

CHAPTER 7

Chronic Kidney Disease – Mineral and Bone Disorder

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SECTION 7.1: TREATMENT OF HYPERPHOSPHATAEMIA

Calcium carbonate continued the declining trend as the main phosphate binder for both HD patients (89%) but remained quite the same for PD patients (84-87%) from 2009-2018. The second most commonly used phosphate binder was Sevelamer in 2018 and its usage still remained low after its official launch in Malaysia in May 2011 in both HD and PD patients. The number of patients took aluminium based phosphate binder had decreased since 2009 for both HD and PD patients. (Tables 7.1.1 and 7.1.2)

Table 7.1.1: Phosphate Binder in HD patients, 2009-2018

Year	Number of patients	Number of patients On CaCO ₃		Number on patients on Al(OH) ₃		Number of patients on Lanthanum		Number of patients on Sevelamer HCl	
		n	%	n	%	n	%	n	%
2018	46153	41260	89	15	0	712	2	1257	3
2017	44618	40278	90	7	0	722	2	964	2
2016	38144	35443	93	3	0	626	2	509	1
2015	35424	32767	92	2	0	818	2	361	1
2014	32586	29975	92	6	0	786	2	212	1
2013	29147	26926	92	10	0	736	3	108	0
2012	25831	23668	92	12	0	648	3	83	0
2011	22512	20623	92	30	0	517	2	72	0
2010	19709	17921	91	27	0	381	2	6	0
2009	18052	16527	92	34	0	247	1	0	0

Table 7.1.2: Phosphate Binder in PD patients, 2009-2018

Year	Number of patients	Number of patients On CaCO ₃		Number on patients on Al(OH) ₃		Number of patients on Lanthanum		Number of patients on Sevelamer HCl	
		n	%	n	%	n	%	n	%
2018	5740	4937	86	1	0	81	1	332	6
2017	5402	4551	84	0	0	94	2	283	5
2016	4702	3951	84	0	0	99	2	171	4
2015	4333	3652	84	0	0	125	3	93	2
2014	3728	3208	86	3	0	119	3	41	1
2013	3260	2805	86	2	0	111	3	23	1
2012	2876	2452	85	3	0	101	4	12	0
2011	2551	2207	87	4	0	90	4	12	0
2010	2360	2085	88	2	0	52	2	1	0
2009	2212	1875	85	7	0	45	2	1	0

It is interesting to note that the major used of Lanthanum and Sevelamer in 2015 was among the NGO patients, but the public sector has caught up since then (Table 7.1.3)

Table 7.1.3: Phosphate Binders by Sector in HD patients

Year	Sector	Lanthanum Carbonate		Sevelamer Hcl		Aluminium binder	
		n	%	n	%	n	%
2018	Public	266	34	682	43	3	19
	Private	218	27	207	13	3	19
	NGO	309	39	700	44	10	63
	Total	793	100	1589	100	16	100
2017	Public	289	35	541	43	1	14
	Private	216	26	140	11	3	43
	NGO	311	38	566	45	3	43
	Total	816	100	1247	100	7	100
2016	Public	300	41	288	42	0	0
	Private	174	24	55	8	0	0
	NGO	251	35	337	50	3	100
	Total	725	100	680	100	3	100
2015	Public	363	38	162	36	1	50
	Private	232	25	45	10	0	0
	NGO	348	37	247	54	1	50
	Total	943	100	454	100	2	100
2014	Public	346	38	78	31	6	67
	Private	234	26	19	8	0	0
	NGO	325	36	156	62	3	33
	Total	905	100	253	100	9	100
2013	Public	339	40	39	30	6	50
	Private	197	23	9	7	5	42
	NGO	311	37	83	63	1	8
	Total	847	100	131	100	12	100
2012	Public	342	46	18	19	6	40
	Private	184	25	8	8	0	0
	NGO	223	30	69	73	9	60
	Total	749	100	95	100	15	100
2011	Public	313	52	19	23	23	68
	Private	140	23	26	31	2	6
	NGO	154	25	39	46	9	26
	Total	607	100	84	100	34	100
2010	Public	202	47	3	43	20	69
	Private	113	26	0	0	5	17
	NGO	118	27	4	57	4	14
	Total	433	100	7	100	29	100
2009	Public	134	46	1	100	18	44
	Private	62	21	0	0	7	17
	NGO	96	33	0	0	16	39
	Total	292	100	1	100	41	100

SECTION 7.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level had remained constant since 2009 for both HD (2.3 mmol/L) and PD (2.3-2.4 mmol/L) patients. 53% of HD patients achieved target serum calcium level of 2.1 to 2.37mmol/L compared to only 44% of PD patients in 2018 (Tables & Figures 7.2.1 and 7.2.2).

Table 7.2.1: Distribution of corrected serum calcium, HD patients 2009-2018

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients ≥ 2.1 & ≤ 2.37 mmol/L
2018	41243	2.2	0.2	2.3	2.1	2.4	53
2017	39759	2.2	0.2	2.3	2.1	2.4	52
2016	35836	2.2	0.2	2.2	2.1	2.4	54
2015	33367	2.2	0.2	2.3	2.1	2.4	54
2014	30633	2.3	0.2	2.3	2.1	2.4	54
2013	27300	2.3	0.2	2.3	2.1	2.4	53
2012	24031	2.3	0.2	2.3	2.1	2.4	54
2011	20950	2.3	0.2	2.3	2.1	2.4	53
2010	18478	2.3	0.2	2.3	2.2	2.4	52
2009	16559	2.3	0.2	2.3	2.2	2.4	52

Figure 7.2.1: Cumulative distribution of corrected serum calcium, HD patients 2009-2018

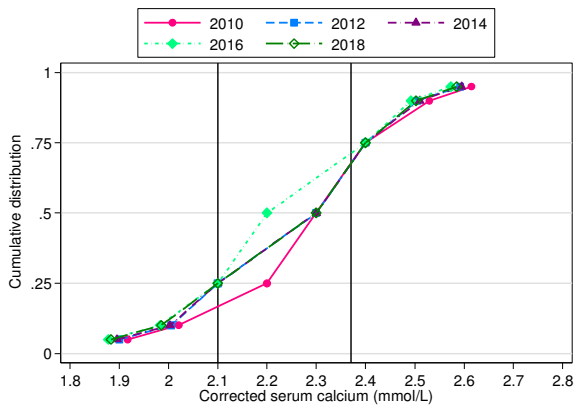


Figure 7.2.2: Cumulative distribution of corrected serum calcium, PD patients 2009-2018

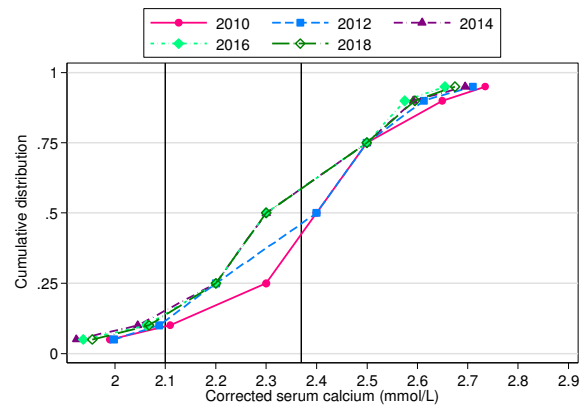


Table 7.2.2: Distribution of corrected serum calcium, PD patients 2009-2018

Year	Number of patients	Mean	SD	Median	LQ	UQ	%patients ≥ 2.1 & ≤ 2.37 mmol/L
2018	5345	2.3	0.2	2.3	2.2	2.5	44
2017	4963	2.3	0.2	2.3	2.2	2.5	42
2016	4503	2.3	0.2	2.3	2.2	2.5	46
2015	4184	2.3	0.2	2.3	2.2	2.5	44
2014	3594	2.3	0.2	2.3	2.2	2.5	43
2013	3146	2.3	0.2	2.3	2.2	2.5	42
2012	2762	2.4	0.2	2.4	2.2	2.5	42
2011	2435	2.4	0.2	2.4	2.3	2.5	38
2010	2285	2.4	0.2	2.4	2.3	2.5	38
2009	2127	2.4	0.2	2.4	2.2	2.5	39

