
UK Renal Registry 16th Annual Report: Chapter 12 Biochemical Variables amongst UK Adult Dialysis patients in 2012: National and Centre-specific Analyses

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Key Words

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

Summary

- 56% of HD patients and 61% of PD patients achieved the audit measure for phosphate.
- 32% of HD and 32% of PD patients had a serum phosphate above the audit standard range.
- 77% of HD and 78% of PD patients had adjusted calcium between 2.2–2.5 mmol/L.
- 58% of HD and 65% of PD patients had a serum PTH between 16–72 pmol/L.
- 16% of HD and 10% of PD patients had a serum PTH >72 pmol/L.
- Simultaneous control of all three parameters within current audit standards was achieved by 51% of HD and PD patients.
- 59% of HD and 80% 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) clinical performance measures [1]. This enables UK renal centres to compare their own performance against each other and to the UK average performance [2]. 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. To supplement these performance analyses, summary statistical data have been provided to enhance understanding of the population characteristics of each centre and longitudinal analyses demonstrate changes over time.

Methods

These analyses relate to biochemical variables in the prevalent dialysis cohort in England, Wales and Northern Ireland in 2012. Scotland is also included in analyses pertaining to phosphate control. The cohort studied were patients prevalent on dialysis treatment on 31st December 2012, excluding patients receiving dialysis for less than 90 days and those who had changed

modality or renal centre in the last 90 days. Haemodialysis (HD) and peritoneal dialysis (PD) cohorts were analysed separately. A full definition of this cohort including inclusion and exclusion criteria is included in appendix B www.renalreg.com.

The biochemical variables analysed were phosphate, calcium, parathyroid hormone, bicarbonate and cholesterol. The method of data collection and validation by the UKRR has been described elsewhere [3]. For each quarter of 2012 the UKRR extracted biochemical data electronically from clinical information systems in UK dialysis centres. The UKRR does not 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 a local reference range [1, 3]. The UKRR has used the RA guideline standard of adjusted calcium between 2.2–2.5 mmol/L as the audit measure for these analyses. 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 Renal Association clinical practice guidelines that were current during 2012 and KDIGO 2009 guidance [3, 5]. This equates to a PTH 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 [1]. A summary of the current Renal Association audit measures and conversion factors to SI units are given in table 12.1.

Quarterly values were extracted from the database for the last two quarters for calcium, phosphate and bicarbonate; the last three quarters for PTH and the entire year for cholesterol. 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 showing centre level performance. Data were also excluded from plots when there were less than 20 patients with data both at centre or country level. These data were analysed to calculate summary

Table 12.1. 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 × 9.5
Bicarbonate	HD Patients: 18–24 mmol/L PD Patients: 22–30 mmol/L	mg/dl = mmol/L × 6.1
Cholesterol	No audit measure	mg/dl = mmol/L × 38.6

descriptive statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile 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. Thus, the control of none, one, two or three parameters, as well as an analysis of combinations of calcium-PTH, calcium-phosphate and phosphate-PTH were collated, with an emphasis on evaluating the effective management and prevention of severe hyperparathyroidism (maintaining PTH ≤ 72 pmol/L). For the purpose of this analysis, the corrected calcium standard of 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.

The analyses presented in this chapter are descriptive. As data are provided unadjusted for confounding factors and due to concerns regarding measurement error in many of the biochemical parameters, hypothesis testing was not utilised.

Centres report several biochemical variables with different levels of accuracy, leading to problems in comparative evaluation. 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 up 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 analysis was used to identify ‘outlying centres’ [6]. The percentage achieving 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 2002 to 2012 and were recalculated for each previous year using the rounding procedure. All data were unadjusted for case-mix.

Results and discussions

Mineral and bone variables

Phosphate

In 2012 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 96% for HD patients and 98% for PD patients although there was considerable variation between centres (tables 12.2 and 12.4). The individual centre means and standard deviations are shown in tables 12.2 and 12.4. Fifty-six percent (95% CI 55–57%) of HD patients and 61% (95% CI 59–63%) of PD patients achieved a phosphate level within the target range specified by the RA clinical audit measure (tables 12.3, 12.5). The proportion of HD patients with hyperphosphataemia was 32% and the proportion with hypophosphataemia was 12% (table 12.3, figures 12.1, 12.2). The proportion of PD patients with hyperphosphataemia was 32% and the proportion with hypophosphataemia was 7% (table 12.5, figures 12.3, 12.4). Longitudinal analysis showed a trend towards improved phosphate control for England, Northern Ireland and Wales combined between 2002 and 2012 that has plateaued in recent years (figure 12.5).

There was significant between centre variation in the proportion of patients below, within and above the phosphate range specified by the clinical performance measure (figures 12.1–12.4). Of note, the percentage of PD patients achieving the target decreased substantially from 2011 for Birmingham Heartlands (from 66% to 43%) and for Cambridge (from 72% to 47%). The same fall was not seen for HD patients at these centres. If the phosphate analyses for both HD and PD patients were conducted in the same laboratories for each centre, it suggests that this was not due to any change in laboratory methods.

Adjusted calcium

In 2012, the following Renal Association clinical practice guideline regarding calcium management was applicable:

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]

The current guidelines are based upon adjusted serum calcium. A variety of formulae have been proposed to permit calculation of the ‘adjusted’ total calcium (i.e. an

Table 12.2. Summary statistics for phosphate in haemodialysis patients in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	401	1.7	0.6	1.6	1.3	2.0
B QEH	96.2	831	1.6	0.5	1.5	1.3	1.8
Basldn	97.3	146	1.4	0.4	1.4	1.2	1.7
Bradfd	98.4	186	1.4	0.6	1.3	1.0	1.7
Brightn	95.6	323	1.6	0.5	1.6	1.2	1.9
Bristol	100.0	461	1.6	0.5	1.5	1.3	1.9
Camb	95.7	310	1.5	0.4	1.5	1.2	1.8
Carlis	100.0	57	1.8	0.7	1.6	1.4	1.9
Carsh	93.4	652	1.6	0.5	1.5	1.3	1.9
Chelms	100.0	121	1.5	0.4	1.5	1.2	1.8
Colchr	92.6	100	1.6	0.4	1.6	1.3	1.8
Covnt	99.7	334	1.7	0.5	1.6	1.3	2.0
Derby	99.5	208	1.6	0.5	1.5	1.3	1.9
Donc	100.0	158	1.5	0.5	1.4	1.2	1.7
Dorset	99.6	243	1.6	0.5	1.5	1.2	1.9
Dudley	100.0	153	1.7	0.5	1.6	1.3	2.0
Exeter	100.0	351	1.5	0.5	1.5	1.2	1.8
Glouc	100.0	193	1.5	0.5	1.4	1.2	1.8
Hull	100.0	310	1.5	0.5	1.5	1.2	1.8
Ipswi	100.0	124	1.5	0.5	1.4	1.2	1.7
Kent	98.3	355	1.7	0.5	1.6	1.3	1.9
L Barts	99.8	844	1.6	0.5	1.6	1.3	1.9
L Guys	89.0	527	1.5	0.5	1.5	1.2	1.8
L Kings	99.8	459	1.5	0.4	1.4	1.2	1.7
L Rfree	84.4	564	1.5	0.5	1.5	1.2	1.8
L St.G	96.3	261	1.5	0.5	1.5	1.2	1.8
L West	98.6	1,323	1.5	0.5	1.5	1.2	1.8
Leeds	100.0	454	1.6	0.5	1.5	1.2	1.9
Leic	99.8	799	1.7	0.5	1.6	1.3	2.0
Liv Ain	98.2	163	1.5	0.5	1.4	1.1	1.8
Liv RI	99.4	343	1.5	0.5	1.4	1.1	1.8
M RI	92.2	437	1.6	0.5	1.5	1.2	1.9
Middlbr	99.4	310	1.6	0.5	1.5	1.3	1.9
Newc	100.0	262	1.6	0.5	1.5	1.3	1.9
Norwch	100.0	303	1.6	0.5	1.6	1.3	1.9
Nottm	99.7	354	1.5	0.5	1.5	1.2	1.8
Oxford	100.0	389	1.6	0.5	1.6	1.3	1.9
Plymth	100.0	119	1.5	0.5	1.4	1.2	1.8
Ports	99.8	509	1.7	0.5	1.6	1.4	2.0
Prestn	99.6	494	1.7	0.5	1.6	1.3	1.9
Redng	100.0	251	1.5	0.4	1.5	1.2	1.8
Salford	88.1	304	1.5	0.6	1.5	1.1	1.8
Sheff	99.8	561	1.6	0.5	1.6	1.3	1.8
Shrew	99.5	183	1.6	0.6	1.5	1.2	1.8
Stevng	99.2	377	1.7	0.5	1.6	1.3	1.9
Sthend	100.0	107	1.6	0.5	1.6	1.3	1.9
Stoke	86.1	253	1.5	0.5	1.4	1.2	1.8
Sund	0.0	0					
Truro	99.3	133	1.5	0.5	1.4	1.2	1.8
Wirral	97.7	173	1.5	0.5	1.5	1.2	1.8
Wolve	98.9	267	1.5	0.6	1.4	1.1	1.8
York	100.0	122	1.5	0.5	1.4	1.1	1.7
N Ireland							
Antrim	100.0	126	1.4	0.5	1.3	1.1	1.7
Belfast	99.0	206	1.5	0.5	1.5	1.2	1.8
Newry	100.0	85	1.7	0.5	1.6	1.3	2.0
Ulster	100.0	101	1.6	0.4	1.5	1.3	1.7
West NI	100.0	129	1.7	0.5	1.6	1.3	1.9

Table 12.2. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Scotland							
Abrdn	94.4	202	1.5	0.5	1.4	1.1	1.8
Airdrie	93.8	165	1.5	0.5	1.4	1.1	1.9
D & Gall	95.8	46	1.5	0.5	1.5	1.2	1.8
Dundee	98.8	169	1.6	0.5	1.6	1.4	1.9
Dunfn	95.0	133	1.7	0.5	1.7	1.4	2.0
Edinb	94.0	235	1.7	0.5	1.6	1.3	1.9
Glasgw	86.0	498	1.6	0.5	1.6	1.3	1.9
Inverns	74.0	54	1.8	0.6	1.8	1.4	2.1
Klmarnk	88.7	125	1.4	0.5	1.4	1.0	1.7
Wales							
Bangor	100.0	82	1.6	0.4	1.5	1.3	1.9
Cardff	99.3	445	1.6	0.5	1.5	1.2	1.8
Clwyd	100.0	76	1.6	0.6	1.5	1.3	1.9
Swanse	100.0	308	1.5	0.5	1.4	1.2	1.8
Wrexm	100.0	86	1.3	0.4	1.3	1.1	1.6
England	96.4	17,662	1.6	0.5	1.5	1.2	1.8
N Ireland	99.7	647	1.6	0.5	1.5	1.2	1.8
Scotland	90.8	1,627	1.6	0.5	1.5	1.2	1.9
Wales	99.7	997	1.5	0.5	1.5	1.2	1.8
UK	96.2	20,933	1.6	0.5	1.5	1.2	1.8

Blank cells denote no data returned

Table 12.3. 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 2012

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 2011	95% LCL change	95% UCL change
England									
B Heart	401	52.4	47.5	57.2	11.0	36.7	-3.7	-10.5	3.2
B QEH	831	58.1	54.7	61.4	11.0	30.9	-1.4	-6.1	3.4
Basldn	146	62.3	54.2	69.8	17.1	20.6	7.9	-3.7	19.4
Bradfd	186	50.5	43.4	57.7	25.8	23.7	1.4	-8.9	11.7
Brightn	323	55.1	49.6	60.5	9.9	35.0	0.9	-6.9	8.7
Bristol	461	53.8	49.2	58.3	10.0	36.2	-2.0	-8.5	4.4
Camb	310	65.2	59.7	70.3	9.7	25.2	0.3	-7.1	7.7
Carlis	57	52.6	39.8	65.1	8.8	38.6	-0.8	-19.1	17.4
Carsh	652	58.7	54.9	62.5	8.9	32.4	-3.2	-8.5	2.1
Chelms	121	65.3	56.4	73.2	8.3	26.5	7.9	-4.5	20.3
Colchr	100	71.0	61.4	79.0	4.0	25.0	9.0	-4.0	22.0
Covnt	334	56.6	51.2	61.8	6.0	37.4	-4.7	-12.2	2.8
Derby	208	55.8	49.0	62.4	9.6	34.6	-2.2	-12.0	7.6
Donc	158	64.6	56.8	71.6	12.7	22.8	2.5	-8.2	13.2
Dorset	243	54.7	48.4	60.9	14.0	31.3	-11.6	-20.5	-2.8
Dudley	153	52.9	45.0	60.7	7.2	39.9	1.5	-10.1	13.0
Exeter	351	58.1	52.9	63.2	12.5	29.3	-3.4	-10.8	4.0
Glouc	193	59.1	52.0	65.8	14.5	26.4	-9.8	-19.4	-0.1
Hull	310	60.0	54.4	65.3	13.6	26.5	-1.7	-9.4	6.0
Ipswi	124	59.7	50.8	67.9	16.1	24.2	6.0	-6.4	18.3
Kent	355	53.5	48.3	58.7	9.0	37.5	-3.1	-10.4	4.3
L Barts	844	51.4	48.1	54.8	12.0	36.6	0.6	-4.2	5.4
L Guys	527	59.0	54.8	63.1	14.0	26.9	4.0	-2.2	10.1
L Kings	459	64.1	59.6	68.3	13.5	22.4	2.4	-3.9	8.8
L Rfree	564	56.9	52.8	61.0	14.5	28.6	0.8	-5.0	6.6

Table 12.3. 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 2011	95% LCL change	95% UCL change
L St.G	261	55.2	49.1	61.1	18.8	26.1	2.8	−5.7	11.2
L West	1,323	57.9	55.2	60.5	15.0	27.1	3.4	−0.4	7.2
Leeds	454	51.1	46.5	55.7	15.6	33.3	−4.6	−11.0	1.9
Leic	799	52.4	49.0	55.9	8.5	39.1	−8.8	−13.7	−3.9
Liv Ain	163	56.4	48.7	63.9	18.4	25.2	−5.7	−16.5	5.2
Liv RI	343	53.6	48.4	58.9	19.0	27.4	−0.6	−8.0	6.7
M RI	437	51.0	46.4	55.7	15.1	33.9	−2.8	−9.6	4.0
Middlbr	310	55.5	49.9	60.9	11.3	33.2	−2.7	−10.7	5.3
Newc	262	56.5	50.4	62.4	10.3	33.2	2.3	−6.4	11.0
Norwch	303	59.4	53.8	64.8	6.6	34.0	−1.8	−9.7	6.0
Nottm	354	57.9	52.7	63.0	15.3	26.8	−5.6	−12.7	1.4
Oxford	389	54.5	49.5	59.4	10.0	35.5	2.1	−5.0	9.2
Plymth	119	60.5	51.5	68.9	14.3	25.2	0.3	−12.0	12.7
Ports	509	52.1	47.7	56.4	9.0	38.9	5.2	−1.1	11.4
Prestn	494	51.6	47.2	56.0	9.9	38.5	−2.9	−9.1	3.4
Redng	251	58.2	52.0	64.1	14.3	27.5	−5.7	−14.2	2.9
Salford	304	53.0	47.3	58.5	21.1	26.0	2.5	−5.6	10.5
Sheff	561	59.5	55.4	63.5	8.6	31.9	−0.8	−6.6	4.9
Shrew	183	54.1	46.8	61.2	16.4	29.5	1.5	−8.9	11.9
Stevng	377	56.5	51.4	61.4	6.9	36.6	4.8	−2.3	11.9
Sthend	107	46.7	37.5	56.2	13.1	40.2	5.5	−7.6	18.6
Stoke	253	57.7	51.5	63.7	13.0	29.3	−3.9	−12.2	4.3
Truro	133	57.1	48.6	65.3	16.5	26.3	−3.0	−14.7	8.7
Wirral	173	56.7	49.2	63.8	14.5	28.9	−1.4	−12.0	9.2
Wolve	267	54.3	48.3	60.2	18.7	27.0	2.9	−5.4	11.2
York	122	59.0	50.1	67.4	16.4	24.6	4.2	−8.4	16.8
N Ireland									
Antrim	126	57.1	48.4	65.5	22.2	20.6	4.7	−7.7	17.1
Belfast	206	51.5	44.7	58.2	17.0	31.6	−2.5	−12.1	7.2
Newry	85	50.6	40.1	61.0	10.6	38.8	−1.4	−15.9	13.0
Ulster	101	68.3	58.6	76.6	7.9	23.8	3.0	−10.0	15.9
West NI	129	53.5	44.9	61.9	7.8	38.8	−3.2	−15.2	8.8
Scotland									
Abrdn	202	56.9	50.0	63.6	17.3	25.7	2.5	−7.3	12.3
Airdrie	165	49.1	41.5	56.7	23.6	27.3	−4.7	−15.6	6.2
D & Gall	46	56.5	42.1	70.0	13.0	30.4	−1.0	−22.0	20.0
Dundee	169	52.1	44.6	59.5	10.7	37.3	−4.5	−15.1	6.1
Dunfn	133	56.4	47.9	64.6	2.3	41.4	−2.7	−14.5	9.1
Edinb	235	54.5	48.1	60.7	7.7	37.9	−2.9	−11.9	6.1
Glasgw	498	51.6	47.2	56.0	11.9	36.6	−4.8	−11.0	1.4
Inverns	54	38.9	26.9	52.4	9.3	51.9	−5.6	−22.9	11.8
Klmarnk	125	52.8	44.1	61.4	25.6	21.6	−4.2	−16.3	7.9
Wales									
Bangor	82	64.6	53.8	74.2	4.9	30.5	−0.1	−14.6	14.4
Cardff	445	58.7	54.0	63.1	10.6	30.8	3.2	−3.3	9.7
Clwyd	76	54.0	42.7	64.8	11.8	34.2	−2.0	−18.9	14.9
Swanse	308	62.3	56.8	67.6	10.7	27.0	−0.3	−7.9	7.2
Wrexm	86	59.3	48.7	69.1	23.3	17.4	17.8	3.0	32.7
England	17,662	56.2	55.5	56.9	12.4	31.4	−0.7	−1.7	0.3
N Ireland	647	55.5	51.6	59.3	13.9	30.6	−0.2	−5.6	5.2
Scotland	1,627	52.7	50.2	55.1	13.2	34.1	−3.2	−6.6	0.2
Wales	997	60.0	56.9	63.0	11.3	28.7	2.5	−1.8	6.8
UK	20,933	56.1	55.4	56.8	12.4	31.5	−0.7	−1.7	0.2

