

CHAPTER IV

RESULTS

The results are comprised three parts according to specific purpose of the study. First, adherence to MBD - CPG for clinical parameter monitoring and using of drug therapy are reported. Second, achievement of clinical parameters is described. Finally, the comparison of percentage of target recommendation achievement between adherent and non-adherent patient is shown.

4.1 Inclusion of patients with CKD into the study

Inclusion of patients with CKD into the study is described in Figure 1. Five hundred patients with CKD were followed up at pre-dialysis and dialysis clinic, nephrology unit, Srinagarind hospital during January 1, 2006 to December 31, 2008. At index date, there were 305 patients eligible to include into the study, 2 died, 32 referred to other hospital, 56 loss followed up and 105 registered after the index date. Two hundreds and ten patients from 305 met the criteria to include into the study, 2 are under 18 years old, 1 CKD stage 1, 4 CKD stage 2 and incomplete data in 88 patients. Four kidney transplant patients were excluded. So, two hundreds and six were analyzed.

4.2 Demographic data

At index date, 80, 62 and 64 patients were classified into CKD stage 3, stage 4 and stage 5, respectively. The average age was 60.6 year old and 59.7% were male. 88.8% hypertension, 41.7% diabetes, 35% dyslipidemia and 13.6% cardiovascular disease were found in these patients. 19.4% and 5.3% of patients were on continuous ambulatory peritoneal dialysis and hemodialysis. The demographic data of the patient in CKD stage 3, 4 and 5 were shown in Table 4.

