CHAPTER 3

DEATH AND SURVIVAL ON DIALYSIS

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SECTION 3.1: DEATH ON DIALYSIS

The annual death rate on dialysis in 2011 was 11.4%. The annual death rate for haemodialysis patients was 11.0% while chronic peritoneal dialysis patients had annual death rate of 15.6%.

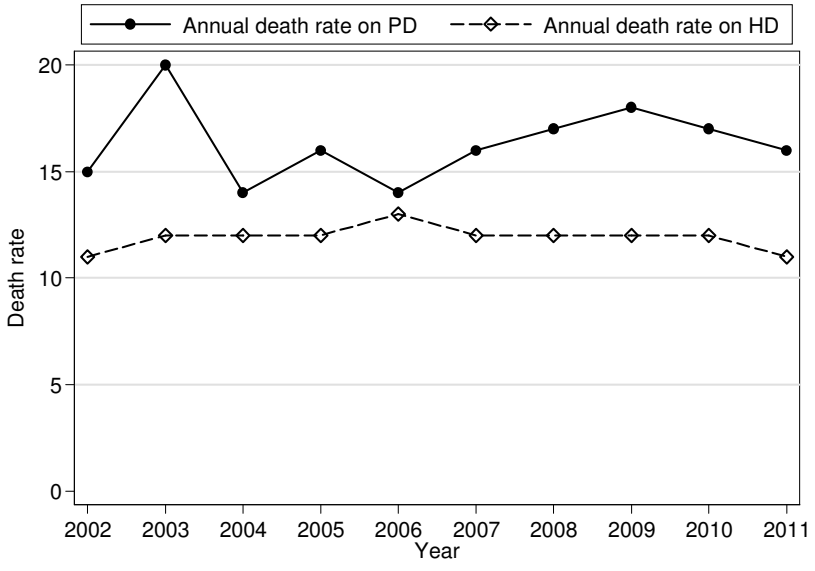
Table 3.1.1: Deaths on dialysis 2002-2011

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number of dialysis patients at risk	8473	9756	11118	12584	14196	16051	18183	20375	22474	24571
Dialysis deaths	961	1214	1320	1516	1820	1986	2190	2589	2831	2802
Dialysis death rate %	11	12	12	12	13	12	12	13	13	11
Number of HD patients at risk	7620	8760	10023	11436	12951	14618	16535	18563	20546	22496
HD deaths	832	1017	1164	1334	1643	1756	1913	2268	2498	2479
HD death rate %	11	12	12	12	13	12	12	12	12	11
Number of PD patients at risk	853	996	1095	1149	1245	1433	1649	1812	1928	2076
PD deaths	129	197	156	182	177	230	277	321	333	323
PD death rate %	15	20	14	16	14	16	17	18	17	16

Figure 3.1.1 shows the annual death rate on dialysis from 2000 till 2011. Despite a higher percentage of diabetics and elderly patients on dialysis in recent years, the overall annual death rate of patients on haemodialysis remained unchanged over the last 10 years with a rate of 11-13% per year.

The annual death rate for those on chronic peritoneal dialysis (PD) continue to fluctuate over the last 10 years but appeared to be on a downward trend since 2009 while the annual death rate for those on haemodialysis remained unchanged over the last 10 years. This resulted in a reduction in the difference of mortality between the 2 dialysis modality over the last 3 years. The difference in annual death rate for those on PD compared with HD decreased from 5.5% in 2009 to 4.6% in 2011.

Figure 3.1.1: Death rates on dialysis 2002-2011



The causes of death on dialysis are shown in Table 3.1.2. Cardiovascular disease remained the main cause of death in 2011; accounting for 38%. Death due to cardiovascular disease appeared to be increasing in the last 7 years and this is probably due to the increasing number of elderly and diabetic patients undergoing dialysis. Death at home accounted for another 19% and a majority of these deaths were probably due to cardiovascular events. Death from infection has increased over the last 7 years and has now became the second most common cause of death in 2011; accounting for 23% of all death.

Table 3.1.2: Causes of death on dialysis 2002-2011

Year	2002		2003		2004		2005		2006	
Causes of Death	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Cardiovascular	315	33	342	28	344	26	377	25	517	28
Died at home	212	22	290	24	307	23	320	21	355	20
Sepsis	149	16	197	16	169	13	184	12	236	13
PD peritonitis	16	2	14	1	13	1	23	2	22	1
GIT bleed	24	2	29	2	24	2	29	2	26	1
Cancer	18	2	29	2	20	2	31	2	41	2
Liver disease	17	2	25	2	29	2	26	2	35	2
Withdrawal	18	2	26	2	9	1	12	1	23	1
Others	104	11	161	13	323	24	407	27	392	22
Unknown	88	9	101	8	82	6	107	7	173	10
Total	961	100	1214	100	1320	100	1516	100	1820	100

Year	2007		2008		2009		2010		2011	
Causes of Death	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Cardiovascular	518	26	685	31	880	34	965	34	1059	38
Died at home	343	17	423	19	493	19	540	19	521	19
Sepsis	224	11	348	16	571	22	662	23	605	22
PD peritonitis	16	1	25	1	31	1	35	1	23	1
GIT bleed	34	2	45	2	47	2	54	2	48	2
Cancer	34	2	56	3	57	2	75	3	73	3
Liver disease	37	2	44	2	27	1	31	1	32	1
Withdrawal	27	1	24	1	35	1	36	1	39	1
Others	552	28	365	17	193	7	110	4	105	4
Unknown	201	10	175	8	255	10	323	11	306	11
Total	1986	100	2190	100	2589	100	2831	100	2811	100

SECTION 3.2: PATIENT SURVIVAL ON DIALYSIS

3.2.1: Patient survival by type of dialysis modality

Patient survival by first dialysis modalities (censored for change of modality) is shown in Table 3.2.1(a) and Figure 3.2.1(a). The overall unadjusted 5 years and 10 years patient survival on dialysis (censored for change in modality) were 55% and 31% respectively. The unadjusted patient survival was better for those on haemodialysis compared to those on PD and this survival difference began to widen after the first year. At 10 years the unadjusted patient survival on haemodialysis was 32% compared 19% in those on PD; a 13% difference in 10-year survival.

However, when patient survival by dialysis modalities was analysed as per ITT (disregarding change of dialysis modality) [Table & Figure 3.2.1(b)], the difference in survival according to dialysis modalities was less apparent. The overall unadjusted 5-year and 10-year patient survival on haemodialysis were 57% and 34% respectively compared to a 5-year and 10-year PD patient survival of 47% and 28% respectively.

