

CHAPTER 10

Management of Renal Bone Disease in Patients on Dialysis

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SECTION 10.1: TREATMENT OF RENAL BONE DISEASE

Calcium carbonate remained the main phosphate binder among both HD patients (92%) and PD patients (86%) over the last decade. The percentage of patients on aluminium based phosphate binders has decreased steadily for both HD and PD patients from 8.1% and 5.9% in 1999 to 0.5% and 0.4% in 2008 respectively. On the other hand, the use of lanthanum as phosphate binder has increased from 0.13% and 0.18% in 2006 to 0.56% and 1.0% in 2008 for both HD and PD patients. However the number is still very small since its first use in 2006. There was a higher percentage of PD patients taking lanthanum compared to HD patients. Calcitriol remained the main Vitamin D used in treatment of renal bone disease for both HD and PD patients. The percentage of patients on calcitriol therapy has increased in both HD and PD patients since 2001 but it remained static for year 2007 and 2008. Paricalcetriol was first used in Malaysia in 2006 and the percentage of usage has remained static for both HD (0.29%) and PD patients (0.2%). Twice as many patients underwent parathyroidectomy in 2008 compared to 2005 for both HD (1.1% vs. 0.5%) and PD patients (0.6% vs. 0.4%) and more HD patients underwent parathyroidectomy compared to PD patients. (Tables 10.1.1 & 10.1.2)

Table 10.1.1: Treatment for renal bone disease, HD patients, 1999- 2008

Year	No. of subjects	No. of subjects on CaCO ₃	% on CaCO ₃	No. on subjects on Al(OH) ₃	No. of subjects on Lanthanum	No. of subjects on calcitriol	% on calcitriol	No. of subjects on Paricalcetriol	No. of subjects had Parathyroidectomy
1999	2996	2693	90	244	0	770	26	0	0
2000	4392	3977	91	239	0	1084	25	0	0
2001	5194	4810	93	145	0	1145	22	0	0
2002	6108	5536	91	171	0	1375	23	0	0
2003	7018	6425	92	118	0	1690	24	0	0
2004	8164	7408	91	106	0	2029	25	0	0
2005	9351	8568	92	98	0	2556	27	0	43
2006	11682	10776	92	71	15	3817	33	34	152
2007	12907	11868	92	57	37	4927	38	58	181
2008	15280	14025	92	72	86	5879	38	43	174

Table 10.1.2: Treatment for renal bone disease, PD patients, 1999- 2008

Year	No. of subjects	No. of subjects on CaCO ₃	% on CaCO ₃	No. on subjects on Al(OH) ₃	No. of subjects on Lanthanum	No. of subjects on calcitriol	% on calcitriol	No. of subjects on Paricalcetriol	No. of subjects had Parathyroidectomy
1999	610	450	74	36	0	75	12	0	0
2000	662	522	79	15	0	96	15	0	0
2001	781	588	75	5	0	84	11	0	0
2002	891	713	80	6	0	130	15	0	0
2003	1543	1306	85	15	0	311	20	0	0
2004	1842	1552	84	24	0	439	24	0	0
2005	2207	1862	84	21	0	534	24	0	8
2006	2787	2373	85	14	5	658	24	6	27
2007	3577	3142	88	8	22	1019	28	9	22
2008	4044	3495	86	14	42	1148	28	6	26

SECTION 10.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level has remained stable for the last decade for both HD and PD patients. However, more HD patients had normal range calcium level (2.1 to 2.37 mmol/L) compared to PD patients (53% vs. 38%) in 2008. (Tables and Figures 10.2.1 and 10.2.2)

Table 10.2.1: Distribution of corrected serum calcium, HD patients, 1999- 2008

Year	No of subjects	Mean	SD	Median	LQ	UQ	%patients ≥ 2.1 & ≤ 2.37 mmol/L
1999	2732	2.3	0.3	2.3	2.2	2.5	39
2000	3703	2.4	0.3	2.3	2.2	2.5	42
2001	4618	2.4	0.2	2.4	2.2	2.5	40
2002	5485	2.3	0.3	2.3	2.2	2.5	43
2003	6466	2.3	0.2	2.3	2.2	2.4	46
2004	7536	2.3	0.2	2.3	2.2	2.4	47
2005	8630	2.3	0.2	2.3	2.2	2.4	49
2006	10881	2.3	0.2	2.3	2.1	2.4	50
2007	12275	2.2	0.2	2.2	2.1	2.4	52
2008	14360	2.3	0.2	2.3	2.1	2.4	53

Figure 10.2.1 Cumulative distribution of corrected serum calcium, HD patients, 1999-2008

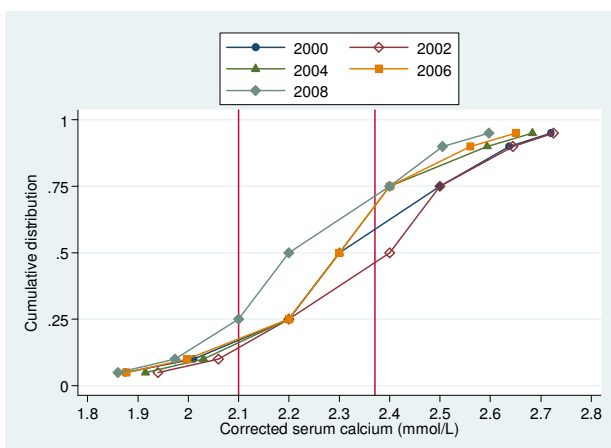


Figure 10.2.2: Cumulative distribution of corrected serum calcium, PD patients, 1999-2008

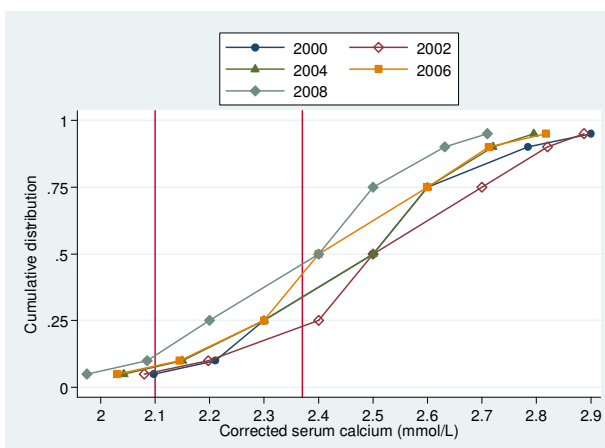


Table 10.2.2: Distribution of corrected serum calcium, PD patients, 1999-2008

Year	No of subjects	Mean	SD	Median	LQ	UQ	%patients 2.1 & ≤ 2.37 mmol/L
1999	593	2.5	0.2	2.5	2.3	2.6	25
2000	635	2.5	0.2	2.5	2.3	2.6	25
2001	744	2.5	0.3	2.5	2.4	2.7	22
2002	859	2.5	0.2	2.5	2.3	2.6	24
2003	1167	2.4	0.2	2.5	2.3	2.6	27
2004	1276	2.5	0.2	2.5	2.3	2.6	23
2005	1338	2.4	0.2	2.4	2.3	2.6	30
2006	1495	2.4	0.2	2.4	2.3	2.5	38
2007	1748	2.4	0.2	2.4	2.2	2.5	42
2008	2017	2.4	0.2	2.4	2.3	2.5	38

PD patients had better phosphate control compared to HD patients (median level 1.5 vs. 1.7mmol/L) and larger percentage of PD patients had normal range phosphate level (1.13-1.78mmol/L) as opposed to HD patients (55 vs. 48%). (Tables and Figures 10.2.3 and 10.2.4)