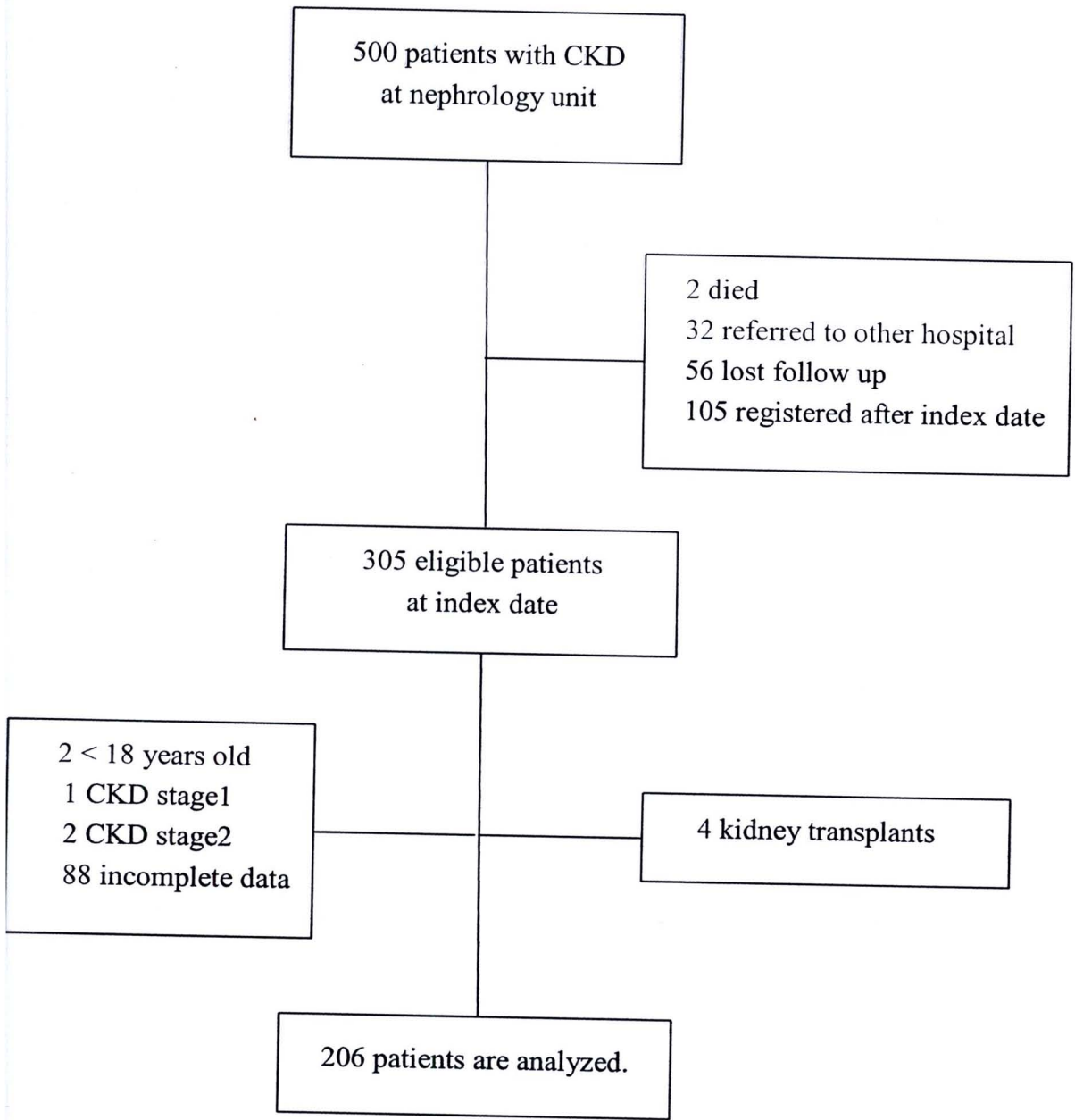


Figure 1 Inclusion of CKD patients into the study

Table 4 Demographic data of the patients with CKD in the study

Characteristics	Total N=206	CKD3 N=80 (38.8%)	CKD4 N=62 (30.1%)	CKD5 N=64 (31.1%)
Male	123 (59.7)	54 (67.5)	35 (55.5)	34 (53.1)
Follow up at nephrology unit > 1 year	180 (87.3)	72 (90.0)	54 (87.0)	54 (84.4)
Age	[Mean (SD)]	62.5 (18.8)	65.5 (17.3)	57.2 (12.2)
Pre-dialysis	[n (%)]	80 (100)	62 (100)	13 (20.3)
Dialysis;				
Continuous ambulatory peritoneal dialysis	[n (%)]	0	0	40 (62.5)
Hemodialysis	[n (%)]	0	0	11 (17.2)
Co-morbidity				
Diabetes mellitus	[n (%)]	25 (31.3)	30 (48.3)	31 (48.4)
Hypertension	[n (%)]	66 (82.5)	55 (88.7)	62 (96.9)
Dyslipidemia	[n (%)]	32 (40.0)	21 (33.9)	19 (29.7)
Cardiovascular disease	[n (%)]	5 (6.25)	10 (16.1)	13 (20.3)
Medications				
Calcium base phosphate binder	[n (%)]	12 (15.0)	29 (46.8)	42 (65.6)
Aluminum base phosphate binder	[n (%)]	0	0	3 (4.7)
VitaminD ₃ therapy	[n (%)]	0	1 (1.6)	4 (6.3)
Laboratory data at index date				
Serum creatinine, (mg/dL)	[Mean (SD)]	1.7 (0.3)	2.8 (0.5)	9.1 (4.5)
Creatinine clearance, (ml/min)	[Mean (SD)]	41.6 (9.2)	22.7 (4.4)	7.3 (3.8)
Albumin, (mg/dL), N= 198	[Mean (SD)]	3.9 (0.4)	3.7 (0.5)	3.4 (0.6)
Corrected-calcium, (mg/dL), N=194	[Mean (SD)]	9.1 (0.4)	9.0 (0.5)	9.8 (1.2)
Phosphate, (mg/dL), N=193	[Mean (SD)]	3.5 (0.5)	3.7 (0.7)	3.9 (1.3)
Correct-Ca x P product, (mg ² /dL ²), N=193	[Mean (SD)]	32.4 (5.3)	33.4 (7.0)	38.3 (14.2)
PTH, (pg/mL), N=47	[Median (IQR)]	38.9 (71.2)	107.6 (199.7)	47.4 (194.1)