Overall, PD patients had better phosphate control compared to HD patients (median level 1.6 vs 1.7mmol/L). In 2018, about 22% of PD patients achieved target phosphate level recommended by KDIGO (0.8 to 1.3mmol/L) compared to only 15% in HD patients. About 40% patients achieved phosphate level of 1.3-1.8mmol/L for both HD and PD patients. Only 14% of PD patients have phosphate level >2.2mmol/L as compared to HD patients (17% with phosphate level > 2.2mmol/L). However, there was an improvement in HD patients since 2009 with a gradual decrease in the number of patients with phosphate >2.2mmol/L whereas the rate increased among PD patients since 2009. (Tables & Figures 7.2.3 and 7.2.4)

Table 7.2.3: Distribution of serum phosphate, HD patients 2009-2018

Year	Number of patients	mean	SD	Median	LQ	UQ	%patients <0.8 mmol/L	%patients ≥0.8&<1.3 mmol/L	%patients ≥1.3&<1.8 mmol/L	%patients ≥1.8&<2.2 mmol/L	%patients ≥2.2 mmol/L
2018	41356	1.8	0.5	1.7	1.4	2.1	1	15	40	28	17
2017	39972	1.8	0.5	1.7	1.4	2.0	1	14	42	26	16
2016	36198	1.8	0.5	1.7	1.4	2.0	1	15	41	28	16
2015	33679	1.7	0.5	1.7	1.4	2.0	1	16	41	26	16
2014	31052	1.7	0.5	1.7	1.4	2.0	1	16	42	25	16
2013	27887	1.8	0.5	1.7	1.4	2.0	1	16	42	25	17
2012	24453	1.8	0.5	1.7	1.4	2.0	1	15	41	25	17
2011	21335	1.8	0.5	1.7	1.4	2.1	1	15	40	26	18
2010	18699	1.8	0.5	1.7	1.4	2.1	1	14	40	26	19
2009	16941	1.8	0.5	1.7	1.4	2.1	1	15	40	26	18

Figure 7.2.3: Cumulative distribution of serum phosphate, HD patients 2009-2018

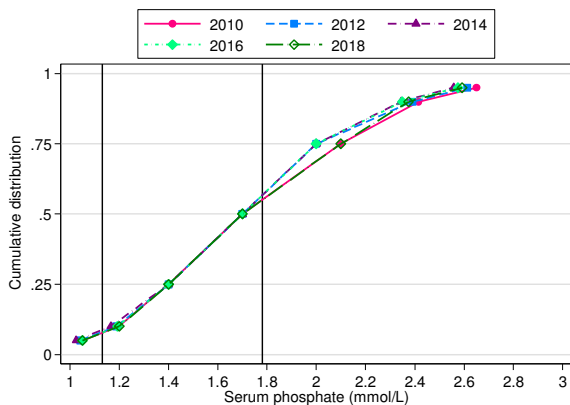


Figure 7.2.4: Cumulative distribution of serum phosphate, PD patients 2009-2018

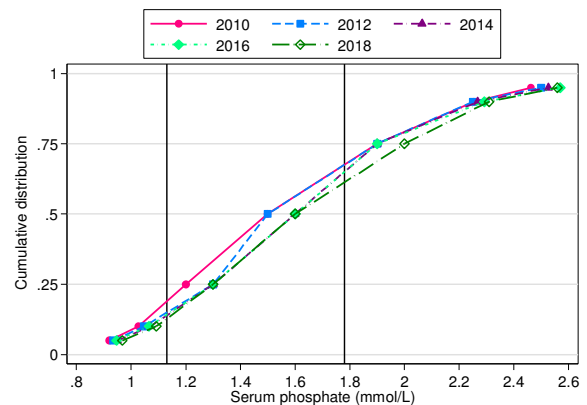


Table 7.2.4: Distribution of serum phosphate, PD patients 2009-2018

Year	Number of patients	mean	SD	Median	LQ	UQ	%patients <0.8 mmol/L	%patients ≥0.8&<1.3 mmol/L	%patients ≥1.3&<1.8 mmol/L	%patients ≥1.8&<2.2 mmol/L	%patients ≥2.2 mmol/L
2018	5354	1.7	0.5	1.6	1.3	2.0	1	22	40	22	14
2017	4983	1.7	0.5	1.6	1.3	1.9	2	23	41	20	13
2016	4537	1.6	0.5	1.6	1.3	1.9	2	25	41	19	13
2015	4204	1.6	0.5	1.6	1.3	1.9	1	25	43	19	12
2014	3621	1.6	0.5	1.6	1.3	1.9	1	26	42	19	12
2013	3149	1.6	0.5	1.5	1.3	1.9	2	26	43	18	11
2012	2773	1.6	0.5	1.5	1.3	1.9	2	27	42	18	11
2011	2461	1.6	0.5	1.5	1.3	1.9	2	27	41	19	11
2010	2287	1.6	0.5	1.5	1.2	1.9	2	28	40	18	12
2009	2139	1.6	0.5	1.5	1.2	1.9	2	27	41	18	12

The corrected serum calcium phosphate product had remained relatively stable in both HD and PD patients. PD patients had better calcium phosphate product than HD patients. About 73% of PD patients had corrected calcium phosphate product <4.5mmol²/L² compared to 71% in HD patients in 2018. Overall there was a positive trend in calcium phosphate product and the percentage of patients with corrected serum calcium phosphate product ≥5.5mmol²/L² had remained less than 11% since 2009. (Tables and Figures 7.2.5 & 7.2.6)

Table 7.2.5: Distribution of corrected calcium x phosphate product, HD patients 2009-2018

Year	Number of patients	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
2018	41074	4.0	1.1	3.9	3.2	4.6	36	35	20	9
2017	39673	3.9	1.1	3.8	3.2	4.6	37	35	18	9
2016	35648	3.9	1.1	3.8	3.2	4.6	37	35	19	9
2015	33211	3.9	1.1	3.8	3.1	4.6	38	34	19	9
2014	30475	3.9	1.1	3.8	3.1	4.6	39	34	19	9
2013	27095	4.0	1.1	3.8	3.2	4.6	37	34	19	9
2012	23824	4.0	1.1	3.8	3.2	4.6	37	34	19	10
2011	20806	4.0	1.2	3.9	3.2	4.7	36	34	20	10
2010	18364	4.1	1.2	3.9	3.2	4.8	34	34	21	11
2009	16432	4.0	1.2	3.9	3.2	4.7	36	34	20	11

Figure 7.2.5: Cumulative distribution of corrected calcium x phosphate product, HD patients 2009-2018

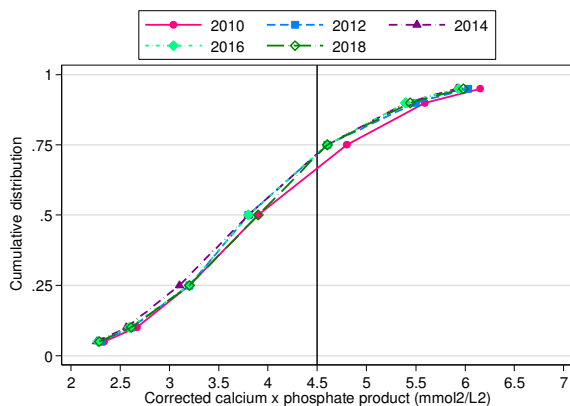


Figure 7.2.6: Cumulative distribution of corrected calcium x phosphate product, PD patients 2009-2018

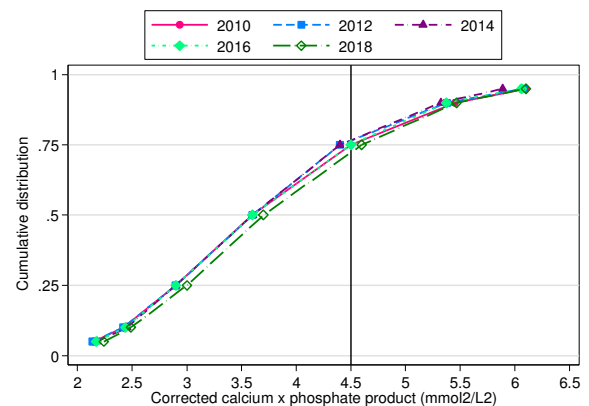


Table 7.2.6: Distribution of corrected calcium x phosphate product, PD patients 2009-2018