Table 12.4. Summary statistics for phosphate in peritoneal dialysis patients in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	42	1.7	0.4	1.75	1.5	2
B QEH	98.0	146	1.6	0.5	1.5	1.2	1.8
Basldn	96.4	27	1.5	0.4	1.4	1.2	1.8
Bradfd	95.8	23	1.7	0.4	1.7	1.4	2
Brightn	94.2	65	1.6	0.4	1.6	1.2	1.9
Bristol	100.0	56	1.8	0.5	1.7	1.5	2
Camb	100.0	32	1.5	0.4	1.45	1.05	1.8
Carlis	100.0	21	1.6	0.4	1.4	1.3	1.7
Carsh	97.9	95	1.6	0.4	1.5	1.3	1.8
Chelms	100.0	25	1.5	0.4	1.5	1.2	1.8
Colchr							
Covnt	91.7	77	1.4	0.3	1.4	1.2	1.6
Derby	100.0	84	1.5	0.4	1.4	1.2	1.7
Donc	100.0	23	1.7	0.4	1.6	1.3	1.9
Dorset	92.1	35	1.5	0.3	1.5	1.2	1.7
Dudley	100.0	53	1.8	0.4	1.8	1.5	2.2
Exeter	98.6	68	1.6	0.4	1.6	1.3	1.8
Glouc	96.8	30	1.6	0.4	1.6	1.3	1.8
Hull	96.2	76	1.7	0.4	1.6	1.4	1.9
Ipswi	100.0	30	1.6	0.4	1.55	1.3	1.8
Kent	98.2	54	1.7	0.5	1.6	1.4	1.9
L Barts	98.8	165	1.6	0.5	1.5	1.2	1.8
L Guys	96.3	26	1.5	0.4	1.5	1.3	1.7
L Kings	100.0	76	1.6	0.4	1.5	1.3	1.8
L Rfree	99.0	101	1.6	0.4	1.5	1.4	1.8
L St.G	97.9	47	1.5	0.3	1.5	1.3	1.7
L West	100.0	47	1.5	0.4	1.4	1.2	1.7
Leeds	100.0	77	1.7	0.4	1.7	1.4	1.9
Leic	97.9	140	1.6	0.4	1.6	1.3	1.8
Liv Ain	100.0	17					
Liv RI	98.2	54	1.5	0.4	1.45	1.2	1.7
M RI	100.0	76	1.7	0.4	1.65	1.4	1.9
Middlbr	87.5	7					
Newc	86.5	32	1.7	0.3	1.7	1.45	2
Norwch	100.0	48	1.5	0.4	1.5	1.3	1.75
Nottm	100.0	72	1.6	0.5	1.6	1.3	1.85
Oxford	100.0	69	1.7	0.5	1.6	1.3	1.9
Plymth	93.6	29	1.6	0.4	1.5	1.2	1.8
Ports	100.0	78	1.6	0.4	1.5	1.4	1.8
Prestn	98.3	58	1.7	0.4	1.7	1.4	2
Redng	100.0	63	1.5	0.4	1.5	1.3	1.7
Salford	93.3	84	1.6	0.5	1.6	1.3	1.9
Sheff	100.0	67	1.7	0.4	1.6	1.4	1.9
Shrew	97.0	32	1.8	0.5	1.6	1.45	1.95
Stevng	100.0	27	1.5	0.3	1.5	1.4	1.7
Sthend	100.0	14					
Stoke	100.0	69	1.6	0.5	1.7	1.3	1.9
Sund	100.0	17					
Truro	100.0	19					
Wirral	72.4	21	1.6	0.3	1.5	1.4	1.6
Wolve	97.6	81	1.6	0.5	1.5	1.3	1.9
York	100.0	27	1.7	0.4	1.6	1.4	2
N Ireland							
Antrim	100.0	10					
Belfast	100.0	25	1.5	0.4	1.6	1.2	1.8
Newry	100.0	14					
Ulster	100.0	6					
West NI	100.0	15					

Table 12.4. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Scotland							
Abrdn	100.0	20	1.7	0.3	1.75	1.4	1.9
Airdrie	100.0	10					
D & Gall	92.9	13					
Dundee	94.7	18					
Dunfn	95.0	19					
Edinb	100.0	35	1.7	0.5	1.7	1.2	2.1
Glasgw	100.0	40	1.7	0.4	1.7	1.4	1.9
Inverns	86.7	13					
Klmarnk	100.0	40	1.6	0.3	1.6	1.4	1.85
Wales							
Bangor	100.0	14					
Cardff	98.6	70	1.5	0.4	1.45	1.2	1.7
Clwyd	100.0	15					
Swanse	98.2	53	1.5	0.4	1.5	1.3	1.7
Wrexm	95.0	19					
England	97.8	2,802	1.6	0.4	1.6	1.3	1.8
N Ireland	100.0	70	1.6	0.4	1.6	1.2	1.8
Scotland	97.7	208	1.7	0.4	1.6	1.4	1.9
Wales	98.3	171	1.5	0.4	1.5	1.3	1.8
UK	97.9	3,251	1.6	0.4	1.6	1.3	1.8

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

Table 12.5. 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 2012

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 2011	95% LCL change	95% UCL change
England									
B Heart	42	42.9	28.9	58.0	7.1	50.0	–22.9	–44.2	–1.7
B QEH	146	67.8	59.8	74.9	6.9	25.3	4.1	–6.8	15.0
Basldn	27	59.3	40.3	75.8	11.1	29.6	0.9	–26.1	28.0
Bradfd	23	56.5	36.3	74.8	0.0	43.5	1.0	–26.6	28.6
Brightn	65	49.2	37.4	61.2	10.8	40.0	–16.4	–33.2	0.4
Bristol	56	53.6	40.6	66.1	1.8	44.6	–2.4	–20.6	15.8
Camb	32	46.9	30.6	63.9	25.0	28.1	–25.0	–48.3	–1.7
Carlis	21	76.2	54.0	89.7	0.0	23.8	n/a	n/a	n/a
Carsh	95	64.2	54.1	73.2	5.3	30.5	0.1	–13.7	13.8
Chelms	25	52.0	33.1	70.4	16.0	32.0	2.0	–26.6	30.6
Covnt	77	76.6	65.9	84.8	9.1	14.3	9.1	–5.0	23.2
Derby	84	63.1	52.3	72.7	16.7	20.2	–2.5	–16.6	11.5
Donc	23	56.5	36.3	74.8	8.7	34.8	–19.7	–46.9	7.6
Dorset	35	65.7	48.8	79.4	11.4	22.9	–9.3	–29.6	11.0
Dudley	53	43.4	30.8	56.9	1.9	54.7	–3.5	–22.9	15.8
Exeter	68	63.2	51.2	73.8	10.3	26.5	–5.6	–21.9	10.7
Glouc	30	63.3	45.1	78.4	6.7	30.0	7.1	–17.3	31.4
Hull	76	61.8	50.5	72.0	2.6	35.5	0.5	–15.0	16.0
Ipswi	30	63.3	45.1	78.4	6.7	30.0	3.3	–21.3	27.9
Kent	54	53.7	40.5	66.5	11.1	35.2	–16.8	–34.3	0.8
L Barts	165	58.2	50.5	65.5	11.5	30.3	–13.6	–24.1	–3.2
L Guys	26	73.1	53.3	86.6	7.7	19.2	23.1	–2.1	48.3
L Kings	76	63.2	51.8	73.2	9.2	27.6	–1.1	–16.7	14.5
L Rfree	101	62.4	52.6	71.3	7.9	29.7	–7.6	–21.4	6.2

Table 12.5. 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 2011	95% LCL change	95% UCL change
L St.G	47	74.5	60.2	84.9	2.1	23.4	11.7	−6.5	29.9
L West	47	70.2	55.8	81.5	8.5	21.3	4.6	−16.4	25.6
Leeds	77	58.4	47.2	68.9	3.9	37.7	−5.8	−20.9	9.4
Leic	140	63.6	55.3	71.1	7.9	28.6	3.4	−8.0	14.8
Liv RI	54	72.2	58.9	82.5	5.6	22.2	0.3	−16.4	17.0
M RI	76	52.6	41.5	63.5	6.6	40.8	−3.7	−19.8	12.4
Newc	32	56.3	39.0	72.1	0.0	43.8	−2.3	−25.2	20.6
Norwch	48	60.4	46.1	73.1	14.6	25.0	−12.5	−31.2	6.2
Nottm	72	52.8	41.3	64.0	9.7	37.5	0.1	−16.1	16.3
Oxford	69	55.1	43.3	66.3	5.8	39.1	3.9	−12.1	19.8
Plymth	29	62.1	43.6	77.6	6.9	31.0	1.0	−22.8	24.7
Ports	78	65.4	54.2	75.1	2.6	32.1	12.8	−2.5	28.1
Prestn	58	58.6	45.7	70.5	1.7	39.7	−4.3	−22.4	13.7
Redng	63	68.3	55.9	78.5	7.9	23.8	−1.2	−16.9	14.5
Salford	84	54.8	44.1	65.0	7.1	38.1	−0.6	−15.2	14.1
Sheff	67	58.2	46.2	69.4	3.0	38.8	−17.7	−34.1	−1.3
Shrew	32	62.5	44.9	77.3	0.0	37.5	−6.7	−31.1	17.7
Stevng	27	81.5	62.5	92.1	7.4	11.1	23.8	−0.2	47.8
Stoke	69	55.1	43.3	66.3	7.3	37.7	−14.5	−30.5	1.5
Wirral	21	76.2	54.0	89.7	4.8	19.1	20.2	−6.5	46.8
Wolve	81	59.3	48.3	69.4	7.4	33.3	−0.4	−16.7	15.8
York	27	55.6	36.9	72.8	3.7	40.7	−4.4	−32.9	24.1
N Ireland									
Belfast	25	48.0	29.6	66.9	16.0	36.0	−23.4	−49.2	2.3
Scotland									
Abrdn	20	50.0	29.4	70.6	0.0	50.0	−4.6	−34.8	25.7
Edinb	35	45.7	30.2	62.1	8.6	45.7	−2.9	−26.2	20.5
Glasgw	40	52.5	37.3	67.3	5.0	42.5	−2.7	−26.5	21.1
Klmarnk	40	65.0	49.2	78.1	5.0	30.0	0.5	−21.9	22.9
Wales									
Cardff	70	64.3	52.5	74.6	11.4	24.3	1.3	−13.7	16.2
Swanse	53	69.8	56.3	80.6	7.6	22.6	2.5	−15.6	20.5
England	2,802	60.9	59.0	62.6	7.5	31.7	−2.3	−4.8	0.3
N Ireland	70	62.9	51.0	73.3	5.7	31.4	−7.9	−23.7	7.9
Scotland	208	54.3	47.5	61.0	4.8	40.9	1.2	−8.9	11.2
Wales	171	66.7	59.3	73.3	8.2	25.2	0.9	−8.9	10.8
UK	3,251	60.8	59.1	62.5	7.3	31.9	−2.1	−4.5	0.3

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 considerable detail in the 2009 report and most of the shortcomings remain. 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 following figures that compare serum adjusted calcium achieved in different renal centres. These issues raise the question as to whether these comparisons between centres of achievement of the calcium guidelines are of value, and also raises questions about the guidelines themselves.

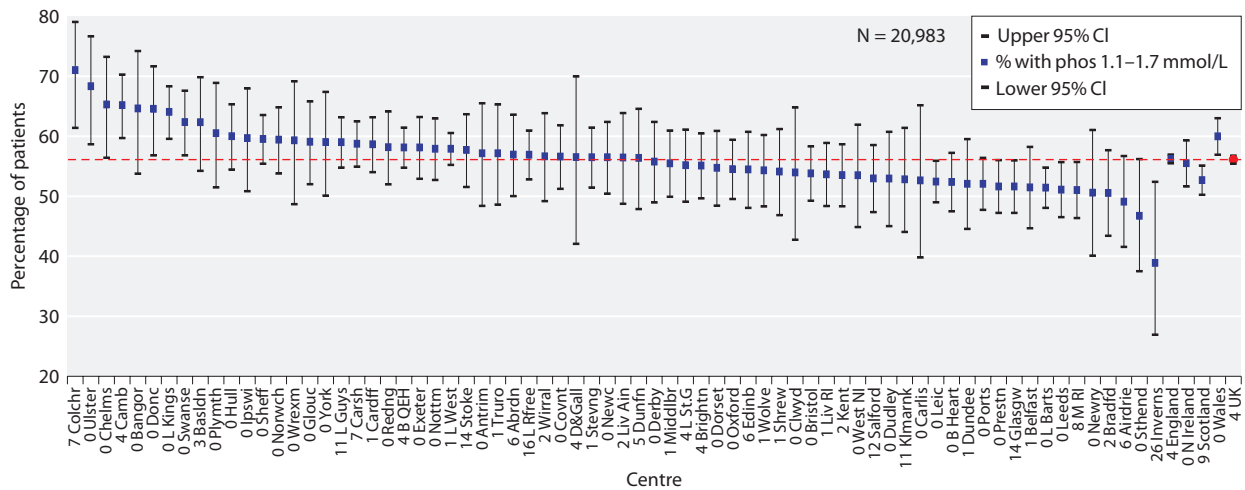


Fig. 12.1. Percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2012

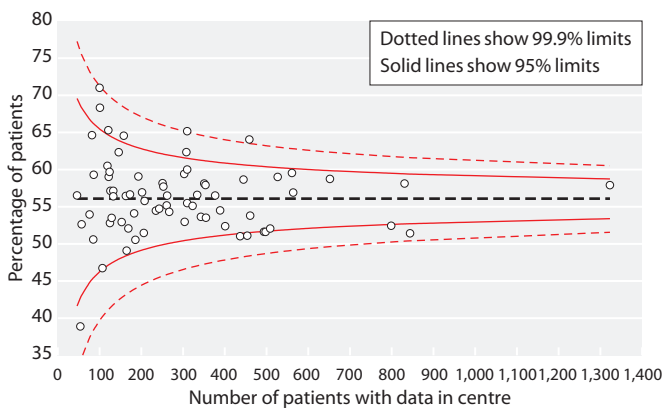


Fig. 12.2. Funnel plot of percentage of haemodialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2012

To try and better understand the variation in current laboratory assays utilised and practice in adjustment formulae applied it is proposed to undertake a short survey of all renal centres in 2013.

The audit measure for calcium in the current Renal Association clinical practice guidelines does not specify a lower limit for calcium and advises that adjusted calcium should ideally be within the normal range as per earlier guidance. Previously the UKRR used 2.2–2.5 mmol/L as the audit measure for adjusted calcium and in the absence of any change in guidance has maintained this range in this report to allow consistency. 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 12.6,

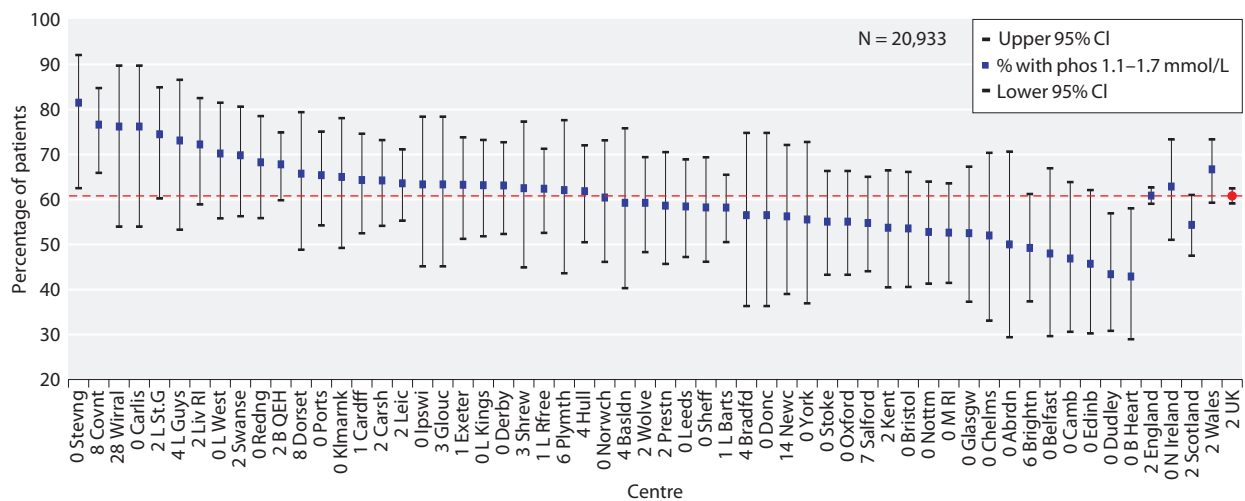


Fig. 12.3. Percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2012

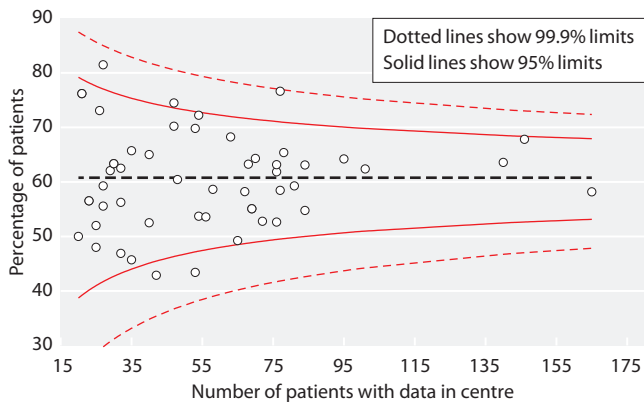


Fig. 12.4. Funnel plot of percentage of peritoneal dialysis patients with phosphate within the range specified by the RA clinical audit measure (1.1–1.7 mmol/L) by centre in 2012

12.8). Seventy-seven percent (95% CI 76–77%) of HD patients and 78% (95% CI 77–80%) of PD patients achieved adjusted calcium between 2.2–2.5 mmol/L (tables 12.7, 12.9), not significantly different from 2011. The proportion of HD patients with hypercalcaemia was 12% and the proportion with hypocalcaemia was 11%. For peritoneal dialysis patients the proportion of patients with hypercalcaemia was 16% and the proportion with hypocalcaemia was 6% (tables 12.7, 12.9, figures 12.6–12.9). The changes in the percentages above, below and within range for the period 2002 to 2012 for England, Northern Ireland and Wales combined

are shown in figure 12.10. The percentage of patients achieving the audit standard for calcium appears to have plateaued for both HD and PD patients in recent years. However, centres should be aware that achievement of the audit standard can 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 (date not shown). 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 has since been recognised that the new equation was over-adjusting calcium results and a revised equation has been introduced from 17th October 2013.