4.3 Adherence to mineral and bone disorder clinical practice guideline

4.3.1 Clinical parameters monitoring

Adherence to clinical parameters monitoring were analyzed in all 12 months and recent 6 months of postindex period which are shown in Table 5. The mean percentages of adherence in each patient are 89.5% for calcium monitoring, 88.6% for phosphate monitoring and 17.1% for PTH monitoring in all 12 months of postindex period. Mean percentage of adherence to calcium monitoring in each patient with CKD stage 3, 4 and 5 are 90.8%, 82.8% and 94.4%, respectively. Evaluations of total adherence to clinical parameters monitoring are 91.0% for calcium, 90.2% for phosphate and 20.4% for PTH. All data in all 12 months and recent 6 months of postindex period are compared by paired t-test. They are not statistical significant difference at $p\text{-value} = 0.05$.

The percentages of adherence to clinical parameters monitoring are categorized into 100%, 75-99.9%, 50-74.9% and less than 50% for calcium, phosphate and PTH monitoring in each CKD staging as shown in Table 6.

4.3.2 Using of phosphate binder

The adherence of MBD – CPG to using of phosphate binder were analyzed in all 12 months and recent 6 months of postindex period which are shown in Table 7. The mean percentage of adherence to using of phosphate binder in each patient is 84.6% in all 12 months of postindex period. The mean percentage of adherence to using of phosphate binder in each patient with CKD stage 3, 4 and 5 are 92.2%, 92.8%, and 68.6%, respectively. Evaluation of total adherence to using of phosphate binder is 78.8%. All data in all 12 months and recent 6 months of postindex period are compared by paired t-test. They are not statistical significant difference at $p\text{-value} = 0.05$.

The percentages of adherence to using of phosphate binder are categorized into 100%, 75-99.9%, 50-74.9% and less than 50% for calcium, phosphate and PTH monitoring in each CKD staging as shown in Table 8

Table 6 Percentage of adherence to clinical parameter monitoring in the patient with CKD

Percentage of adherence to clinical parameter monitoring (%)	All 12 months of postindex period					Recent 6 months of postindex period				
	Total N=206 (%)	CKD3 N=80 (%)	CKD4 N=62 (%)	CKD5 N=64 (%)	Total N=206 (%)	CKD3 N=80 (%)	CKD4 N=62 (%)	CKD5 N=64 (%)		
Calcium monitoring										
100	133 (64.6)	65 (81.3)	26 (41.9)	42 (65.6)	146 (70.9)	67 (83.8)	31 (50.0)	48 (75.0)		
75-99.9	48 (23.3)	7 (8.8)	21 (33.9)	20 (31.3)	24 (11.7)	2 (2.5)	7 (11.3)	15 (23.4)		
50-74.9	16 (7.8)	2 (2.5)	12 (19.4)	2 (3.1)	22 (10.7)	4 (5.0)	17 (27.4)	1 (1.6)		
<50	9 (4.4)	6 (7.5)	3 (4.8)	0	14 (6.8)	7 (8.8)	7 (11.3)	0		
Phosphate monitoring										
100	128 (62.1)	64 (80.0)	24 (38.7)	40 (62.5)	144 (69.9)	66 (82.5)	31 (50.0)	47 (73.4)		
75-99.9	50 (24.3)	8 (10.0)	22 (35.5)	20 (31.3)	24 (11.7)	3 (3.8)	7 (11.3)	14 (21.9)		
50-74.9	18 (8.7)	2 (2.5)	12 (19.4)	4 (6.3)	24 (11.7)	4 (5.0)	17 (27.4)	3 (4.7)		
<50	10 (4.9)	6 (7.5)	4 (6.5)	0	14 (6.8)	7 (8.8)	7 (11.3)	0		
PTH monitoring										
100	1 (0.5)	1 (1.3)	0	0	4 (1.9)	2 (2.5)	0	2 (3.1)		
75-99.9	4 (1.9)	2 (2.5)	0	2 (3.1)	5 (2.4)	2 (2.5)	0	3 (4.7)		
50-74.9	24 (11.7)	3 (3.8)	1 (1.6)	20 (31.3)	33 (16.0)	3 (3.8)	6 (9.7)	24 (37.5)		
<50	177 (85.9)	74 (92.5)	61 (98.4)	42 (65.6)	164 (79.6)	73 (91.3)	56 (90.3)	35 (54.7)		

