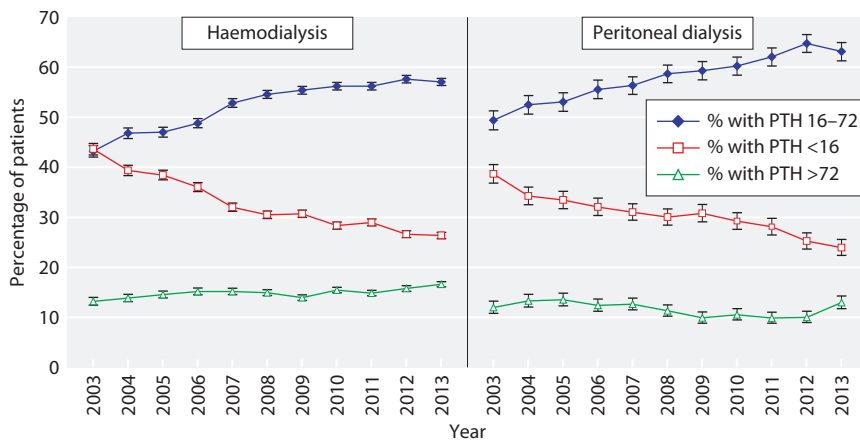


Fig. 8.15. Longitudinal change in percentage of patients with PTH within range (16–72 pmol/L) by dialysis modality 2003–2013

Table 8.15. Percentage of haemodialysis patients within the ranges specified for the simultaneous combinations of control of bone and mineral disorder parameters in preventing severe hyperparathyroidism in 2013

Centre	N	Number of parameters			
		None	One	Two	Three
England					
B Heart	401	5.2	24.7	35.9	34.2
B QEH	806	1.7	12.3	35.9	50.1
Basldn	149	0.0	8.7	32.9	58.4
Bradfd	184	1.1	13.0	28.3	57.6
Brightn	241	0.8	14.9	38.2	46.1
Bristol	478	1.3	9.0	33.3	56.5
Camb	248	0.0	8.1	37.5	54.4
Carlis	57	0.0	15.8	50.9	33.3
Carsh	521	3.5	14.4	38.0	44.1
Chelms	109	0.9	5.5	31.2	62.4
Colchr	96	0.0	9.4	19.8	70.8
Covnt	347	1.7	16.7	36.0	45.5
Derby	202	1.0	7.4	37.1	54.5
Donc	146	0.0	7.5	34.2	58.2
Dorset	241	1.2	10.4	26.6	61.8
Dudley	146	3.4	10.3	33.6	52.7
Exeter	372	0.5	6.2	30.1	63.2
Glouc	187	0.0	9.1	34.2	56.7
Hull	291	2.1	11.3	36.4	50.2
Ipswi	112	0.0	5.4	39.3	55.4
Kent	366	2.7	18.3	41.0	38.0
L Barts	875	3.0	18.9	38.6	39.5
L Guys	418	2.4	14.8	38.3	44.5
L Kings	460	0.9	9.1	31.7	58.3
L Rfree	677	0.7	11.7	33.2	54.4
L St.G	242	1.7	14.5	37.2	46.7
L West	988	3.5	19.6	41.9	34.9
Leeds	455	2.0	13.6	35.6	48.8
Leic	816	2.3	15.4	38.7	43.5
Liv Ain	145	0.0	4.8	32.4	62.8
Liv Roy	332	0.6	8.4	39.8	51.2
M RI	407	2.2	16.5	37.3	44.0
Middlbr	304	1.3	17.8	43.4	37.5
Newc	256	1.2	10.5	31.3	57.0
Norwch	296	2.7	12.8	36.1	48.3
Nottm	354	2.5	12.1	33.1	52.3
Oxford	401	2.0	15.2	34.9	47.9
Plymth	115	1.7	12.2	33.0	53.0
Ports	461	2.6	14.5	38.0	44.9
Prestn	483	2.5	14.1	37.1	46.4
Redng	260	0.0	11.5	27.7	60.8
Salford	300	0.7	8.0	35.7	55.7
Sheff	551	2.0	11.6	36.3	50.1
Shrew	173	2.3	9.2	37.6	50.9
Stevng	403	2.0	12.2	35.7	50.1
Sthend	99	1.0	11.1	48.5	39.4
Stoke	208	2.9	8.2	33.7	55.3
Truro	138	0.7	4.3	35.5	59.4
Wirral	194	0.5	7.7	33.5	58.2
Wolve	260	1.9	12.3	35.4	50.4
York	123	0.8	2.4	26.8	69.9

Table 8.15. Continued

Centre	N	Number of parameters			
		None	One	Two	Three
N Ireland					
Antrim	120	0.0	5.0	33.3	61.7
Belfast	194	2.6	11.9	30.9	54.6
Newry	82	1.2	7.3	35.4	56.1
Ulster	102	2.0	4.9	34.3	58.8
West NI	107	0.9	7.5	37.4	54.2
Wales					
Bangor	83	1.2	3.6	32.5	62.7
Cardff	451	3.3	18.2	33.0	45.5
Clwyd	72	1.4	12.5	38.9	47.2
Swanse	230	0.9	13.9	36.1	49.1
Wrexm	93	0.0	6.5	34.4	59.1
England	16,894	1.9	13.1	36.1	49.0
N Ireland	605	1.5	7.9	33.7	56.9
Wales	929	2.0	14.2	34.3	49.4
E, W & NI	18,428	1.9	13.0	35.9	49.3

Table 8.16. Percentage of peritoneal dialysis patients within the ranges specified for the simultaneous combinations of control of bone and mineral disorder parameters in preventing severe hyperparathyroidism in 2013

Centre	N	Number of parameters			
		None	One	Two	Three
England					
B Heart	31	3.2	22.6	32.3	41.9
B QEH	126	2.4	12.7	34.9	50.0
Basldn	30	3.3	13.3	20.0	63.3
Bradfd	22	0.0	18.2	45.5	36.4
Brightn	64	0.0	6.3	45.3	48.4
Bristol	55	0.0	10.9	52.7	36.4
Covnt	64	0.0	3.1	26.6	70.3
Derby	76	0.0	11.8	38.2	50.0
Donc	29	3.4	6.9	41.4	48.3
Dorset	30	0.0	3.3	23.3	73.3
Dudley	41	0.0	12.2	46.3	41.5
Exeter	63	0.0	7.9	25.4	66.7
Glouc	26	0.0	7.7	38.5	53.8
Hull	40	2.5	2.5	40.0	55.0
Ipswi	22	4.5	27.3	18.2	50.0
Kent	54	0.0	22.2	44.4	33.3
L Barts	169	1.8	12.4	39.1	46.7
L Kings	76	0.0	10.5	39.5	50.0
L Rfree	91	0.0	12.1	38.5	49.5
L St.G	40	2.5	5.0	42.5	50.0
L West	52	3.8	17.3	53.8	25.0
Leeds	62	3.2	21.0	35.5	40.3
Leic	121	0.8	9.9	41.3	47.9
Liv Ain	24	0.0	8.3	29.2	62.5
Liv Roy	48	0.0	2.1	41.7	56.3
M RI	64	1.6	12.5	32.8	53.1
Newc	30	0.0	13.3	46.7	40.0