Similar to that seen in earlier 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 12.6–12.10). 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 3SD limit indicating over dispersion in the

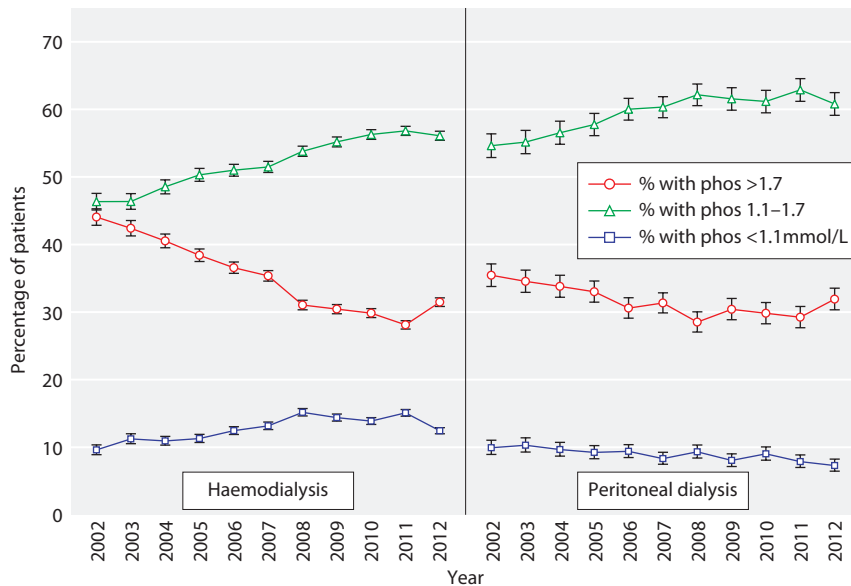


Fig. 12.5. Longitudinal change in percentage of patients with phosphate below, within and above the 2010 RA standard by dialysis modality 2000–2012

Table 12.6. Summary statistics for adjusted calcium in haemodialysis patients in 2012

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	2.4	2.6
B QEH	96.8	836	2.2	0.2	2.2	2.1	2.3
Basldn	98.0	147	2.4	0.2	2.4	2.3	2.5
Bradfd	98.4	186	2.4	0.2	2.4	2.3	2.5
Brightn	67.2	227	2.3	0.2	2.3	2.2	2.4
Bristol	100.0	461	2.4	0.2	2.4	2.3	2.5
Camb	95.1	308	2.3	0.1	2.3	2.2	2.4
Carlis	100.0	57	2.3	0.2	2.3	2.2	2.4
Carsh	93.3	651	2.4	0.2	2.3	2.2	2.5
Chelms	100.0	121	2.3	0.1	2.3	2.2	2.4
Colchr	92.6	100	2.4	0.1	2.4	2.3	2.5
Covnt	100.0	335	2.3	0.2	2.3	2.2	2.4
Derby	99.5	208	2.5	0.2	2.4	2.4	2.5
Donc	100.0	158	2.4	0.1	2.3	2.3	2.5
Dorset	99.6	243	2.4	0.2	2.3	2.2	2.4
Dudley	100.0	153	2.3	0.2	2.3	2.2	2.4
Exeter	100.0	351	2.3	0.2	2.3	2.2	2.4
Glouc	100.0	193	2.4	0.1	2.4	2.3	2.5
Hull	100.0	310	2.3	0.2	2.4	2.2	2.4
Ipswi	100.0	124	2.4	0.2	2.4	2.3	2.5
Kent	98.9	357	2.4	0.2	2.4	2.3	2.5
L Barts	99.8	844	2.3	0.2	2.3	2.1	2.4
L Guys	89.0	527	2.3	0.2	2.3	2.2	2.4
L Kings	99.8	459	2.3	0.1	2.3	2.2	2.4
L Rfree ^a	84.4	564	2.4	0.2	2.4	2.3	2.5
L St.G	96.7	262	2.3	0.2	2.3	2.2	2.4
L West ^b	91.6	1,229	2.4	0.2	2.4	2.3	2.5
Leeds	100.0	454	2.4	0.2	2.4	2.3	2.5
Leic	99.8	799	2.4	0.2	2.4	2.3	2.5
Liv Ain	98.2	163	2.4	0.2	2.3	2.3	2.5
Liv RI	99.4	343	2.4	0.2	2.3	2.3	2.5
M RI	92.2	437	2.4	0.2	2.4	2.3	2.5
Middlbr	99.4	310	2.3	0.2	2.3	2.2	2.4
Newc	100.0	262	2.3	0.2	2.3	2.2	2.4
Norwch	100.0	303	2.4	0.2	2.4	2.3	2.6
Nottm	99.7	354	2.4	0.2	2.4	2.3	2.5
Oxford	100.0	389	2.4	0.2	2.4	2.3	2.5
Plymth	100.0	119	2.4	0.2	2.4	2.3	2.5
Ports	99.8	509	2.4	0.2	2.4	2.3	2.5
Prestn	99.6	494	2.3	0.2	2.3	2.2	2.4
Redng	100.0	251	2.3	0.2	2.3	2.2	2.4
Salford	88.4	305	2.4	0.2	2.4	2.3	2.5
Sheff	99.8	561	2.3	0.2	2.3	2.2	2.4
Shrew	100.0	184	2.3	0.2	2.3	2.2	2.4
Stevng	99.0	376	2.4	0.2	2.4	2.3	2.5
Sthend	100.0	107	2.4	0.2	2.4	2.3	2.5
Stoke	85.0	250	2.4	0.2	2.4	2.3	2.5
Sund	99.5	183	2.4	0.2	2.4	2.2	2.5
Truro	99.3	133	2.4	0.2	2.3	2.2	2.4
Wirral	97.7	173	2.4	0.2	2.4	2.3	2.5
Wolve	99.6	269	2.4	0.2	2.4	2.3	2.5
York	100.0	122	2.4	0.1	2.4	2.3	2.5
N Ireland							
Antrim	99.2	125	2.4	0.1	2.4	2.3	2.5
Belfast	99.0	206	2.3	0.2	2.3	2.2	2.4
Newry	100.0	85	2.4	0.2	2.4	2.3	2.4
Ulster	100.0	101	2.4	0.2	2.4	2.3	2.5
West NI	100.0	129	2.3	0.2	2.3	2.2	2.4

Table 12.6. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Wales							
Bangor	100.0	82	2.4	0.2	2.4	2.3	2.5
Cardiff ^b	99.3	445	2.4	0.2	2.4	2.3	2.5
Clwyd	100.0	76	2.3	0.2	2.3	2.2	2.4
Swanse	100.0	308	2.3	0.2	2.3	2.2	2.4
Wrexm	100.0	86	2.4	0.1	2.4	2.3	2.5
England	96.4	17,662	2.4	0.2	2.4	2.2	2.5
N Ireland	99.5	646	2.4	0.2	2.4	2.3	2.4
Wales	99.7	997	2.3	0.2	2.3	2.2	2.5
E, W & NI	96.7	19,305	2.4	0.2	2.4	2.2	2.5

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

^aLondon Royal Free and Birmingham Heartlands had changes in their calcium assay/albumin adjustment calculations in 2012

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

Table 12.7. Percentage of haemodialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2012

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 2011	95% LCL change	95% UCL change
England									
B Heart	401	57.9	53.0	62.6	4.0	38.2	−15.8	−22.2	−9.4
B QEH	836	70.7	67.5	73.7	26.8	2.5	−2.3	−6.6	2.1
Basldn	147	82.3	75.3	87.7	6.1	11.6	3.2	−6.0	12.5
Bradfd	186	73.1	66.3	79.0	3.8	23.1	−4.3	−13.1	4.6
Brightn	227	78.4	72.6	83.3	15.4	6.2	3.9	−4.1	11.8
Bristol	461	76.6	72.5	80.2	4.8	18.7	1.9	−3.7	7.5
Camb	308	87.3	83.1	90.6	6.5	6.2	6.7	1.0	12.4
Carlis	57	79.0	66.5	87.6	15.8	5.3	−2.1	−16.7	12.5
Carsh	651	81.6	78.4	84.4	9.4	9.1	2.6	−1.7	7.0
Chelms	121	84.3	76.7	89.8	9.9	5.8	−4.4	−13.1	4.3
Colchr	100	87.0	78.9	92.3	0.0	13.0	11.0	0.3	21.7
Covnt	335	77.6	72.8	81.8	10.8	11.6	9.0	2.3	15.7
Derby	208	77.4	71.2	82.6	2.4	20.2	1.3	−7.0	9.7
Donc	158	86.7	80.5	91.2	5.1	8.2	−0.2	−7.7	7.3
Dorset	243	84.8	79.7	88.8	7.4	7.8	4.1	−2.8	10.9
Dudley	153	78.4	71.2	84.2	12.4	9.2	6.8	−3.2	16.8
Exeter	351	76.1	71.3	80.2	14.0	10.0	−6.1	−12.1	0.0
Glouc	193	86.5	81.0	90.7	5.2	8.3	0.7	−6.2	7.7
Hull	310	76.8	71.8	81.1	13.6	9.7	−4.4	−10.9	2.0
Ipswi	124	79.8	71.9	86.0	7.3	12.9	3.0	−7.3	13.3
Kent	357	70.3	65.4	74.8	5.3	24.4	−4.0	−10.6	2.6
L Barts	844	66.7	63.5	69.8	26.0	7.4	−2.1	−6.6	2.4
L Guys	527	73.8	69.9	77.4	14.8	11.4	2.5	−3.0	8.0
L Kings	459	81.9	78.1	85.2	14.8	3.3	−3.4	−8.3	1.5
L Rfree	564	77.0	73.3	80.2	3.9	19.2	11.7	6.4	16.9
L St.G	262	80.5	75.3	84.9	11.1	8.4	−2.4	−8.9	4.2
L West*	1,229	71.4	68.8	73.8	9.1	19.5	−3.9	−7.4	−0.4
Leeds	454	79.5	75.6	83.0	5.7	14.8	2.8	−2.6	8.1
Leic	799	79.0	76.0	81.7	9.1	11.9	−2.0	−6.0	1.9
Liv Ain	163	79.8	72.9	85.2	6.8	13.5	−2.3	−11.0	6.5
Liv RI	343	80.8	76.2	84.6	7.6	11.7	5.8	−0.3	11.9
M RI	437	74.8	70.6	78.7	5.5	19.7	0.0	−6.0	5.9
Middlbr	310	76.1	71.1	80.6	17.7	6.1	4.7	−2.4	11.8

Table 12.7. 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 2011	95% LCL change	95% UCL change
Nottm	354	83.1	78.8	86.6	3.1	13.8	2.1	−3.5	7.6
Oxford	389	78.9	74.6	82.7	8.2	12.9	−1.6	−7.3	4.1
Plymth	119	87.4	80.1	92.3	4.2	8.4	12.6	2.9	22.3
Ports	509	80.0	76.3	83.2	5.5	14.5	−0.2	−5.2	4.8
Prestn	494	75.1	71.1	78.7	18.6	6.3	−2.7	−8.0	2.7
Redng	251	80.5	75.1	84.9	15.5	4.0	−2.5	−9.2	4.3
Salford	305	71.5	66.2	76.3	6.2	22.3	−3.8	−10.8	3.3
Sheff	561	77.7	74.1	81.0	13.6	8.7	1.1	−3.8	6.0
Shrew	184	71.7	64.8	77.8	22.8	5.4	−1.3	−10.5	8.0
Stevng	376	80.1	75.7	83.8	5.1	14.9	1.0	−4.8	6.7
Sthend	107	76.6	67.7	83.7	9.4	14.0	3.0	−8.4	14.3
Stoke	250	78.0	72.4	82.7	8.4	13.6	−0.1	−7.1	7.0
Sund	183	77.1	70.4	82.6	10.4	12.6	4.6	−4.7	13.8
Truro	133	73.7	65.6	80.5	12.8	13.5	−4.6	−14.7	5.6
Wirral	173	81.5	75.0	86.6	12.1	6.4	−1.2	−9.4	7.0
Wolve	269	76.6	71.2	81.3	7.4	16.0	−0.9	−7.9	6.1
York	122	91.0	84.5	94.9	2.5	6.6	7.5	−1.5	16.4
N Ireland									
Antrim	125	84.0	76.5	89.4	1.6	14.4	2.0	−7.3	11.4
Belfast	206	82.0	76.2	86.7	13.1	4.9	−0.3	−7.7	7.1
Newry	85	84.7	75.4	90.9	9.4	5.9	6.7	−4.4	17.9
Ulster	101	81.2	72.4	87.7	6.9	11.9	3.0	−8.1	14.1
West NI	129	83.7	76.3	89.1	7.8	8.5	1.6	−7.5	10.7
Wales									
Bangor	82	82.9	73.2	89.6	1.2	15.9	−7.7	−17.9	2.6
Cardff*	445	73.3	69.0	77.2	11.0	15.7	−5.4	−11.0	0.2
Clwyd	76	73.7	62.7	82.4	21.1	5.3	7.6	−8.0	23.2
Swanse	308	75.3	70.2	79.8	18.2	6.5	0.4	−6.3	7.1
Wrexm	86	88.4	79.7	93.6	5.8	5.8	10.6	−0.7	21.9
England	17,662	76.5	75.9	77.2	10.9	12.6	0.0	−0.9	0.9
N Ireland	646	83.0	79.9	85.7	8.4	8.7	2.0	−2.1	6.2
Wales	997	76.0	73.3	78.6	12.7	11.2	−1.6	−5.3	2.1
E, W & NI	19,305	76.7	76.1	77.3	10.9	12.4	0.0	−0.8	0.9

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

Table 12.8. Summary statistics for adjusted calcium in peritoneal dialysis patients in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	100.0	42	2.5	0.2	2.4	2.3	2.6
B QEH	98.7	147	2.3	0.1	2.3	2.2	2.4
Basldn	96.4	27	2.4	0.2	2.5	2.3	2.6
Bradfd	100.0	24	2.4	0.2	2.4	2.3	2.4
Brightn	94.2	65	2.4	0.8	2.3	2.2	2.4
Bristol	100.0	56	2.5	0.1	2.4	2.4	2.5
Camb	100.0	32	2.4	0.1	2.3	2.3	2.4
Carlis	100.0	21	2.3	0.1	2.3	2.2	2.3
Carsh	97.9	95	2.4	0.2	2.3	2.3	2.5
Chelms	100.0	25	2.4	0.1	2.4	2.3	2.5
Colchr ^a							
Covnt	95.2	80	2.3	0.2	2.3	2.2	2.4
Derby	100.0	84	2.5	0.2	2.5	2.4	2.6
Donc	100.0	23	2.4	0.2	2.4	2.2	2.5

Table 12.8. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Dorset	73.7	28	2.4	0.1	2.4	2.3	2.5
Dudley	100.0	53	2.4	0.2	2.4	2.3	2.5
Exeter	98.6	68	2.3	0.1	2.3	2.2	2.4
Glouc	96.8	30	2.4	0.2	2.4	2.3	2.4
Hull	96.2	76	2.5	0.1	2.4	2.4	2.5
Ipswi	100.0	30	2.4	0.1	2.4	2.3	2.5
Kent	98.2	54	2.5	0.2	2.5	2.4	2.6
L Barts	98.8	165	2.3	0.2	2.3	2.2	2.4
L Guys	96.3	26	2.4	0.1	2.35	2.3	2.5
L Kings	100.0	76	2.3	0.1	2.2	2.2	2.3
L Rfree	99.0	101	2.5	0.2	2.4	2.3	2.5
L St.G	97.9	47	2.4	0.1	2.4	2.4	2.5
L West ^b	100.0	47	2.5	0.1	2.5	2.4	2.6
Leeds	100.0	77	2.4	0.2	2.4	2.3	2.5
Leic	97.9	140	2.4	0.2	2.4	2.3	2.5
Liv Ain	100.0	17					
Liv RI	98.2	54	2.4	0.2	2.3	2.2	2.4
M RI	100.0	76	2.5	0.2	2.5	2.35	2.6
Middlbr	87.5	7					
Newc	86.5	32	2.3	0.1	2.3	2.3	2.4
Norwch	100.0	48	2.5	0.1	2.5	2.4	2.6
Nottm	100.0	72	2.4	0.2	2.4	2.3	2.5
Oxford	100.0	69	2.4	0.2	2.4	2.3	2.5
Plymth	96.8	30	2.4	0.1	2.4	2.4	2.5
Ports	100.0	78	2.4	0.2	2.4	2.3	2.5
Prestn	98.3	58	2.4	0.2	2.4	2.3	2.5
Redng	100.0	63	2.3	0.1	2.3	2.3	2.4
Salford	93.3	84	2.5	0.2	2.45	2.4	2.6
Sheff	100.0	67	2.4	0.1	2.3	2.3	2.4
Shrew	97.0	32	2.3	0.2	2.3	2.2	2.4
Stevng	100.0	27	2.4	0.2	2.4	2.3	2.5
Sthend	100.0	14					
Stoke	87.0	60	2.4	0.2	2.5	2.3	2.5
Sund	100.0	17					
Truro	100.0	19					
Wirral	72.4	21	2.4	0.2	2.3	2.3	2.4
Wolve	98.8	82	2.4	0.2	2.4	2.3	2.5
York	100.0	27	2.4	0.1	2.4	2.4	2.5
N Ireland							
Antrim	100.0	10					
Belfast	100.0	25	2.3	0.2	2.3	2.2	2.4
Newry	100.0	14					
Ulster	100.0	6					
West NI	100.0	15					
Wales							
Bangor	100.0	14					
Cardff ^b	98.6	70	2.4	0.2	2.4	2.3	2.5
Clwyd	100.0	15					
Swanse	98.2	53	2.3	0.2	2.3	2.2	2.4
Wrexm	95.0	19					
England	97.5	2,793	2.4	0.2	2.4	2.3	2.5
N Ireland	100.0	70	2.4	0.2	2.4	2.3	2.5
Wales	98.3	171	2.4	0.2	2.4	2.3	2.5
E, W & NI	97.6	3,034	2.4	0.2	2.4	2.3	2.5

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

^aNo PD patients

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

Table 12.9. Percentage of peritoneal dialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2012

