

## **CHAPTER 3**

### **Death and Survival on Dialysis**

**Wong Hin Seng**

Ong Loke Meng

Keng Tee Chau

Yudisthra A/L M. Ganeshadeva

**SECTION 3.1: DEATH ON DIALYSIS**

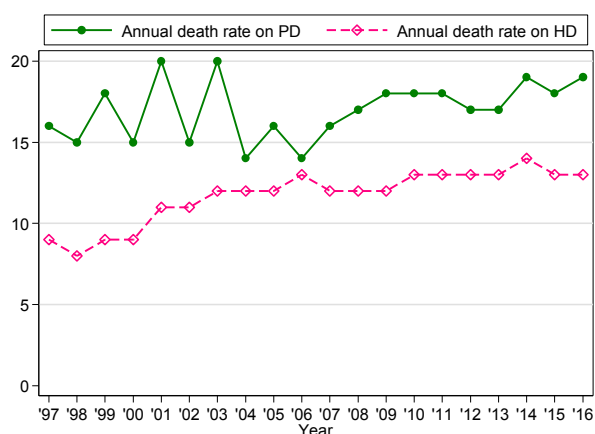
The annual crude death rate on dialysis in 2016 was 13.9% (Table 3.1.1). The crude annual death rate among haemodialysis patients was 13.3% while chronic peritoneal dialysis patients had an annual crude death rate of 19.0%.

The annual crude death rate among haemodialysis (HD) patients has gradually increased in the mid 1990's but plateau off since mid 2000's (Figure 3.1.1). The annual crude death rate of patients on chronic peritoneal dialysis (PD) remained relatively unchanged over the last 2 decades in mid-2000's and remained at 15-19%; 4-5% higher than that of HD patients. The difference in annual death rate between the two modalities persisted over the last 2 decades and is partly contributed by the negative selection of patients for peritoneal dialysis and the changing of modality from HD to PD due to severe cardiovascular disease.

Table 3.1.1: Deaths on dialysis 2007-2016

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of dialysis patients at risk	16094	18250	20507	22675	25057	27841	30755	33577	36341	38720
Dialysis deaths	1988	2191	2601	3048	3292	3646	4014	4717	4988	5366
Dialysis death rate %	12	12	13	13	13	13	13	14	14	14
Number of HD patients at risk	14661	16601	18689	20737	22973	25472	28047	30506	32814	34873
HD deaths	1757	1914	2280	2695	2918	3249	3542	4141	4357	4636
HD death rate %	12	12	12	13	13	13	13	14	13	13
Number of PD patients at risk	1433	1650	1818	1939	2084	2370	2708	3072	3527	3847
PD deaths	231	277	321	353	374	397	472	576	631	730
PD death rate %	16	17	18	18	18	17	17	19	18	19

Figure 3.1.1: Death rates on dialysis 2007-2016



Cardiovascular disease remained the main cause of death and in 2016 accounted for 33% of all death. Death at home accounted for another 16% and a majority of these deaths were probably due to cardiovascular events. Death from sepsis has gradually increased over the last decade and has now become the second most common cause of death; accounting for 28% of all death in 2016.

Table 3.1.2: Causes of death on dialysis 2007-2016

Year Causes of Death	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	631	32	738	34	907	35	1024	34	1206	37
Died at home	342	17	423	19	491	19	546	18	542	16
Sepsis	344	17	400	18	586	23	735	24	775	24
PD peritonitis	23	1	30	1	32	1	37	1	28	1
GIT bleed	39	2	47	2	49	2	61	2	54	2
Cancer	41	2	57	3	57	2	79	3	88	3
Liver disease	39	2	45	2	29	1	33	1	35	1
Withdrawal	27	1	24	1	36	1	42	1	43	1
Others	230	12	192	9	103	4	64	2	79	2
Unknown	272	14	235	11	311	12	427	14	442	13
Total	1988	100	2191	100	2601	100	3048	100	3292	100

Year Causes of Death	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	1279	35	1418	35	1670	35	1681	34	1772	33
Died at home	585	16	680	17	660	14	699	14	746	14
Sepsis	953	26	1006	25	1210	26	1309	26	1502	28
PD peritonitis	18	0	43	1	50	1	46	1	56	1
GIT bleed	63	2	68	2	81	2	76	2	95	2
Cancer	80	2	86	2	116	2	113	2	138	3
Liver disease	31	1	37	1	55	1	29	1	43	1
Withdrawal	51	1	49	1	53	1	65	1	72	1
Others	71	2	97	2	197	4	288	6	313	6
Unknown	515	14	530	13	625	13	682	14	629	12
Total	3646	100	4014	100	4717	100	4988	100	5366	100

## SECTION 3.2: PATIENT SURVIVAL ON DIALYSIS

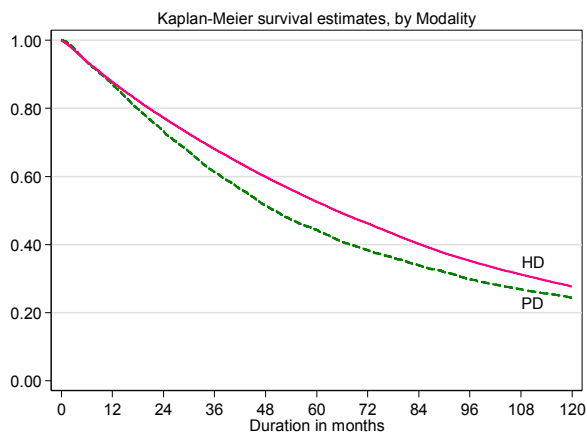
### 3.2.1. Patient survival by type of dialysis modality

The overall unadjusted 5 years and 10 years patient survival on dialysis; analysed as per ITT (patient not censored for change in dialysis modality) were 52% and 27% respectively (Table 3.2.1). The unadjusted patient survival for those on haemodialysis appeared to be superior compared to those on PD and this survival difference began to widen after the first year with maximum difference at 4<sup>th</sup>-5<sup>th</sup> year. The difference in survival began to narrow after that and at 10 years the difference was only 4%.

