

CHAPTER 3

**DEATH AND SURVIVAL
ON DIALYSIS**

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SECTION 3.1: DEATH ON DIALYSIS

The annual death rate on dialysis in 2010 was 11.6%. The annual death rate for haemodialysis patients was 11.2% while chronic peritoneal dialysis patients had annual death rate of 16.6%.

Table 3.1.1: Deaths on Dialysis 2001-2010

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of dialysis patients at risk	7270	8470	9751	11114	12581	14189	16034	18136	20248	22089
Dialysis deaths	850	959	1211	1318	1513	1815	1984	2190	2578	2574
Dialysis death rate %	12	11	12	12	12	13	12	12	13	12
Number of HD patients at risk	6549	7619	8757	10021	11435	12948	14605	16492	18440	20176
HD deaths	711	831	1016	1162	1331	1638	1754	1913	2258	2257
HD death rate %	11	11	12	12	12	13	12	12	12	11
Number of PD patients at risk	721	851	994	1093	1146	1242	1429	1645	1808	1913
PD deaths	139	128	195	156	182	177	230	277	320	317
PD death rate %	19	15	20	14	16	14	16	17	18	17

Figure 3.1.1 shows the annual death rate on dialysis from 2000 till 2010. Despite a higher percentage of diabetics and elderly patients on dialysis in recent years, the overall annual death rate of patients on dialysis remained unchanged over the last 10 years.

The annual death rate for those on chronic peritoneal dialysis (PD) appeared to be on an upward trend since 2006 while the annual death rate for those on haemodialysis remained unchanged over the last 10 years (11-12%). This resulted in widening of the difference in mortality rate between the two modalities. The difference in annual death rate for those on PD compared with HD increased from 1% in 2006 to 5.4% in 2010.

The causes of death on dialysis are shown in Table 3.1.2. Cardiovascular disease remained the main cause of death in 2010; accounting for 34%. Death due to cardiovascular disease appeared to be an increasing in the last 6 years and this is probably due to the increasing number of elderly and diabetic patients undergoing dialysis. Death at home accounted for another 20% and a majority of these deaths were probably due to cardiovascular events. Death from infection has increased over the last 4 years and has now become the second most common cause of death in 2010; accounting for 24% of all death.

Figure 3.1.1: Death Rates on Dialysis 2001-2010

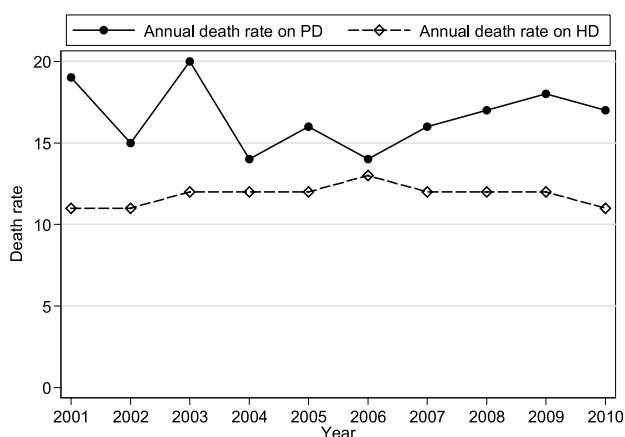


Table 3.1.2: Causes of Death on Dialysis 2001-2010

Year Causes of Death	2001		2002		2003		2004		2005	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	221	26	313	33	341	28	341	26	376	25
Died at home	228	27	212	22	290	24	307	23	320	21
Sepsis	134	16	148	15	197	16	166	13	179	12
PD peritonitis	30	4	16	2	14	1	13	1	22	1
GIT bleed	18	2	24	3	29	2	24	2	29	2
Cancer	18	2	18	2	28	2	20	2	28	2
Liver disease	11	1	16	2	25	2	29	2	26	2
Withdrawal	20	2	18	2	26	2	9	1	11	1
Others	89	10	104	11	161	13	325	25	406	27
Unknown	81	10	90	9	100	8	84	6	116	8
TOTAL	850	100	959	100	1211	100	1318	100	1513	100

Table 3.1.2: Causes of Death on Dialysis 2001-2010 (cont'd.)

Year Causes of Death	2006		2007		2008		2009		2010	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	517	28	516	26	682	31	871	34	871	34
Died at home	354	20	343	17	423	19	492	19	507	20
Sepsis	235	13	222	11	336	15	570	22	605	24
PD peritonitis	22	1	16	1	25	1	30	1	34	1
GIT bleed	26	1	31	2	43	2	44	2	51	2
Cancer	41	2	34	2	53	2	54	2	69	3
Liver disease	35	2	37	2	44	2	26	1	31	1
Withdrawal	23	1	27	1	24	1	34	1	29	1
Others	392	22	552	28	366	17	195	8	108	4
Unknown	170	9	206	10	194	9	262	10	269	10
TOTAL	1815	100	1984	100	2190	100	2578	100	2574	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 modalities) 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 32% 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 33% compared 18% in those on PD; a 15% difference in 10-year survival.