Table 8.16. Continued

Centre	N	Number of parameters			
		None	One	Two	Three
Norwch	35	5.7	8.6	34.3	51.4
Nottm	66	0.0	16.7	28.8	54.5
Oxford	79	2.5	21.5	31.6	44.3
Plymth	22	4.5	9.1	27.3	59.1
Ports	67	1.5	16.4	34.3	47.8
Prestn	52	5.8	9.6	34.6	50.0
Redng	61	1.6	6.6	23.0	68.9
Salford	71	2.8	16.9	31.0	49.3
Sheff	53	0.0	13.2	34.0	52.8
Shrew	26	7.7	7.7	30.8	53.8
Stevng	32	0.0	12.5	18.8	68.8
Stoke	63	6.3	17.5	33.3	42.9
Wolve	77	1.3	20.8	20.8	57.1
York	25	0.0	4.0	28.0	68.0
N Ireland					
Belfast	26	0.0	7.7	42.3	50.0
Wales					
Cardff	61	4.9	18.0	45.9	31.1
Swanse	47	0.0	6.4	44.7	48.9
England	2,299	1.6	12.5	35.3	50.6
N Ireland	26	0.0	7.7	42.3	50.0
Wales	108	2.8	13.0	45.4	38.9
E, W & NI	2,433	1.6	12.5	35.8	50.1

Bicarbonate data were 93% complete for HD patients and 92% complete for PD patients (tables 8.17, 8.19). The proportion of HD patients with a serum bicarbonate within the audit measure range was 59% in 2013 (95% CI 59–60%) (table 8.18); the mean bicarbonate in HD patients was 23 mmol/L (table 8.17).

The proportion with a serum bicarbonate within the audit standard in PD patients was 79% (CI 77–80%) (table 8.20). The mean bicarbonate level in PD patients was 25 mmol/L (table 8.19).

As in previous years, between centre variation was observed in attainment of the audit standard for both

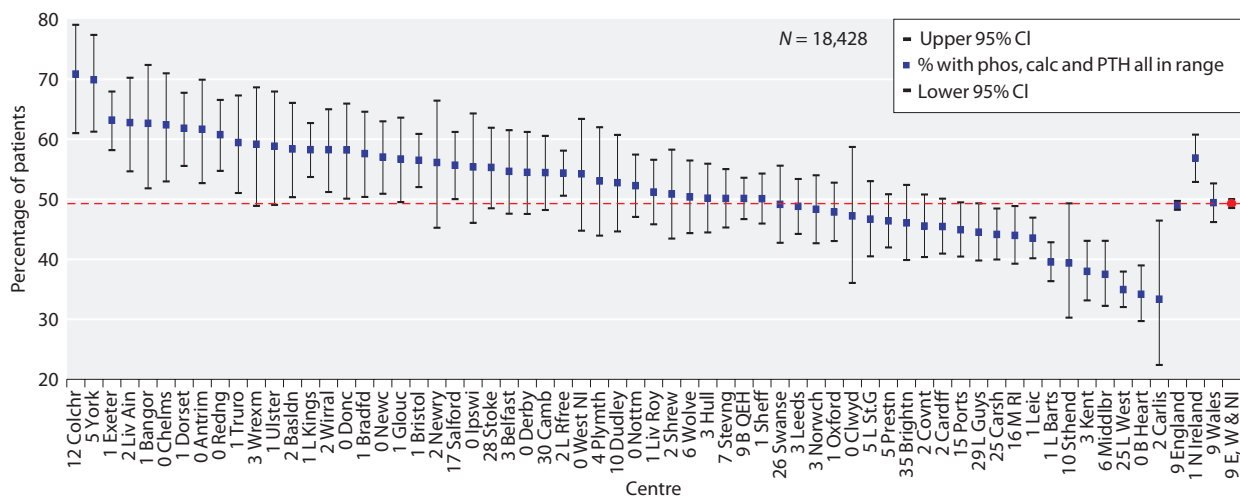


Fig. 8.16. Percentage of HD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2013

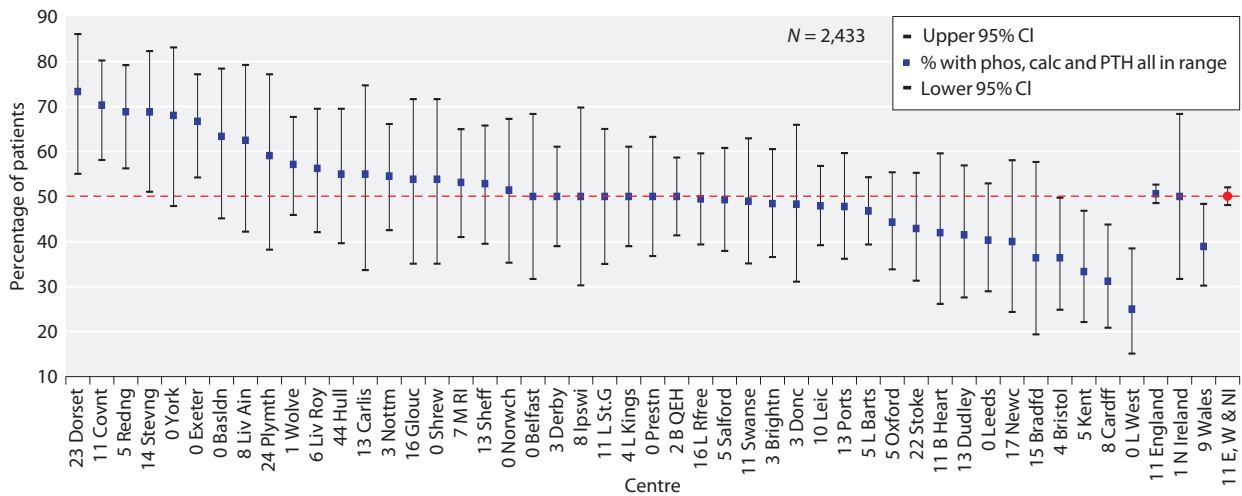


Fig. 8.17. Percentage of PD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2013