Table 3.2.1 : Patient survival by dialysis modality analysis (censored for change of modality)

Dialysis Modality Interval (month)	PD			HD			All		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	11021	100		77903	100		88924	100	
6	9846	93	0	69970	94	0	79810	94	0
12	8735	87	0	62731	88	0	71466	88	0
24	6550	73	0	50243	77	0	56562	77	0
36	4929	61	1	40075	68	0	45004	67	0
48	3722	51	1	31614	60	0	35336	59	0
60	2905	44	1	25007	53	0	27912	52	0
72	2294	38	1	19743	46	0	22037	45	0
84	1860	34	1	15428	40	0	17286	39	0
96	1468	30	1	12139	35	0	13606	35	0
108	1195	27	1	9635	31	0	10785	31	0
120	983	24	1	7638	28	0	8621	27	0

Figure 3.2.1: Patient survival by dialysis modality analysis (censored for change of modality)



### 3.2.2. Patient survival by Age at starting dialysis

Age at starting dialysis has major impact on survival with patients in the age group of 15 to 24 having the best outcome (Table 3.2.2 and Figure 3.2.2). Unadjusted 10 years survival of patients in this age group (15-24) was 10- fold better that those who were 65years and above.

Table 3.2.2: Unadjusted patient survival by age

Age group (years) Interval (month)	<=14			15-24			25-34		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	948	100		3386	100		7062	100	
6	849	97	1	3006	97	0	6254	96	0
12	772	95	1	2684	94	0	5628	94	0
24	603	89	1	2189	89	1	4652	89	0
36	465	86	1	1825	86	1	3965	86	0
48	362	82	2	1529	83	1	3353	82	1
60	269	78	2	1296	81	1	2838	79	1
72	192	73	2	1123	78	1	2412	75	1
84	144	68	2	960	75	1	2052	72	1
96	104	64	3	799	73	1	1744	69	1
108	78	59	3	681	70	1	1476	66	1
120	61	55	3	561	68	1	1261	64	1

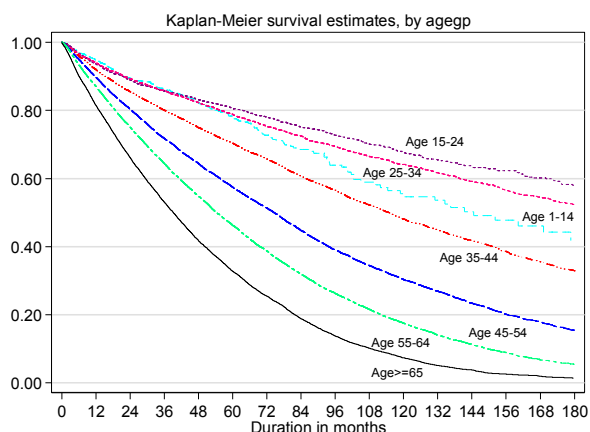
  

Age group (years) Interval (month)	35-44			45-54			55-64		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	11485	100		22641	100		27620	100	
6	10326	96	0	20316	95	0	24288	93	0
12	9254	92	0	18149	90	0	21239	87	0
24	7601	85	0	14444	80	0	16065	75	0
36	6352	80	0	11450	72	0	12060	64	0
48	5277	75	0	9047	64	0	8880	55	0
60	4442	70	1	7177	57	0	6530	46	0
72	3729	66	1	5614	51	0	4727	39	0
84	3076	61	1	4297	45	0	3348	32	0
96	2588	56	1	3271	39	0	2366	26	0
108	2131	52	1	2517	34	0	1668	22	0
120	1753	48	1	1910	30	0	1154	17	0

Age group (years) Interval (month)	>=65		
	n	% survival	SE
0	22088	100	
6	18751	90	0
12	15925	81	0
24	11333	66	0
36	7943	53	0
48	5411	42	0
60	3657	33	0
72	2438	25	0
84	1568	19	0
96	952	14	0
108	604	10	0
120	361	7	0

Figure 3.2.2: Unadjusted patient survival by age



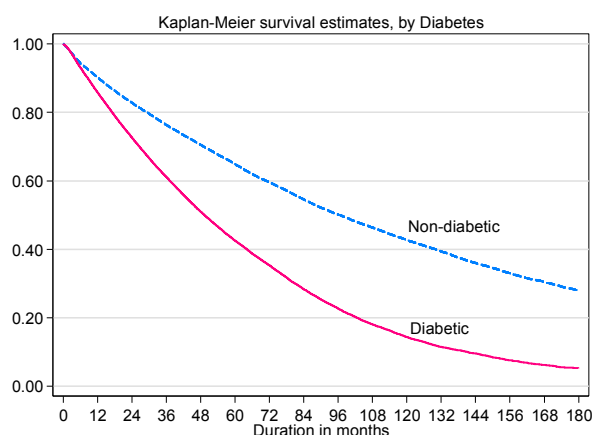
### 3.2.3. Patient survival by Diabetic status

Similar to age at starting dialysis, the presence of diabetes mellitus has major impact on patient survival (Table 3.2.3 and Figure 3.2.3). The unadjusted patient survival began to diverge as early as 6 months after initiation of dialysis and nearly 50% diabetic patients died within 4 years of initiating dialysis. The 10 years unadjusted patient survival among diabetics and non-diabetics were 43% and 14% respectively, a three folds difference.

Table 3.2.3: Unadjusted patient survival by diabetes mellitus status

Diabetes status Interval (month)	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	41499	100		53731	100	
6	36885	94	0	46904	93	0
12	33209	90	0	40442	86	0
24	27063	83	0	29824	73	0
36	22236	76	0	21824	61	0
48	18178	70	0	15681	51	0
60	14905	65	0	11304	43	0
72	12208	60	0	8027	35	0
84	9945	55	0	5498	28	0
96	8109	50	0	3711	23	0
108	6676	46	0	2478	18	0
120	5436	43	0	1622	14	0

Figure 3.2.3: Unadjusted patient survival by diabetes mellitus status



### 3.2.4. Patient survival by 5 years era of starting dialysis

Even though there was no difference in unadjusted patient survival by year of starting dialysis, when unadjusted patient survival was analysed by 5 years era of starting dialysis, it appeared that patient survival has deteriorated over the last 20 years; with patients starting dialysis in the 1996-2000 era having the best outcome (Table 3.2.4 and Figure 3.2.4a). Despite adjusting for age and DM (major change in patient demography over the last 2 decades), the difference in patient survival persisted (Figure 3.2.4b)