Year	Number of patients	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
2018	5333	3.9	1.2	3.7	3.0	4.6	42	31	18	10
2017	4952	3.9	1.2	3.7	3.0	4.5	43	31	17	9
2016	4486	3.8	1.2	3.6	2.9	4.5	46	30	15	9
2015	4171	3.8	1.2	3.6	3.0	4.4	46	30	15	9
2014	3580	3.8	1.2	3.6	2.9	4.4	47	30	15	8
2013	3126	3.7	1.2	3.5	2.9	4.4	49	29	14	8
2012	2754	3.8	1.2	3.6	2.9	4.4	48	29	15	9
2011	2428	3.8	1.2	3.6	2.9	4.5	46	29	16	9
2010	2273	3.8	1.2	3.6	2.9	4.5	47	29	15	10
2009	2122	3.8	1.2	3.6	2.9	4.5	46	29	15	11

In year 2018, corrected median serum calcium level was 2.2 and 2.3 mmol/L in HD and PD patients. The variation in corrected serum calcium level among both HD and PD centres remained wide in 2018. (Table and Figure 7.2.7a & 7.2.8a)

Table 7.2.7(a): Variation in corrected median serum calcium level among HD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	734	1.9	2.1	2.2	2.2	2.3	2.4	2.6
2017	720	1.5	2.1	2.2	2.2	2.3	2.4	2.5
2016	696	1.8	2.1	2.2	2.2	2.3	2.4	2.5
2015	675	2.0	2.1	2.2	2.3	2.3	2.4	2.5
2014	641	2.0	2.1	2.2	2.3	2.3	2.4	2.5
2013	600	2.0	2.1	2.2	2.3	2.3	2.4	2.5
2012	546	2.0	2.1	2.2	2.3	2.3	2.4	2.6
2011	488	1.7	2.1	2.2	2.3	2.3	2.4	2.6
2010	430	1.8	2.2	2.2	2.3	2.3	2.4	2.5
2009	387	1.5	2.1	2.2	2.3	2.3	2.4	2.6

Figure 7.2.7(a): Variation in median serum calcium level among HD patients, HD centres 2018

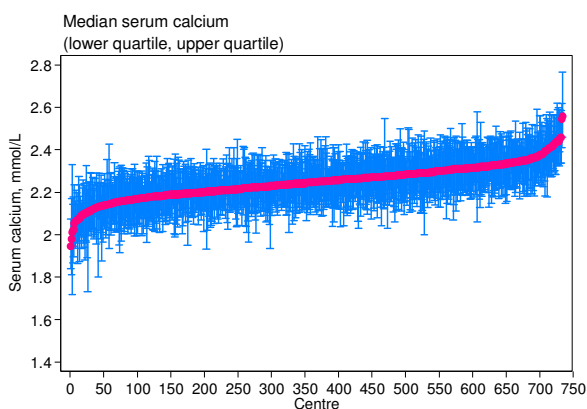


Figure 7.2.8(a): Variation in median serum calcium level among PD patients, PD centres 2018

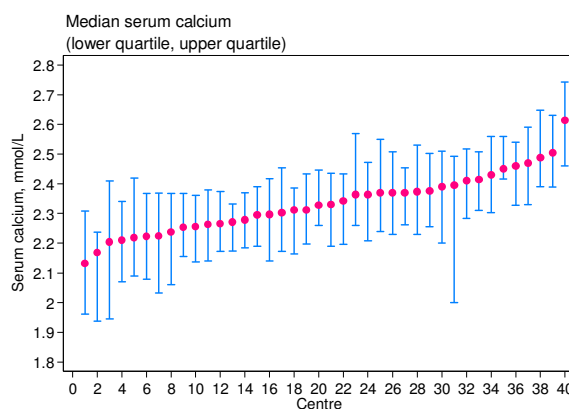


Table 7.2.8(a): Variation in corrected median serum calcium level among PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	2.1	2.2	2.3	2.3	2.4	2.5	2.6
2017	38	2.1	2.1	2.3	2.3	2.4	2.5	2.5
2016	37	2.1	2.2	2.3	2.3	2.4	2.4	2.5
2015	35	2.1	2.1	2.2	2.3	2.4	2.5	2.5
2014	32	2.1	2.1	2.3	2.3	2.4	2.5	2.6
2013	28	2.1	2.2	2.3	2.3	2.4	2.5	2.5
2012	28	2.2	2.2	2.3	2.3	2.4	2.5	2.6
2011	26	2.1	2.3	2.3	2.4	2.4	2.5	2.6
2010	25	2.2	2.3	2.3	2.4	2.5	2.5	2.5
2009	23	2.2	2.3	2.3	2.3	2.4	2.5	2.6

There was also large centre variation among the HD and PD centres with regards to the proportion of patients achieved normal range of corrected serum calcium level (2.1 to 2.37mmol/L); it ranged from 13 to 85% for HD centres and 8-70% for PD centers in 2018. The median was 53% for HD centres and 42% for PD centres. The variation was smaller among PD centres compared to HD centres. (Tables and Figures 7.2.7b & 7.2.8b)

Table 7.2.7(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	734	13	34.0	46.0	53.0	60.0	72.0	85
2017	720	0	35.0	46.0	53.0	60.0	70.5	93
2016	696	11	36.0	48.0	55.5	63.0	73.0	90
2015	675	10	35.0	47.0	55.0	62.0	73.0	94
2014	641	13	33.0	47.0	55.0	62.0	73.0	88
2013	600	8	33.0	47.0	55.0	63.0	74.0	90
2012	546	8	32.0	47.0	55.0	64.0	75.0	93
2011	488	0	33.0	46.0	54.0	62.0	73.0	93
2010	430	0	29.0	44.0	52.0	61.0	73.0	93
2009	387	0	27.0	44.0	53.0	61.0	71.0	90

Figure 7.2.7(b): Variation in proportion of patients with serum calcium 2.1 to 2.37mmol/L, HD centres 2018

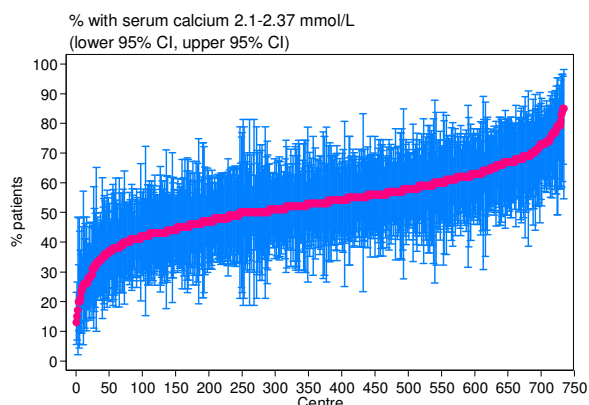


Figure 7.2.8(b): Variation in proportion of patients with serum calcium 2.1 to 2.37mmol/L, PD centres 2018

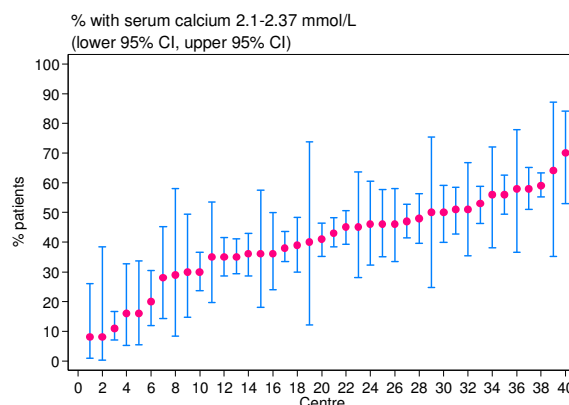


Table 7.2.8(b): Proportion of patients with serum calcium 2.1 to 2.37mmol/L, PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	8	9.5	32.5	42.0	50.5	61.5	70
2017	38	9	9.0	31.0	44.0	50.0	59.0	60
2016	37	21	24.0	39.0	49.0	52.0	57.0	64
2015	35	14	17.0	33.0	47.0	52.0	58.0	60
2014	32	13	16.0	30.0	42.0	51.0	58.0	64
2013	28	10	10.0	32.0	41.5	50.0	59.0	70
2012	28	6	9.0	31.5	42.5	50.5	61.0	71
2011	26	10	17.0	31.0	36.5	44.0	58.0	62
2010	25	14	18.0	28.0	35.0	49.0	56.0	58
2009	23	12	13.0	31.0	41.0	51.0	59.0	65