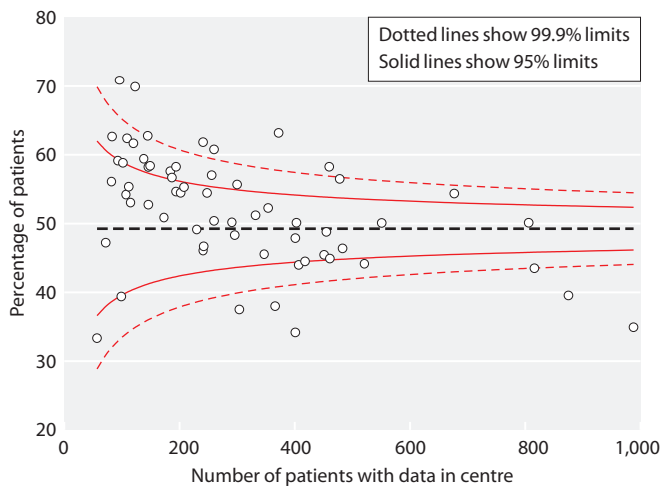


Fig. 8.18. Funnel plot for percentage of HD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2013

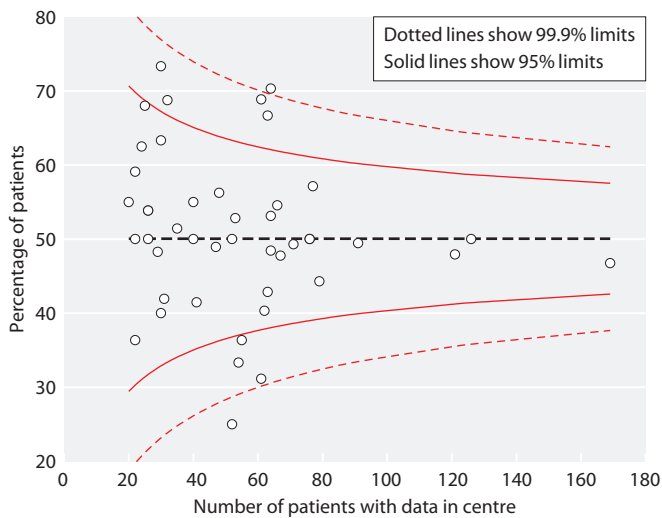


Fig. 8.19. Funnel plot for percentage of PD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2013

Table 8.17. Summary statistics for serum bicarbonate in haemodialysis patients by centre in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	68.6	275	21.1	2.9	21	19	23
B QEH	98.6	873	23.9	2.5	24	22	26
Basldn	99.3	151	22.2	2.7	22	20	24
Bradfd	100.0	186	24.0	2.7	24	22	26
Brightn	95.2	354	23.0	3.0	23	21	25
Bristol	100.0	485	23.5	2.6	24	22	25
Camb	94.4	336	24.1	2.7	24	22	26
Carlis	100.0	58	21.4	2.6	21	19	24
Carsh	93.6	653	24.9	3.8	25	22	28
Chelms	100.0	109	22.4	2.1	22	21	24
Colchr	92.7	101	25.1	1.4	25	24	26
Covnt	89.3	316	23.0	2.8	23	21	25
Derby	99.5	202	22.8	2.6	23	21	24
Donc	100.0	146	25.2	2.8	25	24	27
Dorset	98.8	241	22.8	2.5	23	21	24
Dudley	94.5	154	23.1	3.1	23	21	25
Exeter	100.0	376	22.7	2.7	23	21	24
Glouc	100.0	188	23.5	2.5	24	22	25
Hull	100.0	299	23.4	2.5	24	22	25
Ipswi	98.2	110	22.7	2.9	23	21	24
Kent	99.5	374	21.1	2.6	21	20	23
L Barts	99.7	880	20.5	2.5	21	19	22
L Guys	66.7	394	22.9	2.9	23	21	25
L Kings	99.8	465	25.8	2.1	26	25	27
L Rfree	98.4	677	23.0	2.8	23	21	25
L St.G	98.8	252	27.8	3.1	28	26	30
L West	64.8	853	19.5	2.7	19	18	21
Leeds	99.4	467	21.7	3.0	22	20	24
Leic	99.3	822	24.5	3.4	24	22	26
Liv Ain	99.3	147	24.8	3.1	25	23	26
Liv Roy	99.7	333	24.5	3.4	24	22	27
M RI	93.6	455	23.9	3.1	24	22	26
Middlbr	99.1	319	27.1	3.4	27	25	29
Newc	100.0	257	26.3	3.0	27	25	28
Norwch	99.7	304	24.4	3.1	25	22	26
Nottm	94.4	334	25.4	3.0	25	24	27
Oxford	99.8	404	24.3	3.3	25	22	26
Plymth	98.3	118	24.8	1.9	25	23	26
Ports	98.0	534	23.7	3.3	24	22	26
Prestn	99.4	505	23.8	2.9	24	22	26
Redng	100.0	260	24.8	3.0	25	23	27
Salford	9.9	36					
Sheff	99.8	555	23.7	3.0	24	22	26
Shrew	100.0	176	23.4	3.2	24	22	26
Stevng	97.5	420	23.1	3.0	23	21	25
Sthend	100.0	110	24.9	3.9	25	23	27
Stoke	76.0	219	24.5	2.8	25	22	26
Sund	100.0	177	27.9	2.8	28	26	30
Truro	100.0	139	23.0	2.4	23	22	24
Wirral	93.4	185	23.9	2.7	24	22	26
Wolve	99.6	276	19.0	2.3	19	18	20
York	100.0	129	24.1	2.7	24	22	26

Table 8.17. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
N Ireland							
Antrim	98.3	118	23.8	2.8	24	22	26
Belfast	99.5	198	22.6	2.8	23	21	24
Newry	100.0	84	22.3	2.2	22	21	24
Ulster	100.0	103	24.3	2.4	24	23	26
West NI	100.0	107	23.2	2.6	23	22	25
Wales							
Bangor	100.0	84	26.1	3.2	26	24	28
Cardff	99.1	456	23.3	3.3	24	21	26
Clwyd	100.0	72	22.3	2.5	22	21	24
Swansea	99.7	310	23.0	3.4	23	20	25
Wrexms	100.0	96	22.6	2.3	23	21	24
England	92.1	17,189	23.4	3.4	23	21	26
N Ireland	99.5	610	23.2	2.7	23	22	25
Wales	99.5	1,018	23.3	3.3	23	21	26
E, W & NI	92.7	18,817	23.4	3.4	23	21	26

Blank cells: centres excluded from analyses due to poor data completeness

Table 8.18. Percentage of haemodialysis patients within, below and above the range for bicarbonate (18–24 mmol/L) by centre in 2013