Table 3.2.4: Unadjusted patient survival by 4 Era, 1996-2016

Year Interval (month)	1996-2000			2001-2005			2006-2010			2011-2016		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	7142	100		13934	100		23880	100		46172	100	
6	6645	95	0	12907	94	0	22036	93	0	38728	94	0
12	6204	90	0	11869	88	0	20336	87	0	32143	87	0
24	5390	81	0	10163	78	0	17406	77	0	21274	76	0
36	4666	72	1	8752	69	0	15044	68	0	13248	66	0
48	4042	64	1	7569	60	0	12978	59	0	7155	57	0
60	3533	57	1	6543	53	0	11181	52	0	3040	50	0
72	3086	51	1	5698	47	0	9613	45	0	86		
84	2692	45	1	4873	41	0	6286	39	0			
96	2354	40	1	4228	36	0	3816	33	0			
108	2085	36	1	3691	32	0	2124	29	0			
120	1852	32	1	3198	28	0	881	25	0			

Figure 3.2.4a: Unadjusted patient survival by 4 Era, 1996-2016

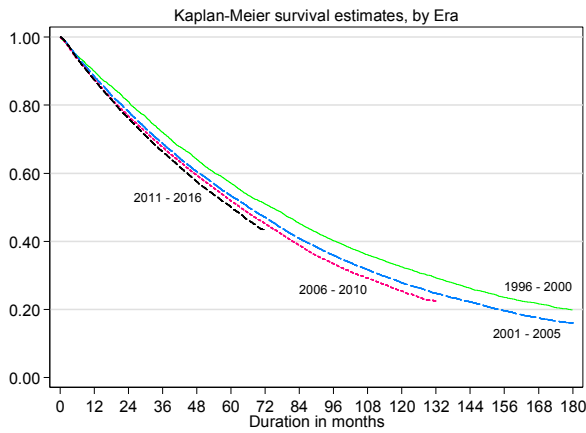
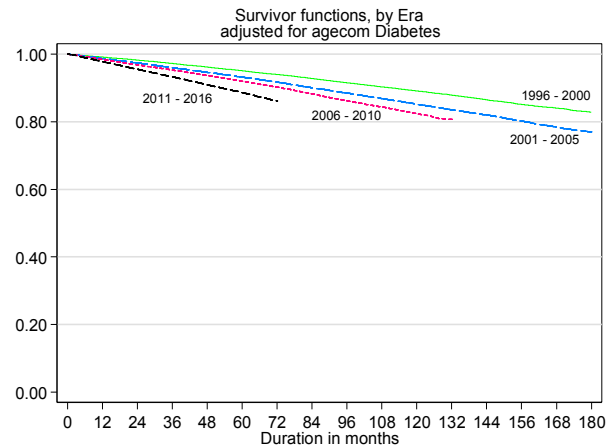


Figure 3.2.4b: Adjusted for Age and Diabetes patient survival by 4 Era, 1996-2016



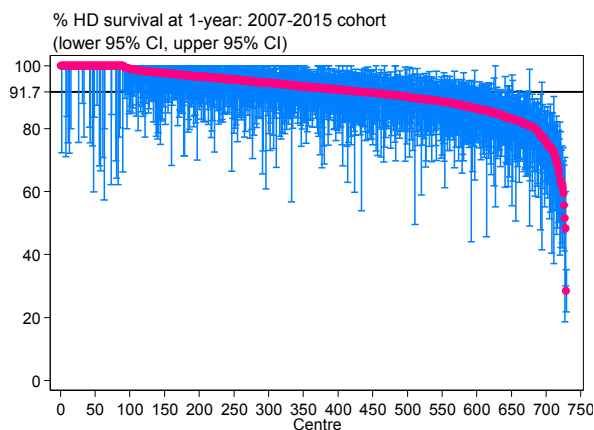
**SECTION 3.3: Survival of incidence patients by centre**

**3.3.1. Survival of incident haemodialysis patients 2007-2015 by centre**

The mean patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2007-2015 cohort was 91.7% [Figure 3.3.1(a)]. There was marked centre variation and when the 1-year patient survival of the individual haemodialysis centres were illustrated in the funnel plots [Figure 3.3.1(b)], where only 176 haemodialysis centres (24.1%) and 253 haemodialysis centres (34.7%) lie within the 2SD and 3SD of the mean respectively.

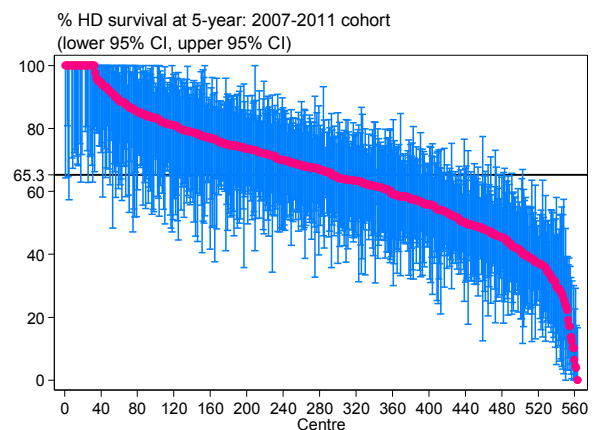
The 5 years mean patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2007-2011 cohort was 65.3% [Figure 3.3.1(c)]. Similar to the 1-year patient survival, there was marked centre variation with only 27.2% and 40.3% of haemodialysis centres lie within 2SD and 3SD of the mean respectively [Figure 3.3.1(d)].