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 2011	95% LCL change	95% UCL change
England									
B Heart	42	71.4	56.1	83.0	0.0	28.6	-7.5	-26.4	11.3
B QEH	147	79.6	72.3	85.4	15.0	5.4	1.5	-7.8	10.9
Basldn	27	66.7	47.3	81.7	3.7	29.6	0.0	-25.9	25.9
Bradfd	24	79.2	58.7	91.1	8.3	12.5	8.8	-14.9	32.5
Brightn	65	81.5	70.2	89.2	6.2	12.3	-4.4	-17.1	8.3
Bristol	56	76.8	64.0	86.0	1.8	21.4	12.4	-4.1	28.9
Camb	32	90.6	74.7	96.9	0.0	9.4	9.4	-7.5	26.3
Carlis	21	81.0	58.9	92.7	19.1	0.0	n/a	n/a	n/a
Carsh	95	80.0	70.8	86.9	10.5	9.5	-7.0	-17.5	3.6
Chelms	25	88.0	68.7	96.1	4.0	8.0	-7.5	-22.9	8.0
Covnt	80	81.3	71.2	88.4	10.0	8.8	7.2	-5.8	20.2
Derby	84	65.5	54.7	74.8	1.2	33.3	-13.7	-26.7	-0.7
Donc	23	82.6	61.8	93.3	4.4	13.0	-3.1	-24.6	18.4
Dorset	28	89.3	71.6	96.5	0.0	10.7	23.4	5.3	41.5
Dudley	53	81.1	68.4	89.5	1.9	17.0	-4.6	-19.0	9.8
Exeter	68	82.4	71.4	89.7	14.7	2.9	5.3	-8.6	19.2
Glouc	30	86.7	69.4	94.9	6.7	6.7	5.4	-12.8	23.6
Hull	76	76.3	65.5	84.5	0.0	23.7	1.6	-12.1	15.4
Ipswi	30	76.7	58.5	88.5	6.7	16.7	-3.3	-24.2	17.5
Kent	54	55.6	42.2	68.1	1.9	42.6	-13.3	-30.9	4.3
L Barts	165	75.8	68.6	81.7	14.6	9.7	1.9	-7.7	11.6
L Guys	26	88.5	69.7	96.2	7.7	3.9	13.5	-6.7	33.7
L Kings	76	76.3	65.5	84.5	21.1	2.6	-9.4	-22.0	3.2
L Rfree	101	73.3	63.8	81.0	2.0	24.8	-3.0	-15.7	9.7
L St.G	47	87.2	74.4	94.2	0.0	12.8	8.8	-6.0	23.6
L West*	47	63.8	49.3	76.2	0.0	36.2	-1.8	-23.2	19.6
Leeds	77	85.7	76.0	91.9	2.6	11.7	5.5	-6.2	17.1
Leic	140	77.9	70.2	84.0	5.0	17.1	-5.5	-14.7	3.8
Liv RI	54	79.6	66.8	88.4	7.4	13.0	0.7	-14.4	15.8
M RI	76	65.8	54.5	75.5	2.6	31.6	-4.6	-19.7	10.4
Newc	32	84.4	67.5	93.3	9.4	6.3	8.8	-9.4	27.0
Norwch	48	64.6	50.2	76.7	0.0	35.4	-16.3	-33.9	1.3
Nottm	72	81.9	71.3	89.2	2.8	15.3	13.0	-0.8	26.8
Oxford	69	78.3	67.0	86.5	4.4	17.4	-1.0	-14.1	12.1
Plymth	30	83.3	65.7	92.9	0.0	16.7	2.3	-16.1	20.6
Ports	78	78.2	67.7	86.0	1.3	20.5	-4.3	-16.7	8.1
Prestn	58	82.8	70.8	90.5	6.9	10.3	-4.3	-17.5	8.9
Redng	63	93.7	84.3	97.6	4.8	1.6	7.5	-2.5	17.5
Salford	84	64.3	53.5	73.8	0.0	35.7	-7.0	-20.7	6.7
Sheff	67	92.5	83.3	96.9	3.0	4.5	14.8	2.0	27.5
Shrew	32	71.9	54.2	84.7	18.8	9.4	10.3	-14.0	34.7
Stevng	27	85.2	66.5	94.3	0.0	14.8	-11.0	-26.3	4.3
Stoke	60	73.3	60.8	83.0	6.7	20.0	10.3	-6.0	26.5
Wirral	21	76.2	54.0	89.7	4.8	19.1	-4.6	-28.3	19.1
Wolve	82	82.9	73.2	89.6	6.1	11.0	2.3	-10.5	15.0
York	27	85.2	66.5	94.3	3.7	11.1	n/a	n/a	n/a
N Ireland									
Belfast	25	64.0	44.0	80.1	20.0	16.0	-7.4	-32.6	17.8
Wales									
Cardff*	70	80.0	69.0	87.8	8.6	11.4	6.1	-6.9	19.1
Swanse	53	81.1	68.4	89.5	11.3	7.6	-0.5	-15.6	14.6
England	2,793	78.0	76.4	79.5	6.1	15.9	0.3	-1.8	2.5
N Ireland	70	71.4	59.8	80.8	8.6	20.0	-7.0	-21.6	7.5
Wales	171	81.3	74.7	86.5	8.8	9.9	4.7	-3.8	13.1
E, W & NI	3,034	78.1	76.5	79.5	6.3	15.7	0.4	-1.7	2.5

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

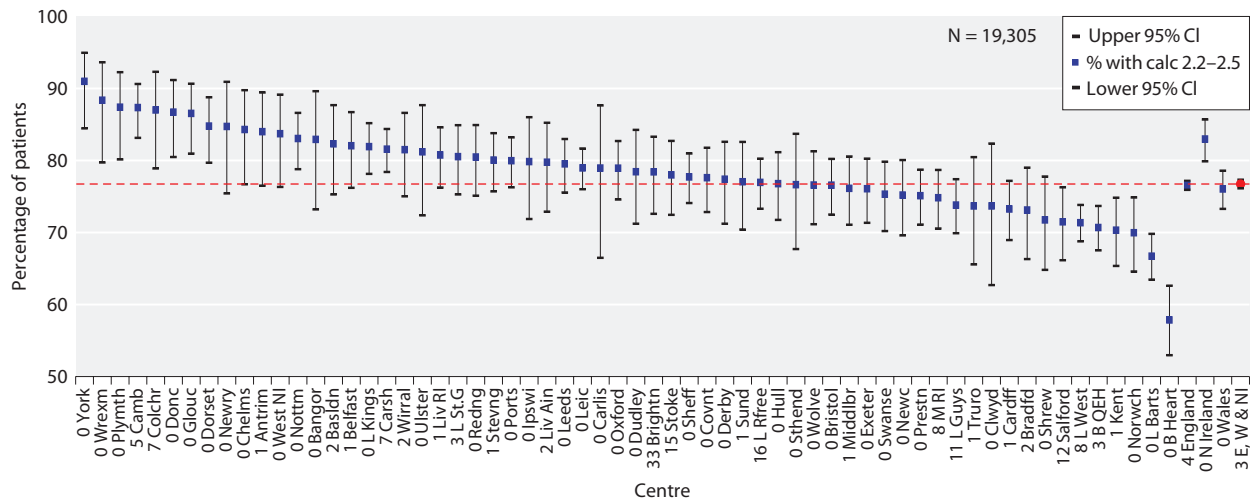


Fig. 12.6. Percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2012

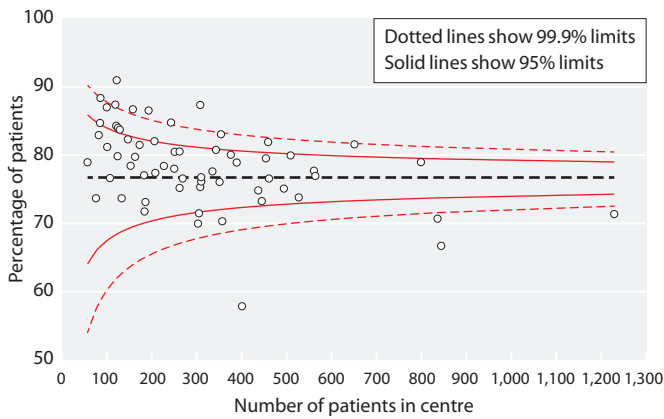


Fig. 12.7. Funnel plot of percentage of haemodialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2012

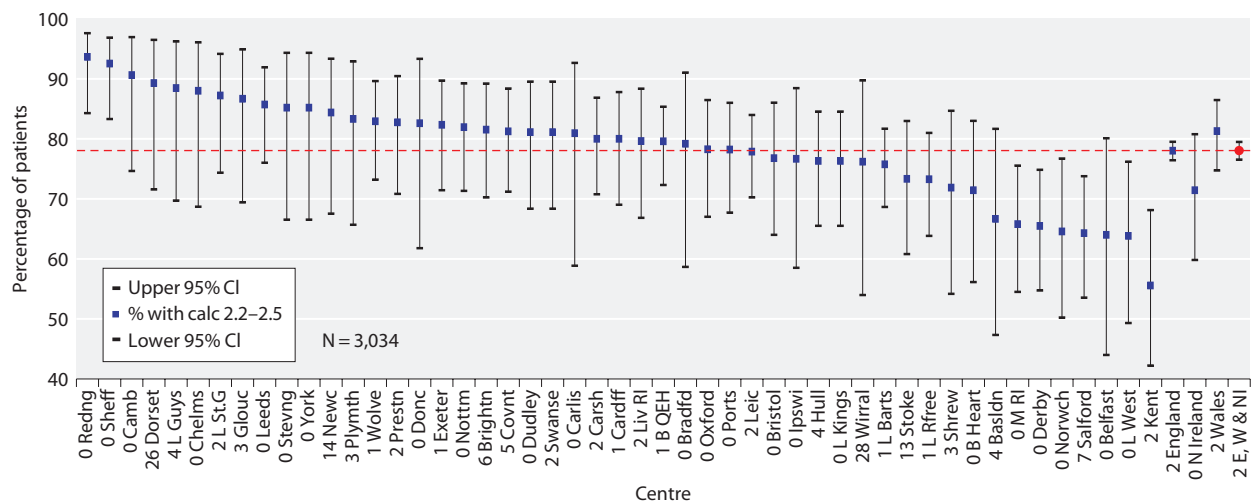


Fig. 12.8. Percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2012

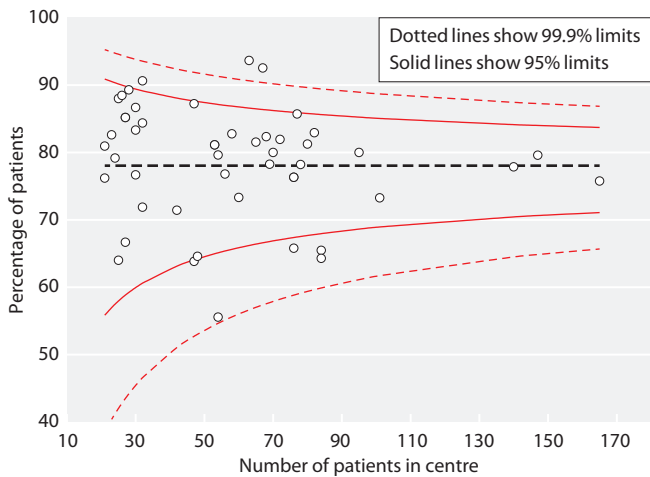


Fig. 12.9. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium within range (2.2–2.5 mmol/L) by centre in 2012

data, possibly due to differences in calcium adjustment factors between centres.

Parathyroid hormone

At the beginning of 2012 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 83% complete for both HD and PD patients overall, although there was between centre variation (tables 12.10, 12.12). Fifty-eight percent (95% CI 57–58%) of HD patients and 65% (95% CI 63–67%) of PD patients achieved a parathyroid hormone between 16–72 pmol/L (tables 12.11, 12.13). In 2010, when the PTH standard target was 16–32 pmol/L, 28% (95% CI 27–29%) of HD patients and 31% (95% CI 29–32%) of PD patients achieved the RA standard.

In 2012, the proportion of HD patients with a parathyroid hormone above the upper limit of the range (>72 pmol/L) was 16% and the proportion with parathyroid hormone below the lower limit of the range was 27%. The proportion of PD patients with parathyroid hormone above the upper limit of the range was 10% and the proportion below the lower limit of the range was 25% (tables 12.11, 12.13, figures 12.11–12.14). 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.

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. 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 [7]. Since current guidelines refer to multiples of the upper reference limit, 53% of

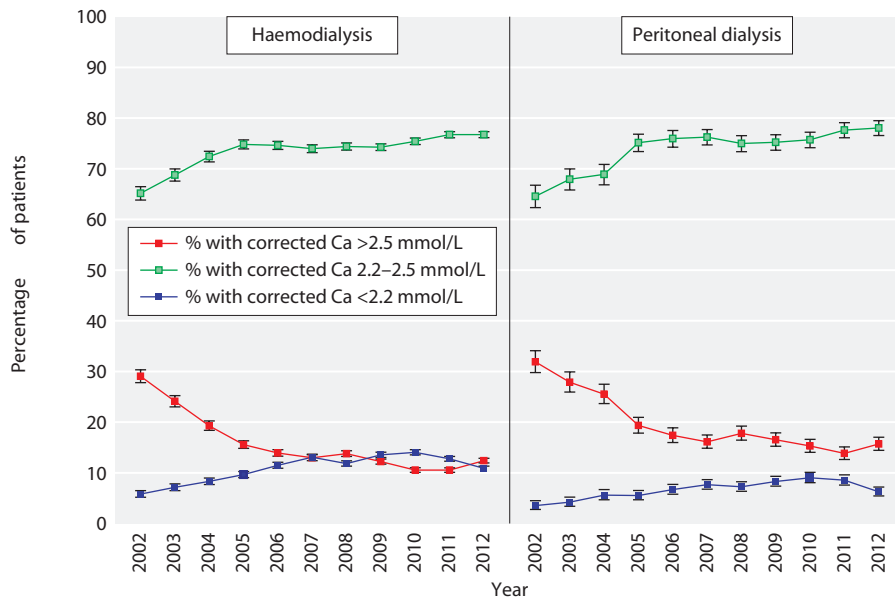


Fig. 12.10. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.5 mmol/L and >2.5 mmol/L by dialysis modality 2002–2012

Table 12.10. Summary statistics for PTH in haemodialysis patients in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	96.0	385	49.4	43.7	37	20	61
B QEH	0.2	2					
Basldn	97.3	146	43.0	44.9	33	16	55
Bradfd	97.9	185	31.3	35.8	17	8	43
Brightn	80.2	271	42.0	41.5	31	12	58
Bristol	98.1	452	41.4	49.6	27	14	48
Camb	68.5	222	45.5	72.3	29	17	46
Carlis	100.0	57	26.3	29.8	18	11	30
Carsh	0.4	3					
Chelms	99.2	120	41.5	32.1	33	19	54
Colchr	95.4	103	33.3	35.5	23	12	37
Covnt	98.8	331	42.2	42.6	30	16	54
Derby	98.6	206	33.1	27.9	26	16	43
Donc	99.4	157	43.6	35.4	35	21	55
Dorset	99.2	242	27.7	33.6	19	9	34
Dudley	96.1	147	50.4	53.8	31	14	62
Exeter	99.2	348	22.0	22.9	14	7	29
Glouc	99.5	192	35.9	33.1	28	15	48
Hull	98.4	305	45.3	47.0	31	16	59
Ipswi	100.0	124	36.6	31.8	30	14	46
Kent	98.3	355	44.2	37.3	38	19	57
L Barts	98.6	834	51.1	47.9	37	20	66
L Guys	77.0	456	48.3	48.0	34	16	62
L Kings	96.5	444	46.3	44.4	32.5	15	66
L Rfree	80.5	538	37.8	39.2	28	14	50
L St.G	92.3	250	57.6	53.7	42	22	74
L West	75.5	1,013	62.8	62.4	43	20	87
Leeds	98.7	448	39.9	38.5	28	14	54
Leic	98.5	789	42.4	45.4	28	11	57
Liv Ain	95.2	158	28.4	33.2	19	7	37
Liv RI	97.1	335	37.8	36.4	28	11	50
M RI	90.1	427	47.6	45.5	34	14	66
Middlbr	93.3	291	52.6	48.4	38	22	67
Newc	99.6	261	37.7	36.4	28	14	50
Norwch	94.4	286	36.9	33.4	29	15	46
Nottm	99.4	353	45.9	49.9	31	17	56
Oxford	98.5	383	51.5	42.2	41	19	70
Plymth	96.6	115	28.5	29.9	19	9	39
Ports	94.7	483	42.2	52.1	25	10	51
Prestn	1.4	7					
Redng	100.0	251	37.6	37.6	30	16	47
Salford	84.9	293	34.7	32.1	25	12	46
Sheff	96.8	544	42.2	42.0	31	17	54
Shrew	99.5	183	37.1	40.0	19	10	48
Stevng	98.2	373	45.4	42.5	38	19	57
Sthend	90.7	97	55.6	59.2	37	20	57
Stoke	87.8	258	51.1	43.2	39.5	23	64
Sund	97.8	180	46.8	50.9	30	14	60
Truro	97.8	131	25.7	37.1	16	6	31
Wirral	96.6	171	38.3	35.5	31	15	48
Wolve	97.0	262	32.5	40.0	21	10	40
York	96.7	118	26.2	29.2	18.5	7	36
N Ireland							
Antrim	100.0	126	33.2	31.5	23	15	42
Belfast	97.1	202	37.1	43.2	23.5	13	48
Newry	100.0	85	25.3	27.3	16	9	30
Ulster	100.0	101	22.5	23.3	16	9	28
West NI	100.0	129	36.0	29.4	29	15	47

Table 12.10. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Wales							
Bangor	98.8	81	25.2	24.5	19	10	31
Cardff	96.7	433	37.3	30.6	29	19	47
Clwyd	100.0	76	32.4	31.6	24.5	14	41
Swanse	72.7	224	40.1	37.0	30.5	16	52
Wrexm	96.5	83	18.4	15.6	19	4	29
England	82.3	15,085	43.4	45.4	30	15	56
N Ireland	99.1	643	32.3	34.1	22	13	41
Wales	89.7	897	34.7	31.6	27	15	44
E, W & NI	83.2	16,625	42.5	44.4	29	14	54

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

Table 12.11. Percentage of haemodialysis patients within, below and above the range for PTH (16–72 pmol/L) in 2012

Centre	N	% PTH 16–72 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >72 pmol/L	Change in % within range from 2011	95% LCL change	95% UCL change
England									
B Heart	385	63.9	59.0	68.5	16.6	19.5	10.4	3.5	17.3
Basldn	146	62.3	54.2	69.8	23.3	14.4	−0.4	−11.7	11.0
Bradfd	185	43.8	36.8	51.0	46.0	10.3	−6.5	−16.8	3.8
Brightn	271	53.5	47.6	59.4	29.9	16.6	6.4	−1.8	14.7
Bristol	452	57.5	52.9	62.0	28.1	14.4	1.3	−5.2	7.8
Camb	222	66.7	60.2	72.6	23.9	9.5	1.5	−7.3	10.3
Carlis	57	57.9	44.8	69.9	36.8	5.3	14.8	−3.3	32.9
Chelms	120	68.3	59.5	76.0	18.3	13.3	12.2	−0.1	24.5
Colchr	103	50.5	40.9	60.0	37.9	11.7	−7.7	−21.4	6.1
Covnt	331	61.6	56.3	66.7	24.2	14.2	5.5	−2.0	13.0
Derby	206	68.9	62.3	74.9	24.8	6.3	1.2	−8.0	10.4
Donc	157	71.3	63.8	77.9	15.3	13.4	6.9	−3.5	17.3
Dorset	242	52.1	45.8	58.3	41.3	6.6	2.3	−6.8	11.4
Dudley	147	51.0	43.0	59.0	27.2	21.8	11.3	−0.4	23.1
Exeter	348	41.7	36.6	46.9	53.5	4.9	−1.8	−9.3	5.7
Glouc	192	64.1	57.0	70.5	25.5	10.4	6.7	−3.2	16.5
Hull	305	57.7	52.1	63.1	24.3	18.0	5.2	−2.8	13.1
Ipswi	124	59.7	50.8	67.9	29.0	11.3	−3.4	−15.6	8.7
Kent	355	67.3	62.3	72.0	15.5	17.2	−2.6	−9.4	4.3
L Barts	834	59.4	56.0	62.6	19.2	21.5	−3.7	−8.4	1.1
L Guys	456	55.3	50.7	59.8	24.6	20.2	5.4	−1.1	11.9
L Kings	444	53.6	49.0	58.2	25.5	21.0	3.8	−2.8	10.5
L Rfree	538	59.7	55.5	63.7	28.6	11.7	0.3	−5.6	6.3
L St.G	250	56.0	49.8	62.0	18.4	25.6	0.1	−8.6	8.7
L West	1,013	50.5	47.5	53.6	19.2	30.3	0.5	−3.9	4.9
Leeds	448	55.6	50.9	60.1	28.4	16.1	−0.8	−7.3	5.6
Leic	789	50.2	46.7	53.7	31.7	18.1	−1.3	−6.2	3.7
Liv Ain	158	50.0	42.3	57.7	43.7	6.3	−2.8	−15.0	9.4
Liv RI	335	55.5	50.2	60.8	32.2	12.2	2.9	−4.5	10.3
M RI	427	51.8	47.0	56.5	26.2	22.0	−7.1	−14.0	−0.3
Middlbr	291	62.2	56.5	67.6	16.5	21.3	2.8	−5.3	10.9
Newc	261	60.5	54.5	66.3	27.2	12.3	0.5	−8.0	9.1
Norwch	286	61.5	55.8	67.0	26.2	12.2	−0.3	−8.4	7.8
Nottm	353	60.1	54.9	65.0	23.0	17.0	6.0	−1.1	13.2
Oxford	383	58.2	53.2	63.1	18.0	23.8	−2.9	−9.9	4.1
Plymth	115	52.2	43.1	61.1	40.0	7.8	6.8	−6.0	19.6