Centre	N	% bicarb 18–24 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <18 mmol/L	% bicarb >24 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	275	81.5	76.4	85.6	8.7	9.8	3.3	–2.9	9.5
B QEH	873	58.2	54.9	61.4	0.8	41.0	–3.9	–8.5	0.8
Basldn	151	76.2	68.7	82.3	4.0	19.9	6.7	–3.4	16.9
Bradfd	186	57.0	49.8	63.9	0.5	42.5	6.2	–3.9	16.3
Brightn	354	65.5	60.4	70.3	4.2	30.2	1.4	–5.9	8.7
Bristol	485	63.9	59.5	68.1	2.5	33.6	–11.6	–17.4	–5.8
Camb	336	58.0	52.7	63.2	0.6	41.4	–7.1	–14.6	0.4
Carlis	58	77.6	65.1	86.5	6.9	15.5	14.4	–2.1	30.9
Carsh	653	42.4	38.7	46.3	2.3	55.3	–10.6	–16.0	–5.2
Chelms	109	83.5	75.3	89.3	0.9	15.6	–3.3	–12.5	5.9
Colchr	101	33.7	25.1	43.4	0.0	66.3	–8.3	–21.7	5.0
Covnt	316	64.6	59.1	69.6	3.2	32.3	11.4	3.9	18.9
Derby	202	73.3	66.7	78.9	3.5	23.3	–3.3	–11.7	5.1
Donc	146	38.4	30.8	46.5	0.0	61.6	–29.4	–40.1	–18.6
Dorset	241	77.6	71.9	82.4	2.1	20.3	3.5	–4.1	11.1
Dudley	154	69.5	61.8	76.2	2.6	27.9	10.3	–0.4	20.9
Exeter	376	77.7	73.2	81.6	3.5	18.9	–4.1	–9.9	1.8
Glouc	188	64.9	57.8	71.4	1.6	33.5	6.6	–3.1	16.4
Hull	299	64.9	59.3	70.1	2.0	33.1	–21.9	–28.5	–15.2
Ipswi	110	73.6	64.6	81.0	1.8	24.6	3.5	–8.0	15.0
Kent	374	82.4	78.2	85.9	8.3	9.4	0.5	–5.0	6.1

Table 8.18. Continued

Centre	N	% bicarb 18–24 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <18 mmol/L	% bicarb >24 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
L Barts	880	83.6	81.0	85.9	10.9	5.5	11.8	7.4	16.3
L Guys	394	71.3	66.7	75.6	2.5	26.1	−3.6	−9.7	2.5
L Kings	465	24.5	20.8	28.6	0.0	75.5	7.4	2.1	12.6
L Rfree	677	68.4	64.8	71.8	2.4	29.3	−1.5	−6.7	3.7
L St.G	252	16.3	12.2	21.4	0.4	83.3	−3.9	−10.5	2.8
L West	853	73.6	70.6	76.5	23.1	3.3	1.9	−2.3	6.1
Leeds	467	75.8	71.7	79.5	7.3	16.9	−0.4	−5.9	5.1
Leic	822	51.2	47.8	54.6	2.0	46.8	3.4	−1.4	8.3
Liv Ain	147	44.9	37.1	53.0	0.7	54.4	−11.9	−23.0	−0.8
Liv Roy	333	48.7	43.3	54.0	1.5	49.9	35.5	29.0	41.9
M RI	455	54.7	50.1	59.3	1.3	44.0	−0.3	−6.9	6.2
Middlbr	319	21.9	17.7	26.8	0.6	77.4	1.7	−4.6	8.1
Newc	257	21.0	16.5	26.4	0.8	78.2	−11.1	−18.6	−3.5
Norwch	304	47.4	41.8	53.0	1.0	51.6	−9.9	−17.8	−2.0
Nottm	334	35.9	31.0	41.2	0.6	63.5	−3.2	−10.5	4.2
Oxford	404	47.3	42.5	52.2	2.2	50.5	−14.3	−21.1	−7.4
Plymth	118	43.2	34.6	52.3	0.0	56.8	14.7	2.6	26.7
Ports	534	58.4	54.2	62.5	2.6	39.0	−12.5	−18.2	−6.7
Prestn	505	59.4	55.1	63.6	1.6	39.0	−1.4	−7.5	4.7
Redng	260	43.5	37.6	49.6	1.2	55.4	−6.3	−15.0	2.3
Sheff	555	58.2	54.1	62.2	2.3	39.5	11.8	5.9	17.6
Shrew	176	56.3	48.8	63.4	4.6	39.2	5.7	−4.6	16.0
Stevng	420	69.8	65.2	74.0	2.1	28.1	0.9	−5.5	7.4
Sthend	110	43.6	34.7	53.0	2.7	53.6	7.5	−5.4	20.5
Stoke	219	48.9	42.3	55.5	0.5	50.7			
Sund	177	10.7	7.0	16.2	0.0	89.3	−9.5	−16.9	−2.1
Truro	139	76.3	68.5	82.6	1.4	22.3	−6.4	−16.0	3.1
Wirral	185	60.0	52.8	66.8	1.1	38.9	12.1	1.7	22.5
Wolve	276	74.6	69.2	79.4	23.6	1.8	−3.1	−10.3	4.0
York	129	52.7	44.1	61.2	1.6	45.7	−9.3	−21.5	2.9
N Ireland									
Antrim	118	59.3	50.3	67.8	0.9	39.8	−4.6	−16.9	7.7
Belfast	198	75.8	69.3	81.2	3.5	20.7	12.8	3.9	21.7
Newry	84	84.5	75.2	90.8	1.2	14.3	11.6	−0.6	23.8
Ulster	103	59.2	49.5	68.3	1.0	39.8	−12.1	−25.0	0.9
West NI	107	69.2	59.8	77.2	1.9	29.0	15.7	3.4	27.9
Wales									
Bangor	84	32.1	23.1	42.8	0.0	67.9	−15.4	−30.1	−0.7
Cardff	456	57.7	53.1	62.1	2.6	39.7	−6.2	−12.6	0.2
Clwyd	72	73.6	62.3	82.5	4.2	22.2	−4.0	−17.9	9.8
Swanse	310	63.9	58.4	69.0	3.6	32.6	13.2	5.5	20.9
Wrexm	96	80.2	71.0	87.0	0.0	19.8	−9.5	−19.7	0.8
England	17,189	58.8	58.0	59.5	4.1	37.2	−0.1	−1.2	0.9
N Ireland	610	69.8	66.1	73.4	2.0	28.2	6.0	0.8	11.2
Wales	1,018	60.7	57.7	63.7	2.6	36.7	−1.0	−5.2	3.3
E, W & NI	18,817	59.2	58.5	59.9	3.9	36.8	0.0	−1.0	1.0

Blank cells: no data available for 2012

Table 8.19. Summary statistics for serum bicarbonate in peritoneal dialysis patients by centre in 2013