Figure 3.3.1(a): Variation in patient survival at 1-year among HD centres adjusted for age and diabetes mellitus status, 2007-2015



\*Horizontal line represents the mean % survival among HD centres

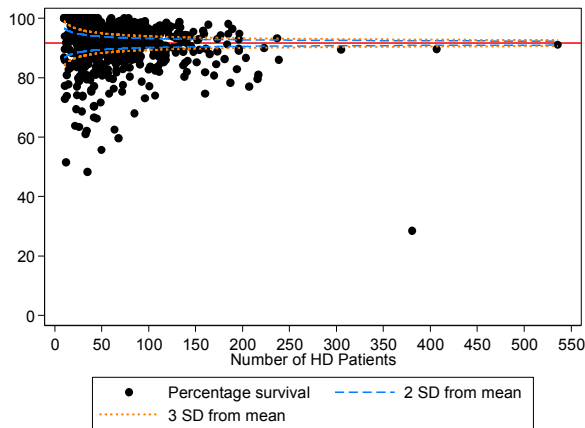
Figure 3.3.1(c): Variation in patient survival at 5-years among HD centres adjusted for age and diabetes mellitus status, 2007-2011



\*Horizontal line represents the mean % survival among HD centres

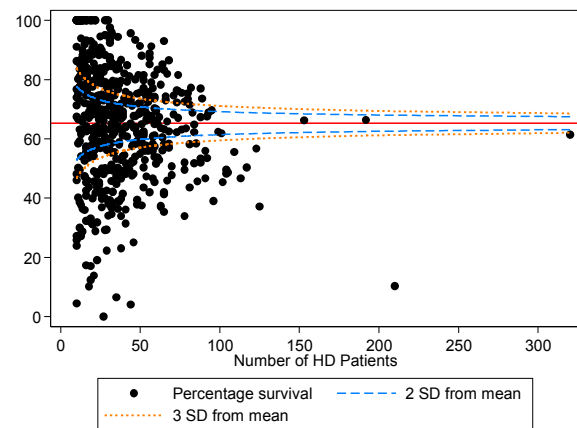


Figure 3.3.1(b): Funnel plot at 1-year among HD centres adjusted for age and diabetes mellitus status, 2007-2015 cohort



\*Horizontal line represents the mean % survival among HD centres

Figure 3.3.1(d): Funnel plot for patient survival at 5-years among HD centres adjusted age and diabetes mellitus, 2007-2011 cohort



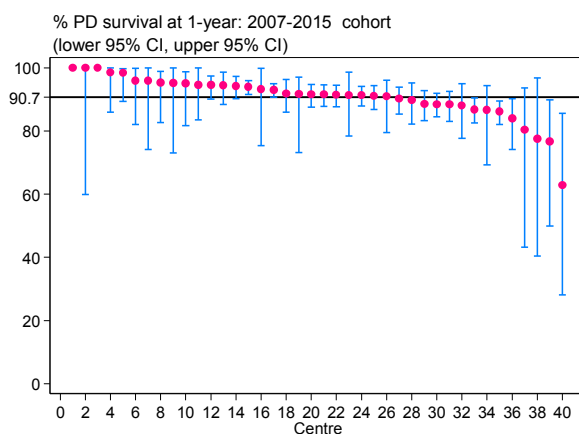
\*Horizontal line represents the mean % survival among HD centres

### 3.3.2. Survival of incidence PD patients by centre

The mean patient survival at 1 year (adjusted for age and diabetes mellitus) among peritoneal dialysis for the 2007-2015 cohort was 90.7% [Figure 3.3.2(a)]. Similar to haemodialysis centres, there was marked centre variation of 1-year patient survival among the peritoneal dialysis centres with only 20.0% and 30.0% of the peritoneal dialysis centres lies within the 2SD and 3SD of the mean respectively [Figure 3.3.2(b)].

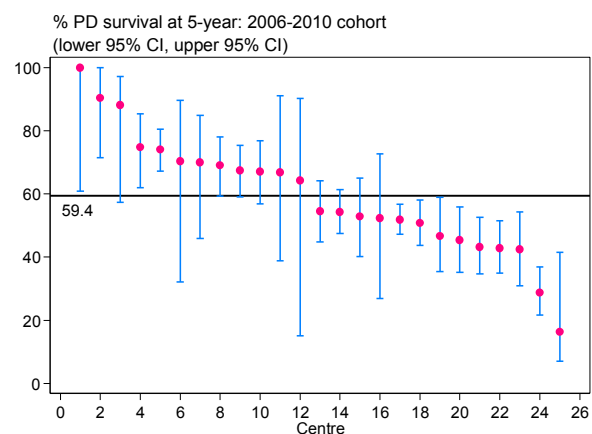
The 5 years mean patient survival (adjusted for age and diabetes mellitus) among peritoneal centres for the 2007-2011 cohort was 59.4% [Figure 3.3.2(c)]. Similar to the 1-year survival, there was a wide variation in the 5-year survival among PD centres with only 12% and 12% of PD centres lied within 2SD and 3SD of the mean respectively [Figure 3.3.2(d)].

Figure 3.3.2(a): Variation in patient survival at 1-year among PD centres adjusted for age and diabetes mellitus, 2007-2015



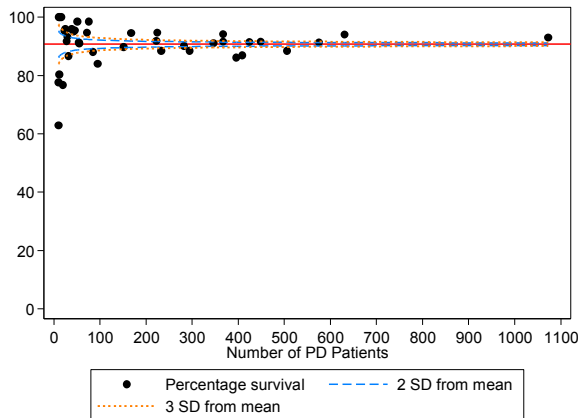
\*Horizontal line represents the mean % survival among PD centres

Figure 3.3.2(c): Variation in patient survival at 5-years among PD centres adjusted for age and diabetes mellitus, 2007-2011



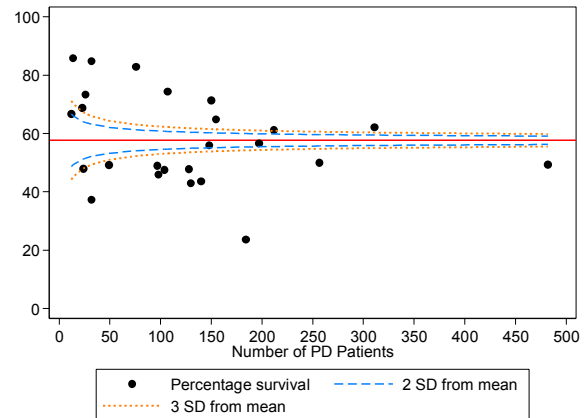
\*Horizontal line represents mean of % survival among PD centres