Median serum phosphate level for HD centres was 1.8mmol/L (ranged from 1.2 to 2.2mmol/L) as opposed to median phosphate level of 1.7mmol/L (ranged from 1.4 to 1.9mmol/L) in PD centres. There was wide centre variation in serum phosphate level among HD and PD centres. Similarly, the variation was smaller among PD centres compared to HD centres. (Tables and Figures 7.2.9a & 7.2.10a)

Table 7.2.9(a): Variation in median serum phosphate level among HD centres, 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	738	1.2	1.5	1.6	1.8	1.9	2.0	2.2
2017	723	0.7	1.5	1.6	1.7	1.8	2.0	2.3
2016	696	1.2	1.5	1.6	1.7	1.8	2.0	2.3
2015	674	1.2	1.5	1.6	1.7	1.8	2.0	2.5
2014	645	1.3	1.5	1.6	1.7	1.8	2.0	2.3
2013	607	1.3	1.5	1.6	1.7	1.8	2.0	2.4
2012	555	1.1	1.5	1.6	1.7	1.8	2.0	2.6
2011	492	1.0	1.5	1.6	1.7	1.8	2.0	2.6
2010	437	1.3	1.5	1.6	1.8	1.8	2.0	2.7
2009	392	1.0	1.5	1.6	1.7	1.8	2.0	2.4

Figure 7.2.9(a): Variation in median serum phosphate level among HD patients, HD centres 2018

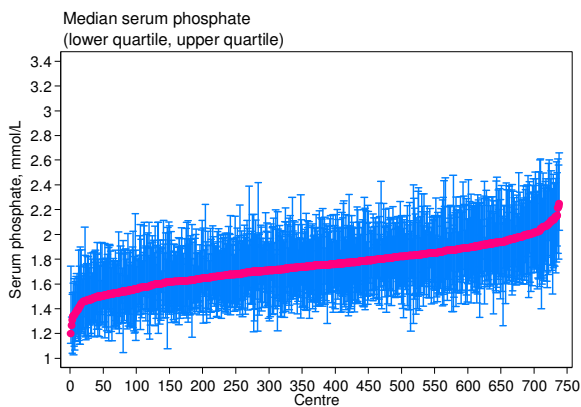


Figure 7.2.10(a): Variation in median serum phosphate level among PD patients, PD centres 2018

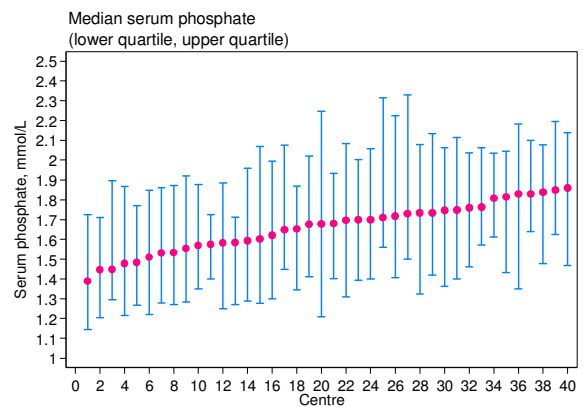


Table 7.2.10(a): Variation in median serum phosphate level among PD centres, 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	1.4	1.4	1.6	1.7	1.7	1.8	1.9
2017	38	1.4	1.4	1.5	1.6	1.7	1.8	2.1
2016	37	1.4	1.4	1.5	1.6	1.7	1.9	1.9
2015	35	1.4	1.4	1.5	1.6	1.7	1.9	2.1
2014	32	1.4	1.4	1.5	1.6	1.8	1.9	1.9
2013	28	1.4	1.4	1.5	1.6	1.7	1.9	1.9
2012	28	1.3	1.4	1.5	1.6	1.7	1.9	1.9
2011	26	1.3	1.3	1.5	1.6	1.7	1.9	1.9
2010	25	1.3	1.3	1.4	1.6	1.8	1.8	1.8
2009	23	1.3	1.4	1.5	1.6	1.7	1.9	2.2

There was also wide centre variation among the HD and PD centres with regards to the proportion of patients achieving the recommended serum phosphate level of 1.13 – 1.78 mmol/L; this ranged from 9 to 92% among HD centres (median 46%) and the range was narrower in PD centres, which was 37-79% (median 51%) in 2018. (Tables and Figures 7.2.9b & 7.2.10b)

Table 7.2.9(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	738	9	26	38.0	46.0	54.0	67	92
2017	723	8	27	39.0	47.0	56.0	73	97
2016	696	15	28	39.5	48.0	55.5	67	87
2015	674	0	29	41.0	49.0	56.0	67	100
2014	645	14	29	40.0	49.0	56.0	67	83
2013	607	7	28	40.0	49.0	56.0	68	84
2012	555	6	29	40.0	48.0	56.0	68	100
2011	492	0	27	39.0	46.0	54.0	67	100
2010	437	4	26	38.0	46.0	54.0	67	76
2009	392	6	27	39.0	46.5	54.0	65	85

Figure 7.2.9(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres 2018

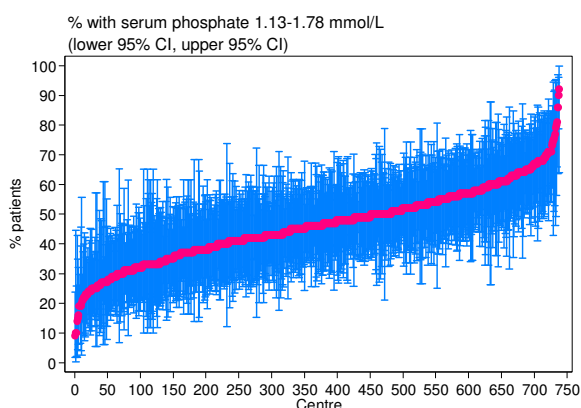


Figure 7.2.10(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2018

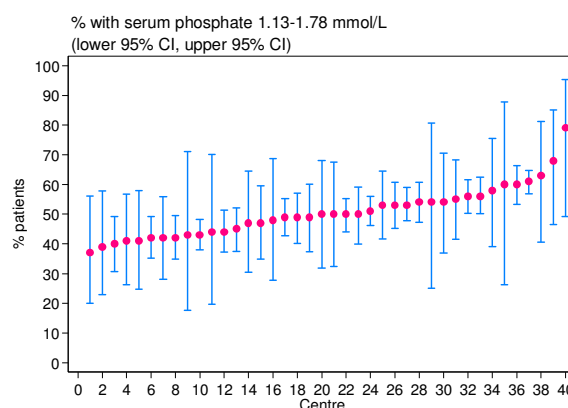


Table 7.2.10(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	37	39.5	43.5	50.0	54.5	65.5	79
2017	38	26	32.0	44.0	50.0	55.0	66.0	71
2016	37	28	33.0	46.0	51.0	56.0	63.0	66
2015	35	17	36.0	45.0	51.0	57.0	65.0	71
2014	32	27	29.0	42.5	48.0	58.0	62.0	62
2013	28	28	36.0	46.5	50.5	55.0	64.0	77
2012	28	26	34.0	48.0	51.5	59.0	63.0	72
2011	26	35	37.0	47.0	52.0	60.0	77.0	81
2010	25	37	39.0	44.0	52.0	58.0	65.0	70
2009	23	20	38.0	48.0	54.0	58.0	65.0	69

Proportion of patients with serum phosphate 0.8-1.3mmol/L (KDIGO recommended level) was higher in PD patients with median of 20% as compared to 14% in HD patients in 2018. The centre variation ranged 0% to 71% for HD centres and 8% to 40% for PD centres. (Tables and Figures 7.2.9c & 7.2.10c)

Table 7.2.9(c): Proportion of patients with serum phosphate 0.8-1.3 mmol/L, HD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	738	0	3.0	9.0	14.0	19.0	32.0	71
2017	723	0	3.0	8.0	13.0	19.0	29.0	47
2016	696	0	3.0	9.0	14.0	19.0	30.0	61
2015	674	0	4.0	10.0	15.0	21.0	32.0	70
2014	645	0	4.0	10.0	15.0	21.0	32.0	59
2013	607	0	3.0	9.0	14.0	20.0	32.0	48
2012	555	0	3.0	9.0	14.0	20.0	32.0	46
2011	492	0	2.0	9.0	14.0	20.0	29.0	83
2010	437	0	0.0	8.0	14.0	19.0	28.0	47
2009	392	0	2.0	9.0	14.0	21.0	31.0	46

Figure 7.2.9(c): Variation in proportion of patients with serum phosphate 0.8-1.3 mmol/L, HD centres 2018