Table 10.2.3: Distribution of serum phosphate, HD patients, 1999- 2008

Year	No of subjects	mean	SD	Median	LQ	UQ	%patients <1.13 mmol/L	%patients ≥1.13&<1.78 mmol/L	%patients ≥1.78 &≤2.6 mmol/L	%patients >2.6 mmol/L
1999	2861	1.9	0.5	1.9	1.5	2.2	7	37	47	9
2000	4080	1.9	0.6	1.8	1.5	2.2	8	37	46	9
2001	4765	1.9	0.5	1.8	1.5	2.2	7	40	45	8
2002	5679	1.9	0.5	1.8	1.5	2.2	7	38	45	10
2003	6588	1.8	0.5	1.8	1.5	2.2	7	41	43	9
2004	7620	1.8	0.5	1.8	1.5	2.2	8	42	42	7
2005	8834	1.8	0.5	1.7	1.4	2.1	9	45	40	6
2006	11129	1.8	0.5	1.7	1.4	2.1	9	46	39	6
2007	12424	1.8	0.5	1.7	1.4	2.1	9	47	39	5
2008	14755	1.7	0.5	1.7	1.4	2	9	48	37	5

Figure 10.2.3: Cumulative distribution of serum phosphate, HD patients, 1999-2008

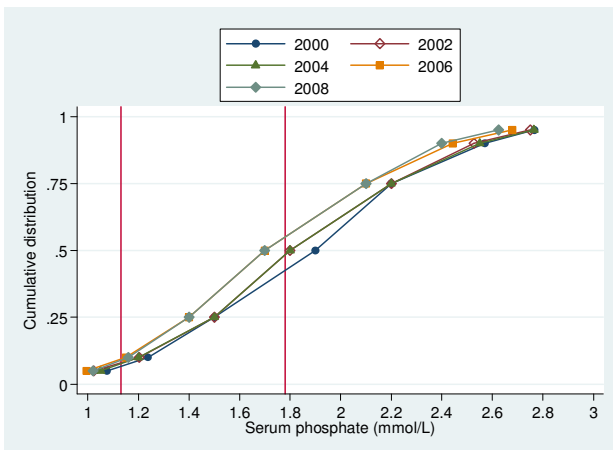


Figure 10.2.4: Cumulative distribution of serum phosphate, PD patients, 1999-2008

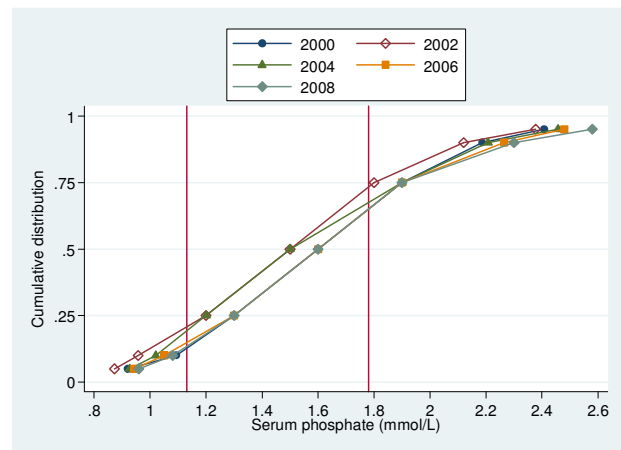


Table 10.2.4: Distribution of serum phosphate, PD patients, 1999- 2008

Year	No of subjects	mean	SD	Median	LQ	UQ	%patients <1.13 mmol/L	%patients ≥1.13&<1.78 mmol/L	%patients ≥1.78&≤2.6 mmol/L	%patients >2.6 mmol/L
1999	583	1.6	0.5	1.6	1.3	1.9	11	56	30	3
2000	633	1.5	0.5	1.5	1.3	1.8	17	55	26	2
2001	732	1.5	0.5	1.5	1.2	1.8	21	53	24	2
2002	862	1.5	0.5	1.5	1.2	1.8	21	52	25	2
2003	1173	1.6	0.5	1.5	1.2	1.9	16	53	28	3
2004	1278	1.6	0.5	1.6	1.3	1.9	15	52	29	3
2005	1343	1.6	0.5	1.6	1.3	1.9	15	52	29	3
2006	1511	1.6	0.5	1.6	1.3	1.9	13	54	29	4
2007	1757	1.6	0.5	1.6	1.3	1.9	13	55	27	5
2008	2022	1.6	0.5	1.5	1.3	1.9	15	55	25	4

The corrected calcium phosphate product had remained the same for both HD and PD patients (median 3.8 and 3.6 mmol/L respectively) for 2007 and 2008. About 47% of PD patients had corrected calcium phosphate product <3.5 mmol²/L² compared to 39% in HD patients. Overall there was a positive trend in calcium phosphate product with higher percentage of HD and PD patients with corrected calcium phosphate product <3.5 mmol²/L² and fewer patients with corrected calcium phosphate product ≥5.5 mmol²/L². (Tables and Figures 10.2.5 and 10.2.6)

Table 10.2.5: Distribution of corrected calcium x phosphate product, HD patients 1999- 2008

Year	No. of subjects	mean	SD	Median	LQ	UQ	Percent patients with calcium phosphate product:			
							<3.5 mmol ² /L ²	≥3.5 & <4.5 mmol ² /L ²	≥4.5 & <5.5 mmol ² /L ²	≥5.5 mmol ² /L ²
1999	2698	4.4	1.3	4.3	3.4	5.2	27	29	26	18
2000	3650	4.4	1.3	4.3	3.5	5.2	25	31	25	19
2001	4555	4.3	1.3	4.2	3.4	5.2	27	31	24	18
2002	5403	4.4	1.3	4.3	3.4	5.2	27	31	24	19
2003	6383	4.2	1.3	4.1	3.3	5.1	30	31	23	16
2004	7414	4.2	1.3	4.1	3.3	5	32	32	22	15
2005	8496	4	1.3	3.9	3.2	4.8	36	32	20	12
2006	10758	4	1.2	3.8	3.1	4.7	38	32	19	11
2007	12172	3.9	1.2	3.8	3.1	4.6	38	33	19	10
2008	14242	3.9	1.2	3.8	3.1	4.6	39	33	19	9

Figure 10.2.5: Cumulative distribution of corrected calcium x phosphate product, HD patients 1999- 2008

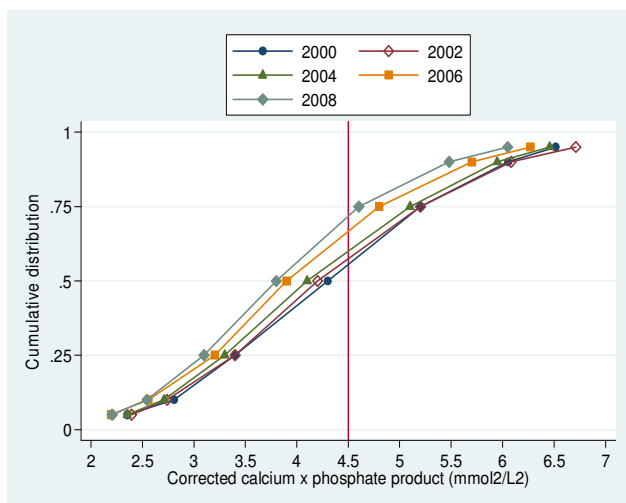


Figure 10.2.6: Cumulative distribution of corrected calcium x phosphate product, PD patients 1999- 2008