However, when patient survival by dialysis modalities was analysed as per ITT (disregarding change of dialysis modality) [Table 3.2.1(b) and Figure 3.2.1(b)], the difference in survival according to dialysis modalities is less apparent. The overall unadjusted 5 years and 10 years patient survival on haemodialysis versus PD were 57% vs 48% and 35% and 28% respectively.

Table 3.2.1 (a): 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	5705	100		39368	100		45073	100	
6	4899	93	0	34744	94	0	39643	94	0
12	4090	87	0	30262	89	0	34352	88	0
24	2760	74	1	23279	79	0	26039	79	0
36	1812	61	1	17929	71	0	19741	70	0
48	1172	51	1	13649	63	0	14821	62	0
60	802	44	1	10337	56	0	11139	55	0
72	542	37	1	7932	50	0	8473	49	0
84	342	31	1	5989	45	0	6330	43	0
96	202	26	1	4588	40	0	4787	39	0
108	126	22	1	3456	36	0	3581	35	0
120	73	18	1	2632	33	0	2705	32	0

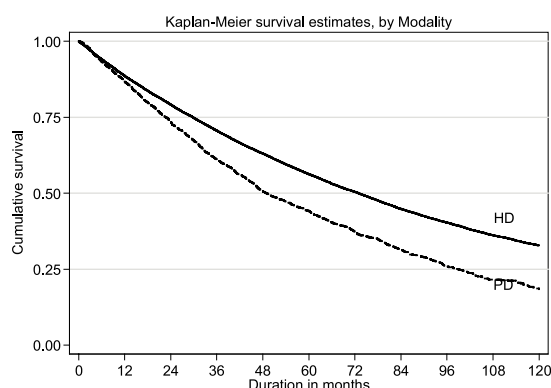
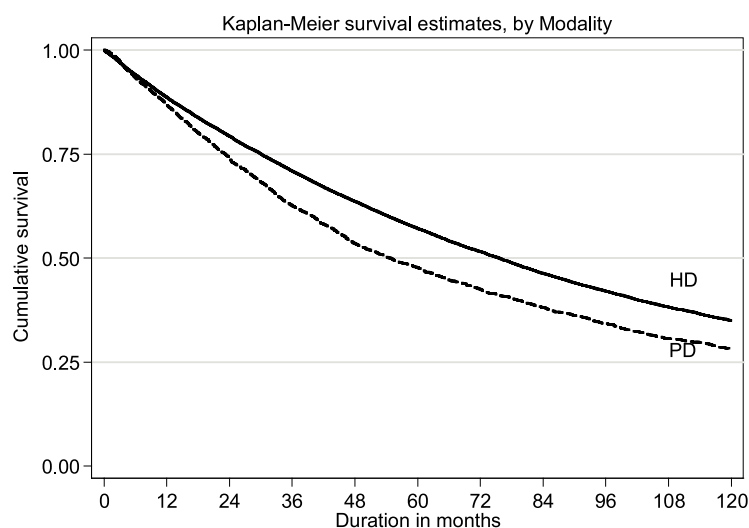
Figure 3.2.1(a): Patient survival by dialysis modality analysis (censored for change of modality)

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

Dialysis modality Interval (month)	PD			HD			All		
	n	% survival	SE	n	% survival	SE	N	% survival	SE
0	5705	100		39368	100		45073	100	
6	5083	93	0	35268	94	0	40351	94	0
12	4470	87	0	31171	89	0	35641	88	0
24	3370	74	1	24544	79	0	27902	79	0
36	2520	63	1	19261	71	0	21781	70	0
48	1883	54	1	14964	64	0	16847	62	0
60	1504	48	1	11616	57	0	13120	56	0
72	1209	43	1	9122	52	0	10330	50	0
84	965	38	1	7085	46	0	8049	45	0
96	751	34	1	5579	42	0	6328	41	0
108	565	31	1	4340	38	0	4904	37	0
120	429	28	1	3426	35	0	3855	34	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 months survival of those starting dialysis in 2010 was 93%. 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 53-54% respectively.