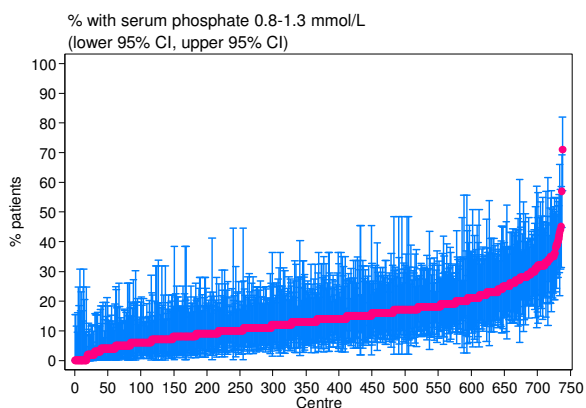


Figure 7.2.10(c): Variation in proportion of patients with serum phosphate 0.8-1.3 mmol/L, PD centres 2018

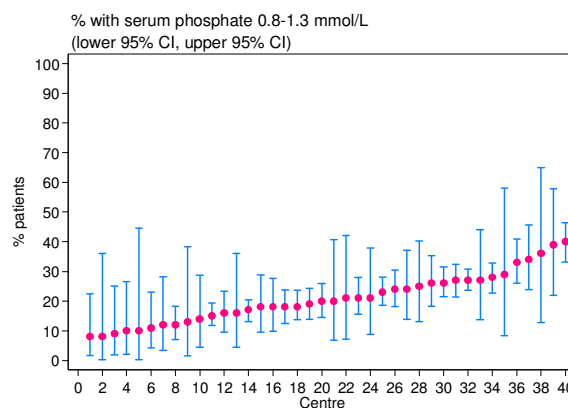


Table 7.2.10(c): Proportion of patients with serum phosphate 0.8-1.3 mmol/L, PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	8	8.5	14.5	20.0	26.5	37.5	40
2017	38	4	10.0	18.0	22.0	26.0	32.0	36
2016	37	6	8.0	16.0	24.0	28.0	35.0	37
2015	35	0	0.0	16.0	22.0	29.0	38.0	38
2014	32	2	4.0	12.0	21.5	29.0	39.0	40
2013	28	5	5.0	13.0	23.5	29.0	35.0	37
2012	28	3	4.0	16.5	21.0	31.5	35.0	48
2011	26	0	0.0	15.0	22.5	34.0	44.0	50
2010	25	7	8.0	16.0	24.0	32.0	42.0	43
2009	23	4	12.0	19.0	25.0	31.0	35.0	43

The corrected serum calcium- phosphate product among 734 HD centres ranged from 2.7 to 5.2mmol²/L² with median of 3.9mmol²/L². The corrected serum calcium- phosphate product among 40 PD centres ranged from 3.3 to 4.5mmol²/L². The variation in corrected serum calcium-phosphate product remained wide in both HD and PD centres since 2009. (Tables and Figures 7.2.11a & 7.2.12a)

Table 7.2.11(a): Variation in corrected median calcium x phosphate product HD centres, 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	734	2.7	3.3	3.6	3.9	4.2	4.5	5.2
2017	719	2.3	3.2	3.6	3.9	4.1	4.5	5.2
2016	696	2.2	3.2	3.6	3.9	4.1	4.5	5.0
2015	674	2.6	3.3	3.6	3.8	4.1	4.5	5.6
2014	639	2.7	3.2	3.6	3.8	4.1	4.4	5.0
2013	594	2.8	3.3	3.6	3.8	4.1	4.6	5.9
2012	543	2.7	3.3	3.6	3.8	4.1	4.5	5.7
2011	486	2.0	3.3	3.7	3.9	4.2	4.6	5.7
2010	430	3.0	3.4	3.7	3.9	4.2	4.7	6.0
2009	383	2.3	3.3	3.7	3.9	4.1	4.7	6.1

Figure 7.2.11(a): Variation in median corrected calcium x phosphate product among HD patients, HD centres 2018

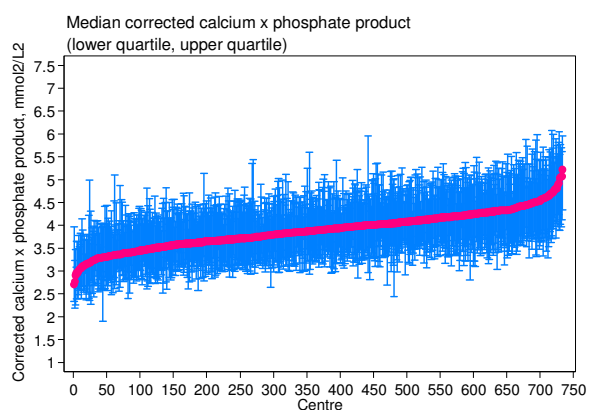


Figure 7.2.12(a): Variation in median corrected calcium x phosphate product among PD patients, PD centres 2018

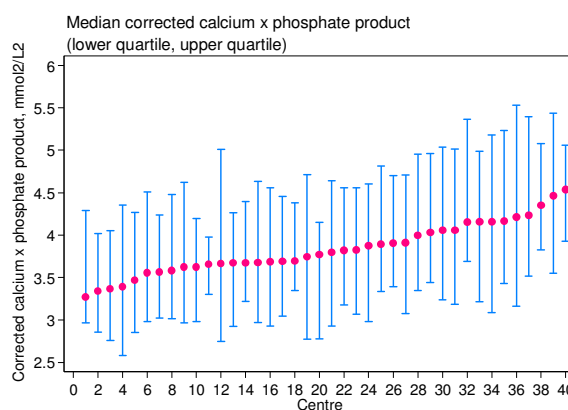


Table 7.2.12(a): Variation in corrected median calcium x phosphate product PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	3.3	3.4	3.6	3.8	4.1	4.4	4.5
2017	38	3.1	3.3	3.5	3.8	4.0	4.5	4.7
2016	37	3.0	3.3	3.5	3.6	4.0	4.3	4.4
2015	35	3.0	3.2	3.4	3.6	3.9	4.4	4.5
2014	32	3.1	3.2	3.4	3.7	4.1	4.5	4.7
2013	28	3.2	3.2	3.3	3.8	3.9	4.3	4.5
2012	28	3.1	3.1	3.5	3.8	4.1	4.2	4.5
2011	26	2.9	3.0	3.4	3.8	4.0	4.6	4.6
2010	25	3.1	3.2	3.3	3.8	4.0	4.4	4.6
2009	23	3.3	3.3	3.5	3.7	3.9	4.6	4.8

Both HD and PD centres had similar proportion of patients with corrected serum calcium- phosphate product less than $4.5 \text{ mmol}^2/\text{L}^2$, with both has median of 72% and 71% respectively in 2018. The variation in corrected serum calcium-phosphate product $<4.5 \text{ mmol}^2/\text{L}^2$ remained wide in both HD and PD centres. It ranged from 32-100% in HD patients and 47-88% in PD patients (Tables and Figures 7.2.11b & 7.2.12b).

Table 7.2.11(b): Proportion of patients with corrected calcium x phosphate $<4.5 \text{ mmol}^2/\text{L}^2$, HD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	734	32	48	62.0	72.0	81.0	90	100
2017	719	30	50	64.0	73.0	83.0	94	100
2016	696	36	50	64.0	74.0	82.0	92	100
2015	674	31	50	65.0	73.0	80.0	91	100
2014	639	30	52	65.0	74.0	81.0	90	100
2013	594	20	48	64.0	73.0	81.0	90	100
2012	543	29	50	63.0	72.0	80.0	92	100
2011	486	20	46	61.0	71.0	79.0	91	100
2010	430	8	44	60.0	69.0	77.0	88	100
2009	383	25	44	61.0	71.0	79.0	90	100

Figure 7.2.11(b): Variation in proportion of patients with corrected calcium x phosphate product $<4.5 \text{ mmol}^2/\text{L}^2$, HD centres 2018