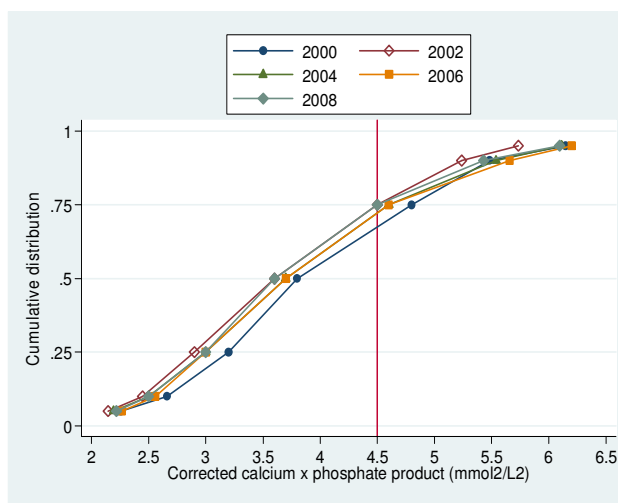


Table 10.2.6: Distribution of corrected calcium x phosphate product, PD patients 1999- 2008

Year	No. of subjects	mean	SD	Median	LQ	UQ	Percent patients with calcium phosphate product:			
							<3.5 mmol ² /L ²	≥3.5 & <4.5 mmol ² /L ²	≥4.5 & <5.5 mmol ² /L ²	≥5.5 mmol ² /L ²
1999	580	4	1.2	3.8	3.2	4.8	36	33	22	10
2000	621	3.8	1.1	3.7	3.1	4.5	44	31	17	8
2001	723	3.8	1.1	3.6	2.9	4.5	46	30	18	7
2002	856	3.8	1.2	3.6	2.9	4.5	45	29	18	8
2003	1162	3.9	1.2	3.7	3	4.6	43	29	17	10
2004	1274	4	1.2	3.8	3	4.7	41	30	18	12
2005	1333	3.9	1.3	3.7	3	4.6	43	29	17	11
2006	1494	3.9	1.2	3.7	3.1	4.6	43	31	17	9
2007	1745	3.8	1.2	3.6	3	4.5	46	29	15	10
2008	2009	3.8	1.2	3.6	3	4.5	47	28	15	10

There was wide variation in corrected serum calcium level among both HD and PD centres. The median corrected serum calcium level among 346 HD centres was 2.2 mmol/L (ranged from 1.9 to 2.6 mmol/L) in 2008 and these figures had remained quite stable for the last 10 years. (Table 10.2.7 and Figure 10.2.7a) The median corrected serum calcium level among 24 PD centres was 2.4mmol/L (ranged from 2.4 to 2.6 mmol/L) and again this range is relatively stable. (Table 10.2.8 and Figure 10.2.8a) PD patients seemed to have higher range of median corrected serum calcium level compare to HD patients.

Table 10.2.7: Variation in corrected serum calcium level among HD centres, 2008
a) median serum calcium level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	67	1.9	2	2.3	2.3	2.4	2.5	2.6
2000	93	2	2.1	2.3	2.3	2.4	2.6	3.2
2001	117	2	2.1	2.3	2.4	2.4	2.5	2.6
2002	138	1.9	2.1	2.2	2.3	2.4	2.5	2.6
2003	169	2	2.1	2.2	2.3	2.4	2.5	2.5
2004	198	1.9	2.1	2.2	2.3	2.4	2.4	2.5
2005	226	1.8	2	2.2	2.3	2.3	2.4	2.5
2006	278	1.9	2.1	2.2	2.3	2.3	2.4	2.5
2007	304	1.7	2	2.2	2.2	2.3	2.4	2.5
2008	346	1.9	2.1	2.2	2.2	2.3	2.4	2.6

Figure 10.2.7(a): Variation in median serum calcium among HD patients, HD centres, 2008

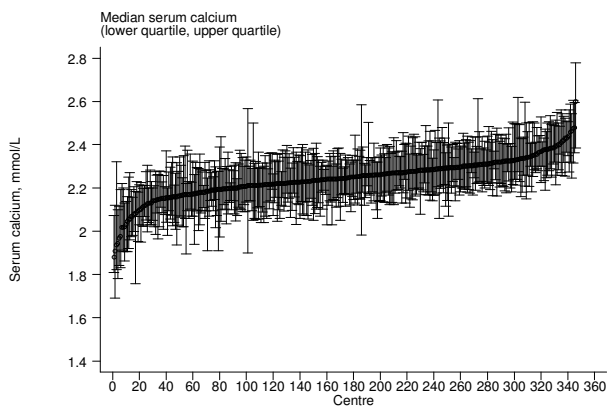


Figure 10.2.8(a): Variation in median serum calcium level among PD patients, PD centres, 2008

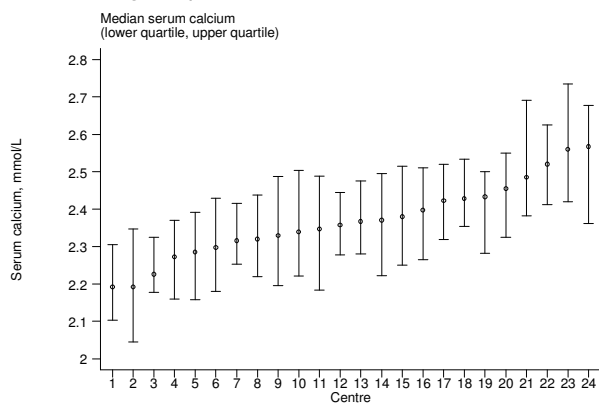


Table 10.2.8: Variation in corrected serum calcium level among PD centres, 2008
a) median serum calcium level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	10	2.4	2.4	2.4	2.5	2.6	2.6	2.6
2000	11	2.4	2.4	2.4	2.5	2.5	2.6	2.6
2001	12	2.3	2.3	2.4	2.5	2.5	2.6	2.6
2002	15	2.4	2.4	2.4	2.5	2.5	2.6	2.6
2003	19	2.2	2.2	2.4	2.4	2.5	2.6	2.6
2004	19	2.2	2.2	2.4	2.4	2.5	2.5	2.5
2005	20	2.2	2.2	2.4	2.4	2.4	2.5	2.6
2006	22	2.2	2.2	2.3	2.4	2.4	2.5	2.6
2007	23	2.2	2.2	2.3	2.3	2.4	2.4	2.5
2008	24	2.2	2.2	2.3	2.4	2.4	2.6	2.6

There was great variation among the HD and PD centres with regards to the proportion of patients achieving the normal range of corrected calcium level of 2.1 to 2.37 mmol/L; it ranged from 12 to 91% for HD centers and 13-65% for PD centers. The median was 53% for HD centres (Table & Figure 10.2.7b) and 42% for PD centres (Table & Figure 10.2.8b).