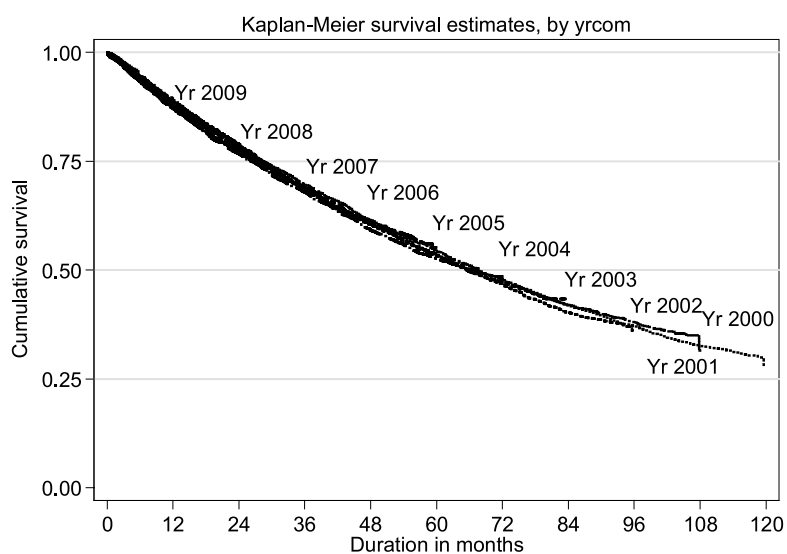
Table 3.2.2: Unadjusted patient survival by year of entry, 2001-2010

Year Interval (month)	2001			2002			2003			2004		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	2238	100		2522	100		2759	100		3086	100	
6	2073	94	1	2359	95	0	2542	94	0	2874	94	0
12	1892	89	1	2179	89	1	2337	88	1	2642	88	1
24	1601	78	1	1841	79	1	2009	78	1	2286	79	1
36	1383	69	1	1595	70	1	1716	68	1	1955	69	1
48	1193	61	1	1383	61	1	1489	60	1	1693	60	1
60	1023	54	1	1195	54	1	1292	53	1	1465	53	1
72	895	47	1	1037	48	1	1119	47	1	1273	47	1
84	781	42	1	882	42	1	945	40	1	2	-	-
96	679	37	1	783	38	1	8	-	-	-	-	-
108	595	33	1	2	-	-	-	-	-	-	-	-
120	1	-	-	-	-	-	-	-	-	-	-	-

Table 3.2.2: Unadjusted patient survival by year of entry, 2001-2010 (cont'd)

Year Interval (month)	2005			2006			2007			2008		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	3316	100		3875	100		4259	100		4803	100	
6	3047	93	0	3558	93	0	3958	94	0	4451	94	0
12	2796	87	1	3279	87	1	3654	88	1	4106	88	0
24	2399	77	1	2829	77	1	3153	78	1	3495	77	1
36	2077	68	1	2454	68	1	2723	69	1	106	-	-
48	1783	59	1	2162	61	1	43	-	-	-	-	-
60	1548	53	1	42	-	-	-	-	-	-	-	-
72	17	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2009			2010		
	n	% survival	SE	n	% survival	SE
0	5042	100		4840	100	
6	4667	94	0	2532	93	0
12	4301	88	0	86	-	-
24	104	-	-	-	-	-

Figure 3.2.2: Unadjusted patient survival by year of entry, 2001-2010

3.2.3: Patient survival by Age at starting dialysis

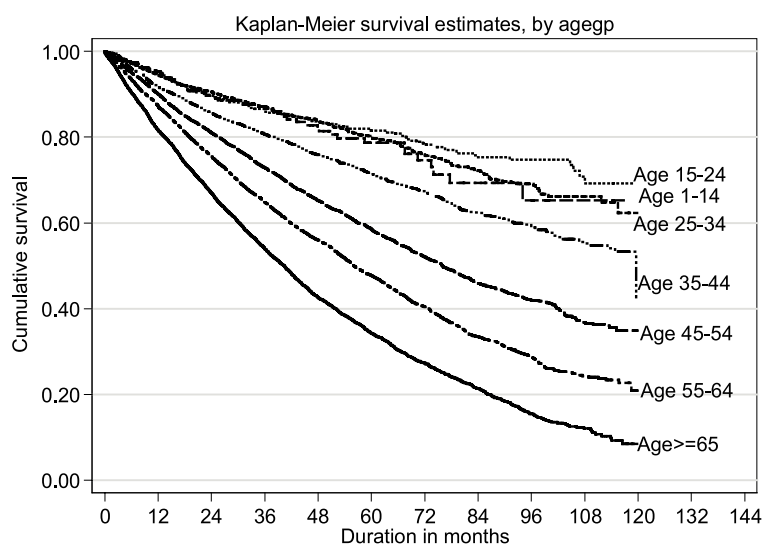
The unadjusted survival for patients starting dialysis at aged less than 35yrs was approximately 80% (79-82%) at 5 years. Beyond the age of 34 years old, the unadjusted survival progressively worsens with increasing age; with approximately 10% reduction in survival at 5 years for every 10 years increase in age at starting dialysis. The 9-year unadjusted survival for those who started dialysis at the age of 15-24 years was 71 % compared with 12% in those aged more than 64 years at the time of initiation of dialysis; a six fold difference.