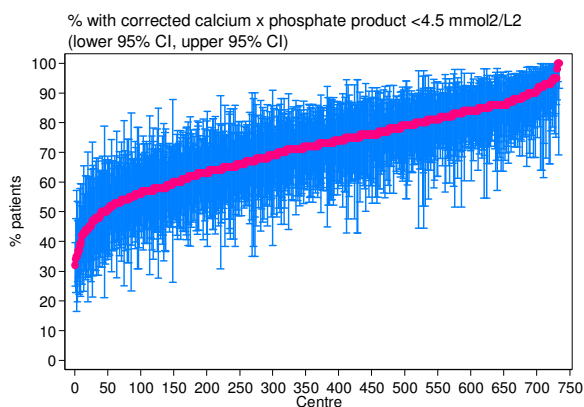


Figure 7.2.12(b): Variation in proportion of patients with corrected calcium x phosphate product $<4.5 \text{ mmol}^2/\text{L}^2$, PD centres, 2018

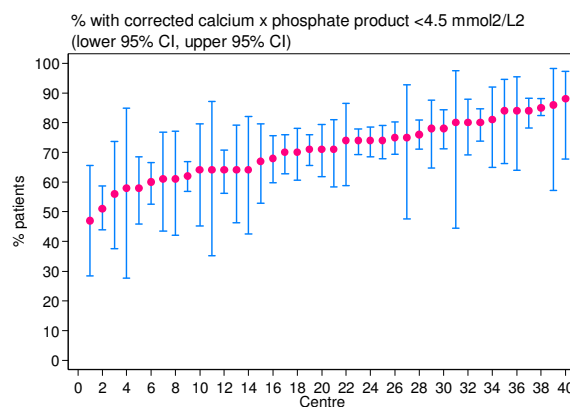


Table 7.2.12(b): Proportion of patients with corrected calcium x phosphate $<4.5 \text{ mmol}^2/\text{L}^2$, PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	40	47	53.5	64.0	71.0	79.0	85.5	88
2017	38	43	49.0	64.0	73.0	79.0	84.0	89
2016	37	52	56.0	67.0	76.0	80.0	89.0	92
2015	35	47	50.0	67.0	74.0	80.0	87.0	89
2014	32	46	49.0	68.0	75.0	79.5	87.0	89
2013	28	49	61.0	66.5	73.0	82.0	89.0	94
2012	28	46	55.0	66.5	71.5	83.5	90.0	91
2011	26	45	47.0	63.0	72.5	80.0	92.0	95
2010	25	48	50.0	70.0	75.0	80.0	89.0	89
2009	23	40	48.0	64.0	76.0	81.0	85.0	86

SECTION 7.3: SERUM PARATHYROID HORMONE CONTROL

Calcitriol was the main vitamin D receptor activator (VDRA) used in treatment of hyperparathyroidism for both HD and PD patients. The percentage of patients on calcitriol had increased in HD from 38% in 2007 to 55% in 2016. Similarly, the percentage of patients on calcitriol in PD patients had increased from 29% in 2007 to 38% in 2016. The used of Paricalcitol remained low in 2016. Parathyroidectomy had remained stable at about 1% since 2007 in both HD and PD patients. (Tables 7.3.1 a & b)

Table 7.3.1(a): Treatment of hyperparathyroidism in HD patients, 2007-2016 (To be Updated)

Year	Number of patients	Number of Patients on calcitriol		Number of patients on Paricalcitol		Number of patients had Para-thyroidectomy	
		n	%	n	%	n	%
2007	12906	4953	38	60	0	180	1
2008	15402	6346	41	67	0	174	1
2009	17976	7790	43	93	1	167	1
2010	19584	9094	46	160	1	171	1
2011	22310	10765	48	139	1	177	1
2012	25670	11804	46	266	1	264	1
2013	29115	13977	48	212	1	317	1
2014	32470	16826	52	232	1	313	1
2015	35338	19065	54	165	0	248	1
2016	38082	21085	55	204	1	272	1

Table 7.3.1(b): Treatment of hyperparathyroidism in PD patients, 2007-2016 (To be Updated)

Year	Number of patients	Number of patientson calcitriol		Number of patients on Paricalcitol		Number of patients had Para-thyroidectomy	
		n	%	n	%	n	%
2007	3577	1033	29	9	0	22	1
2008	4044	1210	30	8	0	26	1
2009	3482	1232	35	5	0	16	0
2010	3844	1531	40	4	0	11	0
2011	4967	1841	37	24	0	21	0
2012	5752	2162	38	62	1	48	1
2013	6511	2202	34	28	0	38	1
2014	7424	2720	37	10	0	54	1
2015	7979	2961	37	15	0	42	1
2016	7481	2827	38	11	0	42	1

In year 2018, HD patients had mean iPTH of 231.9pg/ml. Sixty one % of HD patients had iPTH level <150pg/ml, 14% within the target level (≥ 150 &<300pg/ml) and 15% had iPTH above 500pg/ml. Mean iPTH was lower in diabetic HD patients than the non diabetic HD patients (203.5pg/ml vs 275.8pg/ml). The diabetic HD patients had higher proportion with iPTH level below 150pg/ml (64%) than non diabetic HD patients (56%). On the other hand, the mean iPTH in PD patients was 271.6pg/ml. About 46% of PD patients had iPTH <150pg/ml, 22% achieved target iPTH (≥ 150 &<300pg/ml) and 16% had iPTH more than 500pg/ml in 2018. Similarly, mean iPTH was lower in diabetic PD patients than non diabetic PD patients (213.4pg/ml vs 337.9pg/ml). The diabetic PD patients had higher proportion with iPTH level below 150pg/ml (52%) than non diabetic HD patients (40%). (Tables and Figures 7.3.2b, 7.3.2c , 7.3.3b & 7.3.3c)

Table 7.3.2(a): Distribution of iPTH, HD patients 2009-2018

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2018	36481	231.9	321.5	88.5	34.8	305.2	61	14	11	15
2017	35595	257.2	337.2	108.3	38.8	351.1	57	15	12	17
2016	29269	265.3	344.1	111.0	38.5	372.1	56	15	12	18
2015	27471	300.8	346.9	169.6	47.2	433.8	48	17	15	21
2014	24881	296.9	356.9	159.7	44.3	417.5	49	17	14	20
2013	21360	233.6	315.7	100.0	34.2	312.0	59	15	12	14
2012	18808	291.9	340.1	167.7	46.9	410.3	47	18	15	19
2011	16276	223.5	311.9	87.6	29.5	305.0	61	14	12	14
2010	14320	235.3	319.0	98.4	30.5	319.2	58	15	11	15
2009	12518	270.0	337.2	141.1	40.4	367.4	52	18	13	17

Figure 7.3.2(a): Cumulative distribution of iPTH, HD patients 2009-2018

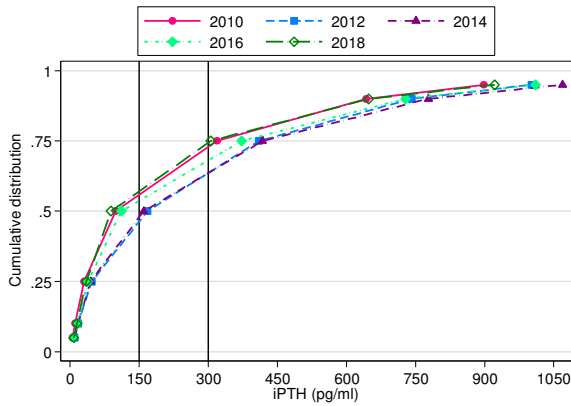


Figure 7.3.2(b): Cumulative distribution of iPTH, diabetic HD patients 2009-2018

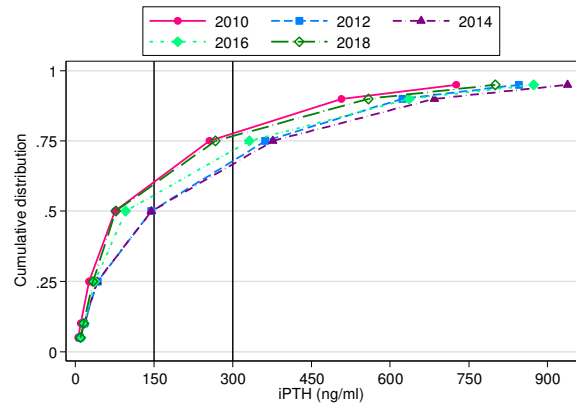


Table 7.3.2(b): Distribution of iPTH, diabetic HD patients, 2009-2018

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & >300 pg/ml	≥300 & >500 pg/ml	≥500 pg/ml
2018	22122	203.5	284.1	76.7	33.5	267.0	64	13	11	12
2017	21162	228.3	300.3	94.8	37.3	312.7	59	15	12	14
2016	16915	235.8	308.5	95.8	36.7	331.6	58	14	12	15
2015	15336	272.2	316.1	150.9	44.7	394.7	50	17	15	18
2014	13830	266.3	321.7	144.6	41.4	376.3	51	18	15	17
2013	11448	199.8	272.3	84.0	31.7	268.1	62	15	11	11
2012	9796	252.5	296.3	144.6	42.3	362.0	51	18	15	15
2011	8193	183.2	265.5	67.5	25.0	241.6	66	13	10	10
2010	7111	190.3	270.4	75.4	26.0	256.0	64	15	11	10
2009	5968	222.2	290.9	113.0	34.0	293.3	57	19	12	12