Table 10.2.7(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	67	0	9	25	39	48	58	79
2000	93	0	13	30	41	50	65	96
2001	117	7	11	30	39	50	64	87
2002	138	5	15	33	44	53	64	73
2003	169	13	24	36	47	54	70	85
2004	198	8	22	38	47	58	70	82
2005	226	0	19	38	50	57	70	83
2006	278	12	30	42	51	59	71	86
2007	304	8	29	45	52	61	75	89
2008	346	15	28	45	53	61	73	91

Figure 10.2.7(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2008

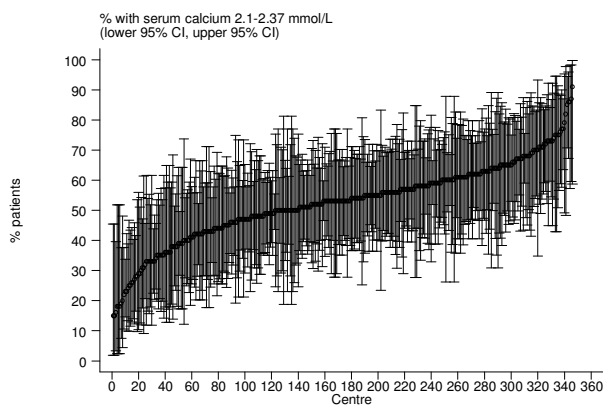


Figure 10.2.8(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, PD centres, 2008

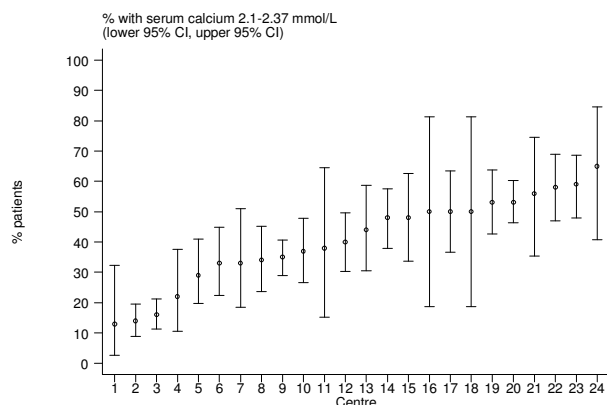


Table 10.2.8(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	10	5	5	22	27.5	31	42	42
2000	11	14	14	18	24	33	48	48
2001	12	12	12	17	23.5	34.5	38	38
2002	15	12	12	20	25	34	41	41
2003	19	9	9	19	33	40	58	58
2004	19	11	11	18	25	31	53	53
2005	20	16	17	25.5	34.5	40	48	51
2006	22	16	23	35	43	49	61	76
2007	23	19	29	31	44	50	62	63
2008	24	13	14	33	42	51.5	59	65

There was also wide variation in serum phosphate level among HD centers and PD centers (Tables and Figures 10.2.9a and 10.2.10a). PD patients seemed to have better phosphate control compared to HD patients. 52% of PD centers achieved the recommended target of serum phosphate level 1.13 – 1.78 mmol/L. compared to 46% of HD centres. There was a great variation between the HD centres with regards to the proportion of patients with serum phosphate 1.13 – 1.78 mmol/L, ranging from 12 to 88% while the range is narrower in PD centers (30-71%) (Tables and Figures 10.2.9b and 10.2.10b).

Table 10.2.9: Variation in serum phosphate level among HD centres, 1999-2008

a) Median serum phosphate level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	69	1.1	1.6	1.8	1.9	2	2.1	2.1
2000	101	1.4	1.6	1.7	1.9	1.9	2.2	3.8
2001	118	1.3	1.5	1.7	1.8	1.9	2.1	2.4
2002	146	1.3	1.5	1.8	1.9	2	2.3	2.4
2003	176	0.8	1.5	1.7	1.8	1.9	2.2	2.4
2004	198	1.3	1.5	1.7	1.8	1.9	2.1	2.3
2005	228	0.8	1.4	1.6	1.7	1.9	2.1	2.4
2006	283	0.9	1.5	1.6	1.7	1.8	2	2.3
2007	309	0.9	1.5	1.6	1.7	1.8	2	2.4
2008	351	1.2	1.4	1.6	1.7	1.8	2	2.5

Figure 10.2.9(a): Variation in median serum phosphate level among HD patients, HD centres, 2008

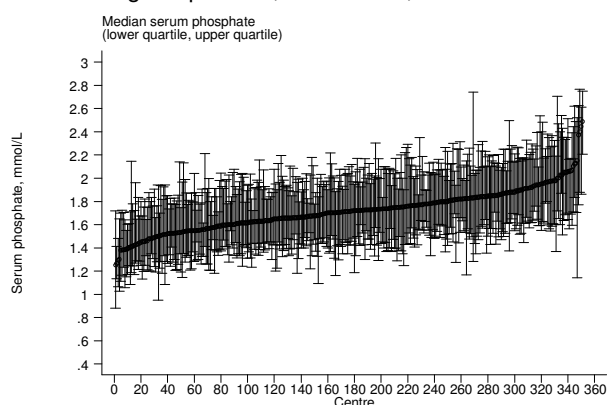
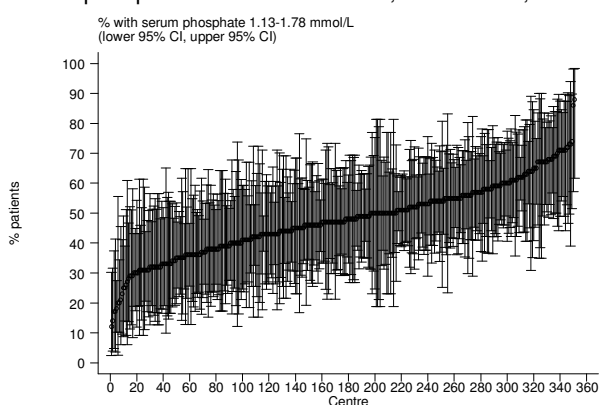


Figure 10.2.9(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres, 2008



(b) proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres, 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	69	8	14	27	36	44	59	65
2000	101	9	18	30	36	44	57	73
2001	118	0	19	32	39	47	62	67
2002	146	6	14	29	37	46	64	91
2003	176	9	20	31	40	48	67	93
2004	198	0	18	31	40	51	65	92
2005	228	10	23	36	43	53	68	90
2006	283	7	27	38	45	54	68	93
2007	309	19	28	39	46	55	68	92
2008	351	12	30	39	47	55	68	88

Table 10.2.10: Variation in serum phosphate levels among PD centres, 1999-2008

a) Median serum phosphate level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	1.5	1.5	1.5	1.6	1.6	1.7	1.7
2000	11	1.3	1.3	1.4	1.5	1.6	1.7	1.7
2001	12	1.3	1.3	1.4	1.5	1.7	1.9	1.9
2002	15	1.4	1.4	1.4	1.5	1.6	2.1	2.1
2003	19	1.2	1.2	1.4	1.5	1.6	1.7	1.7
2004	19	1.3	1.3	1.5	1.5	1.7	1.8	1.8
2005	20	1.4	1.4	1.5	1.5	1.7	1.9	1.9
2006	22	1.3	1.4	1.5	1.6	1.7	1.8	1.8
2007	23	1.3	1.4	1.5	1.6	1.7	1.9	2.4
2008	24	1.3	1.3	1.5	1.6	1.8	2	2.1

Figure 10.2.10(a): Variation in median serum phosphate level among PD patients, PD centres 2008