Table 7 Adherence to mineral and bone disorder clinical practice guideline for using of phosphate binder

Using of phosphate binder	All 12 months of postindex period					Recent 6 months of postindex period				
	Total	CKD3	CKD4	CKD5	Total	CKD3	CKD4	CKD5		
	N=195	N= 70	N=61	N= 64	N=180	N= 60	N= 56	N= 64		
Total visit of calcium and phosphate monitoring (visit)	1006	194	258	554	538	108	133	297		
Adherence to using of phosphate binder (visit)	793	179	238	376	421	99	123	199		
Percentage of adherence to using of phosphate binder (%)	78.8	92.3	92.2	67.9	78.3	91.7	92.5	67.0		
Adherence to using of phosphate binder in each patients	84.6	92.2	92.8	68.6	83.7	91.9	94.0	66.8		
[% , Mean (SD)]	(26.0)	(18.8)	(18.4)	(31.2)	(29.6)	(22.7)	(20.9)	(34.3)		
Adherence to using of phosphate binder (%) = (No of Adherence to using of phosphate binder visit / total visit)*100										
Only the visits that had both calcium and phosphate monitoring were evaluated.										

Table 8 Percentage of adherence to using of phosphate binder in the patient with CKD

Percentage of adherence to using of phosphate binders (%)	All 12 months of postindex period					Recent 6 months of postindex period				
	Total	CKD3	CKD4	CKD5	Total	CKD3	CKD4	CKD5		
	N=195 (%)	N= 70 (%)	N=61 (%)	N= 64 (%)	N=180 (%)	N= 60 (%)	N= 56 (%)	N= 64 (%)		
100	122 (62.6)	57 (81.4)	48 (78.7)	17 (26.6)	126 (70.0)	52 (86.7)	51 (91.1)	23 (35.9)		
75-99.9	35 (17.9)	5 (7.1)	9 (14.8)	21 (32.8)	11 (6.1)	0	0	11 (17.2)		
50-74.9	17 (8.7)	6 (8.6)	2 (3.3)	9 (14.1)	21 (11.7)	5 (8.3)	3 (5.4)	13 (20.3)		
<50	21 (10.8)	2 (2.9)	2 (3.2)	17 (26.6)	22 (12.2)	3 (5.0)	2 (3.6)	17 (26.6)		

4.3.3 Using of vitaminD₃

The adherence of MBD – CPG to using of vitaminD₃ was analyzed in all 12 months and recent 6 months of postindex period which are shown in Table 9. The mean percentage of adherence to using of vitaminD₃ in each patient is 72.2% in all 12 months of postindex period. The mean percentage of adherence to using of vitaminD₃ in each patient with CKD stage 3, 4 and 5 are 40.0%, 76.9%, and 74.2%, respectively. Evaluation of total adherence to using of vitaminD₃ is 68.4%. All data in all 12 months and recent 6 months of postindex period are compared by paired t-test. They are not statistical significant difference at p-value = 0.05.

The percentages of adherence to using of vitaminD₃ are categorized into 100%, 75-99.9%, 50-74.9% and less than 50% for calcium, phosphate and PTH monitoring in each CKD staging as shown in Table 10.