Figure 3.3.2(b): Funnel plot at 1-year among PD centres adjusted for age and diabetes mellitus status, 2007-2015 cohort



\*Horizontal line represents the mean % survival among PD centres

Figure 3.3.2(d): Funnel plot for patient survival at 5-years among PD centres adjusted age and diabetes mellitus, 2007-2011 cohort



\*Horizontal line represents mean of % survival among PD centres

### SECTION 3.4: Adjusted mortality of dialysis patient

#### 3.4.1. Adjusted hazard ratio for mortality of dialysis patients

The mortality and hazard ratio of the 1996-2016 cohort, adjusted for age, gender, primary diagnosis, year commencing dialysis, dialysis modality, body mass index (BMI), serum albumin, serum cholesterol, diastolic blood pressure, haemoglobin, serum calcium, calcium phosphate product, serum phosphate, viral hepatitis status and presence of cardiovascular disease were showed in Table 3.4.1.

Patient variables that had significant impact on mortality were age, gender, primary renal disease, year starting dialysis, dialysis modality, BMI, diastolic blood pressure and the presence cardiovascular disease. The biochemical variables associated with a significant risk factor for mortality were serum albumin, serum cholesterol, haemoglobin, calcium, calcium phosphate product, phosphate and hepatitis B status.

There was positive correlation between mortality and age of patient and diastolic blood pressure [Figure 3.4.1(a)], while serum albumin, haemoglobin concentration [Figure 3.4.1(b)] and serum phosphate [Figure 3.4.1(c)] were negatively correlated with mortality.

Female patients have 16.4% lower risk of mortality compared to their male counterpart while patients with diabetic nephropathy as the primary aetiology of renal failure has the highest mortality risk when compared to other causes of end stage renal failure. Patients initiating dialysis in this era (2001-2016) has a 36.8% higher risk of mortality compared to those who started dialysis in the earlier years (1996-2000).

There was no difference in adjusted survival between haemodialysis patients and peritoneal dialysis patients .

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (1996-2016)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14	752	0.822	(0.715, 0.944)	0.006
Age 15-24	2591	0.875	(0.799, 0.957)	0.004
Age 25-34 <sup>(ref*)</sup>	5499	1.000		
Age 35-44	9533	1.591	(1.500, 1.687)	<0.001
Age 45-54	20465	2.266	(2.144, 2.395)	<0.001
Age 55-64	25534	3.027	(2.862, 3.202)	<0.001
Age >=65	20808	4.426	(4.177, 4.689)	<0.001
<b>Gender</b>				
Male <sup>(ref*)</sup>	47365	1.000		
Female	37817	0.836	(0.820, 0.853)	<0.001
<b>Primary diagnosis</b>				
Unknown primary	17508	1.393	(1.324, 1.466)	<0.001
Diabetes mellitus	48752	1.850	(1.758, 1.946)	<0.001
GN/SLE <sup>(ref*)</sup>	4893	1.000		
Polycystic kidney	1491	1.285	(1.184, 1.394)	<0.001
Obstructive nephropathy	326	1.022	(0.862, 1.212)	0.799
Others	12212	1.137	(1.076, 1.201)	<0.001
<b>Year start dialysis</b>				
1996-2000 <sup>(ref*)</sup>	6730	1.000		
2001-2005	13081	1.123	(1.086, 1.162)	<0.001
2006-2010	22543	1.252	(1.210, 1.296)	<0.001
2011-2016	42828	1.368	(1.318, 1.418)	<0.001
<b>Modality</b>				
HD <sup>(ref*)</sup>	74825	1.000		
PD	10357	1.032	(0.997, 1.068)	0.075
<b>BMI</b>				
BMI<18.5	4750	0.924	(0.885, 0.965)	<0.001
BMI 18.5-25 <sup>(ref*)</sup>	50295	1.000		
25-30	24822	1.000	(0.978, 1.023)	0.992
>=30	5315	0.804	(0.770, 0.840)	<0.001
<b>Serum albumin (g/L)</b>				
<30	5708	3.802	(3.631, 3.980)	<0.001
30-<35	14061	2.253	(2.177, 2.332)	<0.001
35-<40	44829	1.824	(1.778, 1.873)	<0.001
>=40 <sup>(ref*)</sup>	20584	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	8602	0.897	(0.869, 0.926)	<0.001
3.5-<5.2 <sup>(ref*)</sup>	63104	1.000		
5.2-<6.2	9690	0.875	(0.848, 0.904)	<0.001
>=6.2	3786	1.102	(1.051, 1.157)	<0.001
<b>Diastolic BP (mmHg)</b>				
<70	15164	0.823	(0.798, 0.849)	<0.001
70-<80	34380	0.998	(0.974, 1.022)	0.858
80-<90 <sup>(ref*)</sup>	27011	1.000		
90-<100	6958	1.032	(0.989, 1.077)	0.147
>=100	1669	1.630	(1.509, 1.761)	<0.001

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (1996 – 2016) ('cont.)

Factors	n	Hazard ratio	95% CI	P-value
<b>Hemoglobin (g/dL)</b>				
<10	34287	1.557	(1.526, 1.588)	<0.001
10-<12 (ref*)	46150	1.000		
>=12	4745	0.773	(0.739,0.807)	<0.001
<b>Serum calcium (mmol/L)</b>				
<2.1	18394	0.902	(0.879, 0.926)	<0.001
2.1-<=2.37 (ref*)	56311	1.000		
>2.37	10477	0.687	(0.665, 0.710)	<0.001
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	32007	0.806	(0.785, 0.827)	<0.001
3.5-<4.5 (ref*)	38281	1.000		
4.5-<5.5	11219	0.753	(0.722, 0.785)	<0.001
>=5.5	3675	1.004	(0.931, 1.082)	0.922
<b>Serum Phosphate (mmol/L)</b>				
<0.8	426	1.816	(1.624, 2.029)	<0.001
0.8-<1.3 (ref*)	9728	1.000		
1.3-<1.8	43313	1.044	(1.011, 1.078)	0.009
1.8-<2.2	23201	0.976	(0.935, 1.019)	0.269
>=2.2	8514	1.042	(0.973, 1.116)	0.240
<b>HBsAg</b>				
Negative (ref*)	82556	1.000		
Positive	2656	1.116	(1.062, 1.172)	<0.001
<b>Anti-HCV</b>				
Negative (ref*)	83160	1.000		
Positive	2022	1.007	(0.954, 1.063)	0.796
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	73756	1.000		
CVD	11426	1.297	(1.265, 1.329)	<0.001