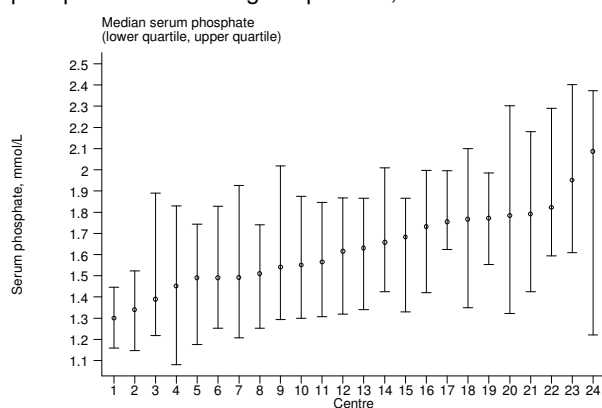


Figure 10.2.10(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2008

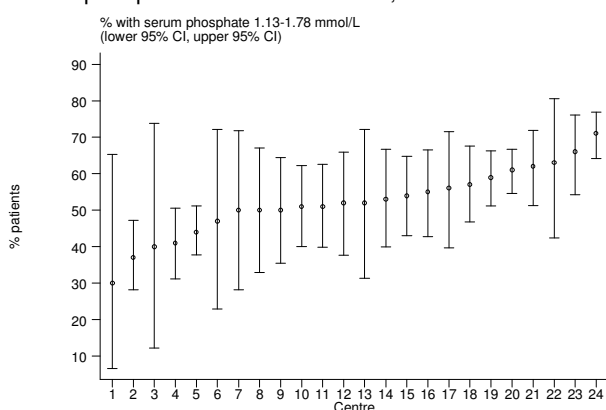


Table 10.2.10(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	45	45	51	58	66	68	68
2000	11	43	43	48	53	61	64	64
2001	12	42	42	48.5	54	58	77	77
2002	15	43	43	47	53	60	83	83
2003	19	40	40	47	54	61	77	77
2004	19	37	37	49	52	66	76	76
2005	20	36	38.5	46	53	58	73	76
2006	22	39	44	48	52.5	58	66	68
2007	23	39	40	48	53	59	73	78
2008	24	30	37	48.5	52	58	66	71

In 2008, the corrected serum calcium phosphate product among 342 HD centres ranged from 2.7 to 6.0 with median of 4.1mmol/L (Table 10.2.11 and Figure 10.2.11a). The median corrected serum calcium phosphate product among 24 PD centres ranged from 3.1 to 5.1 mmol/L with median of 3.7 mmol/L (Table 10.2.12 and Figure 10.2.12a). There was not much difference between HD and PD centres.

Table 10.2.11: Variation in corrected calcium x phosphate product HD centres, 1999-2008
a) median corrected calcium x phosphate product among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	66	2.3	3.2	4	4.3	4.7	5.1	5.2
2000	92	3.1	3.5	4	4.3	4.6	5.1	6.2
2001	114	2.9	3.6	3.9	4.3	4.6	5	6
2002	138	2.9	3.5	4	4.3	4.5	5.2	5.9
2003	169	2	3.3	3.8	4.1	4.4	5	5.5
2004	196	2.9	3.4	3.8	4.1	4.3	4.9	5.6
2005	219	2.1	3.2	3.6	3.9	4.2	4.7	5.6
2006	276	1.8	3.2	3.6	3.9	4.2	4.7	5.2
2007	302	2.2	3.2	3.6	3.9	4.1	4.5	5.4
2008	342	2.7	3.1	3.6	3.8	4.1	4.5	6

Figure 10.2.11(a): Variation in median corrected calcium x phosphate product among HD patients, HD centres, 2008

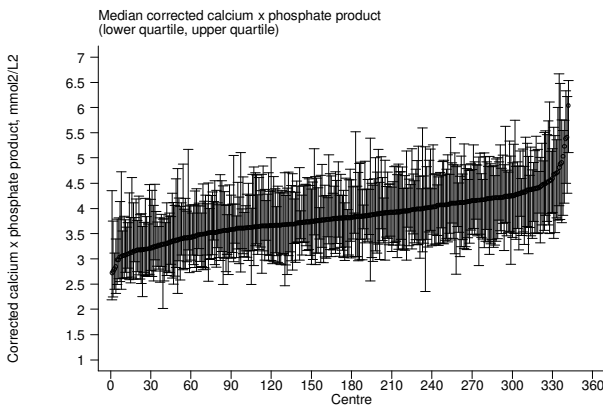


Figure 10.2.12(a): Variation in median corrected calcium x phosphate product among PD centres, 2008

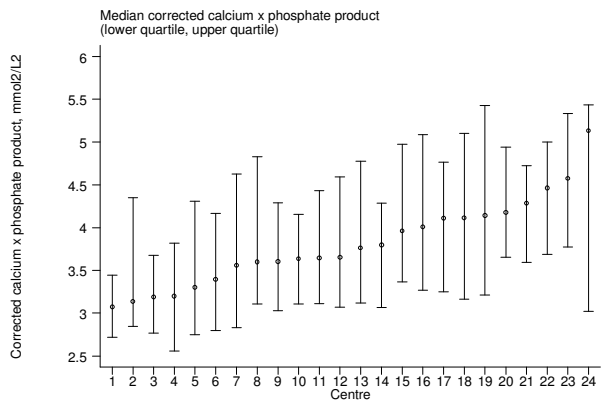


Table 10.2.12: Variation in corrected calcium x phosphate product among PD centres, 1999-2008
a) median corrected calcium x phosphate product among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	3.6	3.6	3.7	3.9	4.1	4.2	4.2
2000	11	3.4	3.4	3.5	3.7	4	4.3	4.3
2001	12	3.1	3.1	3.4	3.7	3.9	4.3	4.3
2002	15	3.3	3.3	3.4	3.6	4	4.9	4.9
2003	19	2.9	2.9	3.4	3.6	3.9	4.1	4.1
2004	19	3.2	3.2	3.5	3.8	4	4.4	4.4
2005	20	3.3	3.4	3.6	3.7	4	4.2	4.3
2006	22	3	3.3	3.6	3.7	4	4.2	4.4
2007	23	3.1	3.2	3.5	3.8	4.1	4.3	4.6
2008	24	3.1	3.1	3.5	3.7	4.1	4.6	5.1

With regards to the proportion of patients with calcium phosphate product less than $4.5 \text{ mmol}^2/\text{L}^2$, the median was 73% for HD centres (Table & Figure 10.2.11b) and 69.5% for PD centres (Table & Figure 10.2.12 b). This figure was the lowest ever achieved in PD centers for the last 10 years. There was again a great variation between the HD centres with regards to the proportion of patients with calcium phosphate product less than $4.5 \text{ mmol}^2/\text{L}^2$, ranging from 21% to 100%. (Table 10.2.11b) Among the PD centres, the proportion of patients with calcium phosphate product less than $4.5 \text{ mmol}^2/\text{L}^2$, ranged from 40% to 97% (Table 10.2.12b).

Table 10.2.11(b): Proportion of patients with corrected calcium x phosphate $< 4.5 \text{ mmol}^2/\text{L}^2$, HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	66	18	31	47	55	65	91	100
2000	92	13	27	47.5	56	65.5	80	88
2001	114	18	38	47	57	70	82	91
2002	138	11	32	48	57	68	89	100
2003	169	25	33	52	62	72	88	100
2004	196	18	36	54.5	64	72.5	90	100
2005	219	23	45	58	69	77	93	100
2006	276	32	46	60.5	69	79	91	100
2007	302	30	48	62	72	81	92	100
2008	342	21	50	63	73	82	92	100

Figure 10.2.11(b): Variation in proportion of patients with corrected calcium x phosphate product $< 4.5 \text{ mmol}^2/\text{L}^2$, HD centres 2008

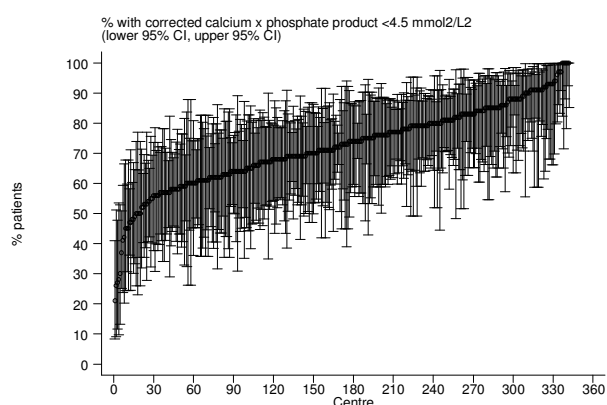


Figure 10.2.12(b): Variation in proportion of patients with corrected calcium x phosphate product $< 4.5 \text{ mmol}^2/\text{L}^2$, PD centres, 2008