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	35	21.4	3.0	22	19	23
B QEH	94.6	122	23.7	3.1	24	22	26
Basldn	80.0	24	25.5	2.6	26	24	28
Bradfd	96.2	25	26.5	2.2	27	25	28
Brightn	10.0	66	24.2	3.0	24	22	27
Bristol	98.3	56	22.9	2.6	23	21	25
Camb	89.5	17					
Carlis	100.0	23	22.7	2.4	23	22	24
Carsh	77.1	81	23.1	3.0	23	21	25
Chelms	95.0	19					
Colchr*							
Covnt	86.1	62	25.2	2.7	25	23	27
Derby	97.4	76	24.7	2.7	25	23	27
Donc	100.0	30	26.8	3.2	27	25	28
Dorset	89.7	35	22.5	2.2	23	21	24
Dudley	97.9	46	24.6	4.0	24	22	27
Exeter	100.0	63	24.5	2.6	25	23	26
Glouc	100.0	31	24.5	3.0	25	22	27
Hull	100.0	72	25.3	3.2	26	23	28
Ipswi	100.0	24	27.1	2.9	28	25	29
Kent	100.0	57	22.9	2.5	23	21	25
L Barts	98.9	176	22.3	2.8	22	21	24
L Guys	85.7	24	23.0	3.5	23	20	27
L Kings	98.7	78	25.6	2.6	26	24	27
L Rfree	74.1	80	24.6	3.3	25	23	27
L St.G	100.0	45	28.4	2.9	29	27	30
L West	100.0	52	23.0	2.9	24	21	25
Leeds	100.0	62	26.3	3.0	26	25	27
Leic	93.3	126	26.2	3.6	26	24	29
Liv Ain	100.0	26	26.4	2.1	27	24	28
Liv Roy	100.0	51	24.7	2.5	25	23	26
M RI	98.6	68	25.8	4.0	26	24	28
Middlbr	100.0	11					
Newc	88.9	32	25.7	3.2	26	24	28
Norwch	97.1	34	24.3	2.3	24	23	26
Nottm	50.0	34	27.8	3.3	28	27	30
Oxford	80.7	67	25.2	3.1	25	23	27
Plymth	93.1	27	23.7	3.4	25	21	26
Ports	96.1	74	26.4	3.6	27	24	29
Prestn	100.0	52	26.2	3.4	27	24	29
Redng	100.0	64	26.8	3.3	26	24	29
Salford	9.3	7					
Sheff	100.0	61	24.7	3.3	25	23	27
Shrew	100.0	26	25.4	3.2	25	23	28
Stevng	89.2	33	26.4	3.1	27	25	28
Sthend	100.0	15					
Stoke	98.8	80	25.5	3.0	25	24	27
Sund	100.0	8					
Truro	94.4	17					
Wirral	74.1	20	25.8	3.4	26	24	28
Wolve	98.7	77	21.3	2.3	21	20	23
York	100.0	25	26.7	2.8	26	24	29

Table 8.19. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
N Ireland							
Antrim	73.3	11					
Belfast	100.0	26	23.8	3.2	24	21	26
Newry	100.0	17					
Ulster	100.0	4					
West NI	92.9	13					
Wales							
Bangor	100.0	12					
Cardff	100.0	66	25.4	3.1	26	23	27
Clwyd	100.0	14					
Swanse	100.0	53	24.7	2.6	25	23	27
Wrexm	100.0	19					
England	91.1	2,516	24.8	3.4	25	23	27
N Ireland	93.4	71	24.4	3.3	24	22	27
Wales	100.0	164	25.0	3.0	25	23	27
E, W & NI	91.6	2,751	24.8	3.4	25	23	27

Blank cells: low patient numbers or poor data completeness

*No PD patients

Table 8.20. Percentage of peritoneal dialysis patients within, below and above the range for bicarbonate (22–30 mmol/L) by centre in 2013

Centre	N	% bicarb 22–30 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <22 mmol/L	% bicarb >30 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
England									
B Heart	35	57.1	40.6	72.3	42.9	0.0	15.7	−6.6	38.0
B QEH	122	75.4	67.0	82.2	23.8	0.8	3.1	−7.6	13.9
Basldn	24	91.7	72.1	97.9	8.3	0.0	17.6	−2.3	37.5
Bradfd	25	96.0	76.5	99.4	0.0	4.0	−4.0	−11.7	3.7
Brightn	66	75.8	64.0	84.6	24.2	0.0	−4.2	−19.0	10.5
Bristol	56	73.2	60.2	83.2	26.8	0.0	10.7	−6.5	27.9
Carlis	23	78.3	57.2	90.7	21.7	0.0	21.1	−5.9	48.2
Carsh	81	66.7	55.8	76.0	33.3	0.0	−14.0	−27.2	−0.8
Covnt	62	91.9	82.1	96.6	6.5	1.6	5.5	−4.9	15.8
Derby	76	89.5	80.3	94.7	10.5	0.0	7.3	−3.4	18.0
Donc	30	83.3	65.7	92.9	6.7	10.0	5.1	−16.4	26.6
Dorset	35	68.6	51.7	81.7	31.4	0.0	−3.4	−26.8	19.9
Dudley	46	67.4	52.7	79.3	23.9	8.7	−17.2	−34.0	−0.5
Exeter	63	85.7	74.8	92.4	14.3	0.0	30.6	16.1	45.2
Glouc	31	87.1	70.3	95.1	9.7	3.2	0.4	−16.5	17.4
Hull	72	83.3	72.9	90.3	12.5	4.2	−7.3	−18.2	3.5
Ipswi	24	91.7	72.1	97.9	4.2	4.2	18.3	−1.0	37.6
Kent	57	66.7	53.6	77.6	33.3	0.0	−13.0	−29.2	3.3
L Barts	176	61.4	54.0	68.3	38.6	0.0	−17.8	−27.3	−8.3
L Guys	24	62.5	42.2	79.2	37.5	0.0	−14.4	−39.7	10.8
L Kings	78	91.0	82.4	95.7	5.1	3.9	9.5	−1.3	20.2
L Rfree	80	80.0	69.8	87.4	17.5	2.5	−3.1	−15.0	8.8
L St.G	45	77.8	63.4	87.6	0.0	22.2	−11.4	−26.5	3.8
L West	52	73.1	59.5	83.4	26.9	0.0	19.9	1.2	38.6
Leeds	62	90.3	80.1	95.6	3.2	6.5	8.5	−2.8	19.8
Leic	126	77.8	69.7	84.2	10.3	11.9	−1.2	−11.2	8.7
Liv Ain	26	96.2	77.2	99.5	0.0	3.9			
Liv Roy	51	94.1	83.3	98.1	5.9	0.0	11.1	−0.9	23.1