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

Dialysis Modality	PD			HD			All		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	6334	100		44761	100		51095	100	
6	5425	93	0	39345	94	0	44770	94	0
12	4514	87	0	34364	89	0	38878	88	0
24	3091	74	1	26630	79	0	29721	78	0
36	2044	62	1	20548	71	0	22592	70	0
48	1346	51	1	15746	63	0	17092	62	0
60	911	44	1	12024	56	0	12935	55	0
72	608	37	1	9165	50	0	9772	49	0
84	395	31	1	6967	44	0	7361	43	0
96	249	26	1	5324	40	0	5570	38	0
108	152	22	1	4045	36	0	4196	34	0
120	92	19	1	3080	32	0	3172	31	0

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

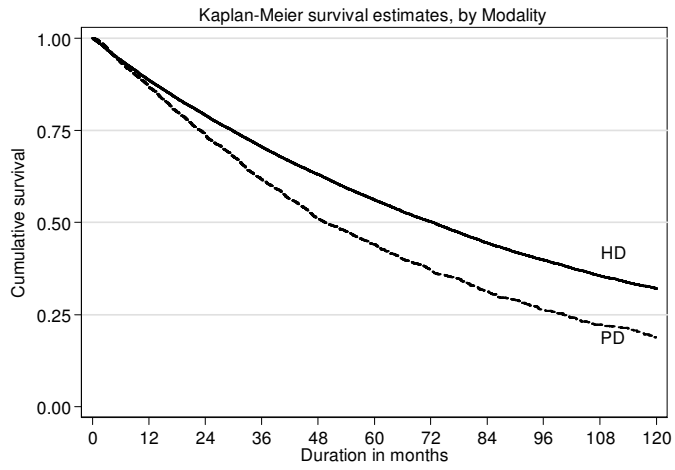
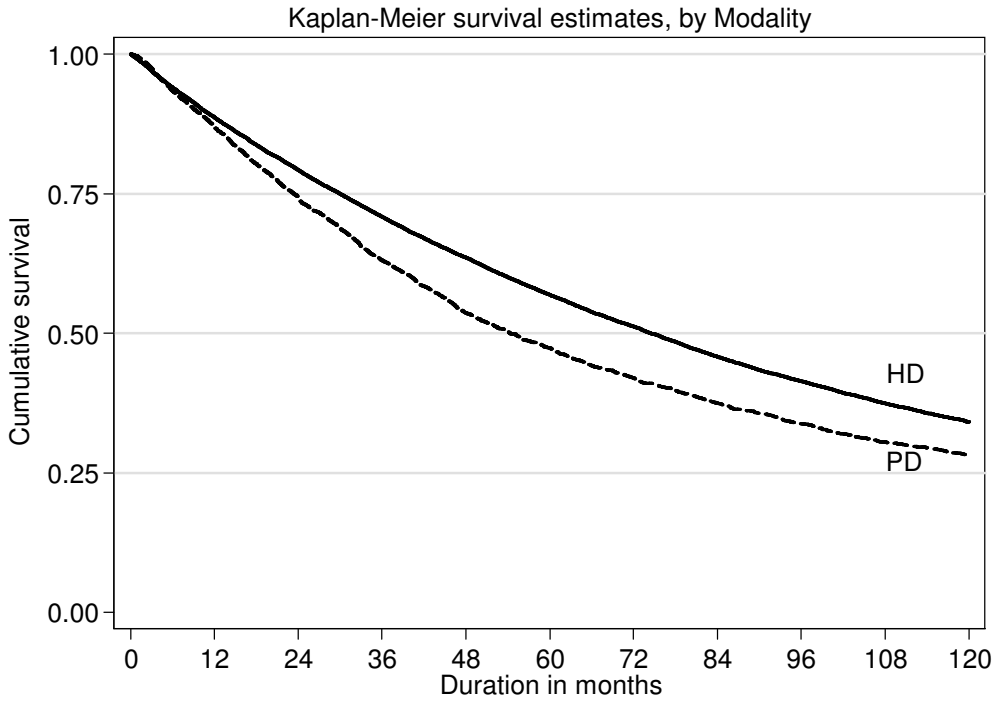


Table 3.2.1(b): Patient survival by dialysis modality analysis (not censored for change of modality)

Dialysis modality	PD			HD			All		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	6334	100		44761	100		51095	100	
6	5620	93	0	39912	94	0	45532	94	0
12	4946	87	0	35297	89	0	40239	88	0
24	3786	74	1	27967	79	0	31737	79	0
36	2848	63	1	21965	71	0	24813	70	0
48	2146	54	1	17156	63	0	19302	62	0
60	1671	47	1	13386	57	0	15056	56	0
72	1343	42	1	10453	51	0	11795	50	0
84	1082	37	1	8155	46	0	9236	45	0
96	871	34	1	6402	41	0	7271	40	0
108	680	30	1	5031	37	0	5710	36	0
120	519	28	1	3956	34	0	4475	33	0

Figure 3.2.1(b): Patient survival by dialysis modality analysis (not censored for change of modality)



3.2.2: Patient survival by year of starting dialysis

Table 3.2.2 and Figure 3.2.2 show the unadjusted patient survival by year of entry. The unadjusted 6-month survival of those starting dialysis in 2011 was 94%. Despite a progressive increase in the number of diabetic patients and older people starting dialysis in recent years, the unadjusted patient survival remained constant over the last 10 years with a 1-year and 5-year survival of 87-89% and 52-54% respectively.

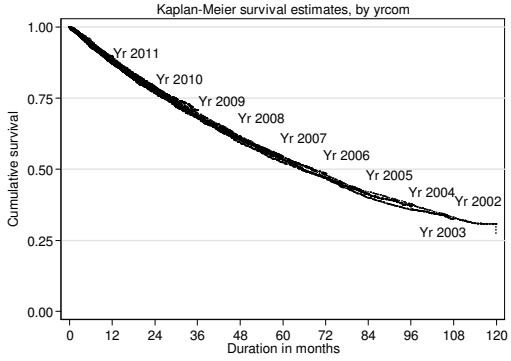
Table 3.2.2: Unadjusted patient survival by year of entry, 2002-2011

Year	2002			2003			2004			2005		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	2526	100		2758	100		3084	100		3320	100	
6	2362	95	0	2542	94	0	2872	94	0	3051	93	0
12	2181	89	1	2337	88	1	2640	88	1	2800	87	1
24	1843	79	1	2009	78	1	2284	79	1	2408	77	1
36	1597	70	1	1714	68	1	1952	69	1	2086	68	1
48	1384	61	1	1487	60	1	1691	60	1	1793	59	1
60	1196	54	1	1290	53	1	1462	53	1	1551	52	1
72	1038	48	1	1118	47	1	1269	47	1	1366	47	1
84	884	42	1	938	40	1	1095	41	1	16	-	-
96	780	38	1	830	36	1	2	-	-	-	-	-
108	670	33	1	8	-	-	-	-	-	-	-	-
120	2	-	-	-	-	-	-	-	-	-	-	-