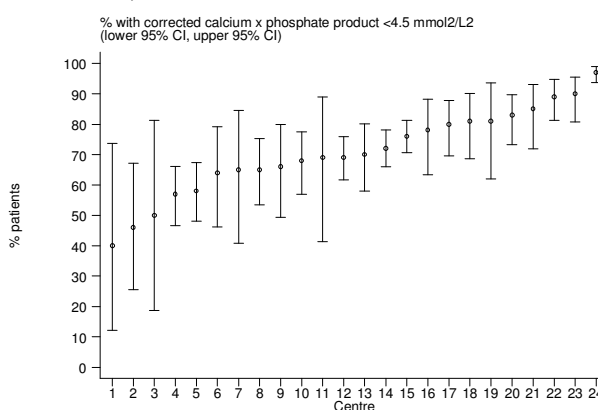


Table 10.2.12(b): Proportion of patients with corrected calcium x phosphate $< 4.5 \text{ mmol}^2/\text{L}^2$, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	59	59	65	72	77	79	79
2000	11	64	64	70	73	81	85	85
2001	12	50	50	71.5	75	81.5	84	84
2002	15	43	43	65	78	82	88	88
2003	19	61	61	64	75	82	100	100
2004	19	57	57	66	72	79	90	90
2005	20	55	55.5	65	73.5	78	84.5	85
2006	22	55	57	65	72	78	88	96
2007	23	50	51	63	73	79	89	98
2008	24	40	46	64.5	69.5	81	90	97

SECTION 10.3: SERUM PARATHYROID HORMONE CONTROL

Current trend showed that for the last 10 years, the intact parathyroid hormone (iPTH) level was on the rise in both HD and PD patients. PD patients had relatively higher level of iPTH compared to HD patients. The mean iPTH level for HD patients was 260.1ng/ml with the median of 126.2ng/ml (Table and Figure 10.3.1a). For PD patients, the mean iPTH level was 264.2ng/ml with the median of 170.3ng/ml. (Table and Figure 10.3.2a). There was higher percentage of HD patients with iPTH level less than 150 ng/ml (54%) compared to PD patients (46%). Diabetic patients had lower iPTH level than non diabetic patients in both HD and PD populations, with the mean of 208.4ng/ml vs. 300.4ng/ml for HD patients and 209.2ng/ml vs. 309.4ng/ml for PD patients. (Tables and Figures 10.3.1b, 10.3.1c, 10.3.2b and 10.3.2c)

Table 10.3.1(a): Distribution of iPTH, HD patients, 1999-2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
1999	1533	185.6	260.7	78.9	23.5	240	64	16	10	10
2000	2244	149.3	230	58	17.6	178.3	72	13	8	7
2001	2760	141.2	219.5	57	18	164.8	73	15	6	7
2002	3391	161.6	248	64	19	191	70	14	8	8
2003	4068	219.1	328.8	79	24.3	263.3	64	14	9	14
2004	4748	212.1	325.6	74.3	22.6	257.3	65	13	9	13
2005	5826	221.6	312.5	83.8	26.5	297	61	14	11	14
2006	7744	219.1	307.2	88	29	292	61	14	11	13
2007	9151	245.8	332.7	105	30.4	335.5	58	15	12	16
2008	10710	260.1	330.2	126.2	36	360	54	17	13	17

Figure 10.3.1(a): Cumulative distribution of iPTH, HD, 1999- 2008

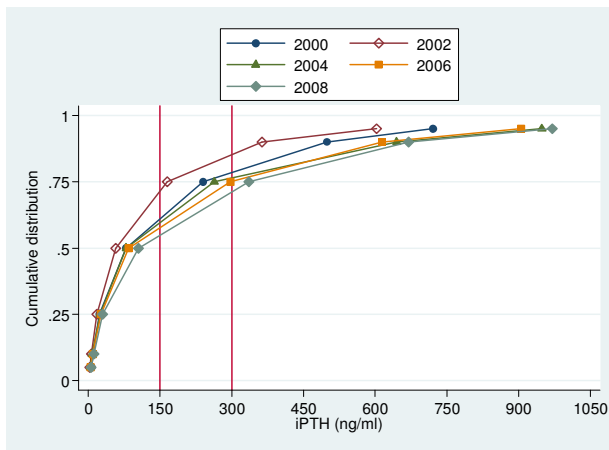


Figure 10.3.1(b): Cumulative distribution of iPTH, diabetic HD patients, 1999- 2008

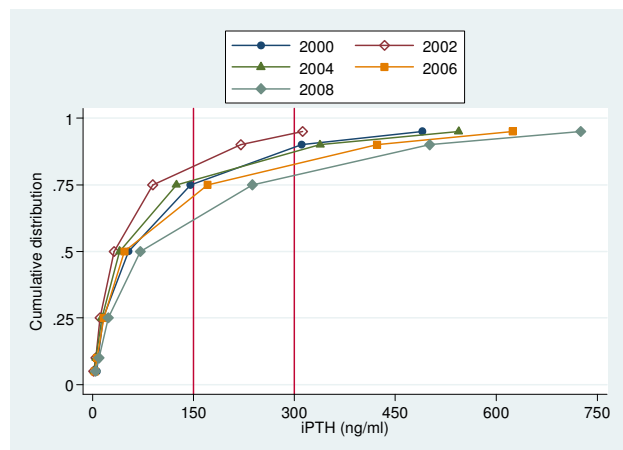


Table 10.3.1(b): Distribution of iPTH, diabetic HD patients, 1999- 2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
1999	336	121.5	181.8	53.5	16	145.8	75	14	6	5
2000	531	87.4	137.1	35.6	10.6	101	83	9	6	2
2001	720	82.5	139.6	32	10.9	89.5	83	11	3	2
2002	967	92.5	161.5	35	11	99	83	10	4	3
2003	1249	122.1	210.8	40.5	13.5	124.5	78	10	6	6
2004	1581	113.4	196.3	38	14	118	80	10	5	5
2005	2164	150.7	248	47.5	16.3	171	72	12	8	8
2006	3146	154.6	252.1	54.3	20.9	173	72	12	8	7
2007	3804	184.4	269.5	71.1	23	237.8	65	14	10	10
2008	4692	208.4	275	98.2	29.1	286.3	59	17	12	12

Table 10.3.1(c): Distribution of iPTH, non diabetic HD patients, 1999- 2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
1999	1197	203.6	276.3	93.2	26.5	267.2	61	17	11	11
2000	1713	168.5	248.8	65.7	21.8	204	69	14	9	9
2001	2040	162	238.1	71	23.5	198	69	16	7	8
2002	2424	189.2	270.2	85	26	236.8	65	15	10	10
2003	2819	262	361	108.5	33.6	331	57	16	10	17
2004	3167	261.3	363.9	102.8	31	341	58	14	12	17
2005	3662	263.5	338.1	115	36	365	55	15	13	17
2006	4598	263.3	332.7	125.3	39.6	366	54	16	13	17
2007	5347	289.5	364.9	135.8	39	406	52	15	13	20
2008	6018	300.4	362.5	156	43	423	49	17	14	21

Figure 10.3.1(c): Cumulative distribution of iPTH, non diabetic HD patients, 1999- 2008