Table 12.11. Continued

Centre	N	% PTH 16–72 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >72 pmol/L	Change in % within range from 2011	95% LCL change	95% UCL change
Ports	483	47.0	42.6	51.5	36.2	16.8	3.1	−3.4	9.5
Redng	251	65.7	59.7	71.4	24.7	9.6	−3.1	−11.4	5.2
Salford	293	55.3	49.6	60.9	33.5	11.3	8.9	0.7	17.1
Sheff	544	63.6	59.5	67.5	22.1	14.3	3.6	−2.2	9.3
Shrew	183	49.7	42.5	56.9	35.0	15.3	−8.6	−18.8	1.7
Stevng	373	66.0	61.0	70.6	15.6	18.5	−0.6	−7.4	6.1
Sthend	97	66.0	56.0	74.7	15.5	18.6	5.0	−8.2	18.3
Stoke	258	66.7	60.7	72.2	14.3	19.0	3.8	−4.2	11.8
Sund	180	54.4	47.1	61.6	27.8	17.8	−1.8	−12.4	8.8
Truro	131	45.0	36.7	53.6	48.1	6.9	−1.0	−12.9	11.0
Wirral	171	64.9	57.5	71.7	25.2	9.9	−3.5	−14.5	7.6
Wolve	262	52.7	46.6	58.7	38.9	8.4	9.3	0.9	17.6
York	118	48.3	39.4	57.3	45.8	5.9	4.1	−8.8	16.9
N Ireland									
Antrim	126	67.5	58.8	75.1	25.4	7.1	1.1	−10.6	12.8
Belfast	202	57.4	50.5	64.1	32.2	10.4	−4.6	−14.2	4.9
Newry	85	45.9	35.6	56.5	48.2	5.9	−8.1	−22.5	6.3
Ulster	101	47.5	38.0	57.2	48.5	4.0	8.5	−5.1	22.2
West NI	129	66.7	58.1	74.3	25.6	7.8	−10.2	−21.0	0.6
Wales									
Bangor	81	56.8	45.9	67.1	40.7	2.5	−1.5	−16.6	13.5
Cardff	433	71.1	66.7	75.2	18.2	10.6	5.7	−0.5	11.9
Clwyd	76	61.8	50.5	72.0	29.0	9.2	17.0	0.2	33.8
Swanse	224	63.0	56.4	69.0	24.1	13.0	2.5	−6.4	11.4
Wrexm	83	51.8	41.1	62.3	48.2	0.0	3.1	−12.3	18.4
England	15,085	57.0	56.2	57.8	26.5	16.5	1.9	0.7	3.0
N Ireland	643	58.2	54.3	61.9	34.2	7.6	−3.0	−8.3	2.3
Wales	897	65.2	62.0	68.3	25.4	9.4	4.6	0.1	9.1
E, W & NI	16,625	57.5	56.7	58.2	26.8	15.8	1.8	0.8	2.9

Table 12.12. Summary statistics for PTH in peritoneal dialysis patients in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	76.2	32	52.6	31.5	44.5	33.0	65.5
B QEH	0.0	0					
Basldn	96.4	27	35.4	25.3	29.0	19.0	49.0
Bradfd	91.7	22	45.6	51.1	27.0	14.0	57.0
Brightn	88.4	61	32.2	30.9	23.0	14.0	37.0
Bristol	94.6	53	34.9	33.3	25.0	14.0	44.0
Camb	100.0	32	32.2	27.6	29.5	14.5	38.5
Carlis	95.2	20	30.6	24.0	26.5	13.5	38.0
Carsh	0.0	0					
Chelms	100.0	25	36.2	16.3	37.0	24.0	51.0
Colchr*							
Covnt	92.9	78	28.3	28.3	19.5	12.0	34.0
Derby	98.8	83	28.2	23.6	25.0	15.0	33.0
Donc	100.0	23	42.3	36.4	32.0	19.0	65.0
Dorset	73.7	28	28.2	20.0	26.0	16.5	38.0
Dudley	86.8	46	20.9	16.9	17.5	9.0	28.0

Table 12.12. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Exeter	98.6	68	23.8	23.9	17.0	10.0	29.0
Glouc	80.7	25	23.1	18.5	19.0	8.0	34.0
Hull	88.6	70	25.7	27.5	18.0	10.0	32.0
Ipswi	96.7	29	53.5	46.4	37.0	23.0	78.0
Kent	90.9	50	35.7	27.3	29.0	19.0	48.0
L Barts	88.6	148	34.5	26.1	27.0	14.0	46.0
L Guys	96.3	26	37.5	19.2	39.5	25.0	49.0
L Kings	98.7	75	45.4	37.5	37.0	17.0	70.0
L Rfree	69.6	71	42.1	47.0	33.0	18.0	46.0
L St.G	89.6	43	37.4	29.7	30.0	22.0	46.0
L West	97.9	46	37.0	31.1	29.0	17.0	44.0
Leeds	100.0	77	46.5	34.8	37.0	26.0	57.0
Leic	95.8	137	37.3	35.6	26.0	12.0	52.0
Liv Ain	94.1	16					
Liv RI	96.4	53	28.0	22.2	20.0	13.0	39.0
M RI	97.4	74	43.5	33.8	35.5	21.0	62.0
Middlbr	75.0	6					
Newc	86.5	32	33.9	22.8	27.5	22.0	45.0
Norwch	89.6	43	28.5	24.3	21.0	13.0	40.0
Nottm	98.6	71	50.9	45.5	38.0	21.0	66.0
Oxford	95.7	66	51.0	36.5	40.0	25.0	66.0
Plymth	90.3	28	28.7	40.1	12.5	9.5	29.5
Ports	98.7	77	41.1	35.3	31.0	18.0	53.0
Prestn	15.3	9					
Redng	96.8	61	33.9	42.7	24.0	15.0	37.0
Salford	93.3	84	37.0	35.3	26.5	15.5	45.0
Sheff	79.1	53	33.2	22.1	31.0	19.0	42.0
Shrew	93.9	31	37.2	37.4	29.0	19.0	48.0
Stevng	92.6	25	31.9	29.7	29.0	10.0	38.0
Sthend	92.9	13					
Stoke	94.2	65	58.7	52.2	40.0	26.0	68.0
Sund	100.0	17					
Truro	94.7	18					
Wirral	62.1	18					
Wolve	94.0	78	28.6	18.4	27.0	15.0	40.0
York	92.6	25	29.9	23.2	22.0	13.0	49.0
N Ireland							
Antrim	100.0	10					
Belfast	92.0	23	27.4	18.3	21.0	15.0	38.0
Newry	100.0	14					
Ulster	100.0	6					
West NI	100.0	15					
Wales							
Bangor	100.0	14					
Cardff	98.6	70	43.8	31.9	37.0	20	61
Clwyd	73.3	11					
Swanse	92.6	50	29.3	20.9	26.0	16	36
Wrexm	95.0	19					
England	82.3	2,358	36.3	33.2	27.0	15	47
N Ireland	97.1	68	26.0	17.9	21.5	12.5	37.5
Wales	94.3	164	34.5	26.2	29.5	17	46
E, W & NI	83.3	2,590	35.9	32.5	27.0	15	47

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

*No PD patients

Table 12.13. Percentage of peritoneal dialysis patients within, below and above the range for PTH (16–72 pmol/L) in 2012

Centre	N	% PTH 16–72 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	% PTH >72 pmol/L	Change in % within range from 2011	95% LCL change	95% UCL change
England									
B Heart	32	75.0	57.4	87.0	3.1	21.9	−0.7	−21.1	19.7
Basldn	27	81.5	62.5	92.1	14.8	3.7	27.3	2.6	52.1
Bradfd	22	54.6	34.1	73.5	27.3	18.2	10.1	−17.9	38.1
Brightn	61	63.9	51.3	74.9	27.9	8.2	2.0	−15.0	19.0
Bristol	53	60.4	46.8	72.5	30.2	9.4	4.2	−14.2	22.7
Camb	32	65.6	47.9	79.8	25.0	9.4	−6.3	−28.9	16.4
Carlis	20	60.0	38.0	78.6	35.0	5.0	n/a	n/a	n/a
Chelms	25	88.0	68.7	96.1	12.0	0.0	28.0	3.0	53.0
Covnt	78	60.3	49.1	70.5	32.1	7.7	14.3	−1.4	30.0
Derby	83	73.5	63.0	81.9	25.3	1.2	−1.3	−14.2	11.7
Donc	23	65.2	44.3	81.6	21.7	13.0	−4.8	−32.7	23.2
Dorset	28	67.9	48.9	82.4	25.0	7.1	4.0	−19.4	27.3
Dudley	46	52.2	38.0	66.1	45.7	2.2	−6.9	−27.4	13.6
Exeter	68	50.0	38.3	61.7	47.1	2.9	0.9	−16.6	18.3
Glouc	25	56.0	36.6	73.7	40.0	4.0	7.6	−18.6	33.8
Hull	70	54.3	42.6	65.5	38.6	7.1	3.6	−13.0	20.2
Ipswi	29	58.6	40.4	74.8	13.8	27.6	−8.1	−32.7	16.6
Kent	50	64.0	50.0	76.0	24.0	12.0	−13.1	−30.0	3.9
L Barts	148	63.5	55.5	70.9	26.4	10.1	−4.5	−15.3	6.3
L Guys	26	80.8	61.3	91.8	15.4	3.9	14.1	−9.3	37.5
L Kings	75	58.7	47.3	69.2	21.3	20.0	3.5	−12.9	19.8
L Rfree	71	67.6	55.9	77.4	22.5	9.9	10.1	−5.2	25.5
L St.G	43	69.8	54.6	81.6	18.6	11.6	5.9	−13.5	25.4
L West	46	69.6	55.0	81.1	19.6	10.9	0.8	−20.0	21.7
Leeds	77	66.2	55.0	75.9	14.3	19.5	−7.8	−22.1	6.4
Leic	137	59.9	51.4	67.7	27.0	13.1	4.2	−7.6	16.0
Liv RI	53	64.2	50.5	75.8	32.1	3.8	−9.5	−26.8	7.7
M RI	74	73.0	61.8	81.9	13.5	13.5	3.4	−11.4	18.2
Newc	32	75.0	57.4	87.0	18.8	6.3	8.3	−12.7	29.4
Norwch	43	51.2	36.6	65.6	41.9	7.0	5.0	−16.6	26.6
Nottm	71	63.4	51.6	73.7	14.1	22.5	2.3	−13.6	18.2
Oxford	66	65.2	53.0	75.6	10.6	24.2	4.4	−11.4	20.1
Plymth	28	39.3	23.3	58.0	53.6	7.1	−16.6	−41.2	8.0
Ports	77	67.5	56.4	77.0	22.1	10.4	8.4	−7.1	23.9
Redng	61	68.9	56.3	79.2	26.2	4.9	1.2	−14.7	17.2
Salford	84	61.9	51.1	71.6	25.0	13.1	10.8	−3.9	25.4
Sheff	53	73.6	60.2	83.7	18.9	7.6	2.5	−15.3	20.3
Shrew	31	67.7	49.7	81.7	19.4	12.9	−5.0	−29.8	19.9
Stevng	25	52.0	33.1	70.4	36.0	12.0	−29.8	−55.2	−4.5
Stoke	65	67.7	55.5	77.9	10.8	21.5	9.9	−6.7	26.5
Wolve	78	71.8	60.9	80.7	25.6	2.6	2.4	−12.8	17.7
York	25	64.0	44.0	80.1	28.0	8.0	−6.0	−33.5	21.5
N Ireland									
Belfast	23	65.2	44.3	81.6	30.4	4.4	15.2	−11.6	42.1
Wales									
Cardff	70	65.7	53.9	75.8	17.1	17.1	3.9	−11.1	18.9
Swanse	50	72.0	58.1	82.7	24.0	4.0	16.7	−2.2	35.6
England	2,358	64.4	62.5	66.3	25.1	10.5	2.3	−0.4	5.0
N Ireland	68	64.7	52.7	75.1	33.8	1.5	4.7	−11.7	21.2
Wales	164	68.3	60.8	75.0	23.2	8.5	8.0	−2.2	18.1
E, W & NI	2,590	64.7	62.8	66.5	25.2	10.1	2.7	0.1	5.3

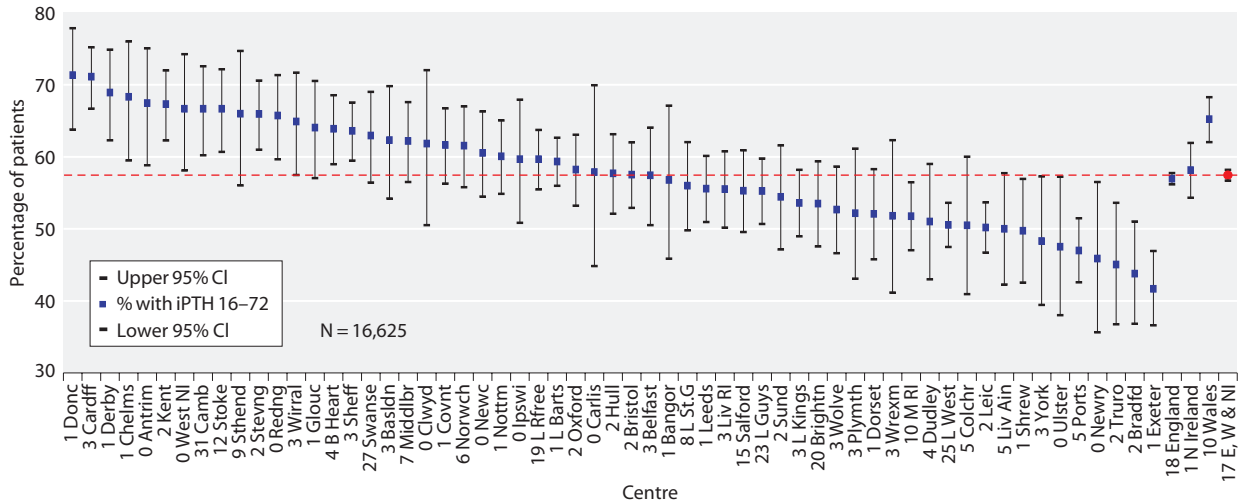


Fig. 12.11. Percentage of haemodialysis patients with PTH within range (16–72 pmol/L) by centre in 2012

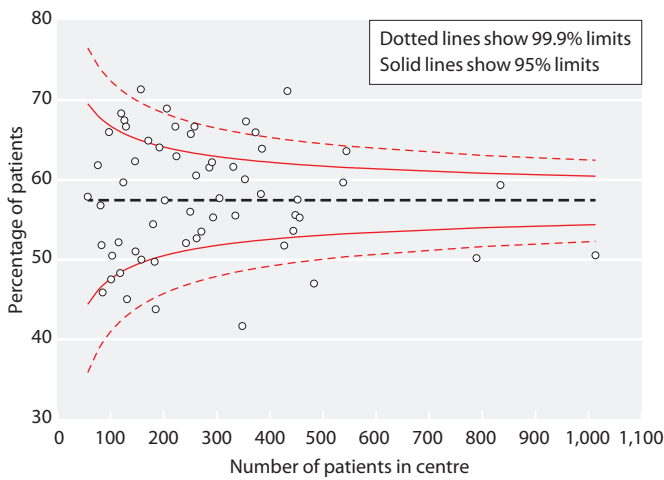


Fig. 12.12. Funnel plot of percentage of haemodialysis patients with PTH within range (16–72 pmol/L) by centre in 2012

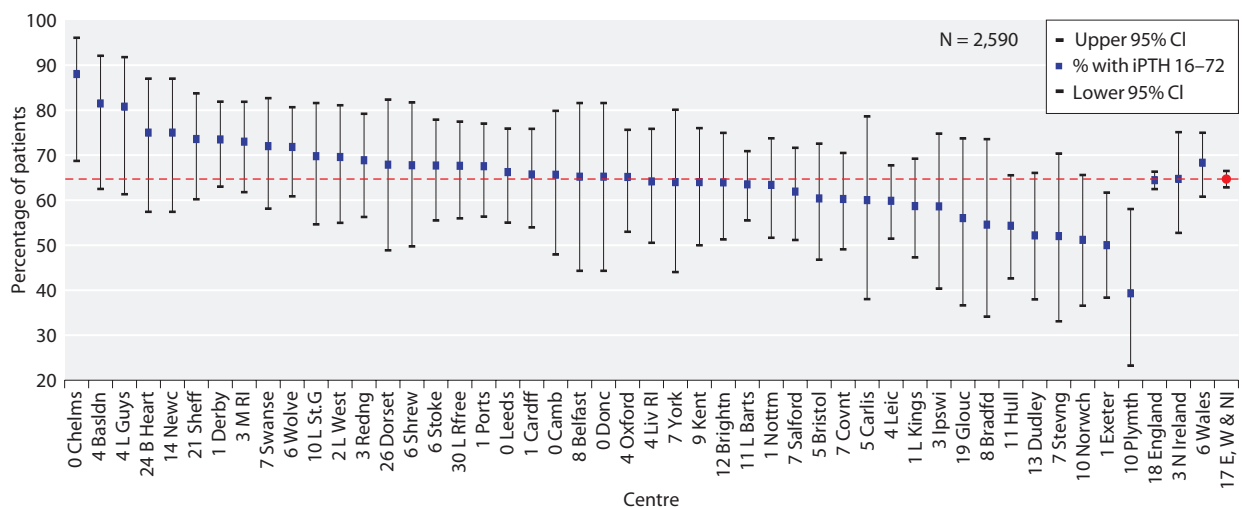


Fig. 12.13. Percentage of peritoneal dialysis patients with PTH within range (16–72 pmol/L) by centre in 2012

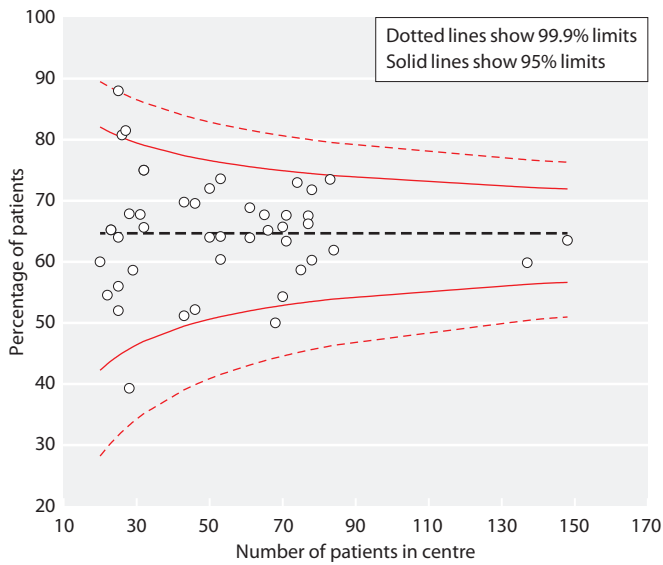


Fig. 12.14. Funnel plot of percentage of peritoneal dialysis patients with PTH within range (16–72 pmol/L) by centre in 2012

patients were classified differently by different methods with implications for treatment e.g. with Cinacalcet. In an excellent accompanying editorial, Garrett and Goldsmith [8] also highlighted the high biological variability of PTH and its poor ability to predict skeletal or patient outcomes. 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 [9].