Year	2006			2007			2008			2009		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	3880	100		4276	100		4847	100		5170	100	
6	3565	93	0	3973	94	0	4493	94	0	4794	94	0
12	3284	87	1	3670	88	0	4147	88	0	4423	89	0
24	2836	77	1	3169	78	1	3521	77	1	3826	79	1
36	2462	68	1	2736	69	1	3065	68	1	90	-	-
48	2164	61	1	2360	61	1	100	-	-	-	-	-
60	1894	54	1	36	-	-	-	-	-	-	-	-
72	31	-	-	-	-	-	-	-	-	-	-	-

Year	2010			2011		
Interval (month)	n	% survival	SE	n	% survival	SE
0	5503	100		5571	100	
6	4993	93	0	2783	94	0
12	4619	87	0	168		
24	78	-	-	-	-	-

Figure 3.2.2: Unadjusted patient survival by year of entry, 2002-2011



3.2.3: Patient survival by age at starting dialysis

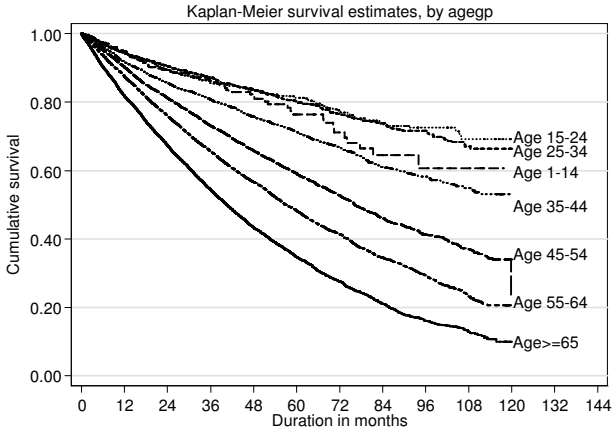
The unadjusted survival for patients starting dialysis at age less than 35 years was approximately 80% (76 -81%) at 5 years. Beyond the age of 34 years old, the unadjusted survival progressively worsens with increasing age; with approximately 10% reduction in 5-year survival for every 10-year increase in age at starting dialysis. The 9-year unadjusted survival for those who started dialysis at the age of 15-24 years was 69 % compared with 13% for those aged more than 64 years at the time of initiation of dialysis; a five folds difference.

Table 3.2.3: Unadjusted patient survival by age, 2002-2011

Age group (years) Interval (month)	≤14			15-24			25-34			35-44		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	459	100		1481	100		2739	100		4610	100	
6	412	97	1	1337	97	0	2428	97	0	4109	96	0
12	359	95	1	1181	94	1	2117	94	0	3577	92	0
24	265	89	2	904	89	1	1624	91	1	2763	86	1
36	174	86	2	688	86	1	1271	87	1	2151	81	1
48	117	82	2	542	83	1	963	84	1	1580	76	1
60	77	76	3	400	81	1	702	80	1	1191	71	1
72	50	71	4	284	78	2	504	77	1	832	67	1
84	30	64	5	192	73	2	359	74	1	539	61	1
96	17	61	6	112	73	2	226	72	1	315	58	1
108	10	61	6	49	69	3	103	67	2	150	55	1
120	1			1			1			1		

Age group (years) Interval (month)	45-54			55-64			≥65		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	10038	100		11799	100		9809	100	
6	8836	95	0	10166	94	0	8133	90	0
12	7608	90	0	8591	87	0	6672	82	0
24	5670	81	0	6105	76	0	4568	67	1
36	4157	73	1	4235	66	1	2936	54	1
48	2960	66	1	2879	57	1	1841	43	1
60	2074	59	1	1868	48	1	1104	35	1
72	1323	53	1	1170	41	1	631	28	1
84	803	46	1	668	35	1	336	21	1
96	452	41	1	343	29	1	150	16	1
108	201	37	1	111	23	1	48	13	1
120	2			1			1		

Figure 3.2.3: Unadjusted patient survival by age, 2002-2011



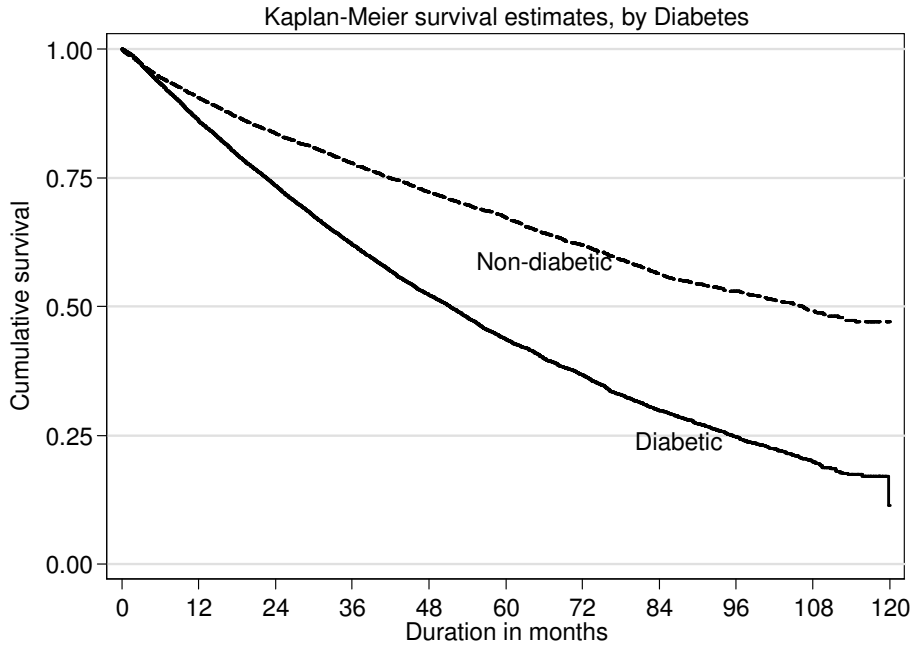
3.2.4: Patient survival by diabetic status

The presence of diabetes mellitus has major impact on patient survival. The unadjusted patient survival among diabetic and non-diabetic patients is shown in Table 3.2.4 and Figure 3.2.4. The difference in the unadjusted patient survival diverged as early as 6 months after initiation of dialysis. The 9 years unadjusted patient survival among diabetics and non-diabetics were 49% and 20% respectively, a two and a half fold difference in patient survival.