Table 3.2.3: Unadjusted patient survival by age, 2001-2010

Age group (years) Interval (month)	<15			15-24			25-34			35-44		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	434	100	-	1417	100		2522	100	-	4318	100	-
6	396	97	1	1271	97	0	2237	97	0	3847	96	0
12	340	95	1	1117	95	1	1924	94	0	3341	92	0
24	247	89	2	828	90	1	1479	91	1	2577	86	1
36	163	87	2	647	86	1	1148	87	1	1962	81	1
48	114	82	2	489	83	1	870	84	1	1498	76	1
60	74	79	3	359	82	1	634	80	1	1089	71	1
72	51	75	4	263	79	2	467	76	1	801	67	1
84	27	69	4	169	75	2	317	72	1	511	62	1
96	17	65	6	101	75	2	184	69	2	327	59	1
108	7	65	6	47	71	3	69	66	2	147	55	2
120	1	-	-	1	-	-	1	-	-	2	-	-

Age group (years) Interval (month)	45-54			55-64			≥65		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	8995	100	-	10442	100	-	8612	100	-
6	7992	95	0	9063	94	0	7251	90	0
12	6845	90	0	7664	87	0	5957	82	0
24	5086	81	0	5424	76	0	3967	67	1
36	3731	73	1	3781	65	1	2577	54	1
48	2653	65	1	2536	56	1	1572	43	1
60	1798	59	1	1629	48	1	942	34	1
72	1184	52	1	1006	40	1	559	27	1
84	733	46	1	564	34	1	294	21	1
96	429	42	1	281	29	1	125	15	1
108	180	37	1	106	24	1	43	12	1
120	1	-	-	1	-	-	1	-	-

Figure 3.2.3: Unadjusted patient survival by age, 2001-2010



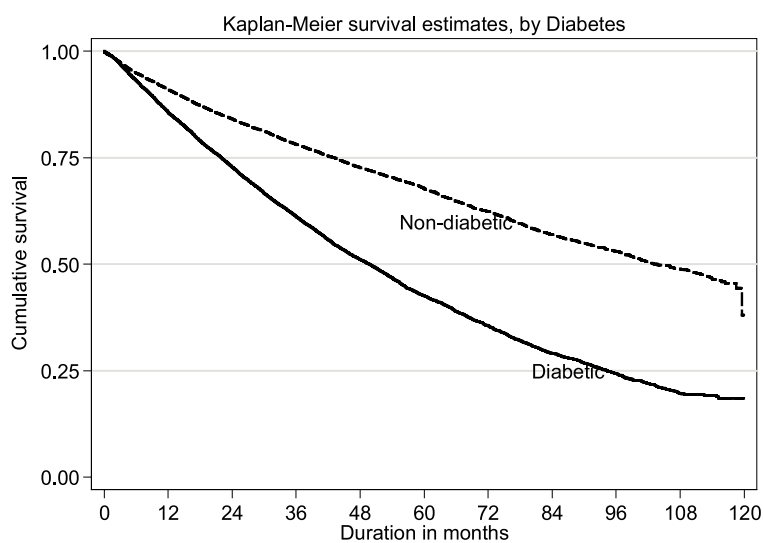
3.2.4: Patient survival by Diabetic status

The unadjusted patient survival among diabetic and non-diabetic patients is shown in Table 3.2.4 and Figure 3.2.4. The presence of diabetes mellitus has major impact on patient survival. 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 status, 2001-2010

Diabetes status Interval (month)	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	16218	100		20522	100	
6	14230	95	0	17823	93	0
12	12282	91	0	14903	86	0
24	9310	84	0	10297	73	0
36	7068	78	0	6940	61	0
48	5214	73	0	4485	51	0
60	3785	68	0	2737	43	0
72	2684	62	1	1638	36	1
84	1710	57	1	901	29	1
96	1013	53	1	449	24	1
108	445	49	1	150	20	1
120	1	-	-	1	-	-