Figure 3.4.1(a): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (1996-2016 cohort)

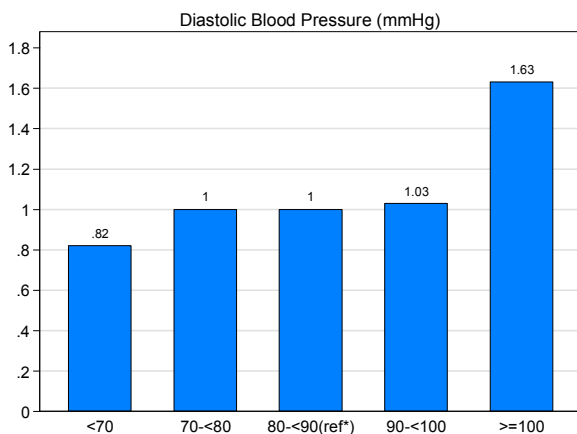


Figure 3.4.1(b): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by hemoglobin (1996-2016 cohort)

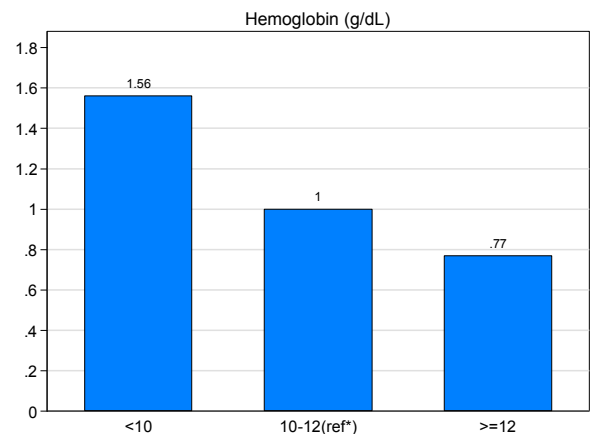
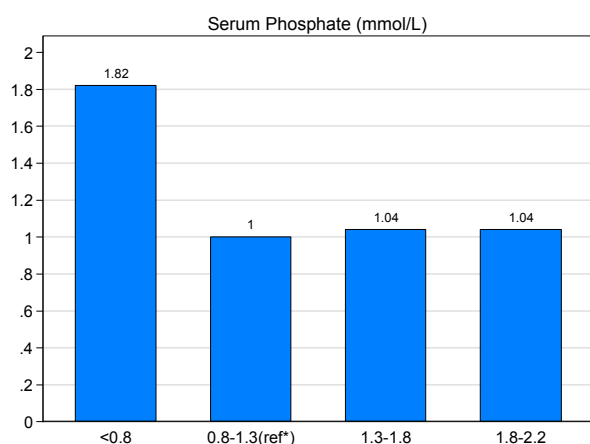


Figure 3.4.1(c): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (1996-2016 cohort)



### 3.4.2. Adjusted hazard ratio for mortality of haemodialysis patients

The adjusted hazard ratio for mortality of haemodialysis patients [Table 3.4.2] demonstrated identical pattern with the whole cohort of 1996-2016 dialysis patients since 90% of the dialysis population consisted of haemodialysis patients. The dose of dialysis treatment (Kt/V) and patient mortality appeared to have a “J” curve relationship with Kt/V of 1.2 to 1.4 having the best outcome [Figure 3.4.2].

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients [ITT analysis] (1996-2016 cohort)

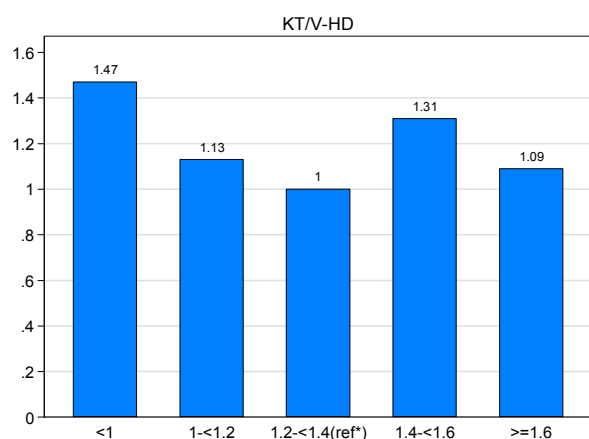
Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14	157	1.420	(1.069, 1.886)	0.016
Age 15-24	1807	0.893	(0.801, 0.996)	0.042
Age 25-34 <sup>(ref*)</sup>	4597	1.000		
Age 35-44	8345	1.566	(1.467, 1.670)	<0.001
Age 45-54	18266	2.225	(2.093, 2.364)	<0.001
Age 55-64	22875	2.971	(2.793, 3.161)	<0.001
Age >=65	18778	4.386	(4.116, 4.673)	<0.001
<b>Gender</b>				
Male <sup>(ref*)</sup>	42088	1.000		
Female	32737	0.833	(0.815, 0.852)	<0.001
<b>Primary diagnosis</b>				
Unknown primary	15728	1.386	(1.309, 1.468)	<0.001
Diabetes mellitus	43440	1.819	(1.718, 1.927)	<0.001
GN/SLE <sup>(ref*)</sup>	3656	1.000		
Polycystic kidney	1170	1.331	(1.215, 1.459)	<0.001
Obstructive nephropathy	273	1.092	(0.906, 1.317)	0.354
Others	10558	1.135	(1.067, 1.208)	<0.001
<b>Year start dialysis</b>				
1996-2000 <sup>(ref*)</sup>	5786	1.000		
2001-2005	11509	1.175	(1.133, 1.219)	<0.001
2006-2010	19976	1.343	(1.294, 1.394)	<0.001
2011-2016	37554	1.472	(1.415, 1.531)	<0.001

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients [ITT analysis] (1996-2016 cohort) ('cont.)