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. [7] and a recent editorial review [10] urge adoption of assay-specific action limits for PTH in CKD patients. 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. [7] was PTH (intact) that was not standardised and cross-reacted with PTH 7–84. Roche have recently launched the more expensive PTH (1–84) that is standardised against the WHO international standard 95/646 and has $\leq 0.1\%$ cross-reactivity with both PTH (1–34) and PTH (7–84) (information supplied by Roche Diagnostics).

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 58 HD and 45 PD centres, covering 16,300 HD and 2,377 PD patients, from England, Wales and Northern Ireland. The ranges used for this audit were adjusted calcium 2.2–2.5 mmol/L, phosphate ≤ 1.7 mmol/L, and PTH ≤ 72 pmol/L.

Tables 12.14 and 12.15 identify each centre and detail the numbers of patients who had received HD and PD and the results of the BMD combination analyses.

Figures 12.15 and 12.16, demonstrate the caterpillar plots of all centres and the percentage achievement of

Table 12.14. 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 2012

Centre	N	Number of parameters			
		None	One	Two	Three
England					
B Heart	385	5.2	23.1	36.1	35.6
Basldn	145	0.7	7.6	35.9	55.9
Bradfd	185	0.5	15.7	28.1	55.7
Brightn	206	2.4	15.5	33.5	48.5
Bristol	452	1.5	16.6	36.9	44.9
Camb	214	0.9	8.4	29.0	61.7
Carlisle	57	1.8	10.5	38.6	49.1
Chelms	120	0.8	12.5	27.5	59.2
Colchr	98	0.0	7.1	36.7	56.1
Covnt	331	2.1	15.7	36.9	45.3
Derby	206	1.0	12.1	36.9	50.0
Donc	157	1.3	5.7	34.4	58.6

Table 12.14. Continued

Centre	N	Number of parameters			
		None	One	Two	Three
Dorset	241	0.4	10.4	30.3	58.9
Dudley	147	3.4	17.0	40.1	39.5
Exeter	348	1.7	6.9	38.8	52.6
Glouc	192	0.5	7.3	34.4	57.8
Hull	305	3.6	11.1	35.4	49.8
Ipswi	124	0.0	8.9	37.9	53.2
Kent	351	2.6	18.8	39.9	38.7
L Barts	834	4.1	19.3	41.1	35.5
L Guys	452	3.5	13.1	36.3	47.1
L Kings	444	1.8	11.5	33.1	53.6
L Rfree	531	2.4	10.9	34.5	52.2
L St.G	249	2.0	13.3	38.2	46.6
L West	1,007	3.1	17.5	44.1	35.4
Leeds	448	2.2	15.0	33.5	49.3
Leic	789	2.3	16.9	37.3	43.6
Liv Ain	158	1.9	7.0	31.0	60.1
Liv RI	335	1.8	8.7	36.1	53.4
M RI	426	2.6	17.1	39.0	41.3
Middlbr	291	2.1	17.9	38.5	41.6
Newc	261	2.3	12.6	37.9	47.1
Norwch	286	2.8	13.3	41.6	42.3
Nottm	353	2.0	13.0	28.9	56.1
Oxford	383	3.1	17.0	36.0	43.9
Plymth	115	1.7	7.0	27.8	63.5
Ports	483	2.5	14.1	40.0	43.5
Redng	251	2.4	7.2	35.1	55.4
Salford	292	2.1	12.3	34.6	51.0
Sheff	544	1.3	14.0	36.6	48.2
Shrew	182	2.2	15.4	35.7	46.7
Stevng	370	1.9	16.2	37.6	44.3
Sthend	97	3.1	18.6	38.1	40.2
Stoke	236	1.3	12.7	41.1	44.9
Truro	131	0.0	11.5	35.1	53.4
Wirral	171	0.6	13.5	29.2	56.7
Wolve	261	1.1	8.8	37.2	52.9
York	118	0.0	7.6	24.6	67.8
N Ireland					
Antrim	125	0.8	7.2	27.2	64.8
Belfast	202	1.5	12.4	31.2	55.0
Newry	85	2.4	7.1	38.8	51.8
Ulster	101	0.0	6.9	32.7	60.4
West NI	129	1.6	12.4	33.3	52.7
Wales					
Bangor	81	0.0	8.6	33.3	58.0
Cardff	432	1.9	12.7	37.0	48.4
Clwyd	76	1.3	11.8	42.1	44.7
Swanse	224	1.8	12.1	35.3	50.9
Wrexm	83	0.0	1.2	25.3	73.5
England	14,762	2.2	14.0	36.7	47.1
N Ireland	642	1.2	9.8	32.1	56.9
Wales	896	1.5	11.0	35.6	51.9
E, W & NI	16,300	2.2	13.7	36.4	47.8

Target range: adjusted calcium 2.2–2.5 mmol/L; phosphate \leq 1.7 mmol/L; PTH \leq 72 pmol/L

Table 12.15. 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 2012

Centre	N	Number of parameters			
		None	One	Two	Three
England					
B Heart	32	3.1	25.0	40.6	31.3
Basldn	27	0.0	14.8	37.0	48.1
Bradfd	21	4.8	14.3	38.1	42.9
Brighntn	61	0.0	9.8	44.3	45.9
Bristol	53	0.0	13.2	49.1	37.7
Camb	32	0.0	3.1	40.6	56.3
Carlis	20	0.0	20.0	10.0	70.0
Chelms	25	0.0	8.0	28.0	64.0
Covnt	76	1.3	2.6	28.9	67.1
Derby	83	1.2	7.2	37.3	54.2
Donc	23	0.0	21.7	21.7	56.5
Dorset	22	0.0	9.1	13.6	77.3
Dudley	46	0.0	6.5	60.9	32.6
Exeter	68	0.0	4.4	38.2	57.4
Glouc	25	0.0	8.0	32.0	60.0
Hull	69	1.4	10.1	42.0	46.4
Ipswi	29	6.9	10.3	37.9	44.8
Kent	48	2.1	18.8	47.9	31.3
L Barts	147	0.7	13.6	34.7	51.0
L Guys	25	0.0	4.0	28.0	68.0
L Kings	75	1.3	17.3	33.3	48.0
L Rfree	71	1.4	15.5	35.2	47.9
L St.G	43	0.0	4.7	37.2	58.1
L West	46	0.0	13.0	43.5	43.5
Leeds	77	2.6	14.3	35.1	48.1
Leic	136	2.9	11.0	32.4	53.7
Liv RI	53	0.0	7.5	32.1	60.4
M RI	74	4.1	20.3	35.1	40.5
Newc	32	0.0	12.5	40.6	46.9
Norwch	43	2.3	9.3	44.2	44.2
Nottm	71	2.8	15.5	39.4	42.3
Oxford	66	4.5	15.2	42.4	37.9
Plymth	27	0.0	7.4	44.4	48.1
Ports	77	1.3	13.0	35.1	50.6
Redng	61	0.0	6.6	23.0	70.5
Salford	83	1.2	24.1	34.9	39.8
Sheff	53	0.0	9.4	37.7	52.8
Shrew	31	3.2	9.7	45.2	41.9
Stevng	25	0.0	8.0	24.0	68.0
Stoke	57	5.3	22.8	28.1	43.9
Wolve	77	0.0	5.2	41.6	53.2
York	25	0.0	16.0	36.0	48.0
N Ireland					
Belfast	23	0.0	17.4	43.5	39.1
Wales					
Cardff	69	2.9	8.7	33.3	55.1
Swanse	50	0.0	6.0	34.0	60.0
England	2,235	1.4	12.1	36.6	49.9
N Ireland	23	0.0	17.4	43.5	39.1
Wales	119	1.7	7.6	33.6	57.1
E, W & NI	2,377	1.4	11.9	36.5	50.1

Target range: adjusted calcium 2.2–2.5 mmol/L; phosphate \leq 1.7 mmol/L; PTH \leq 72 pmol/L

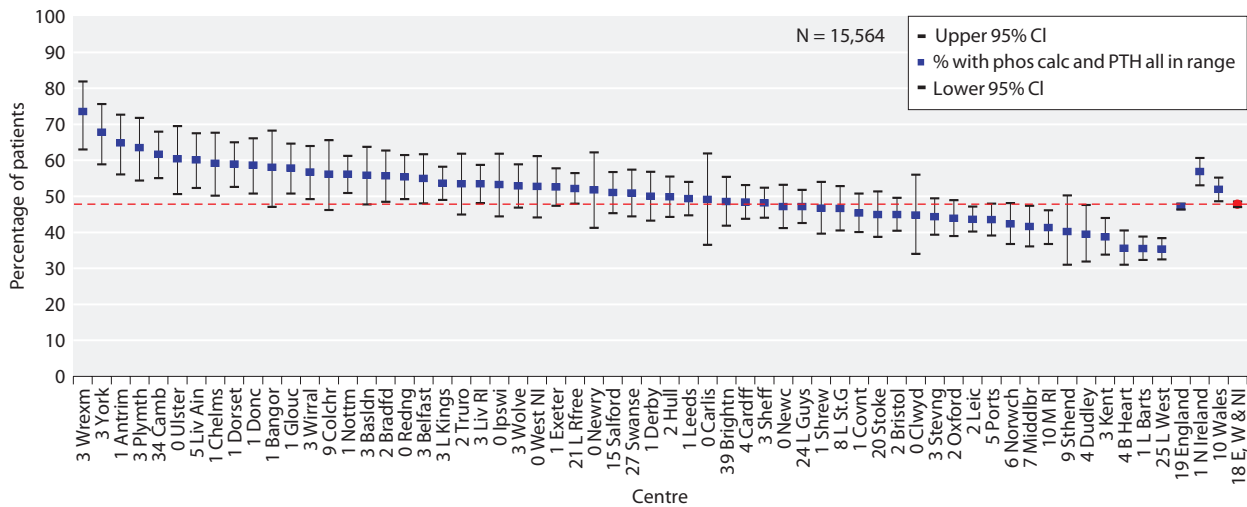


Fig. 12.15. Percentage of HD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2012

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

Control of none of the parameters of BMD was found in 2.2% of HD patients and 1.4% of PD patients; of one parameter in 13.7% of HD and 11.9% of PD patients; of two parameters in 36.4% of HD and 36.5% of PD patients; and of all three parameters in 47.8% of HD and 50.1% of PD patients (tables 12.14, 12.15).

The details of single parameters alone and combinations of adjusted calcium, phosphate and PTH are detailed in table 12.16 (aggregate information has been presented as a percentage measure for all centres with valid data).

Figures 12.17 and 12.18 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.

Mineral and bone variables

There are convincing observational data that hyperphosphataemia is associated with increased mortality in

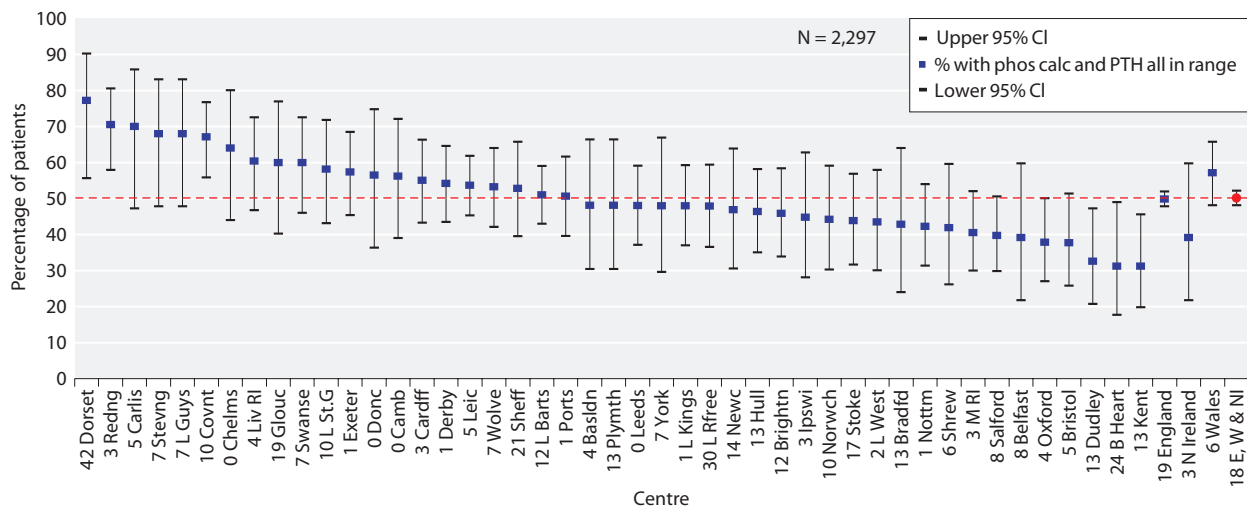


Fig. 12.16. Percentage of PD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2012

Table 12.16. Average control of BMD parameters in preventing severe hyperparathyroidism across renal centres in 2012

BMD combination of parameters	HD			PD		
	Avg (%)	Min (%)	Max (%)	Avg (%)	Min (%)	Max (%)
None	1.8	0.0	5.2	1.3	0.0	6.9
One	12.2	1.2	23.1	11.9	2.6	25.0
Two	35.2	24.6	44.1	36.1	10.0	60.9
Three	50.8	35.4	73.5	50.8	31.3	77.3
Adj.Ca alone	4.2	0.0	9.1	4.0	0.0	13.0
Phosphate alone	2.1	0.0	7.3	1.8	0.0	6.5
PTH alone	5.8	1.0	13.0	6.2	0.0	15.0
Adj.Ca and phosphate	5.1	0.0	17.3	3.3	0.0	10.3
Adj.Ca and PTH	18.4	10.3	29.4	20.4	5.0	47.8
Phosphate and PTH	11.8	6.1	17.4	12.4	0.0	30.4

Adj.Ca = adjusted calcium
Avg = average

dialysis patients but the data linking calcium and parathyroid hormone to patient survival are less clear [11–15]. A recent cohort study has demonstrated that simultaneous achievement of all three audit measures does appear to be associated with better outcomes [16].

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.

Finally, it is important to consider data quality and the potential for measurement bias particularly in light of the variability in assay methods for parathyroid hormone as discussed above. However, detecting these centre level differences is an important step in understanding the factors associated with exceptional performance.

Bicarbonate

In 2012 the following Renal Association clinical practice guidelines regarding bicarbonate management were applicable:

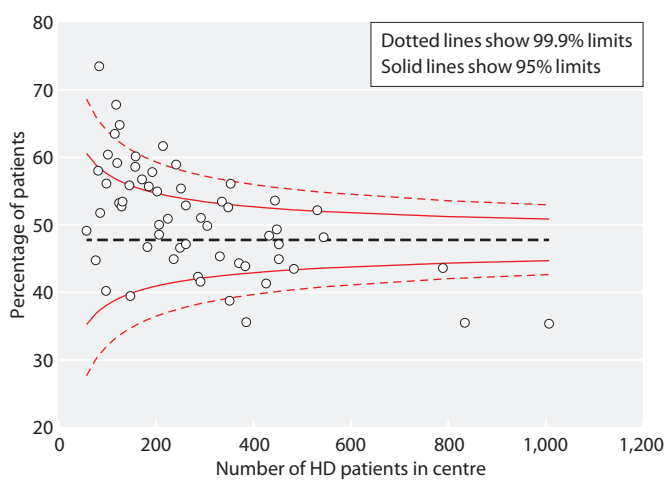


Fig. 12.17. Funnel plot for percentage of HD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2012

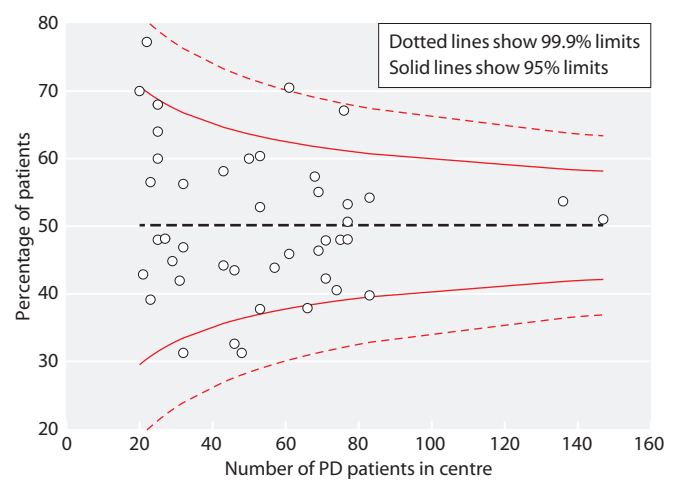


Fig. 12.18. Funnel plot for percentage of PD patients achieving simultaneous control of all three BMD parameters in preventing severe hyperparathyroidism by centre in 2012

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. (2C)' [17]

Peritoneal Dialysis Guideline 6.2 – PD: Metabolic factors

'We recommend that plasma bicarbonate should be maintained within the normal range' [18]

Citing evidence for reduced risk of adverse events, the haemodialysis module of the 5th edition of the Renal Association clinical practice guidelines published in December 2009 [1, 17–18] recommended a target range for serum bicarbonate of 18–24 mmol/L, a reduction from the previous guideline range of 20–26 mmol/L.