Table 8.20. Continued

Centre	N	% bicarb 22–30 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <22 mmol/L	% bicarb >30 mmol/L	Change in % within range from 2012	95% LCL change	95% UCL change
M RI	68	85.3	74.8	91.9	8.8	5.9	-1.4	-12.8	10.0
Newc	32	81.3	64.1	91.3	12.5	6.3	0.0	-19.1	19.1
Norwch	34	91.2	76.0	97.1	8.8	0.0	22.4	6.2	38.6
Nottm	34	79.4	62.7	89.9	5.9	14.7	4.4	-14.7	23.5
Oxford	67	88.1	77.9	93.9	9.0	3.0	1.8	-10.4	14.0
Plymth	27	66.7	47.3	81.7	33.3	0.0	-23.0	-43.9	-2.0
Ports	74	81.1	70.6	88.5	9.5	9.5	-12.4	-22.9	-1.9
Prestn	52	82.7	70.0	90.7	9.6	7.7	1.7	-12.7	16.1
Redng	64	78.1	66.4	86.6	3.1	18.8	-5.0	-18.6	8.7
Sheff	61	75.4	63.1	84.6	18.0	6.6	-4.9	-19.3	9.6
Shrew	26	84.6	65.5	94.1	11.5	3.9	3.4	-16.0	22.7
Stevng	33	81.8	65.0	91.6	12.1	6.1	-10.5	-27.2	6.2
Stoke	80	87.5	78.3	93.1	8.8	3.8	13.9	1.4	26.4
Wirral	20	75.0	52.2	89.2	15.0	10.0	-20.5	-41.3	0.4
Wolve	77	49.4	38.4	60.4	50.7	0.0	-37.8	-51.2	-24.4
York	25	92.0	73.1	98.0	0.0	8.0	-4.3	-17.1	8.5
N Ireland									
Belfast	26	73.1	53.3	86.6	26.9	0.0	-8.7	-32.2	14.7
Wales									
Cardff	66	81.8	70.7	89.4	13.6	4.6	7.6	-6.5	21.6
Swanse	53	90.6	79.3	96.0	9.4	0.0	7.2	-5.4	19.9
England	2,516	78.5	76.8	80.0	17.1	4.4	-0.7	-3.0	1.5
N Ireland	71	78.9	67.9	86.8	18.3	2.8	-7.7	-20.9	5.6
Wales	164	84.2	77.7	89.0	12.2	3.7	3.2	-5.0	11.4
E, W & NI	2,751	78.8	77.2	80.3	16.9	4.3	-0.6	-2.8	1.5

Blank cells: no data available for 2012

HD and PD groups (tables 8.18, 8.20, figures 8.20–8.23).

There was a notable deterioration in the achievement of bicarbonate within range compared with 2012 at a

number of centres (tables 8.18, 8.20). For these HD centres there was a uniform shift to higher bicarbonate concentrations (Doncaster, Hull, Oxford, Bangor) whereas for PD centres there was a downward shift in

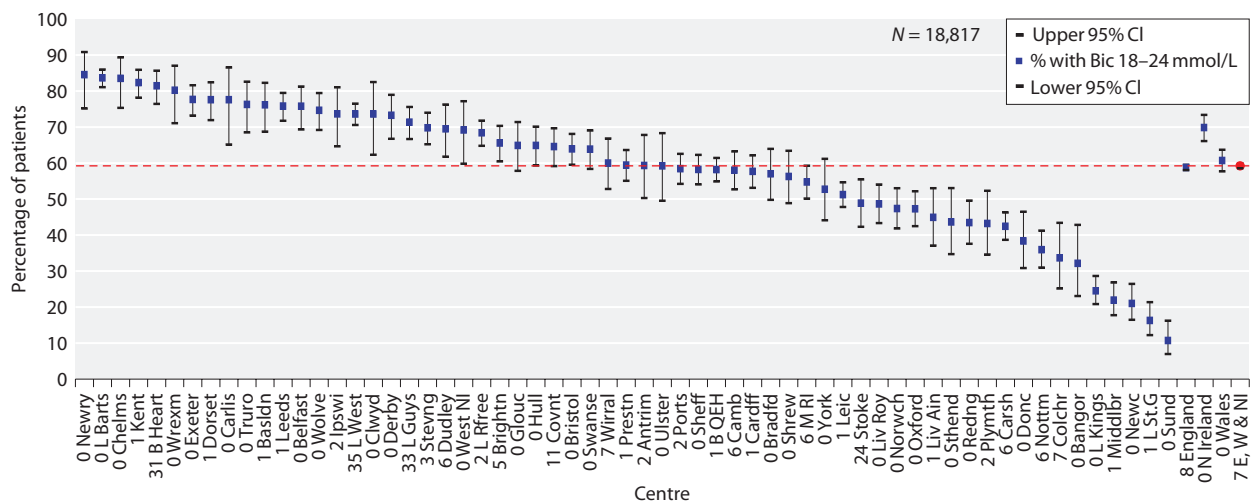


Fig. 8.20. Percentage of haemodialysis patients with serum bicarbonate within range (18–24 mmol/L) by centre in 2013

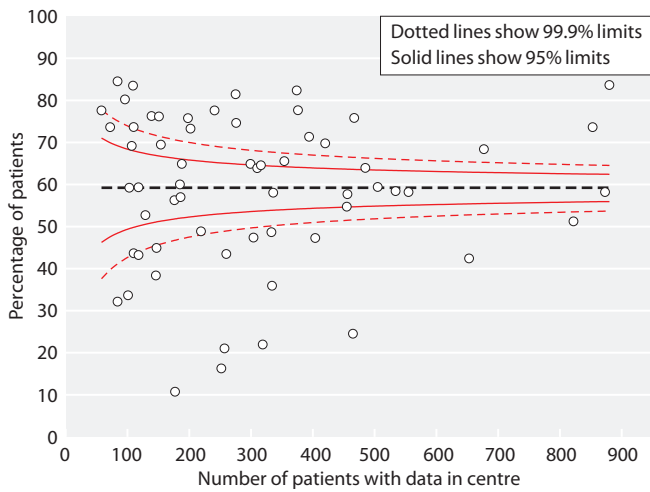


Fig. 8.21. Funnel plot for percentage of haemodialysis patients within the range for bicarbonate (18–24 mmol/L) by centre in 2013