Table 3.2.4: Unadjusted patient survival by diabetes mellitus status, 2002-2011

Diabetes status	Non-diabetic			Diabetic		
Interval (month)	n	% survival	SE	n	% survival	SE
0	17785	100		23150	100	
6	15415	94	0	20005	93	0
12	13279	91	0	16822	86	0
24	10067	84	0	11823	73	0
36	7624	78	0	7987	62	0
48	5610	72	0	5264	52	0
60	4075	67	0	3315	44	0
72	2831	62	1	1958	37	0
84	1827	56	1	1089	30	1
96	1066	53	1	544	25	1
108	470	49	1	200	20	1
120	1			1		

Figure 3.2.4: Unadjusted patient survival by diabetes mellitus status, 2002-2011

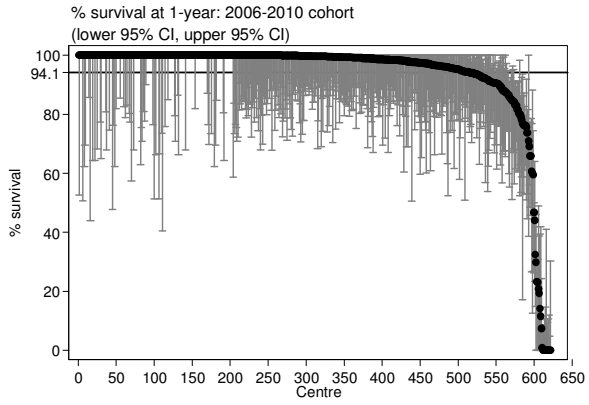


SECTION 3.3: SURVIVAL OF INCIDENCE PATIENTS BY CENTRE

3.3.1: Survival of incident haemodialysis patients 2002-2010 by centre

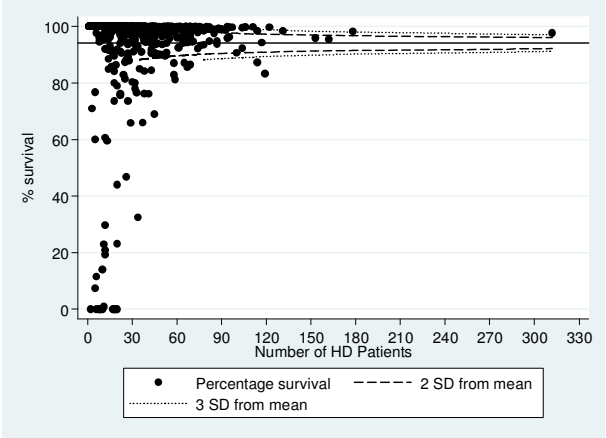
The mean patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2006-2010 cohort was 94.1%. [Figure 3.3.1(a)] There was minimal centre variation and when the 1 year patient survival of the individual heamodialysis centres were illustrated in the funnel plots [Figure 3.3.1 (b)], 72.2% and 89.5% of the haemodialysis centres lies within the 2SD and 3SD of the mean 1 year patient survival respectively.

Figure 3.3.1 (a): Variation in patient survival at 1-year among HD centres adjusted for age and diabetes mellitus status, 2006-2010



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

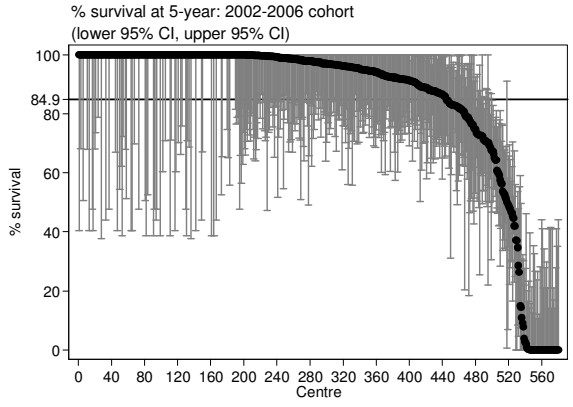
Figure 3.3.1 (b): Funnel plot for adjusted age at 1-year among HD centres adjusted for age and diabetes mellitus status, 2006-2010 cohort



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

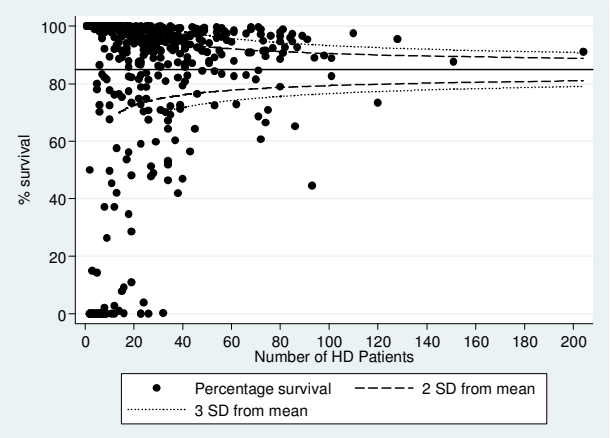
The mean 5-year patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2002-2006 cohort was 84.9%. [Figure 3.3.1(c)] As illustrated in the funnel plots [Figure 3.3.1(d)], there was marked centre variation with only 60.9% and 77.6% of haemodialysis centres lie within 2SD and 3SD respectively.

Figure 3.3.1 (c): Variation in patient survival at 5 -years among HD centres adjusted for age and diabetes mellitus status, 2002-2006



**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, 2002-2006 cohort

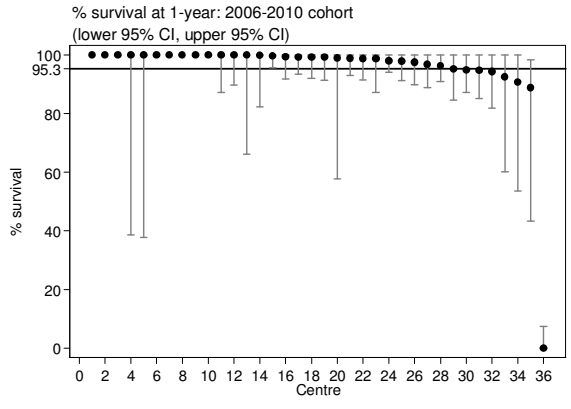


**Horizontal line represents the mean % survival among HD centres*

3.3.2: Survival of incidence PD patients by centre

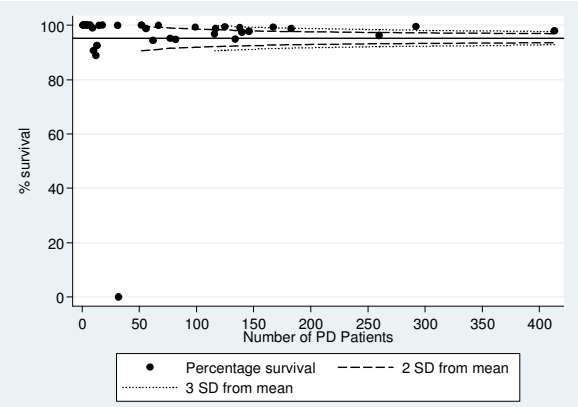
The mean patient survival at 1 year (adjusted for age and diabetes mellitus) among peritoneal dialysis for the 2006-2010 cohort was 95.3%. [Figure 3.3.2(a)] Similar to haemodialysis centres, there was minimal centre variation of 1-year patient survival among the peritoneal dialysis centres and majority of the these centres lies within or above the 3SD as illustrated in the funnel plots. [Figure 3.3.2(b)]