4.4 Achievement of K/DOQI target recommendations

The analysis of achievement of K/DOQI target recommendations for clinical parameters; serum calcium, serum phosphate, serum CaxP product and serum PTH are composed of the percentage of patients K/DOQI target recommendations achievement at the end of study and during 12 months of postindex period as follow:

4.4.1 Percentage of patients with CKD K/DOQI target recommendation achievement at the end of study.

Achieving target recommendations are analyzed only in patients whose parameters were monitored according to MBD – CPG. There are 73.7% of serum calcium, 76.1% of serum phosphate, 94.6% of calculated CaxP product and 23.7% of serum PTH achievement. The achievement in each CKD stage are shown in Table 11. PTH was monitored in only 38 from 206 patients.

Table 9 Adherence to mineral and bone disorder clinical practice guideline for using of VitaminD₃

Using of VitaminD ₃	All 12 months of postindex period					Recent 6 months of postindex period				
	Total	CKD3	CKD4	CKD5	Total	CKD3	CKD4	CKD5	Total	
	N=68	N= 5	N= 13	N= 50	N=50	N= 3	N=12	N= 35	N=50	
Total visit of calcium, phosphate and PTH monitoring (visit)	98	6	13	79	60	4	12	44		
Adherence to using of vitaminD ₃ (visit)	67	3	10	54	43	2	10	31		
Percentage of adherence to using of vitaminD ₃ (%)	68.4	50.0	76.9	68.4	71.1	50.0	83.3	70.5		
Adherence to using of vitaminD ₃ in each patients	72.2	40.0	76.9	74.2	76.5	33.3	83.3	77.9		
[%, Mean (SD)]	(42.8)	(54.8)	(43.9)	(40.9)	(42.4)	(57.7)	(38.9)	(41.5)		
Adherence to using of vitaminD ₃ (%) = (No of Adherence to using of vitaminD ₃ visit / total visit)*100										
Note: Only the visits that had all of calcium phosphate and PTH monitoring were evaluated.										

Table 10 Percentage of adherence to using of VitaminD₃ in the patient with CKD

Percentage of adherence to using of vitaminD ₃ (%)	All 12 months of postindex period					Recent 6 months of postindex period						
	Total	CKD3	CKD4	CKD5	Total	CKD3	CKD4	CKD5	Total	CKD3	CKD4	CKD5
	N=68 (%)	N= 5 (%)	N= 13 (%)	N= 50 (%)	N=50 (%)	N= 3 (%)	N=12 (%)	N= 35 (%)	N=50 (%)	N= 3 (%)	N=12 (%)	N= 35 (%)
100	46 (67.6)	2 (40.0)	10 (76.9)	34 (68.0)	38 (76)	1 (33.3)	10 (83.3)	27 (77.1)				
75-99.9	0	0	0	0	0	0	0	0				
50-74.9	5 (7.4)	0	0	5 (10.0)	0	0	0	0				
<50	17 (25.0)	3 (60.0)	3 (23.1)	11 (22.0)	12 (5.8)	2 (66.7)	2 (3.2)	8 (22.9)				



Table 11 Percentage of patients with K/DOQI target recommendation achievement at the end of study

Clinical parameter		Total N (%)	CKD3 N (%)	CKD4 N (%)	CKD5 N (%)
Calcium	N=186	137 (73.7)	64 (91.4)	49 (94.2)	24 (37.5)
Phosphate	N=184	140 (76.1)	62 (88.6)	47 (92.2)	31 (49.2)
CaxP product	N=184	174 (94.6)	70 (100.0)	51 (100.0)	53 (84.1)
PTH	N=38	9 (23.7)	1 (14.3)	3 (27.3)	5 (25.0)

4.4.2 Percentage of the patients K/DOQI target recommendation achievement during 12 months of postindex period.

The percentage of K/DOQI recommendation achievement in each patient was analyzed in every visit during 12 months of postindex period that clinical parameters had been monitored. The mean percentage of K/DOQI target recommendation achievement in each patient was 79.3% for calcium achievement, 78.1% for phosphate achievement, 95.8% for serum CaxP product achievement and 26.3% for PTH achievement. Mean percentage of calcium achievement in each patient with CKD stage 3, 4 and 5 are 93.2%, 95.9% and 48.1% respectively. The percentage of phosphate, CaxP product and PTH achievement are shown in Table 12. Evaluations of total K/DOQI recommendation achievement are 69.9% for calcium, 69.9% for phosphate, 92.5% for CaxP product and 24.0% for PTH.