Factors	n	Hazard ratio	95% CI	P-value
<b>BMI</b>				
BMI<18.5	3847	0.921	(0.879, 0.966)	0.001
BMI 18.5-25 (ref*)	44887	1.000		
BMI 25-30	21550	0.975	(0.950, 1.000)	0.051
>=30	4541	0.786	(0.745, 0.829)	<0.001
<b>Serum albumin (g/L)</b>				
<30	3030	4.647	(4.410, 4.897)	<0.001
30-<35	9144	2.100	(2.024, 2.180)	<0.001
35-<40	42726	1.842	(1.792, 1.892)	<0.001
>=40 (ref*)	19925	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	8130	0.883	(0.855, 0.912)	<0.001
3.5-<5.2	56660	1.000		
5.2-<6.2	7481	0.868	(0.837, 0.901)	<0.001
>=6.2 (ref*)	2554	1.138	(1.074, 1.205)	<0.001
<b>Kt/V</b>				
<1	1590	1.466	(1.352, 1.590)	<0.001
1-<1.2	4871	1.127	(1.071, 1.185)	<0.001
1.2-<1.4 (ref*)	10424	1.000		
1.4-<1.6	20233	1.307	(1.263, 1.353)	<0.001
>=1.6	37707	1.093	(1.056, 1.132)	<0.001
<b>Diastolic BP (mmHg)</b>				
<70	14118	0.809	(0.783, 0.836)	<0.001
70-<80	30513	0.982	(0.957, 1.008)	0.173
80-<90 (ref*)	22718	1.000		
90-<100	5995	1.028	(0.982, 1.077)	0.232
>=100	1481	1.673	(1.543, 1.815)	<0.001
<b>Hemoglobin (g/dL)</b>				
<10	31171	1.649	(1.614, 1.685)	<0.001
10-<12 (ref*)	39712	1.000		
>=12	3942	0.749	(0.713, 0.787)	<0.001
<b>Serum calcium (mmol/L)</b>				
<2.1	15644	0.902	(0.877, 0.928)	<0.001
2.1-<=2.37 (ref*)	49959	1.000		
>2.37	9222	0.669	(0.646, 0.692)	<0.001
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	26303	0.767	(0.746, 0.789)	<0.001
3.5-<4.5 (ref*)	34786	1.000		
4.5-<5.5	10377	0.752	(0.720, 0.785)	<0.001
>=5.5	3359	1.019	(0.941, 1.102)	0.648
<b>Serum Phosphate (mmol/L)</b>				
<0.8	314	1.701	(1.496, 1.935)	<0.001
0.8-<1.3 (ref*)	7697	1.000		
1.3-<1.8	37444	1.015	(0.979, 1.051)	0.430
1.8-<2.2	21595	0.929	(0.886, 0.974)	0.002
>=2.2	7775	0.978	(0.909, 1.052)	0.551

Factors	n	Hazard ratio	95% CI	P-value
<b>HBsAg</b>				
Negative (ref*)	72519	1.000		
Positive	2306	1.112	(1.055, 1.173)	<0.001
<b>Anti-HCV</b>				
Negative (ref*)	72991	1.000		
Positive	1834	1.017	(0.961, 1.077)	0.552
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	65403	1.000		
CVD	9422	1.266	(1.233, 1.300)	<0.001

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (1996-2016 cohort)



### 3.4.3. Adjusted hazard ratio for mortality of peritoneal dialysis patients

The adjusted hazard ratio for peritoneal dialysis patients [Table 3.4.3] showed similarity to the whole cohort of 2007-2016 dialysis patients. However, there were no significant correlations between gender, serum cholesterol, calcium phosphate product, and viral hepatitis status with mortality in peritoneal dialysis patients. These differences were partly contributed by the smaller number of peritoneal dialysis patients in this cohort.

There was no correlation between Kt/V and mortality of patients on peritoneal dialysis.

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients [ITT analysis] (1996-2016 cohort)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14	595	0.682	(0.485, 0.959)	0.028
Age 15-24	784	0.886	(0.704, 1.115)	0.302
Age 25-34 <sup>(ref*)</sup>	902	1.000		
Age 35-44	1188	1.515	(1.311, 1.750)	<0.001
Age 45-54	2199	2.178	(1.898, 2.499)	<0.001
Age 55-64	2659	2.879	(2.494, 3.323)	<0.001
Age ≥65	2030	4.030	(3.478, 4.671)	<0.001
<b>Gender</b>				
Male <sup>(ref*)</sup>	5277	1.000		
Female	5080	1.043	(0.966, 1.125)	0.285
<b>Primary diagnosis</b>				
Unknown primary	1780	1.299	(1.154, 1.462)	<0.001
Diabetes mellitus	5312	1.849	(1.629, 2.099)	<0.001
GN/SLE <sup>(ref*)</sup>	1237	1.000		
Polycystic kidney	321	1.138	(0.949, 1.363)	0.162
Obstructive nephropathy	53	0.750	(0.494, 1.140)	0.178
Others	1654	1.051	(0.924, 1.195)	0.449
<b>Year start dialysis</b>				
1996-2000 <sup>(ref*)</sup>	944	1.000		
2001-2005	1572	0.971	(0.884, 1.067)	0.540
2006-2010	2567	1.039	(0.943, 1.145)	0.443
2011-2016	5274	1.129	(1.020, 1.249)	0.019
<b>BMI</b>				
BMI<18.5	903	1.217	(1.076, 1.376)	0.002
BMI 18.5-25 <sup>(ref*)</sup>	5408	1.000		
BMI 25-30	3272	1.005	(0.944, 1.070)	0.877
BMI ≥30	774	0.899	(0.806, 1.003)	0.056
<b>Serum albumin (g/L)</b>				
<30	2678	2.099	(1.766, 2.494)	<0.001
30-<35	4917	1.850	(1.564, 2.189)	<0.001
35-<40	2103	1.071	(0.898, 1.277)	0.447
≥40 <sup>(ref*)</sup>	659	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	472	1.135	(1.003, 1.284)	0.044
3.5-<5.2 <sup>(ref*)</sup>	6444	1.000		
5.2-<6.2	2209	0.931	(0.867, 1.000)	0.051
≥6.2	1232	1.064	(0.972, 1.164)	0.181
<b>Kt/V</b>				
<1.7	6151	1.069	(0.968, 1.181)	0.190
1.7-<2.0 <sup>(ref*)</sup>	3217	1.000		
≥2.0	989	1.067	(0.816, 1.396)	0.634
<b>Diastolic BP (mmHg)</b>				
<70	1046	1.049	(0.951, 1.157)	0.335
70-<80	3867	1.038	(0.971, 1.110)	0.277
80-<90 <sup>(ref*)</sup>	4293	1.000		
90-<100	963	1.111	(0.988, 1.249)	0.079
≥100	188	1.384	(1.075, 1.782)	0.012