Table 7.3.2(c): Distribution of iPTH, non-diabetic HD patients, 2009-2018

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & >300 pg/ml	≥300 & >500 pg/ml	≥500 pg/ml
2018	14359	275.8	367.5	111.1	38.0	374.9	56	14	11	19
2017	14433	299.6	381.0	130.9	41.9	418.5	53	15	12	21
2016	12354	305.6	383.8	137.0	42.4	430.0	52	15	12	21
2015	12135	336.9	379.2	192.5	52.3	499.6	45	16	14	25
2014	11051	335.3	393.2	181.3	48.6	488.0	46	16	13	24
2013	9912	272.5	355.4	123.0	38.3	373.0	55	15	12	18
2012	9012	334.7	377.5	197.6	52.9	481.8	44	17	15	24
2011	8083	264.2	348.0	113.4	36.0	365.5	55	15	13	17
2010	7209	279.7	355.0	130.0	37.5	393.3	53	15	12	20
2009	6550	313.7	369.1	174.8	48.7	442.7	47	17	15	22

Figure 7.3.2(c): Cumulative distribution of iPTH, non-diabetic HD patients 2009-2018

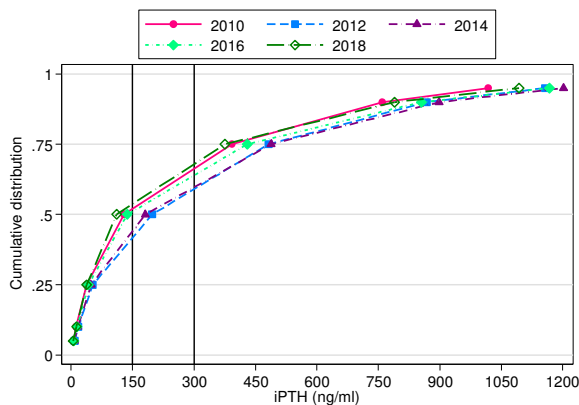


Figure 7.3.3(a): Cumulative distribution of iPTH, PD patients 2009-2018

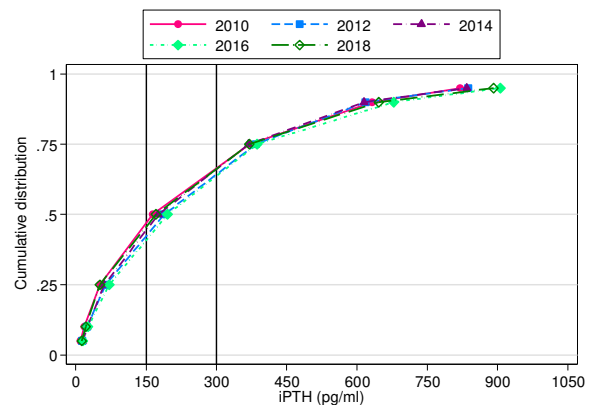


Table 7.3.3(a): Distribution of iPTH, PD patients 2009-2018

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & >300 pg/ml	≥300 & >500 pg/ml	≥500 pg/ml
2018	4095	271.6	308.0	171.5	51.3	370.0	46	22	16	16
2017	3989	263.6	305.8	163.5	52.8	344.5	47	24	14	15
2016	3651	287.9	305.2	195.5	71.3	387.0	42	23	17	18
2015	3465	262.8	299.7	154.2	51.0	362.5	49	20	14	16
2014	2934	268.7	289.5	176.0	61.0	369.0	45	22	17	16
2013	2594	213.0	250.4	134.0	52.0	284.0	53	24	14	9
2012	2256	274.2	291.7	188.4	64.0	384.3	43	22	19	16
2011	2035	249.1	282.5	160.5	50.0	343.0	48	23	16	14
2010	1897	261.2	293.4	164.0	51.4	371.0	48	20	16	16
2009	1818	271.1	293.0	174.3	68.0	381.0	45	22	16	16

Table 7.3.3(b): Distribution of iPTH, diabetic PD patients, 2009-2018

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & >300 pg/ml	≥300 & >500 pg/ml	≥500 pg/ml
2018	2182	213.4	242.4	141.0	42.6	297.1	52	23	15	10
2017	2125	211.3	239.4	140.0	46.1	282.6	52	25	13	10
2016	1959	233.8	240.0	160.0	66.0	314.4	48	25	16	11
2015	1839	211.9	241.5	125.0	45.5	288.7	55	22	13	11
2014	1541	222.8	234.1	148.2	53.3	313.0	50	23	15	11
2013	1311	177.1	208.4	113.0	45.0	228.0	58	26	10	6
2012	1090	211.9	226.3	138.5	54.1	301.0	51	24	16	9
2011	962	200.6	232.4	130.7	45.0	279.8	53	25	16	7
2010	863	204.3	225.9	131.2	41.5	298.5	54	21	15	9
2009	865	199.2	203.6	134.5	57.5	268.0	53	25	13	9

Figure 7.3.3(b): Cumulative distribution of iPTH, diabetic PD patients, 2009-2018

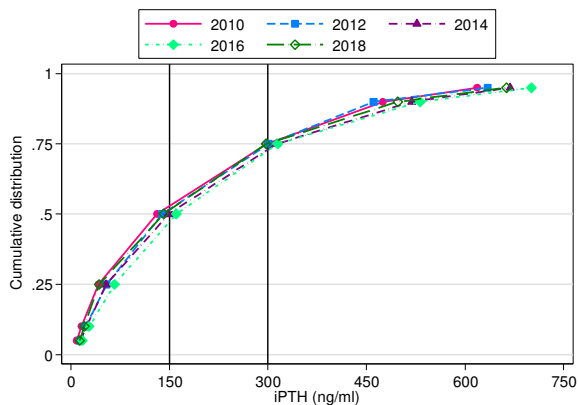


Figure 7.3.3(c): Cumulative distribution of iPTH, non diabetic PD patients, 2009-2018

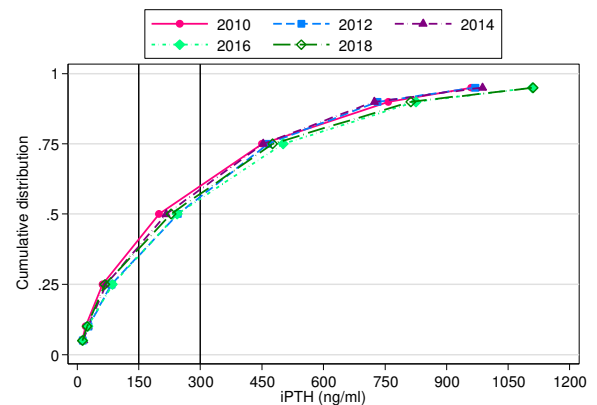


Table 7.3.3(c): Distribution of iPTH, non diabetic PD patients, 2009-2018

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & >300 pg/ml	≥300 & >500 pg/ml	≥500 pg/ml
2018	1913	337.9	357.5	228.2	67.0	475.8	40	20	17	23
2017	1864	323.3	358.1	206.5	66.0	437.7	41	22	16	21
2016	1692	350.4	356.5	243.0	85.3	501.6	37	21	17	25
2015	1626	320.4	345.3	204.0	61.3	465.5	43	19	16	23
2014	1393	319.4	333.4	216.5	69.7	453.0	40	20	19	22
2013	1283	249.7	282.5	162.0	61.3	344.5	48	21	19	12
2012	1166	332.3	331.4	245.4	82.6	464.5	36	21	21	22
2011	1073	292.7	314.6	202.0	59.0	419.0	44	21	16	20
2010	1034	308.8	332.2	199.5	61.4	450.4	43	19	16	22
2009	953	336.3	342.4	234.3	83.8	462.5	38	20	19	23

There was wide variation in iPTH level among HD centres and PD centres. The degree of variation seemed to become wider since 2009 in PD centres but improved among HD centres. (Tables and Figures 7.3.4a & 7.3.5a) The median for the proportion of patients with serum iPTH level in the range 150-300 pg/ml was 12% for HD centres and 21.5% for PD centres (Tables and Figures 7.3.4b & 7.3.5b).