Figure 3.3.2 (a): Variation in patient survival at 1-year among PD centres adjusted for age and diabetes mellitus, 2006-2010



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

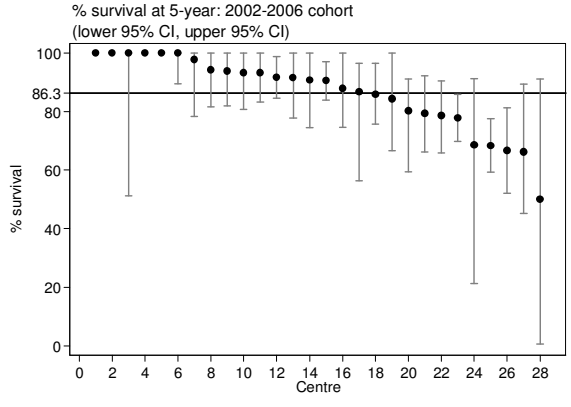
Figure 3.3.2 (b): Funnel plot of 1-year patient survival from the 90th day of dialysis adjusted for age and diabetes mellitus among PD centres, 2006 -2010 cohort



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

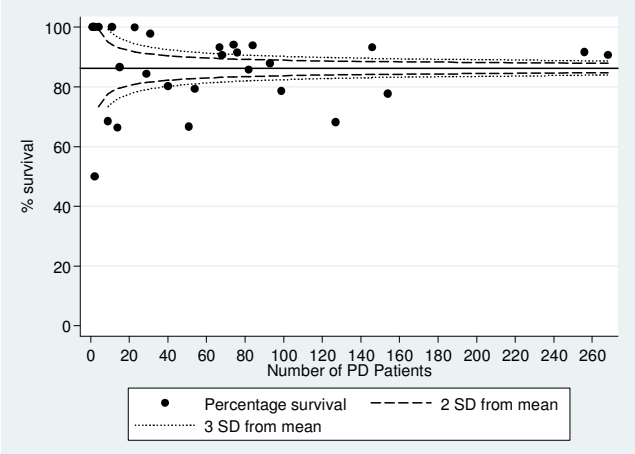
The mean 5-year patient survival (adjusted for age and diabetes mellitus) among peritoneal centres for the 2002-2006 cohort was 86.3%. [Figure 3.3.2(c)] Unlike the 1 year survival among PD centres, there was a wide variation in the 5-year survival among PD centres with 9 out of 28 (28.6%) PD centres lying below the 3SD of the mean survival. [Figure 3.3.2(d)]

Figure 3.3.2 (c): Variation in patient survival at 5-years among PD centres adjusted for age and diabetes mellitus, 2002-2006



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

Figure 3.3.2 (d): Funnel plot of 5-years patient survival from 90 day of dialysis adjusted for age and diabetes mellitus among PD centres, 2002-2006 cohort



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

SECTION 3.4: ADJUSTED MORTALITY OF DIALYSIS PATIENT

3.4.1: Adjusted hazard ratio for mortality of dialysis patients

Table 3.4.1 shows the adjusted hazard ratio for mortality of dialysis patients (2002-2011). The 2002-2011 cohort was 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.

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

There were positive correlation between mortality and age of patient, diastolic blood pressure [Figure 3.4.1(a)], while BMI, serum albumin, serum cholesterol, serum calcium, serum phosphate [Figure 3.4.1 (b)] and haemoglobin concentration [Figure 3.4.1(c)] were negatively correlated with mortality. Female patients had a 20% lower mortality compared with their male counterpart. Patients with diabetic nephropathy as the primary aetiology of renal failure had the highest mortality when compared to other causes of end stage renal failure.

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2002-2011)

Factors	n	Hazard Ratio	95% CI	P-value
Age (years):				
Age 1-14 (ref*)	395	1.00		
Age 15-24	1258	1.26	(0.96;1.66)	0.100
Age 25-34	2447	1.32	(1.01;1.71)	0.041
Age 35-44	4252	1.93	(1.5;2.49)	<0.001
Age 45-54	9482	2.70	(2.1;3.47)	<0.001
Age 55-64	11262	3.52	(2.74;4.53)	<0.001
Age ≥65	9436	4.86	(3.78;6.25)	<0.001
Gender:				
Male (ref*)	21437	1.00		
Female	17095	0.80	(0.77;0.83)	<0.001
Primary diagnosis:				
Unknown primary	10514	1.20	(1.08;1.35)	0.001
Diabetes mellitus	21542	1.69	(1.51;1.88)	<0.001
GN/SLE (ref*)	1751	1.00		
Polycystic kidney	359	0.94	(0.75;1.19)	0.625
Obstructive nephropathy	878	1.16	(1;1.36)	0.056
Others	3488	1.11	(0.98;1.25)	0.097
Year start dialysis:				
2001-2002 (ref*)	2352	1.00		
2003-2004	5499	1.00	(0.94;1.07)	0.929
2005-2006	6809	1.03	(0.97;1.1)	0.297
2007-2008	8654	1.00	(0.94;1.07)	0.964
2009-2010	10017	0.92	(0.86;0.99)	0.025