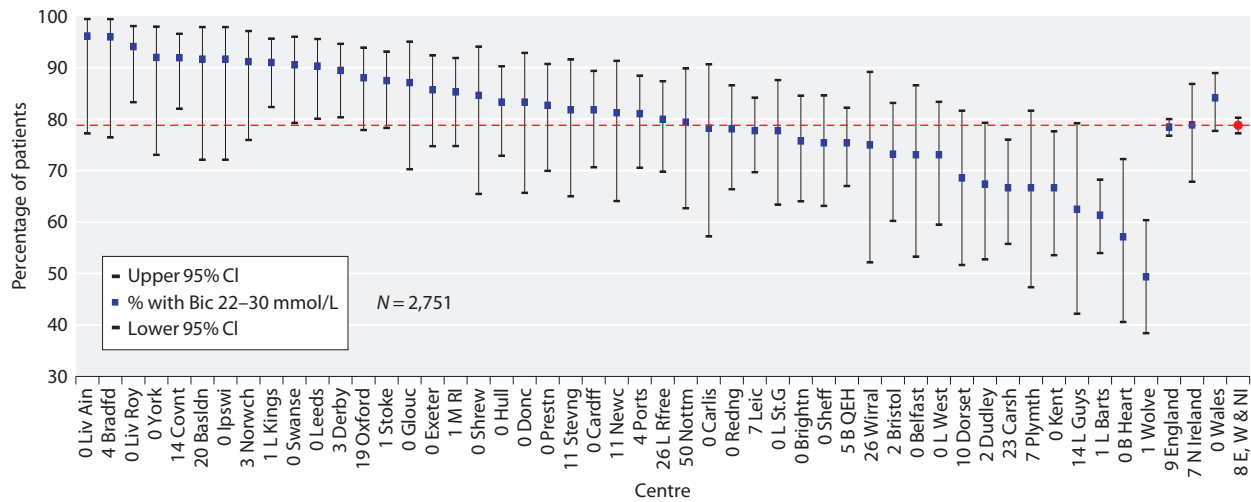


Fig. 8.22. Percentage of peritoneal dialysis patients with serum bicarbonate within range (22–30 mmol/L) by centre in 2013

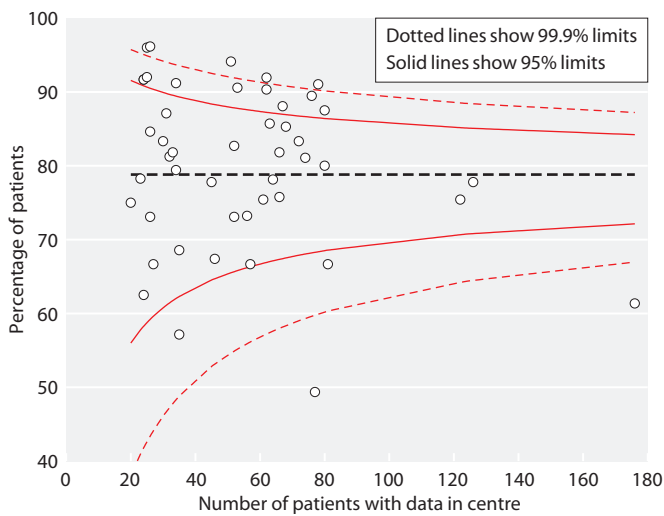


Fig. 8.23. Funnel plot for percentage of peritoneal dialysis patients within the range for bicarbonate (22–30 mmol/L) by centre in 2013

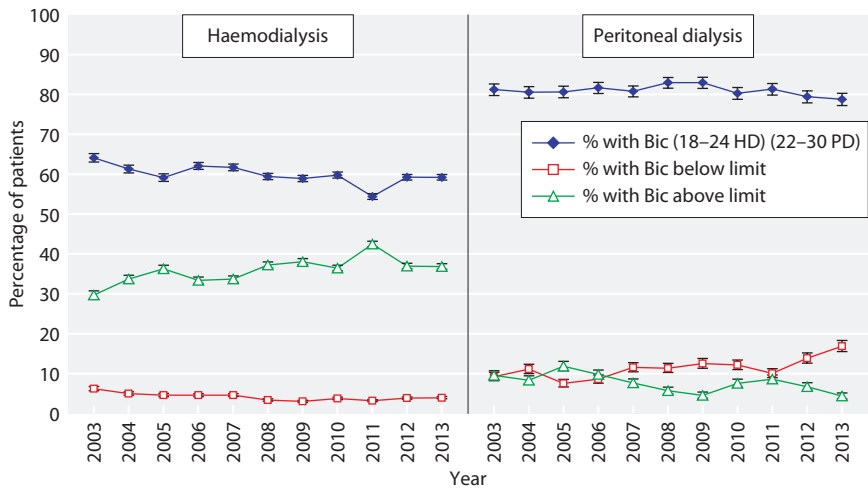


Fig. 8.24. Longitudinal change in percentage of patients within the range for bicarbonate (18–24 mmol/L for HD and 22–30 mmol/L for PD) by dialysis modality 2003–2013

bicarbonate concentrations (Carshalton, Dudley, Kent, London St Bartholemew’s, London Guy’s, Plymouth, Wirral, Wolverhampton).

Serial trends in serum bicarbonate measures between 2003 and 2013 by dialysis modality are presented in figure 8.24. Sample processing, case-mix, differences in dialysis, residual renal function and oral bicarbonate prescriptions may all contribute to the variation observed.

Conclusions

The UKRR has consistently demonstrated between centre variation in achievement of audit measures for bone and mineral parameters but little is understood about the causes of this ‘centre effect’. The complexity of the clinical processes required to manage mineral and bone disorders is probably further confounded by case-mix. In the future, with centres moving to newer IT systems, medications used in the management of bone and mineral diseases may become available to aid in better analyses of these parameters.

Additionally, it is important to consider data quality and the potential for measurement error particularly in light of the variability in assay methods, for example for parathyroid hormone. However, detecting these centre level differences is an important step in understanding the factors associated with variation in performance. Some specifics for consideration are highlighted below.

Bone Mineral Variables

Observational data support that hyperphosphataemia is associated with increased mortality in dialysis patients but the data linking calcium and parathyroid hormone to patient survival are less clear [9–13]. A cohort study has however suggested that simultaneous achievement of all three audit measures does appear to be associated with better patient outcomes [14].

Possible issues relating to calcium measures

The current RA guidelines are based upon measures of adjusted serum calcium [3]. A variety of formulae have been proposed to permit calculation of the ‘adjusted’ total calcium (i.e. an estimation of the expected total calcium were the serum albumin normal) from the total calcium and albumin concentration, but there are no data to support the use of mathematical corrections of serum calcium amongst patients with ERF. This topic was discussed in detail in the 2009 annual report and most of the shortcomings remain [15]. However, the ongoing restructuring of pathology into a smaller number of services together with harmonisation should increase measurement uniformity across laboratories and hence renal centres. UK laboratories are still in the process of adopting the guidelines to harmonise albumin-adjusted calcium reference ranges to 2.2–2.6 mmol/L using method-specific adjustment equations normalised to a mean calcium of 2.4 mmol/L. Until this process is complete, differences between laboratories in the reported adjusted calcium are likely to continue. Meanwhile, centres must work with their laboratories to ensure that

the calcium results are adjusted correctly for the methods in use. These problems must be borne in mind when trying to interpret the figures that compare serum adjusted calcium achieved in different renal centres.