The percentages of K/DOQI recommendation achievement are categorized into 100%, 75-99.9%, 50-74.9% and less than 50% for calcium, phosphate, CaxP product and PTH achievement in each CKD staging as shown in Table 13.

Table 12 Achievement of K/DOQI target recommendations in patient with CKD during 12 months of post index period

Achievement of K/DOQI target recommendations	All 12 months of postindex period			
	Total	CKD3	CKD4	CKD5
Calcium				
Total visit of calcium monitoring (visit)	1038	203	271	564
Achievement of target recommendation (visit)	726	189	262	275
Percentage of achievement for calcium (%)	69.9	93.1	96.7	48.8
Percentage of achievement for calcium in each patients [%; Mean (SD)], N=196 (%)	79.3 (31.3)	93.2 (20.1)	95.9 (10.6)	48.1 (31.9)
Phosphate				
Total visit of phosphate monitoring (visit)	1011	194	259	558
Achievement of target recommendation (visit)	707	180	233	294
Percentage of achievement for phosphate (%)	69.9	92.8	90.0	52.7
Percentage of achievement for phosphate in each patients [%; Mean (SD)], N=195 (%)	78.1 (31.0)	89.4 (25.6)	90.4 (20.0)	54.2 (31.4)
CaxP product				
Total visit of calcium and phosphate monitoring (visit)	1010	194	258	558
Achievement of target recommendation (visit)	934	194	257	483
Percentage of achievement for CaxP product (%)	92.5	100.0	99.6	86.6
Percentage of achievement for CaxP product in each patients [%; Mean (SD)], N=195 (%)	95.8 (15.5)	100.0	99.8 (1.4)	87.5 (25.2)
PTH				
Total visit of PTH monitoring (visit)	104	8	15	81
Achievement of target recommendation (visit)	25	1	3	21
Percentage of achievement for PTH (%)	24.0	12.5	20.0	25.9
Percentage of achievement for PTH in each patients [%; Mean (SD)], N=72 (%)	26.3 (39.9)	14.3 (37.8)	17.9 (37.2)	30.2 (40.9)

Percentage of achievement for target recommendations (%) = (No of achievement of target recommendations visit / total visit)*100

Note: Only the visits that had calcium, phosphate and PTH monitoring were evaluated.

Table 13 Percentage of the patients had achieving K/DOQI target recommendations during 12 months of post index period

Percentage of achievement for clinical parameters (%)		All 12 months of postindex period			
		Total	CKD3	CKD4	CKD5
Calcium		N=196 (%)	N=70 (%)	N=62 (%)	N=64 (%)
100		118 (60.2)	59 (84.3)	53 (85.5)	6 (9.4)
75-99.9		22 (11.2)	6 (8.6)	6 (9.7)	10 (15.6)
50-74.9		21 (10.7)	2 (2.9)	3 (4.8)	16 (25.0)
<50		35 (17.9)	3 (4.3)	0	32 (50.0)
Phosphate		N=195 (%)	N=70 (%)	N=61 (%)	N=64 (%)
100		107 (54.9)	56 (80.0)	45 (73.8)	6 (9.4)
75-99.9		29 (14.9)	4 (5.7)	8 (13.1)	17 (26.6)
50-74.9		30 (15.4)	6 (8.6)	6 (9.8)	18 (28.1)
<50		29 (14.9)	4 (5.7)	2 (3.3)	23 (35.9)
CaxP product		N=195 (%)	N=70 (%)	N=61 (%)	N=64 (%)
100		177 (90.8)	70 (100.0)	60 (98.4)	47 (73.4)
75-99.9		6 (3.1)	0	1 (1.6)	5 (7.8)
50-74.9		4 (2.1)	0	0	4 (6.3)
<50		8 (4.1)	0	0	8 (12.5)
PTH		N=72 (%)	N=7 (%)	N=14 (%)	N=51 (%)
100		14 (19.4)	1 (14.3)	2 (14.3)	11 (21.6)
75-99.9		0	0	0	0
50-74.9		8 (11.1)	0	1 (7.1)	7 (13.7)
<50		50 (69.4)	6 (85.7)	11 (78.6)	33 (64.7)