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2002-2011) *(cont)*

Factors	n	Hazard Ratio	95% CI	P-value
Modality:				
HD (ref*)	34094	1.00		
PD	4438	1.03	(0.97;1.1)	0.380
BMI:				
BMI<18.5	2709	1.26	(1.17;1.35)	<0.001
BMI 18.5-25	22848	1.11	(1.07;1.15)	<0.001
≥25 (ref*)	12975	1.00		
Serum albumin (g/L):				
<30	2578	4.18	(3.87;4.52)	<0.001
30-<35	5489	2.31	(2.17;2.45)	<0.001
35-<40	18835	1.85	(1.77;1.93)	<0.001
≥40 (ref*)	11630	1.00		
Serum cholesterol (mmol/L):				
<3.5	3522	0.91	(0.83;0.99)	0.037
3.5-<5.2	27213	0.97	(0.91;1.05)	0.501
5.2-<6.2	5418	0.86	(0.79;0.94)	0.001
≥6.2 (ref*)	2379	1.00		
Diastolic BP (mmHg):				
<70	6192	0.89	(0.84;0.94)	<0.001
70-<80	15554	1.11	(1.06;1.15)	<0.001
80-<90 (ref*)	12387	1.00		
90-<100	3524	1.04	(0.97;1.12)	0.239
≥100	875	1.45	(1.27;1.65)	<0.001
Hemoglobin:				
<10	19182	1.87	(1.8;1.94)	<0.001
10-<12 (ref*)	17046	1.00		
≥12	2304	0.78	(0.72;0.85)	<0.001
Serum calcium (mmol/L):				
<2.1	7974	1.03	(0.98;1.07)	0.249
2.1-≤2.37 (ref*)	24689	1.00		
>2.37	5869	0.83	(0.79;0.87)	<0.001
Calcium Phosphate product ($mmol^2/L^2$):				
<3.5	14675	0.83	(0.79;0.87)	<0.001
3.5-<4.5 (ref*)	16010	1.00		
4.5-<5.5	5613	0.79	(0.74;0.85)	<0.001
≥5.5	2234	1.02	(0.9;1.16)	0.787
Serum Phosphate (mmol/L):				
<0.8	257	1.82	(1.54;2.15)	<0.001
0.8-<1.3 (ref*)	5091	1.00		
1.3-<1.8	18458	0.95	(0.9;1)	0.047
1.8-<2.2	10095	0.82	(0.76;0.88)	<0.001
≥2.2	4631	0.86	(0.76;0.97)	0.014
HBsAg:				
Negative (ref*)	37246	1.00		
Positive	1286	1.09	(1;1.19)	0.064
Anti-HCV:				
Negative (ref*)	37683	1.00		
Positive	849	1.06	(0.95;1.17)	0.294
Cardiovascular disease (CVD)				
No CVD (ref*)	32590	1.00		
CVD	5942	1.31	(1.26;1.37)	<0.001

Figure 3.4.1 (a): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (2002-2011 cohort)

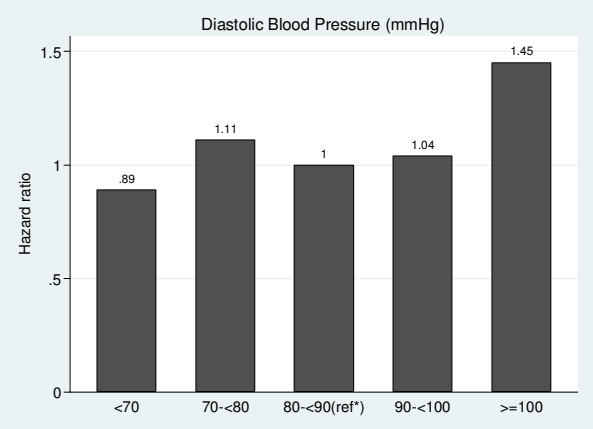


Figure 3.4.1 (b): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (2002-2011 cohort)

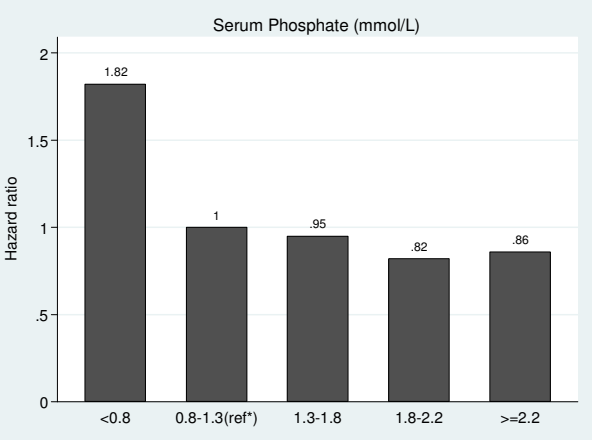
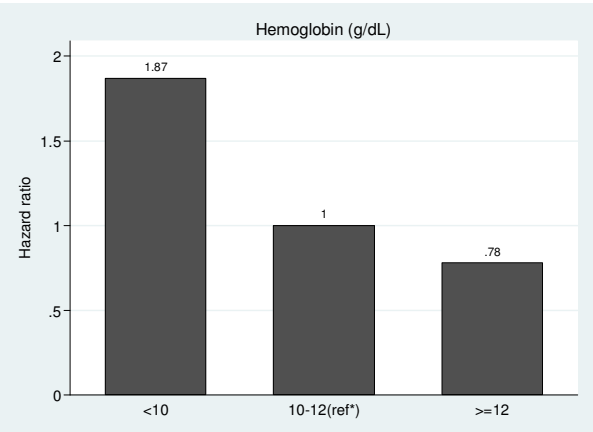


Figure 3.4.1 (c): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by hemoglobin (2002-2011 cohort)



3.4.2: Adjusted hazard ratio for mortality of haemodialysis patients

The adjusted hazard ratio for mortality for hemodialysis patients [Table 3.4.2] in this cohort demonstrated identical pattern with the whole cohort of 2002-2011 dialysis patients since more than 90% of this dialysis population consisted of haemodialysis patients. The dose of dialysis treatment (KT/V) [Figure 3.4.2] inversely correlate with mortality in hemodialysis patients but appeared to plateau off at a KT/V of 1.2-1.4

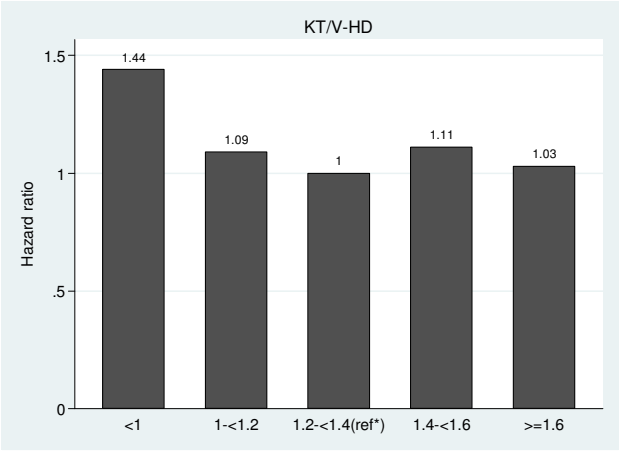
Table 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2002 -2011 cohort)