Table 7.3.4(a): Variation in iPTH among HD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	720	7.2	29.3	44.2	65.8	273.1	442.3	758.1
2017	702	11.4	30.4	47.7	91.5	289.0	460.5	669.8
2016	649	16.4	29.7	47.1	114.9	279.8	468.6	1271.7
2015	628	11.3	31.1	73.3	201.4	306.1	456.9	803.5
2014	593	11.7	28.8	60.1	183.1	301.0	466.0	1082.0
2013	521	10.0	22.3	44.6	97.3	252.0	426.7	998.5
2012	485	11.4	31.7	73.3	186.9	287.7	452.2	768.3
2011	423	3.3	18.8	40.5	91.7	233.5	420.7	1217.5
2010	365	5.5	18.5	39.7	102.3	242.2	394.8	629.0
2009	324	2.0	25.8	61.7	161.3	264.5	416.0	1007.9

Figure 7.3.4(a): Variation in median iPTH among HD patients, HD centres, 2018

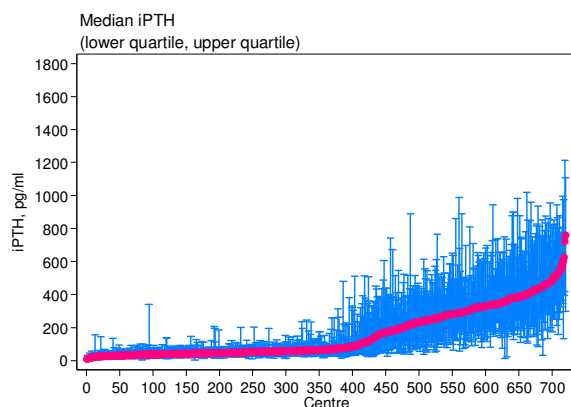


Figure 7.3.4(b): Variation in proportion of patients with iPTH 150-300pg/ml, HD centres, 2018

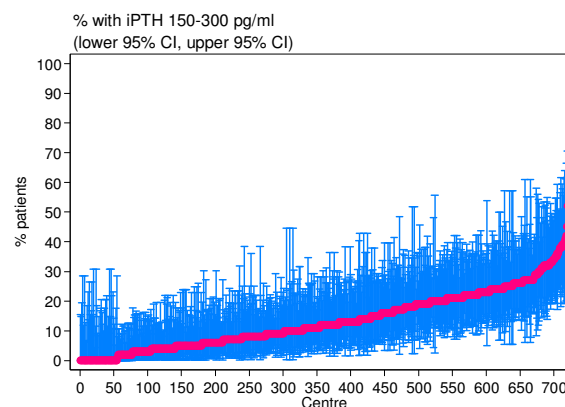


Table 7.3.4(b): Variation in proportion of patients with iPTH 150-300pg/ml, HD centres, 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	720	0	0.0	5.5	12.0	20.0	31.5	52
2017	702	0	0.0	7.0	13.0	20.0	30.0	53
2016	649	0	0.0	7.0	13.0	21.0	30.0	46
2015	628	0	0.0	9.0	16.0	22.0	31.0	56
2014	593	0	2.0	10.0	16.0	23.0	33.0	54
2013	521	0	0.0	6.0	13.0	22.0	34.0	60
2012	485	0	3.0	10.0	17.0	24.0	33.0	53
2011	423	0	0.0	6.0	13.0	20.0	32.0	60
2010	365	0	0.0	6.0	14.0	22.0	33.0	48
2009	324	0	0.0	9.5	18.0	24.5	35.0	46

Table 7.3.5(a): Variation in median iPTH among PD patients 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	34	22.3	31.1	126.0	215.8	319.8	473.2	643.8
2017	35	34.6	35.3	108.0	185.0	285.0	516.9	654.3
2016	36	38.8	65.9	138.6	211.9	313.4	530.3	645.5
2015	34	38.8	42.0	115.8	202.3	296.0	490.5	521.0
2014	29	40.6	41.0	115.8	215.0	299.5	374.5	402.0
2013	26	37.0	41.7	69.2	188.3	258.5	293.0	467.0
2012	26	34.8	45.0	137.5	266.3	324.5	478.5	495.5
2011	24	25.9	26.8	99.1	201.7	290.3	421.5	434.5
2010	24	28.5	30.0	117.8	211.5	285.2	512.0	783.2
2009	22	36.0	56.5	143.5	206.8	258.5	462.5	1047.0

Figure 7.3.5(a): Variation in median iPTH among PD patients, PD centres, 2018

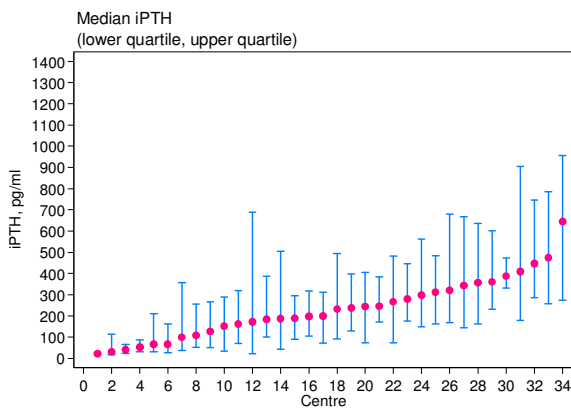


Figure 7.3.5(b): Variation in proportion of patients with iPTH 150-300pg/ml, PD centres 2018

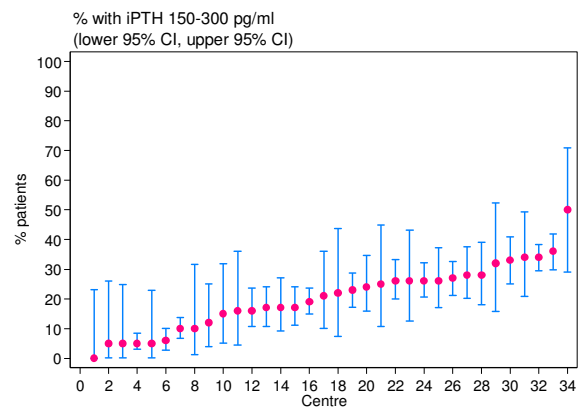


Table 7.3.5(b): Variation in proportion of patients with iPTH 150-300pg/ml, PD centres 2009-2018

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2018	34	0	5	12.0	21.5	27.0	36	50
2017	35	4	4	16.0	23.0	32.0	38	38
2016	36	4	8	17.0	23.5	27.5	34	40
2015	34	6	7	13.0	19.0	28.0	36	41
2014	29	0	6	14.0	20.0	24.0	33	50
2013	26	3	4	11.0	23.0	32.0	38	38
2012	26	1	10	16.0	19.0	26.0	31	31
2011	24	3	4	13.5	22.5	29.0	31	39
2010	24	0	4	13.5	20.0	27.0	31	40
2009	22	10	11	16.0	21.5	27.0	28	28

Conclusion

CKD-MBD is a common problem in the dialysis population. KDIGO guidelines clearly defined the 3 major components in this disease which include laboratory abnormalities (serum calcium, serum phosphorus and iPTH), bone abnormalities and vascular calcification. We cannot ascertain the prevalence of this disease in our dialysis population because we only have data on the laboratory abnormalities. Bone biopsy and assessment for vascular calcification were not routinely performed in Malaysia. We observed some improvement in the laboratory parameters since 2009. Our data also showed that diabetic dialysis patients had lower iPTH level than non diabetic dialysis patients.

Phosphate lowering and parathyroid suppression therapy was the mainstay of medical treatment in CKD-MBD. Calcium based phosphate binder and calcitriol were the major medical therapy used in Malaysia for the treatment. There was a slow but steady increase in the use of non calcium based phosphate binder (lanthanum and sevelamer). Parathyroidectomy had remained stable at about 1% since 2009 in HD patients.

Overall, the control of calcium, phosphate and iPTH parameters in CKD-MBD still need improvement among the dialysis patients with wide centre variation especially among the HD centres. We need to have strategies to improve and standardise the management of CKD-MBD among dialysis patients in Malaysia.