4.5 Percentage comparison of target recommendation achievement between adherent and non-adherent patients

The percentage comparisons of target recommendation achievement between adherent and non-adherent patients during 12 months of postindex periods are described in Table 14. Adherence to MBD - CPG for calcium, phosphate and PTH monitoring, using of phosphate binder and using of vitaminD₃ are classified into 4 groups; 100%, 75.0 – 99.9%, 50.0 – 74.9% and less than 50% adherence.

The 100% achievement of target recommendations during 12 months of postindex period are compared between group of 100% adherence and the other three groups. Chi-square test was used. The achievement of serum calcium, phosphate and CaxP product target recommendations are statistical significant difference in using of phosphate binder, odd ratio 5.43 (95% confidence interval (CI) 2.43 – 12.11), 11.33 (95% CI 4.63 – 27.72) and 11.75 (95% CI 2.92 – 47.24), respectively in comparison between 100% and 75.0-99.9% adherence group. But there are no statistical significant difference in calcium, phosphate and PTH monitoring. And also the same results are shown between the group of 100% VS 50.0-74.5% and 100% VS less than 50.0% as described in Table 14.

Table 14 Odd ratio of 100% achievement of target recommendations during 12 months of the study period between 100% and less than 100% adherence to mineral and bone disorder clinical practice guideline

Adherence to clinical practice guideline		Odd ratio (Over all 100% achievement)			
Adherence to guideline 100% VS 75 - 99.9%		Serum calcium	Serum phosphate	CaxP product	Serum PTH
Calcium monitoring		1.36 (0.69 – 2.69)	1.52 (0.77 – 3.00)	0.34 (0.07 – 1.54)	0.59 (0.17 – 2.04)
Phosphate monitoring		1.26 (0.64 – 2.48)	1.26 (0.64 – 2.46)	0.31 (0.07 – 1.41)	0.66 (0.19 – 2.28)
PTH monitoring		NA	NA	NA	NA
Using of phosphate binder		5.43 (2.43 – 12.11) ^a	11.33	11.75	1.13 (0.26 – 4.84)
Using of vitaminD ₃		NA	(4.63 – 27.72) ^a	(2.92 – 47.24) ^a	NA
Adherence to guideline 100% VS 50.0 - 74.9%					
Calcium monitoring		0.62 (0.19 – 2.10)	0.20 (0.04 – 0.94) ^a	NA	NA
Phosphate monitoring		0.94 (0.32 – 2.74)	0.55 (0.18 – 1.67)	NA	NA
PTH monitoring		NA	NA	NA	NA
Using of phosphate binder		4.58 (1.60 – 13.12) ^a	8.06 (2.61 – 24.83) ^a	NA	0.60 (0.09 – 4.01)
Using of vitaminD ₃		NA	NA	7.12 (1.02 – 49.82)	NA
Adherence to guideline 100% VS <50%					
Calcium monitoring		0.52 (0.05 – 5.13)	0.61 (0.05 – 6.87)	NA	NA
Phosphate monitoring		0.39 (0.04 – 3.59)	0.40 (0.04 – 3.97)	NA	NA
PTH monitoring		NA	NA	NA	NA
Using of phosphate binder		13.63	NA	19.83	1.03
Using of vitaminD ₃		(4.25 – 43.75) ^a	(4.60 – 85.53) ^a	(4.60 – 85.53) ^a	(0.21 – 5.06)
		1.28 (0.38 – 4.28)	0.67 (0.19 – 2.34)	2.59 (0.74 – 9.07)	5.65 (0.68 – 47.27)

^a p-value < 0.05, thus the significant difference,
NA = not assessment by calculated statistics.