Factors	n	Hazard Ratio	95% CI	P-value
Age (years):				
Age 1-14 (ref*)	77	1.00		
Age 15-24	875	0.87	(0.5; 1.51)	0.617
Age 25-34	2079	0.86	(0.5; 1.48)	0.588
Age 35-44	3735	1.23	(0.73; 2.1)	0.437
Age 45-54	8555	1.76	(1.04; 2.99)	0.036
Age 55-64	10174	2.31	(1.36; 3.92)	0.002
Age ≥65	8599	3.16	(1.86; 5.35)	<0.001
Gender:				
Male (ref*)	19193	1.00		
Female	14901	0.79	(0.76; 0.83)	<0.001
Primary diagnosis:				
Unknown primary (ref*)	9515	1.00		
Diabetes mellitus	19362	1.37	(1.31; 1.44)	<0.001
GN/SLE	1222	0.81	(0.71; 0.92)	0.001
Polycystic kidney	326	0.80	(0.64; 1)	0.048
Obstructive nephropathy	703	0.95	(0.83; 1.08)	0.452
Others	2966	0.94	(0.87; 1.01)	0.106
Year start dialysis:				
2001-2002 (ref*)	2043	1.00		
2003-2004	4838	1.01	(0.95; 1.08)	0.676
2004-2006	6097	1.04	(0.98; 1.12)	0.203
2007-2008	7570	1.00	(0.94; 1.07)	0.940
2009-2010	8933	0.94	(0.87; 1.02)	0.119
BMI:				
BMI<18.5	2145	1.31	(1.2; 1.42)	<0.001
BMI 18.5-25	20584	1.12	(1.07; 1.18)	<0.001
≥25 (ref*)	11365	1.00		
Serum albumin (g/L):				
<30	1219	4.80	(4.38; 5.25)	<0.001
30-<35	3807	2.31	(2.17; 2.47)	<0.001
35-<40	17754	1.87	(1.78; 1.96)	<0.001
≥40 (ref*)	11314	1.00		
Serum cholesterol (mmol/L):				
<3.5	3331	0.87	(0.78; 0.97)	0.009
3.5-<5.2	24985	0.96	(0.88; 1.05)	0.351
5.2-<6.2	4182	0.80	(0.72; 0.89)	<0.001
≥6.2 (ref*)	1596	1.00		
Kt/V				
<1	815	1.44	(1.28; 1.62)	<0.001
1-<1.2	2890	1.09	(1.02; 1.18)	0.018
1.2-<1.4 (ref*)	6166	1.00		
1.4-<1.6	8784	1.11	(1.05; 1.17)	<0.001
≥1.6	15439	1.03	(0.98; 1.09)	0.268

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2002 -2011 cohort) *(cont)*

Factors	n	Hazard Ratio	95% CI	P-value
Diastolic BP (mmHg):				
<70	5588	0.85	(0.8;0.91)	<0.001
70-<80	13953	1.11	(1.06;1.16)	<0.001
80-<90 (ref*)	10714	1.00		
90-<100	3027	1.04	(0.96;1.13)	0.292
≥100	812	1.52	(1.33;1.75)	<0.001
Hemoglobin:				
<10	17540	1.94	(1.87;2.02)	<0.001
10-<12 (ref*)	14702	1.00		
≥12	1852	0.74	(0.67;0.81)	<0.001
Serum calcium (mmol/L):				
<2.1	6855	1.03	(0.98;1.08)	0.317
2.1-<=2.37 (ref*)	22245	1.00		
>2.37	4994	0.79	(0.75;0.84)	<0.001
Calcium Phosphate product ($mmol^2/L^2$):				
<3.5	12074	0.80	(0.76;0.84)	<0.001
3.5-<4.5 (ref*)	14757	1.00		
4.5-<5.5	5191	0.78	(0.72;0.84)	<0.001
≥5.5	2072	1.00	(0.88;1.15)	0.960
Serum Phosphate (mmol/L):				
<0.8	204	1.69	(1.39;2.05)	0.000
0.8-<1.3 (ref*)	3877	1.00		
1.3-<1.8	16320	0.97	(0.91;1.03)	0.262
1.8-<2.2	9404	0.82	(0.75;0.89)	<0.001
≥2.2	4289	0.85	(0.74;0.96)	0.012
HBsAg:				
Negative (ref*)	32957	1.00		
Positive	1137	1.09	(0.99;1.2)	0.070
Anti-HCV:				
Negative (ref*)	33316	1.00		
Positive	778	1.06	(0.95;1.18)	0.314
Cardiovascular disease (CVD)				
No CVD (ref*)	29076	1.00		
CVD	5018	1.29	(1.23;1.35)	<0.001

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (2002-2011 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) was similar to the whole cohort of 2001-2010 dialysis patients. However correlations of gender, serum cholesterol and dose of dialysis treatment (Kt/V) with mortality were not demonstrated in peritoneal dialysis patients. This difference could be partly contributed by the smaller number of peritoneal dialysis patients in this cohort.

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2002-2011 cohort)

Factors	n	Hazard Ratio	95% CI	P-value
Age (years):				
Age 1-14 (ref*)	318	1.00		
Age 15-24	383	1.50	(1;2.27)	0.052
Age 25-34	368	1.66	(0.9;3.06)	0.108
Age 35-44	517	2.60	(1.44;4.73)	0.002
Age 45-54	927	3.62	(2;6.54)	<0.001
Age 55-64	1088	4.46	(2.47;8.07)	<0.001
Age ≥65	837	6.71	(3.76;11.96)	<0.001
Gender:				
Male (ref*)	2244	1.00		
Female	2194	0.97	(0.85;1.12)	0.700
Primary diagnosis:				
Unknown primary (ref*)	999	1.00		
Diabetes mellitus	2180	1.64	(1.4;1.92)	<0.001
GN/SLE	529	1.00	(0.8;1.25)	0.997
Polycystic kidney	33	0.69	(0.36;1.3)	0.247
Obstructive nephropathy	175	1.17	(0.87;1.57)	0.313
Others	522	0.83	(0.68;1.01)	0.060
Year start dialysis:				
2001-2002 (ref*)	369	1.00		
2003-2004	661	0.94	(0.79;1.12)	0.476
2004-2006	712	0.95	(0.8;1.14)	0.584
2007-2008	1084	0.88	(0.74;1.05)	0.159
2009-2010	1084	0.72	(0.59;0.88)	0.002
BMI:				
BMI<18.5	564	1.30	(1.05;1.6)	0.014
BMI 18.5-25	2264	1.13	(1.02;1.26)	0.019
≥25 (ref*)	1610	1.00		
Serum albumin (g/L):				
<30	1359	1.75	(1.36;2.25)	<0.001
30-<35	1682	1.15	(0.9;1.47)	0.278
35-<40	1081	0.89	(0.69;1.14)	0.353
≥40 (ref*)	316	1.00		
Serum cholesterol (mmol/L):				
<3.5	191	1.07	(0.83;1.38)	0.576
3.5-<5.2	2228	0.95	(0.82;1.09)	0.429
5.2-<6.2	1236	1.00	(0.86;1.16)	0.979
≥6.2 (ref*)	783	1.00		
Kt/V				
<1.7	2610	1.13	(0.94;1.35)	0.190
1.7-<2.0 (ref*)	1298	1.30	(0.82;2.05)	0.263
≥2.0	530	1.00		