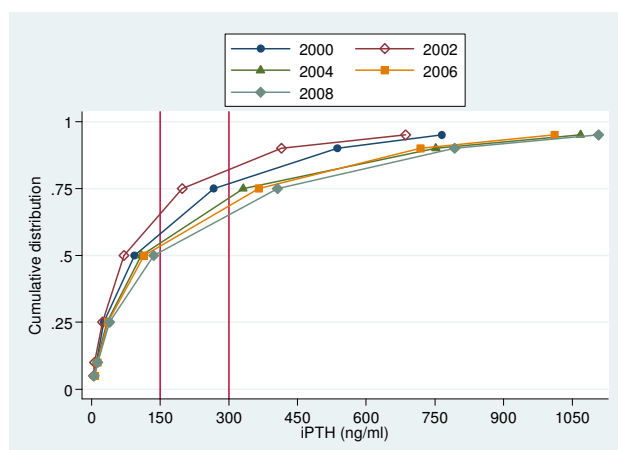


Figure 10.3.2(a): Cumulative distribution of iPTH, PD patients, 1999- 2008

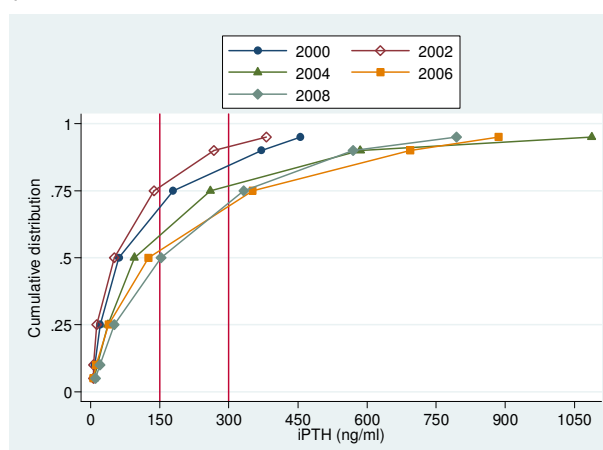


Table 10.3.2(a): Distribution of iPTH, PD patients, 1999- 2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
1999	365	132.8	176.4	61.5	21	179.3	71	15	10	4
2000	406	109.8	192.4	46.8	15.5	118	80	12	5	4
2001	531	108	155.8	51.5	13.5	137.6	76	15	6	3
2002	681	160.6	219.1	82	26	196	67	17	8	7
2003	938	230.3	340.3	95	37.4	260	61	18	9	12
2004	1115	216.4	302.9	105	39.5	260	60	19	10	11
2005	1071	247.1	306.4	125.3	39	352	54	18	13	15
2006	1265	224.6	271.9	128	41.5	318	54	20	14	12
2007	1436	248.4	297.1	152.5	51	332.8	50	22	15	14
2008	1608	264.2	295.3	170.3	57.3	357.7	46	22	18	15

Table 10.3.2(b): Distribution of iPTH, diabetic PD patients, 1999-2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
1999	100	95.8	145.2	41	17	111.6	81	11	5	3
2000	114	66.2	174.5	27.7	6	69	89	9	2	1
2001	166	65.4	87.4	32.8	7.5	82.5	87	10	2	1
2002	208	100.4	154.6	59.5	16	131.5	80	14	3	2
2003	330	122.9	176.2	68	29	154.3	74	16	6	4
2004	385	131.3	190.8	65.5	24.8	151	75	15	4	5
2005	372	162.4	237.8	73.1	24.5	197.3	70	16	8	7
2006	467	152.5	198.6	92	33	190	67	19	8	5
2007	575	177.2	204	113	42	239	58	25	11	6
2008	726	209.2	225.9	141.3	56	292.5	51	25	16	8

Figure 10.3.2(b): Cumulative distribution of iPTH, diabetic PD patients, 1999- 2008

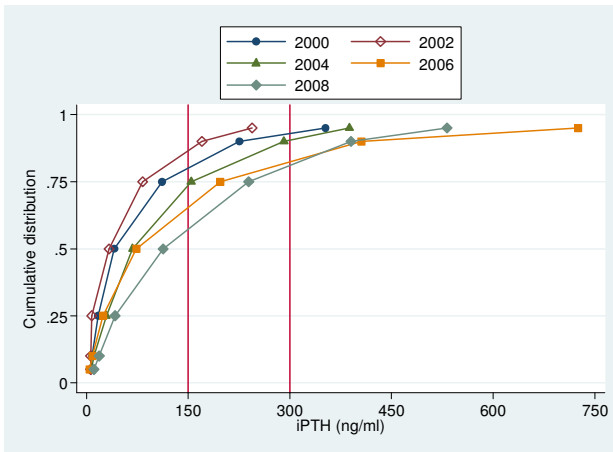


Figure 10.3.2(c): Cumulative distribution of iPTH, non diabetic PD patients, 1999- 2008

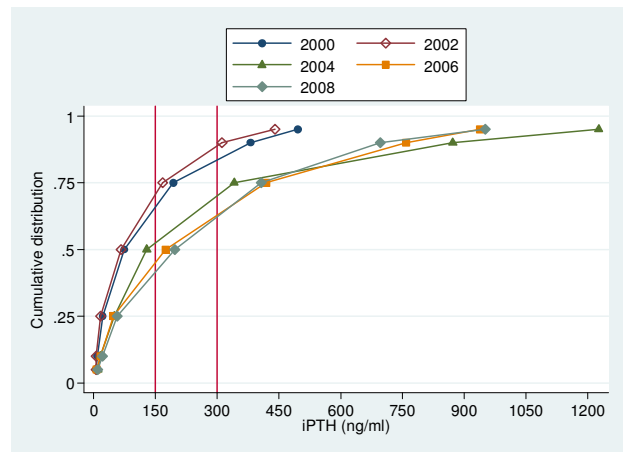


Table 10.3.2(c): Distribution of iPTH, non diabetic PD patients, 1999- 2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
1999	265	146.8	185.2	75	22.5	194	67	16	12	5
2000	292	126.7	196.6	57.3	22.7	139	76	13	6	5
2001	365	127.4	175.1	67	17	168	72	18	7	4
2002	473	187.1	237.5	100	33	242	62	19	10	10
2003	608	288.6	390.1	129	50.5	341.5	54	18	10	17
2004	730	261.3	339.4	140.3	50	329	52	21	12	15
2005	699	292.1	328.6	174.5	48	419	46	19	16	19
2006	798	266.8	298.9	166.8	50	390	47	21	17	16
2007	861	296	337.4	197	57.7	407	44	20	18	18
2008	882	309.4	335.5	213.9	58	431	41	20	18	21

There was wide variation in iPTH among HD and PD centers and the degree of variation seemed to become wider since 1999. The variation also was noted to be greater among HD centers compared to PD centers. With regards to the proportion of patients with serum iPTH level in the range 150-300 ng/ml, the median was only 16% for HD centres (Table & Figure 10.3.3b) and 19.5% for PD centres (Table & Figure 10.3.4b).