Factors	n	Hazard ratio	95% CI	P-value
<b>Hemoglobin (g/dL)</b>				
<10	3116	1.149	(1.074, 1.229)	<0.001
10-<12 (ref*)	6438	1.000		
>=12	803	0.956	(0.861, 1.061)	0.394
<b>Serum calcium (mmol/L)</b>				
<2.1	2750	1.011	(0.943, 1.084)	0.760
2.1-<=2.37 (ref*)	6352	1.000		
>2.37	1255	0.884	(0.804, 0.971)	0.010
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	5704	1.036	(0.960, 1.118)	0.366
3.5-<4.5 (ref*)	3495	1.000		
4.5-<5.5	842	0.971	(0.837, 1.126)	0.697
>=5.5	316	1.092	(0.850, 1.401)	0.492
<b>Serum Phosphate (mmol/L)</b>				
<0.8	112	2.132	(1.704, 2.668)	<0.001
0.8-<1.3 (ref*)	2031	1.000		
1.3-<1.8	5869	1.116	(1.037, 1.202)	0.004
1.8-<2.2	1606	1.006	(0.886, 1.141)	0.929
>=2.2	739	1.324	(1.072, 1.635)	0.009
<b>HBsAg</b>				
Negative (ref*)	10037	1.000		
Positive	320	1.082	(0.941, 1.245)	0.266
<b>Anti-HCV</b>				
Negative (ref*)	10169	1.000		
Positive	188	1.125	(0.936, 1.352)	0.208
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	8353	1.000		
CVD	2004	1.397	(1.312,1.488)	<0.001

### 3.4.4. Risk Adjusted Mortality Rate by haemodialysis centres

There appeared to a marked centre variations in risk adjusted mortality rate (RAMR) and the median RAMR for haemodialysis patients by HD centre was 22 [Figure 3.4.4(a)]. When adjusted for the size of haemodialysis centres using funnel plot, only 413 (59.7%) and 523 (75.6 %) of haemodialysis centres were within the 95% CI and 99% CI of the median RAMR respectively [Figure 3.4.4(b)].

Figure 3.4.4(a): Variations in RAMR by HD centre, 2015

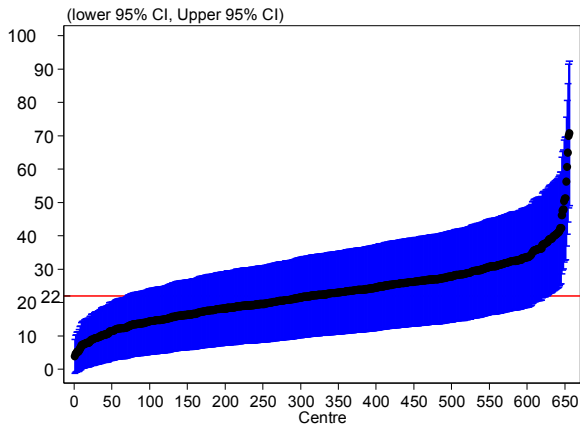
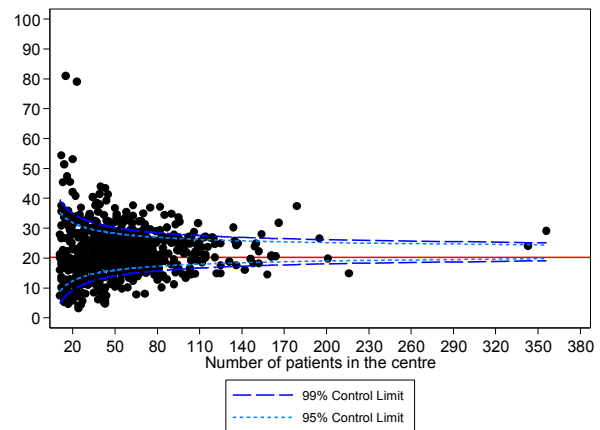


Figure 3.4.4(b): Funnel plot of RAMR by HD centre, 2015



### 3.4.5. Risk Adjusted Mortality Rate by PD centres

There was a wide variation in RAMR among PD centres with a median risk adjusted mortality rate (RAMR) of 28 [Figure 3.4.5(a)]. The variation of the RAMR rate among the various PD centres in this country were rather similar to haemodialysis centres where only 48.5% and 66.7% of PD centres were within the 95% CI and 99% CI of the median RAMR respectively [Figure 3.4.5(b)].

Figure 3.4.5(a): Variations in RAMR by PD centres, 2015

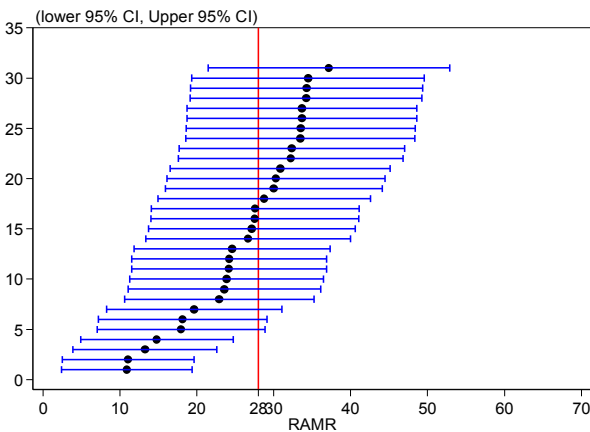


Figure 3.4.5(b): Funnel plot for RAMR by PD centres, 2015