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2002-2011 cohort) *(cont)*

Factors	n	Hazard Ratio	95% CI	P-value
Diastolic BP (mmHg):				
<70	604	1.23	(1.05;1.43)	0.009
70-<80	1601	1.04	(0.93;1.17)	0.461
80-<90 (ref*)	1673	1.00		
90-<100	497	1.08	(0.9;1.29)	0.400
≥100	63	0.81	(0.5;1.32)	0.400
Hemoglobin:				
<10	1642	1.44	(1.3;1.6)	<0.001
10-<12 (ref*)	2344	1.00		
≥12	452	0.94	(0.8;1.12)	0.501
Serum calcium (mmol/L):				
<2.1	1119	1.05	(0.93;1.19)	0.417
2.1-<=2.37 (ref*)	2444	1.00		
>2.37	875	1.04	(0.91;1.18)	0.563
Calcium Phosphate product ($mmol^2/L^2$):				
<3.5	2601	1.10	(0.95;1.28)	0.207
3.5-<4.5 (ref*)	1253	1.00		
4.5-<5.5	422	1.06	(0.83;1.34)	0.655
≥5.5	162	1.13	(0.75;1.71)	0.558
Serum Phosphate (mmol/L):				
<0.8	53	2.69	(1.89;3.82)	<0.001
0.8-<1.3 (ref*)	1214	1.00		
1.3-<1.8	2138	0.90	(0.8;1.02)	0.113
1.8-<2.2	691	0.88	(0.69;1.11)	0.263
≥2.2	342	1.06	(0.74;1.52)	0.760
HBsAg:				
Negative (ref*)	4289	1.00		
Positive	149	1.03	(0.81;1.31)	0.810
Anti-HCV:				
Negative (ref*)	4367	1.00		
Positive	71	1.11	(0.79;1.57)	0.544
Cardiovascular disease (CVD)				
No CVD (ref*)	3514	1.00		
CVD	924	1.34	(1.2;1.5)	<0.001

3.4.4: Risk adjusted mortality rate for haemodialysis patients by haemodialysis centres

The median risk adjusted mortality rate (RAMR) for haemodialysis patients by HD centres was 19.30. There was a marked centre variations in RAMR ranging from 1.64 to 79.23. [Figure 3.4.4(a)] Despite taking into account the size of the haemodialysis centres, the variation of the RAMR rate among the various haemodialysis centres in this country persisted as demonstrated in the funnel plot. [Figure 3.4.4 (b)]

Figure 3.4.4(a): Variations in RAMR by HD centre, 2010

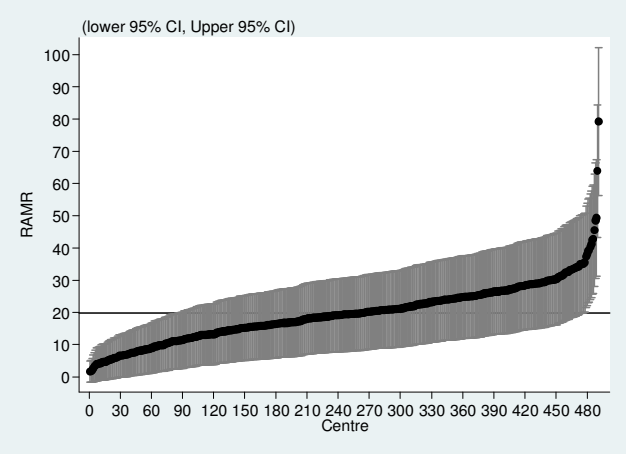
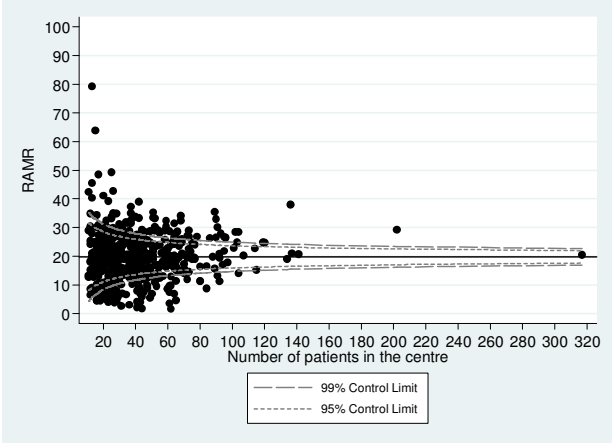


Figure 3.4.4(b): Funnel plot of RAMR by HD centre, 2010



3.4.5: Risk Adjusted Mortality Rate by PD centres

The median risk adjusted mortality rate (RAMR) for peritoneal dialysis patients by PD centres was 25.01. There was a marked centre variations in RAMR ranging from ranging from 8.23 to 36.93. [Figure 3.4.5 (a)] However after taking into account the size of the PD unit, only 17.4% of the PD centres lie below the 3SD as demonstrated in the funnel plot. [Figure 3.4.5(b)]

Figure 3.4.5(a): Variations in RAMR by PD centres, 2010

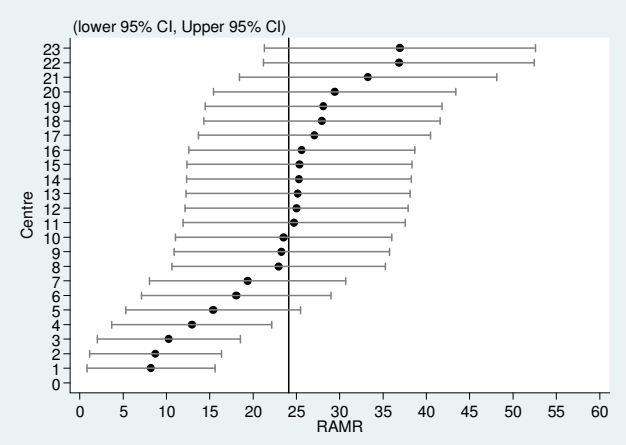


Figure 3.4.5(b): Funnel plot for RAMR by PD centres, 2010