Table 10.3.3(a): Variation in iPTH among HD centres 1999-2008
a) median iPTH among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	42	10	19.7	36.3	76	145.2	250	443.5
2000	59	5.6	15.5	30	51.5	94.1	355	487.5
2001	68	7.2	10.4	26.3	52.3	87	225.8	566.5
2002	93	1.4	10.8	27.9	46.5	136.5	309	660.3
2003	113	4	10.8	37.7	96.3	195.2	344.3	624.5
2004	134	3.6	12.4	30.5	76	203.5	412	702
2005	164	5.8	14.3	36.8	95.8	228.3	369.2	612.3
2006	220	7.7	16.5	41.7	89.9	208.3	377.5	681.3
2007	245	9.5	19.6	46	123	240.2	440.4	615
2008	286	8.5	22	55.6	131.2	255.8	399	716.9

Figure 10.3.3(a): Variation in median iPTH among HD patients, HD centres 2008

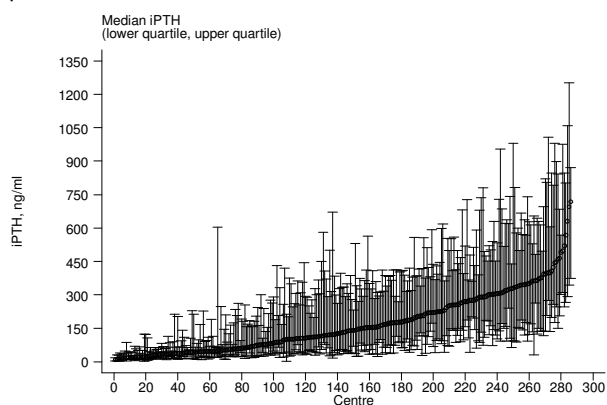


Figure 10.3.3(b): Variation in proportion of patients with iPTH 150-300ng/ml, HD centres, 2008

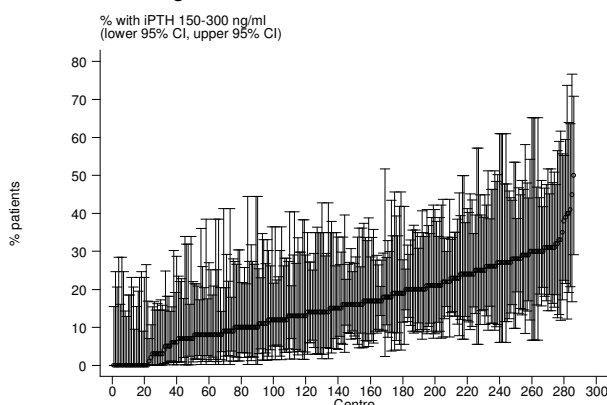


Table 10.3.3(b): Proportion of patients with iPTH 150-300ng/ml, HD centres, 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	42	0	0	9	16	23	33	37
2000	59	0	0	5	10	16	33	45
2001	68	0	0	5	10	20.5	31	40
2002	93	0	0	2	10	20	33	45
2003	113	0	0	7	14	21	38	43
2004	134	0	0	5	11	20	35	50
2005	164	0	0	6	13	19.5	33	47
2006	220	0	0	7	14	21	29	45
2007	245	0	0	8	15	21	30	53
2008	286	0	0	9	16	23	31	50

Table 10.3.4: Variation in iPTH among PD centres, 1999-2008

a) Median iPTH among PD patients

	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	8	16.5	16.5	49.9	75.2	87.5	200.9	200.9
2000	9	16	16	33	46.5	63.5	122	122
2001	11	15.4	15.4	42.5	59.5	91	274	274
2002	14	27.3	27.3	50	82.9	107	280.5	280.5
2003	17	22.3	22.3	70	136	175	298.5	298.5
2004	18	41.5	41.5	74.5	138.8	169.3	329.1	329.1
2005	19	25	25	87.5	179.1	321.5	496.9	496.9
2006	21	34.5	36.9	101	177.5	233	386	429
2007	22	26.3	32	108.8	203.7	290.5	440	504
2008	22	34.5	62	144	206.6	310.9	352.3	454.5

Figure 10.3.4(a): Variation in median iPTH among PD patients, PD centres 2008

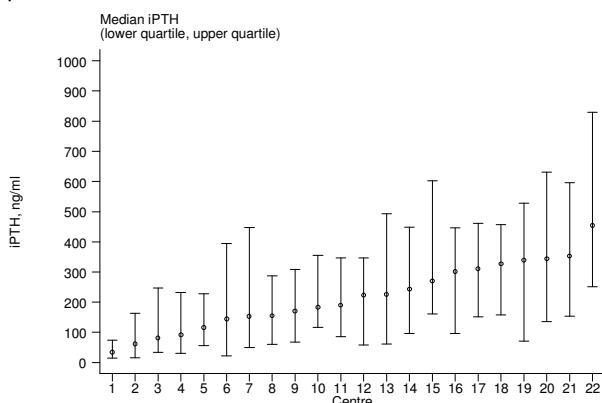


Figure 10.3.4(b): Variation in proportion of patients with iPTH 150-300ng/ml, PD centres 2008

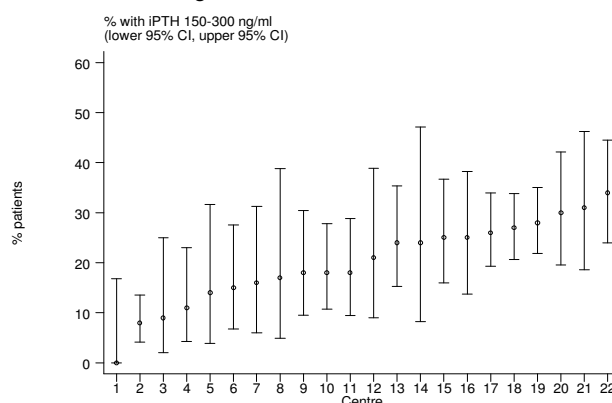


Table 10.3.4(b): Proportion of patients with iPTH 150-300ng/ml, PD centres 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	8	6	6	7	12	21.5	26	26
2000	9	0	0	5	12	17	18	18
2001	11	0	0	9	14	19	30	30
2002	14	0	0	10	15.5	21	24	24
2003	17	2	2	12	18	22	33	33
2004	18	7	7	14	20	25	30	30
2005	19	0	0	9	18	23	31	31
2006	21	5	6	14	20	26	32	42
2007	22	0	3	17	21	27	31	38
2008	22	0	8	15	19.5	26	31	34

Conclusion

There were no major changes in the type of phosphate binders used for both HD and PD patients. About 92% of HD patients and 86% of PD patients were still taking calcium carbonate as their phosphate binder in 2008. The use of lanthanum as phosphate binder has increased slowly since 2006 whereas the aluminium based phosphate binder continued to decrease. Calcitriol remained the main vitamin D used in both HD and PD patients and its use continued to rise. Paracalcitol was first introduced in Malaysia in 2006 and its usage remained around 0.2-0.3% in 2008. The percentage of patients who underwent parathyroidectomy has doubled in 2008 compared to 2005 among those HD and PD patients. This may be due to the increased availability of endocrine surgery services in more government hospitals in Malaysia and also due to a better awareness and understanding of the associated morbidity and mortality secondary to hyperparathyroidism.

The mean corrected serum calcium remained slightly lower in the HD patients (2.3 mmol/L) compared to PD patients (2.4 mmol/L). Phosphate control continued to be better in PD patients. The proportion of PD patients achieving target serum phosphate 1.13-1.78 mmol/L was 52% compared to 47% of HD patients. However, HD patients had shown an improved trend in phosphate control since 1998. More HD patients achieved the target serum calcium phosphate product of less than $4.5 \text{ mmol}^2/\text{L}^2$ (73%) compared with PD patients (69.5%) for year 2008.

The intact parathyroid hormone (iPTH) level seemed to be on increasing trend among both HD and PD patients. PD patients had relatively higher level of iPTH compared to HD patients. Interestingly, diabetic patients had lower iPTH level than non diabetic patients in both HD and PD populations. There was wide variation in iPTH level among HD and PD centers and the degree of variation seemed to become wider for the last 10 years. The variation was also greater among HD centers compared to PD centers.

There was consistently wide variation among HD and PD centres in achieving various target reflecting the differences in management of renal bone disease among dialysis centres.