Bicarbonate data were 91% complete for both HD and PD patients (tables 12.17, 12.19). A lower bicarbonate RA target range in haemodialysis patients was introduced in 2010. The proportion of patients achieving the audit measure was 59% in 2012 (95% CI 58–60%) (table 12.18); the mean bicarbonate was 24 mmol/L (table 12.17). The proportion achieving the standard in

Table 12.17. Summary statistics for serum bicarbonate in haemodialysis patients by centre in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	93.8	376	21.8	3.0	22	20	24
B QEH	96.2	831	23.6	2.6	24	22	25
Basldn	96.7	145	23.2	3.2	24	22	25
Bradfd	98.4	186	24.0	3.2	24	22	26
Brightn	90.8	307	23.2	3.1	23	21	25
Bristol	100.0	461	22.7	2.4	23	21	24
Camb	94.8	307	23.7	2.2	24	22	25
Carlis	100.0	57	22.0	3.0	22	20	25
Carsh	92.8	648	23.4	3.9	24	21	26
Chelms	100.0	121	21.9	2.0	22	21	23
Colchr	92.6	100	24.6	1.7	25	23	26
Covnt	98.5	330	24.5	3.3	24	22	27
Derby	99.5	208	22.1	2.7	22	20	24
Donc	100.0	158	23.1	3.1	23	21	25
Dorset	99.6	243	22.8	2.8	23	21	24
Dudley	100.0	153	23.7	2.7	24	22	25
Exeter	100.0	351	21.0	2.6	21	19	23
Glouc	100.0	193	24.0	2.6	24	22	26
Hull	100.0	310	22.0	2.3	22	21	23
Ipswi	100.0	124	23.0	2.8	23	21	25
Kent	99.5	359	21.8	2.7	22	20	23
L Barts	66.4	562	22.4	3.1	22	21	24
L Guys	71.6	424	22.3	3.0	22	20	24
L Kings	99.8	459	26.5	2.2	26	25	28
L Rfree	82.9	554	23.1	2.9	23	21	25
L St.G	97.4	264	26.6	2.8	26.5	25	28.5
L West	65.6	880	19.2	2.7	19	17	21
Leeds	100.0	454	22.3	3.6	22	20	25
Leic	99.5	797	24.8	3.7	24	22	27
Liv Ain	98.2	163	24.0	2.9	24	22	26
Liv RI	99.4	343	27.3	2.9	28	26	29
M RI	92.2	437	24.1	3.1	24	22	26
Middlbr	99.4	310	27.2	3.2	27	25	29
Newc	100.0	262	25.0	3.2	26	24	27
Norwch	99.3	301	24.0	2.9	24	22	26
Nottm	94.4	335	25.1	3.0	25	23	27
Oxford	100.0	389	23.5	3.2	24	22	25
Plymth	100.0	119	25.6	2.6	26	24	27

Table 12.17. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Ports	99.8	509	22.9	2.8	23	21	25
Prestn	98.8	490	23.3	3.0	23	21	25
Redng	100.0	251	24.5	2.4	24	23	26
Salford	9.0	31					
Sheff	99.8	561	24.8	3.2	25	23	27
Shrew	100.0	184	24.5	2.9	24	22	26
Stevng	97.9	372	23.3	3.1	23	21	25
Sthend	100.0	107	25.1	3.6	25	23	27
Stoke	33.3	98					
Sund	99.5	183	26.5	3.1	27	25	29
Truro	99.3	133	21.5	2.4	21	20	23
Wirral	97.7	173	24.3	2.8	25	22	26
Wolve	98.9	267	21.9	2.6	22	20	24
York	100.0	122	23.6	2.7	23	22	25
N Ireland							
Antrim	97.6	123	23.6	2.8	23	22	25
Belfast	99.0	206	23.8	2.4	24	22	25
Newry	100.0	85	22.4	2.8	22	20	24
Ulster	100.0	101	23.3	2.9	23	22	25
West NI	100.0	129	24.1	2.7	24	22	26
Wales							
Bangor	100.0	82	24.9	3.4	25	23	27
Cardff	96.0	430	22.8	4.0	22	20	25
Clwyd	100.0	76	22.6	2.7	23	21	24
Swanse	100.0	308	24.5	2.9	24	23	26
Wrexm	100.0	86	21.4	2.1	22	20	23
England	90.1	16,502	23.5	3.5	23	21	26
N Ireland	99.2	644	23.6	2.7	23	22	25
Wales	98.2	982	23.4	3.5	23	21	26
E, W & NI	90.8	18,128	23.5	3.5	23	21	26

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

Table 12.18. Percentage of haemodialysis patients within, below and above the range for bicarbonate (18–24 mmol/L) by centre in 2012

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 2011	95% LCL change	95% UCL change
England									
B Heart	376	78.5	74.0	82.3	5.9	15.7	52.7	46.5	59.0
B QEH	831	62.1	58.7	65.3	0.8	37.1	8.8	4.0	13.5
Basldn	145	69.0	61.0	76.0	3.5	27.6	−7.2	−17.6	3.3
Bradfd	186	51.1	43.9	58.2	2.7	46.2	−4.9	−15.1	5.4
Brightn	307	64.2	58.7	69.3	3.9	31.9	1.8	−5.9	9.6
Bristol	461	75.5	71.4	79.2	3.0	21.5	25.0	19.0	31.1
Camb	307	64.8	59.3	70.0	0.7	34.5	0.5	−7.0	8.0
Carlis	57	63.2	50.0	74.6	8.8	28.1	−2.4	−19.9	15.1
Carsh	648	52.9	49.1	56.8	6.5	40.6	−8.3	−13.7	−2.9
Chelms	121	86.8	79.5	91.7	2.5	10.7	25.0	14.3	35.8
Colchr	100	42.0	32.7	51.9	0.0	58.0	27.0	15.1	38.9
Covnt	330	53.3	47.9	58.7	1.8	44.9	18.8	11.3	26.2
Derby	208	76.9	70.7	82.2	2.9	20.2	23.2	14.1	32.3
Donc	158	67.7	60.1	74.6	1.3	31.0	1.1	−9.4	11.5

Table 12.18. 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 2011	95% LCL change	95% UCL change
Dorset	243	74.1	68.2	79.2	1.2	24.7	11.0	2.6	19.4
Dudley	153	58.8	50.9	66.3	2.0	39.2	3.2	-8.3	14.7
Exeter	351	82.1	77.7	85.7	9.1	8.8	12.7	6.3	19.1
Glouc	193	58.0	51.0	64.8	0.5	41.5	3.4	-6.6	13.4
Hull	310	86.1	81.8	89.6	2.3	11.6	3.7	-2.1	9.4
Ipswi	124	70.2	61.6	77.6	0.8	29.0	35.7	24.1	47.4
Kent	359	81.9	77.6	85.5	3.9	14.2	6.4	0.4	12.4
L Barts	562	71.7	67.8	75.3	5.7	22.6	25.2	20.1	30.3
L Guys	424	75.0	70.7	78.9	4.3	20.8	13.0	6.4	19.6
L Kings	459	17.0	13.8	20.7	0.0	83.0	-13.3	-18.9	-7.8
L Rfree	554	69.7	65.7	73.4	2.5	27.8	0.1	-5.4	5.5
L St.G	264	20.1	15.7	25.3	0.0	79.9	-9.3	-16.6	-2.0
L West	880	71.7	68.6	74.6	25.3	3.0	-2.9	-7.1	1.2
Leeds	454	63.7	59.1	68.0	8.8	27.5	-10.5	-16.4	-4.5
Leic	797	47.8	44.4	51.3	2.6	49.6	-3.1	-8.0	1.8
Liv Ain	163	57.1	49.4	64.4	0.0	42.9	-6.3	-17.1	4.4
Liv RI	343	13.4	10.2	17.4	0.6	86.0	-45.5	-51.8	-39.3
M RI	437	54.9	50.2	59.5	2.1	43.0	-7.1	-13.8	-0.4
Middlbr	310	20.3	16.2	25.2	0.0	79.7	-2.7	-9.4	4.0
Newc	262	32.1	26.7	38.0	3.1	64.9	12.9	5.4	20.4
Norwch	301	57.8	52.2	63.3	0.7	41.5	1.9	-6.1	9.9
Nottm	335	39.1	34.0	44.4	1.5	59.4	10.4	3.4	17.3
Oxford	389	61.4	56.5	66.2	2.8	35.7	14.7	7.7	21.6
Plymth	119	28.6	21.2	37.3	0.0	71.4	-50.5	-61.3	-39.6
Ports	509	70.9	66.8	74.7	3.1	25.9	-0.5	-6.2	5.2
Prestn	490	60.8	56.4	65.0	3.1	36.1	0.9	-5.2	7.1
Redng	251	49.8	43.7	56.0	0.8	49.4	-3.9	-12.6	4.9
Sheff	561	46.5	42.4	50.7	0.7	52.8	-2.2	-8.1	3.6
Shrew	184	50.5	43.4	57.7	0.0	49.5	-9.1	-19.4	1.1
Stevng	372	68.8	63.9	73.3	1.6	29.6	10.5	3.7	17.4
Sthend	107	36.5	27.9	46.0	1.9	61.7	-11.8	-24.7	1.1
Sund	183	20.2	15.0	26.7	1.6	78.1	17.1	10.7	23.5
Truro	133	82.7	75.3	88.2	4.5	12.8	37.8	27.3	48.3
Wirral	173	47.4	40.1	54.8	0.6	52.0	1.2	-9.6	11.9
Wolve	267	78.3	72.9	82.8	3.8	18.0	3.1	-3.9	10.1
York	122	62.3	53.4	70.4	1.6	36.1	20.6	8.1	33.0
N Ireland									
Antrim	123	63.4	54.6	71.4	1.6	35.0	41.6	30.3	52.9
Belfast	206	63.6	56.8	69.9	0.5	35.9	10.4	0.9	19.9
Newry	85	72.9	62.6	81.3	3.5	23.5	32.1	18.6	45.7
Ulster	101	71.3	61.7	79.3	2.0	26.7	5.0	-7.8	17.7
West NI	129	53.5	44.9	61.9	1.6	45.0	-14.4	-26.1	-2.7
Wales									
Bangor	82	47.6	37.0	58.3	1.2	51.2	14.6	-0.1	29.3
Cardff	430	64.0	59.3	68.4	5.8	30.2	-0.2	-6.6	6.1
Clwyd	76	77.6	66.9	85.6	2.6	19.7	-0.3	-14.5	13.8
Swanse	308	51.0	45.4	56.5	1.6	47.4	16.1	8.5	23.7
Wrexm	86	89.5	81.1	94.5	3.5	7.0	0.4	-8.9	9.7
England	16,502	58.5	57.8	59.3	3.9	37.6	4.1	3.0	5.1
N Ireland	644	64.0	60.2	67.6	1.6	34.5	13.3	8.0	18.6
Wales	982	61.8	58.7	64.8	3.7	34.5	7.0	2.7	11.3
E, W & NI	18,128	58.9	58.2	59.6	3.8	37.3	4.5	3.5	5.6

Table 12.19. Summary statistics for serum bicarbonate in peritoneal dialysis patients by centre in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	97.6	41	21.2	2.6	21	20	23
B QEH	92.0	137	24.2	3.5	25	22	26
Basldn	96.4	27	27.6	3.9	27	24	30
Bradfd	95.8	23	26.3	2.5	27	24	28
Brightn	79.7	55	25.3	3.5	26	22	28
Bristol	100.0	56	22.5	2.7	23	21	24
Camb	93.8	30	27.8	3.4	29	25	30
Carlis	100.0	21	22.3	3.8	23	21	24
Carsh	90.7	88	26.7	3.5	27	25	29
Chelms	100.0	25	24.7	3.4	26	23	27
Colchr*							
Covnt	89.3	75	26.2	2.8	26	24	28
Derby	100.0	84	24.3	3.1	25	22	26
Donc	100.0	23	25.5	3.4	26	22	29
Dorset	68.4	26	24.5	3.5	25	23	28
Dudley	98.1	52	27.3	3.1	28	26	29
Exeter	100.0	69	21.7	3.1	22	20	24
Glouc	93.6	29	25.2	2.9	26	23	26
Hull	94.9	75	26.1	3.0	27	25	28
Ipswi	100.0	30	28.2	3.1	29	26	31
Kent	98.2	54	23.9	2.8	23	22	26
L Barts	97.6	163	23.9	2.7	24	22	26
L Guys	96.3	26	23.8	2.7	24	22	26
L Kings	98.7	75	27.1	2.9	27	25	29
L Rfree	81.4	83	26.6	3.0	27	25	29
L St.G	97.9	47	27.5	2.6	28	26	29
L West	100.0	47	21.5	2.7	22	20	24
Leeds	100.0	77	26.0	3.1	26	24	29
Leic	96.5	138	26.8	3.7	27	25	29
Liv Ain	100.0	17					
Liv RI	98.2	54	25.8	3.4	26	24	28
M RI	98.7	75	26.0	3.2	26	24	28
Middlbr	87.5	7					
Newc	86.5	32	24.1	2.5	24	23	26
Norwch	100.0	48	22.9	3.2	23	21	24
Nottm	55.6	40	28.6	3.2	28	26	31
Oxford	76.8	53	25.1	3.6	25	24	27
Plymth	93.6	29	25.2	2.3	26	24	27
Ports	98.7	77	25.6	2.6	26	24	27
Prestn	98.3	58	24.8	3.7	26	22	28
Redng	100.0	63	27.8	2.6	28	26	29
Salford	11.1	10					
Sheff	100.0	67	26.0	3.3	26	24	28
Shrew	97.0	32	26.5	3.3	27	25	29
Stevng	96.3	26	26.0	2.5	26	25	27
Sthend	100.0	14					
Stoke	98.6	68	26.9	3.5	27	25	29
Sund	100.0	17					
Truro	94.7	18					
Wirral	75.9	22	25.1	2.2	25	24	27
Wolve	97.6	81	24.6	2.7	25	23	26
York	100.0	27	26.3	2.5	27	24	29

Table 12.19. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
N Ireland							
Antrim	30.0	3					
Belfast	96.0	24	25.4	3.3	25	23	28
Newry	57.1	8					
Ulster	100.0	6					
West NI	86.7	13					
Wales							
Bangor	100.0	14					
Cardff	93.0	66	26.5	3.9	26	23	30
Clwyd	100.0	15					
Swanse	100.0	54	25.6	3.3	27	24	28
Wrexm	95.0	19					
England	91.2	2,611	25.4	3.5	26	23	28
N Ireland	77.1	54	24.6	2.9	24	23	27
Wales	96.6	168	25.9	3.4	26	24	28
E, W & NI	91.2	2,833	25.4	3.5	26	23	28

Blank cells denote low patient numbers or poor data completeness

*No PD patients

PD patients was 80% (CI 78–81%) (table 12.20). Collectively there was significant inter-centre variation for both HD and PD (tables 12.18, 12.20, figures 12.19, 12.20). There was even greater between centre variation in the proportion of patients with bicarbonate values above and below the specified range for the audit measure

(tables 12.18, 12.20). The UKRR has previously conducted a limited survey into the possible underlying causes of this variation. The study predominantly looked at measures of sample processing and of dialysis treatment. It did not adjust for case-mix and was unable to detect any significant differences between centres.

Table 12.20. Percentage of peritoneal dialysis patients within, below and above the range for bicarbonate (22–30 mmol/L) by centre in 2012

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 2011	95% LCL change	95% UCL change
England									
B Heart	41	41.5	27.6	56.9	58.5	0.0	–47.7	–65.8	–29.6
B QEH	137	72.3	64.2	79.1	24.1	3.7	–8.4	–18.4	1.5
Basldn	27	74.1	54.7	87.1	3.7	22.2	–21.8	–40.1	–3.4
Bradfd	23	100.0	0.0	100.0	0.0	0.0	22.2	6.5	37.9
Brightn	55	80.0	67.4	88.6	14.6	5.5	1.3	–13.4	16.1
Bristol	56	62.5	49.3	74.1	37.5	0.0	–27.3	–42.2	–12.5
Camb	30	76.7	58.5	88.5	6.7	16.7	–4.6	–24.9	15.7
Carlis	21	57.1	36.0	76.0	42.9	0.0	24.0	24.0	24.0
Carsh	88	80.7	71.1	87.6	8.0	11.4	4.5	–7.6	16.7
Chelms	25	76.0	55.8	88.8	24.0	0.0	–14.9	–35.5	5.7
Covnt	75	86.7	77.0	92.7	8.0	5.3	1.1	–9.9	12.2
Derby	84	82.1	72.5	88.9	15.5	2.4	–3.3	–14.1	7.5
Donc	23	78.3	57.2	90.7	17.4	4.4	–17.0	–36.1	2.2
Dorset	26	73.1	53.3	86.6	23.1	3.9	–1.3	–23.2	20.6
Dudley	52	84.6	72.1	92.1	3.9	11.5	5.5	–9.7	20.6
Exeter	69	55.1	43.3	66.3	44.9	0.0	–30.2	–44.9	–15.5
Glouc	29	86.2	68.5	94.7	6.9	6.9	–7.5	–22.6	7.6
Hull	75	90.7	81.7	95.5	8.0	1.3	2.8	–7.1	12.8
Ipswi	30	73.3	55.0	86.1	0.0	26.7	–16.7	–35.8	2.5
Kent	54	79.6	66.8	88.4	20.4	0.0	10.8	–5.0	26.6
L Barts	163	79.1	72.2	84.7	20.3	0.6	–8.0	–16.3	0.2
L Guys	26	76.9	57.2	89.3	23.1	0.0	–5.2	–26.8	16.3