Centres should also be aware that achievement of the audit standard can however mask population shifts in concentration. This can be illustrated by data from the Royal Free for HD patients: in 2011 30% had an adjusted calcium <2.2 mmol/L, 65% were within range, and 5% were >2.5 mmol/L; in 2012 4% had an adjusted calcium <2.2 mmol/L, 77% were within range and 19% were >2.5 mmol/L. A similar pattern was observed in PD patients. However, the figures for unadjusted calcium remained stable. This shift can be attributed to a change in the equation used to adjust calcium that was introduced on July 6th 2012 before the UKRR collection of data in the last two quarters. The new equation increased adjusted calcium values by approximately 0.2 mmol/L. It was subsequently recognised that the new equation was over-adjusting calcium results and a revised equation was introduced from October 2013 that conformed to current harmonisation guidelines. Accordingly for 2013, the Royal Free show a decline from 19% (2012) to 5% >2.5 mmol/L, an increase from 4% (2012) to 10% <2.2 mmol/L and an increase from 77% (2012) to 86% within range. Mean and median adjusted calcium fell from 2.4 mmol/L (2012) to 2.3 mmol/L in 2013. These shifts were mirrored in the PD population at the Royal Free. A similar change was observed in Newcastle's HD data following a change in the equation to conform with harmonisation guidelines in April 2013 that increased the adjusted calcium – compared with 2012, the 2013 data show a decrease in results <2.2 mmol/L (from 22% to 8%).

Centres showing significant shifts in any biochemical parameter should consider whether there have been any changes in laboratory methodology that may account for the apparent deterioration or whether it is truly treatment-related.

Possible issues relating to PTH measures

A significant contributor to centre variation will be the assay used to measure PTH. This has been demonstrated by a study undertaken by the Scottish Clinical Biochemistry Managed Diagnostic Network in association with the Scottish Renal Registry [16]. Analysis of samples from 106 haemodialysis patients by six different PTH immunoassays in common use showed a 1.2- to 2.7-fold variation in results in spite of similar reference ranges for each method. Since current guidelines refer to multiples of the upper reference limit, 53% of patients were classified differently by different methods with implications for treatment e.g. with Cinacalcet. In an accompanying editorial, Garrett and Goldsmith also highlighted the high biological variability of PTH and its poor ability to predict skeletal or patient outcomes [17]. Whether more accurate and specific assays would improve this or whether PTH will be supplanted by other markers such as bone specific alkaline phosphatase that also have greater pre-analytical stability remains to be determined.

Improvement of PTH assays to achieve consensus results within CKD patients requires manufacturers to consider two principal factors: adoption of a common reference preparation for standardisation, such as the WHO international standard 95/646, and selection of pairs of antibodies that do not detect PTH fragments such as 7–84 that accumulate in CKD. Meanwhile Almond et al and a further editorial review urge adoption of assay-specific action limits for PTH in CKD patients [16, 18]. However, this approach raises a number of difficult governance issues. There is already evidence that the manufacturers of the major diagnostic platforms used throughout the world have started to respond. The Roche assay used by Almond et al was PTH (intact) that was not standardised and cross-reacted with PTH 7–84 [16].

Conflicts of interest: none

References

- 1 Renal Association: Clinical Practice Guidelines. 5th Edition. <http://www.renal.org/Clinical/GuidelinesSection/Guidelines.aspx>
- 2 Ansell D, Tomson CRV: Chapter 15 UK Renal Registry Annual Report: UK Renal Registry, UKRR database, validation and methodology. *Nephron Clin Pract.* 2009;111(Suppl 1):c277–85
- 3 Steedon S, Sharpes E: Renal Association Clinical Practice Guideline. CKD-Mineral and Bone Disorders, 2010. <http://www.renal.org/guidelines/modules/ckd-mineral-and-bone-disorders>
- 4 Morton AR, Garland JS, Holden RM: Is the calcium correct? Measuring serum calcium in dialysis patients. *Semin Dial.* 2010;23(3): 283–289
- 5 Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Work Group: KDIGO clinical practice guideline for the diagnosis, evaluation, prevention, and treatment of chronic kidney disease–mineral and bone disorder (CKD-MBD). *Kidney International* 2009; 76(Suppl 113): S1–S130

- 6 Spiegelhalter DJ: Funnel plots for comparing institutional performance. *Statistics in Medicine* 2005;24:1185–1202
- 7 Mactier R, Hoenich N, Breen C: Renal Association Clinical Practice Guideline Haemodialysis, 2009. <http://www.renal.org/Clinical/Guidelines/Section/Haemodialysis.aspx>
- 8 Woodrow G, Davies S: Renal Association Clinical Practice Guideline Peritoneal Dialysis, 2010. <http://www.renal.org/Clinical/Guidelines/Section/PeritonealDialysis.aspx>
- 9 Kalantar-Zadeh K, Kuwae N, Regidor DL, Kovesdy CP, Kilpatrick RD, Shinaberger CS, McAllister CJ, Budoff MJ, Salusky IB, Kopple JD: Survival predictability of time-varying indicators of bone disease in maintenance hemodialysis patients. *Kidney Int* 2006;70:771–780
- 10 Melamed ML, Eustace JA, Plantinga L, Jaar BG, Fink NE, Coresh J, Klag MJ, Powe NR: Changes in serum calcium, phosphate, and pth and the risk of death in incident dialysis patients: A longitudinal study. *Kidney Int* 2006;70:351–357
- 11 Noordzij M, Korevaar JC, Boeschoten EW, Dekker FW, Bos WJ, Krediet RT: The kidney disease outcomes quality initiative (k/doqi) guideline for bone metabolism and disease in ckd: Association with mortality in dialysis patients. *Am J Kidney Dis* 2005;46:925–932
- 12 Stevens LA, Djurdjev O, Cardew S, Cameron EC, Levin A: Calcium, phosphate, and parathyroid hormone levels in combination and as a function of dialysis duration predict mortality: Evidence for the complexity of the association between mineral metabolism and outcomes. *J Am Soc Nephrol* 2004;15:770–779
- 13 Block GA, Klassen PS, Lazarus JM, Ofsthun N, Lowrie EG, Chertow GM: Mineral metabolism, mortality, and morbidity in maintenance hemodialysis. *J Am Soc Nephrol* 2004;15:2208–2218
- 14 Danese MD, Belozeroff V, Smirnakis K, Rothman KJ: Consistent control of mineral and bone disorder in incident hemodialysis patients. *Clin J Am Soc Nephrol* 2008;2:2
- 15 Ansell D, Tomson CRV: Twelfth Annual Report: Chapter 10 Biochemistry Profile of Patients Receiving Dialysis in the UK in 2008: national and centre-specific analyses. Bristol, UK Renal Registry, 2009
- 16 Almond A, Ellis AR, Walker SW: Current parathyroid hormone immunoassays do not adequately meet the needs of patients with chronic kidney disease. *Ann Clin Biochem* 2011;49:63–67
- 17 Garrett G, Goldsmith DJA: Parathyroid hormone measurements, guidelines statements and clinical treatments: a real world cautionary tale. *Ann Clin Biochem* 2011;49:4–6
- 18 Sturgeon CM, Sprague SM, Metcalfe W: Variation in parathyroid hormone immunoassay results – a critical governance issue in the management of chronic kidney disease. *Nephrol Dial Transplant* 2011;26:3440–3445