Table 12.20. 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 2011	95% LCL change	95% UCL change
L Kings	75	81.3	70.9	88.6	1.3	17.3	-15.8	-25.5	-6.2
L Rfree	83	83.1	73.5	89.8	9.6	7.2	-0.6	-12.0	10.8
L St.G	47	87.2	74.4	94.2	4.3	8.5	18.6	2.7	34.5
L West	47	53.2	39.1	66.8	46.8	0.0	-18.7	-39.8	2.4
Leeds	77	81.8	71.6	88.9	11.7	6.5	-7.1	-18.1	3.9
Leic	138	79.0	71.4	85.0	5.8	15.2	3.1	-6.9	13.0
Liv RI	54	83.3	71.0	91.1	7.4	9.3	-0.9	-14.6	12.8
M RI	75	86.7	77.0	92.7	6.7	6.7	-0.6	-11.6	10.3
Newc	32	81.3	64.1	91.3	18.8	0.0	-0.3	-18.6	18.0
Norwch	48	68.8	54.4	80.2	29.2	2.1	2.8	-16.1	21.6
Nottm	40	75.0	59.5	86.0	0.0	25.0	0.0	0.0	0.0
Oxford	53	86.8	74.8	93.6	9.4	3.8	22.0	6.3	37.6
Plymth	29	89.7	72.4	96.6	10.3	0.0	0.5	-14.5	15.4
Ports	77	93.5	85.3	97.3	3.9	2.6	5.7	-3.6	14.9
Prestn	58	81.0	68.9	89.2	17.2	1.7	1.4	-13.3	16.1
Redng	63	82.5	71.2	90.1	0.0	17.5	7.5	-6.2	21.2
Sheff	67	80.6	69.4	88.4	9.0	10.5	2.8	-11.8	17.4
Shrew	32	81.3	64.1	91.3	9.4	9.4	-2.8	-22.5	17.0
Stevng	26	92.3	73.9	98.1	3.9	3.9	0.3	-14.5	15.1
Stoke	68	75.0	63.4	83.9	8.8	16.2	19.8	4.0	35.5
Wirral	22	95.5	73.9	99.4	4.6	0.0	28.8	8.0	49.6
Wolve	81	86.4	77.1	92.3	13.6	0.0	-0.7	-11.9	10.5
York	27	96.3	77.9	99.5	3.7	0.0	1.3	-10.6	13.2
N Ireland									
Belfast	24	83.3	63.1	93.6	12.5	4.2	15.5	-7.4	38.3
Wales									
Cardff	66	74.2	62.4	83.4	9.1	16.7	-6.9	-20.2	6.4
Swanse	54	83.3	71.0	91.1	13.0	3.7	7.8	-7.8	23.4
England	2,611	79.2	77.6	80.7	14.2	6.6	-2.2	-4.4	0.0
N Ireland	54	87.0	75.2	93.7	11.1	1.9	8.1	-5.8	22.0
Wales	168	81.0	74.3	86.2	10.1	8.9	-1.4	-9.5	6.8
E, W & NI	2,833	79.5	77.9	80.9	13.9	6.6	-1.9	-4.0	0.1

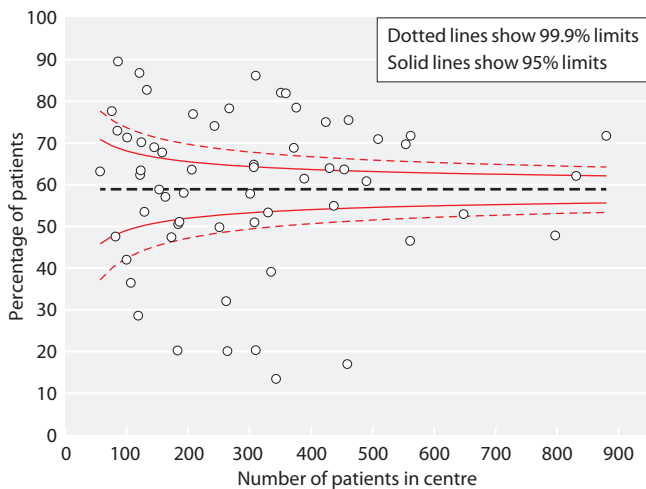


Fig. 12.19. Funnel plot for percentage of haemodialysis patients within the range for bicarbonate (18–24 mmol/L) by centre in 2012

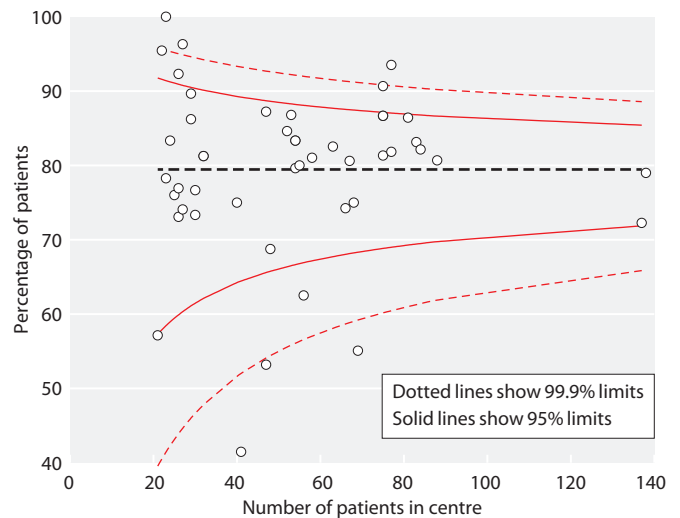


Fig. 12.20. Funnel plot for percentage of peritoneal dialysis patients within the range for bicarbonate (22–30 mmol/L) by centre in 2012

However, it is possible that there may be unmeasured processes including dialysis and oral bicarbonate prescription that might account for the variation observed [19].

Total cholesterol

There is no audit standard for total cholesterol in the Renal Association clinical practice guidelines. Current guidance on lipid management states:

'We recommend that statins (or 3 hydroxy-3 methyl-glutaryl-coenzyme A reductase inhibitors) should be considered for primary prevention in all CKD Stages 1-4 and transplant patients with a 10-year risk of cardiovascular disease, calculated as >20% according to the Joint British Societies' Guidelines - JBS2 (British Hypertension Society British Cardiac Society 2005).

We recommend that a total cholesterol of <4 mmol/L or a 25% reduction from baseline, or a fasting low density lipoprotein (LDL)-cholesterol of <2 mmol/L or a 30% reduction from baseline, should be achieved, whichever is the greatest reduction in all patients.

Statins should not be withdrawn from patients in whom they were previously indicated and should continue to be prescribed when such patients start renal replacement therapy (RRT) or change modality.' [20]

Total cholesterol data were 82% complete for HD patients and 78% complete for PD patients. As there are no specific audit measures for total cholesterol, summary data are presented for each dialysis centre (tables 12.21, 12.22, figures 12.21, 12.22). There are a number of case-mix factors (comorbidity, inflammation,

Table 12.21. Summary statistics for total cholesterol in haemodialysis patients by centre in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	98.8	396	4.2	1.1	4.1	3.3	4.8
B QEH	93.8	810	4.0	1.1	3.8	3.2	4.6
Basldn	98.0	147	3.9	1.0	3.7	3.2	4.6
Bradfd	91.5	173	3.8	1.0	3.7	3.1	4.4
Brightn	32.8	111					
Bristol	94.8	437	4.1	1.1	3.9	3.4	4.7
Camb	83.3	270	3.8	1.1	3.6	3.0	4.5
Carlis	100.0	57	4.2	1.2	4.1	3.3	5.0
Carsh	85.8	599	4.1	1.1	3.9	3.4	4.8
Chelms	88.4	107	3.6	0.9	3.5	2.9	4.1
Colchr	50.9	55	3.8	1.1	3.7	2.9	4.5
Covnt	0.3	1					
Derby	95.7	200	4.2	1.1	4.0	3.4	4.9
Donc	97.5	154	3.8	0.9	3.7	3.1	4.4
Dorset	91.4	223	3.9	1.0	3.9	3.2	4.6
Dudley	89.5	137	3.7	1.0	3.6	3.0	4.3
Exeter	96.6	339	3.9	1.0	3.8	3.2	4.5
Glouc	95.9	185	4.0	1.1	4.0	3.3	4.6
Hull	23.6	73					
Ipswi	90.3	112	3.8	1.0	3.6	3.1	4.3
Kent	92.0	332	4.0	1.1	3.9	3.2	4.7
L Barts	94.1	796	4.1	1.1	4.0	3.4	4.9
L Guys	39.5	234					
L Kings	89.8	413	3.8	0.9	3.7	3.1	4.4
L Rfree	61.8	413	4.1	1.2	3.9	3.3	4.7
L St.G	90.4	245	4.0	1.1	3.9	3.3	4.6
L West	83.5	1,120	3.6	0.9	3.5	2.9	4.2
Leeds	98.5	447	3.8	0.9	3.7	3.2	4.4
Leic	95.3	763	3.8	1.0	3.8	3.1	4.4
Liv Ain	88.6	147	4.0	1.1	3.8	3.1	4.8
Liv RI	96.5	333	3.8	1.1	3.8	3.0	4.5
M RI	91.1	432	4.0	1.1	3.8	3.2	4.7
Middlbr	80.8	252	4.3	1.1	4.2	3.5	4.9
Newc	100.0	262	3.8	1.0	3.7	3.1	4.3
Norwch	95.7	290	4.0	1.0	3.9	3.2	4.6

Table 12.21. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Nottm	99.2	352	4.0	1.0	3.9	3.3	4.7
Oxford	54.2	211	3.8	1.0	3.6	2.9	4.5
Plymth	90.8	108	3.8	0.9	3.7	3.1	4.3
Ports	67.1	342	4.0	1.2	3.9	3.1	4.8
Prestn	75.2	373	3.9	1.0	3.8	3.1	4.5
Redng	96.4	242	3.8	1.0	3.7	3.1	4.3
Salford	49.3	170					
Sheff	90.9	511	4.1	1.1	4.0	3.3	4.8
Shrew	96.7	178	4.0	1.0	3.9	3.3	4.5
Stevng	20.0	76					
Sthend	94.4	101	3.8	1.1	3.8	3.1	4.5
Stoke	90.8	267	3.7	0.9	3.7	3.0	4.2
Sund	98.4	181	3.8	1.0	3.7	3.2	4.3
Truro	98.5	132	4.0	1.1	3.9	3.2	4.7
Wirral	91.5	162	3.8	1.1	3.6	3.0	4.4
Wolve	98.5	266	4.3	1.1	4.2	3.5	4.9
York	98.4	120	4.2	1.1	4.1	3.4	4.9
N Ireland							
Antrim	98.4	124	3.7	1.1	3.5	3.0	4.3
Belfast	82.7	172	3.8	1.0	3.7	3.1	4.5
Newry	100.0	85	3.5	0.8	3.5	3.1	3.8
Ulster	100.0	101	3.8	1.1	3.6	3.1	4.6
West NI	100.0	129	3.7	0.8	3.7	3.1	4.2
Wales							
Bangor	95.1	78	4.2	1.1	3.9	3.5	5.0
Cardff	95.3	427	4.1	1.1	4.0	3.3	4.8
Clwyd	97.4	74	3.9	1.0	3.8	3.3	4.4
Swanse	99.0	305	4.0	1.2	3.8	3.2	4.7
Wrexm	67.4	58	4.0	1.3	4.0	3.2	4.8
England	81.1	14,857	3.9	1.1	3.8	3.2	4.6
N Ireland	94.1	611	3.7	1.0	3.6	3.1	4.3
Wales	94.2	942	4.0	1.1	3.9	3.3	4.7
E, W & NI	82.2	16,410	3.9	1.1	3.8	3.2	4.6

Blank cells denote poor data completeness

Table 12.22. Summary statistics for total cholesterol in peritoneal dialysis patients by centre in 2012

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
England							
B Heart	95.2	40	5.0	1.2	4.9	4.2	5.7
B QEH	96.0	143	4.6	1.2	4.5	3.8	5.3
Basldn	96.4	27	4.5	1.5	4.4	3.4	5.2
Bradfd	87.5	21	4.0	0.9	4.1	3.3	4.7
Brightn	18.8	13					
Bristol	82.1	46	5.3	1.5	5.0	4.4	6.4
Camb	100.0	32	4.6	1.1	4.5	3.8	5.3
Carlis	95.2	20	4.4	0.8	4.4	3.8	4.9
Carsh	21.7	21					
Chelms	88.0	22	4.6	1.2	4.4	3.6	5.3
Colchr*							
Covnt	0.0	0					
Derby	86.9	73	4.9	1.5	4.6	3.6	5.9
Donc	52.2	12					
Dorset	65.8	25	5.1	1.5	4.7	4.0	5.6

Table 12.22. Continued

Centre	% completeness	Patients with data N	Mean	SD	Median	Lower quartile	Upper quartile
Dudley	60.4	32	4.3	1.1	4.4	3.4	5.0
Exeter	95.7	66	4.7	1.3	4.6	4.0	5.4
Glouc	83.9	26	4.6	1.0	4.4	4.0	5.0
Hull	25.3	20					
Ipswi	96.7	29	4.5	1.1	4.5	3.7	5.6
Kent	87.3	48	4.6	1.4	4.7	3.5	5.4
L Barts	100.0	167	4.7	1.3	4.6	3.8	5.3
L Guys	55.6	15					
L Kings	98.7	75	4.5	1.3	4.3	3.6	5.1
L Rfree	81.4	83	4.9	1.8	4.6	3.6	5.6
L St.G	97.9	47	4.4	1.2	4.4	3.4	5.4
L West	100.0	47	4.6	1.1	4.4	3.6	5.5
Leeds	90.9	70	4.3	0.9	4.1	3.5	4.9
Leic	96.5	138	4.5	1.2	4.4	3.6	5.1
Liv Ain	94.1	16					
Liv RI	94.6	52	4.6	1.5	4.3	3.5	5.1
M RI	98.7	75	4.4	1.4	4.2	3.6	5.2
Middlbr	37.5	3					
Newc	89.2	33	4.8	1.4	4.8	3.8	5.4
Norwch	100.0	48	4.9	1.4	4.7	3.9	5.6
Nottm	88.9	64	4.6	1.3	4.4	3.6	5.2
Oxford	58.0	40	4.7	1.5	4.4	3.7	5.4
Plymth	61.3	19					
Ports	97.4	76	4.6	1.2	4.4	3.8	5.1
Prestn	86.4	51	4.4	1.2	4.0	3.6	4.7
Redng	71.4	45	4.3	1.5	4.0	3.4	4.9
Salford	85.6	77	4.6	1.3	4.5	3.9	5.4
Sheff	50.8	34	4.7	1.1	4.6	3.9	5.3
Shrew	81.8	27	4.7	1.3	4.5	3.7	5.6
Stevng	44.4	12					
Sthend	78.6	11					
Stoke	100.0	69	4.0	1.1	4.0	3.1	4.8
Sund	70.6	12					
Truro	79.0	15					
Wirral	58.6	17					
Wolve	81.9	68	5.4	1.6	5.2	4.3	6.6
York	88.9	24	5.4	1.4	5.4	4.4	6.1
N Ireland							
Antrim	100.0	10					
Belfast	96.0	24	5.2	1.3	5.0	4.5	5.8
Newry	100.0	14					
Ulster	100.0	6					
West NI	100.0	15					
Wales							
Bangor	100.0	14					
Cardff	57.8	41	4.8	1.2	4.8	3.9	5.6
Clwyd	86.7	13					
Swanse	79.6	43	4.8	1.4	4.5	3.9	5.3
Wrexm	60.0	12					
England	78.4	2,246	4.6	1.3	4.5	3.7	5.3
N Ireland	98.6	69	4.6	1.2	4.6	3.8	5.1
Wales	70.7	123	4.8	1.3	4.7	4.0	5.5
E, W & NI	78.4	2,438	4.7	1.3	4.5	3.7	5.3

Blank cells denote low patient numbers or poor data completeness

*No PD patients

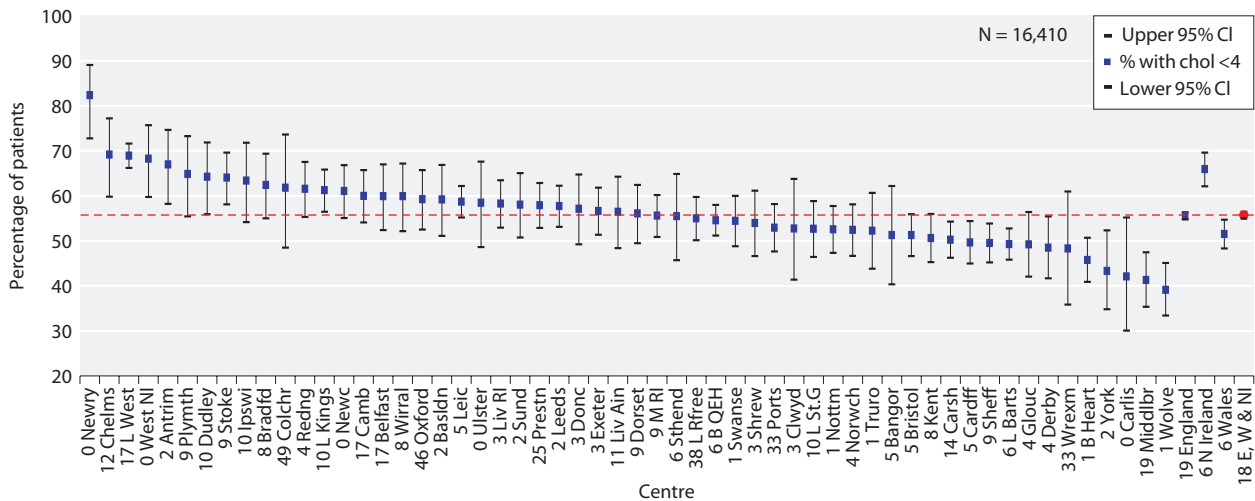


Fig. 12.21. Median total cholesterol in haemodialysis patients by centre in 2012

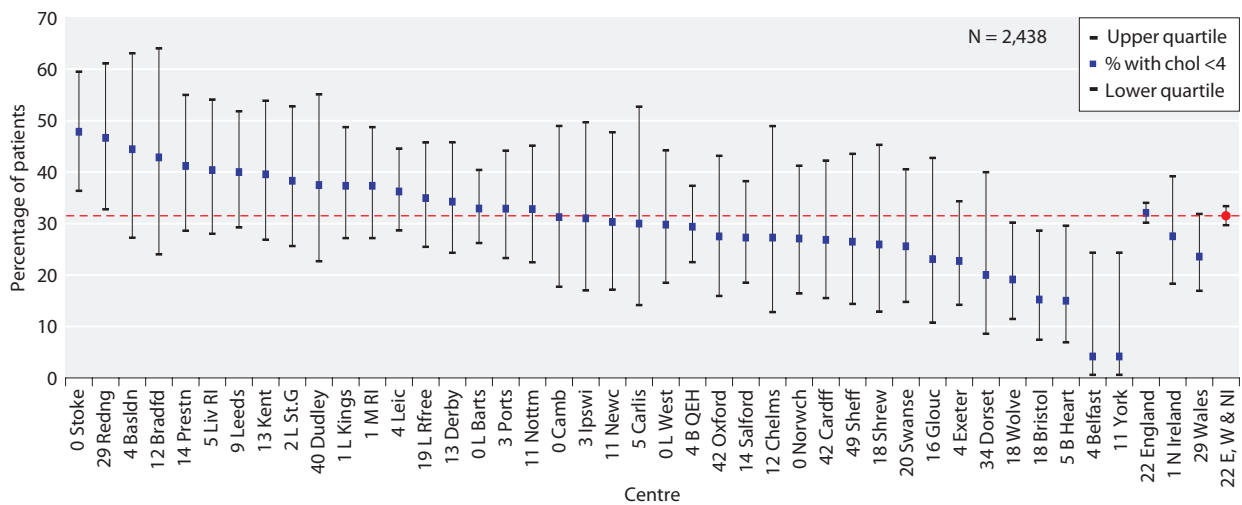


Fig. 12.22. Median total cholesterol in peritoneal dialysis patients by centre in 2012

malnutrition) which may account for any inter-centre variation in addition to differences in prescription of lipid lowering medication and other therapies known to influence serum lipid concentration such as steroids or sevelamer as examples.

Conflicts of interest: none

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