Figure 3.2.4: Unadjusted patient survival by Diabetes status, 2001-2010



SECTION 3.3: SURVIVAL OF INCIDENT PATIENTS BY CENTRE

3.3.1: Survival of incident haemodialysis patients 2001-2010 by centre

The median patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2001-2010 cohort was 92.1% [Figure 3.3.1(a)]. There was a wide 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)], only 40.1% and 61.0% of the haemodialysis centres lies within the 2SD and 3SD of the median 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, 2001-2009

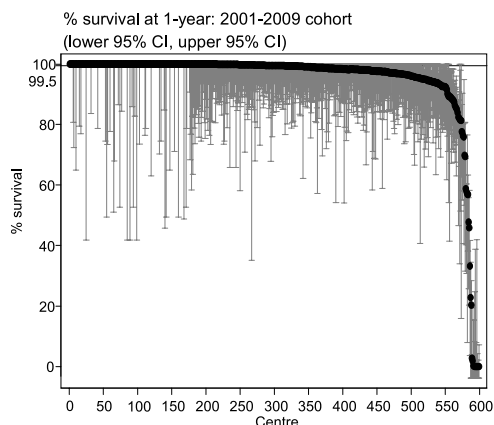
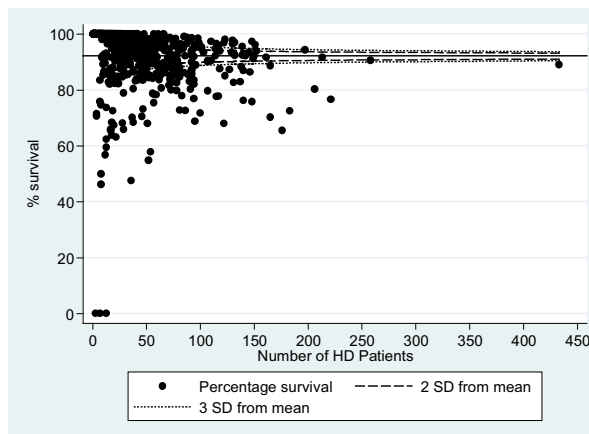


Figure 3.3.1 (b): Funnel plot for patient survival at 1 year among HD centres adjusted age and diabetes, 2001-2009 cohort



*Horizontal line represents the median % survival among HD centres

The 5 years median patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2001-2005 cohort was 71.4% [Figure 3.3.1(c)]. As illustrated in the funnel plots [Figure 3.3.1(d)], there was marked centre variation with only 41.5% and 61.9% 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, 2001-2005

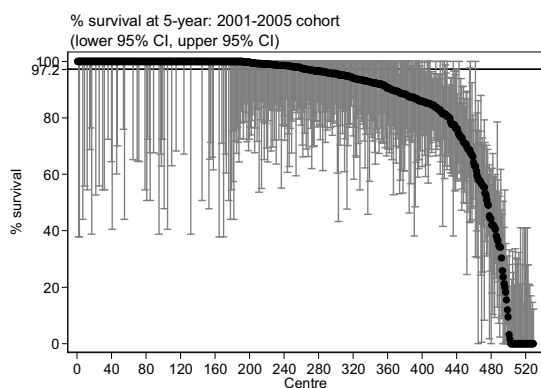
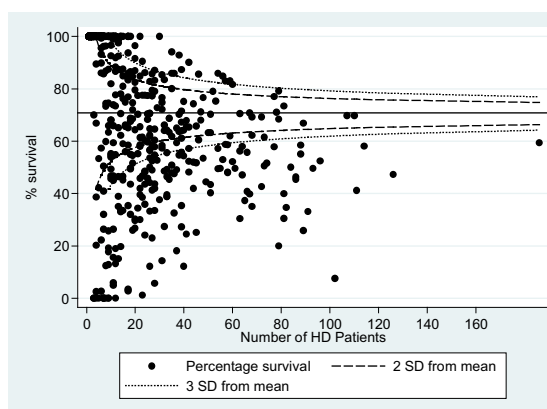


Figure 3.3.1 (d): Funnel plot for patient survival at 5 years among PD centres adjusted for age and diabetes, 2001-2005 cohort



*Horizontal line represents the median % survival among HD centres

3.3.2: Survival of incident PD patients by centre

The median patient survival at 1 year (adjusted for age and diabetes) among peritoneal dialysis for the 2001-2009 cohort was 84.3% [Figure 3.3.2(a)]. There was centre variation and when the 1-year patient survival of the individual peritoneal dialysis centres were illustrated in the funnel plots [Figure 3.3.1(b)], only 50% and 66.7% peritoneal dialysis centres lie within the 2SD and 3SD of the median survival respectively.

Figure 3.3.2 (a): Variation in patient survival at 1 year among PD centres adjusted for age and diabetes, 2001-2009

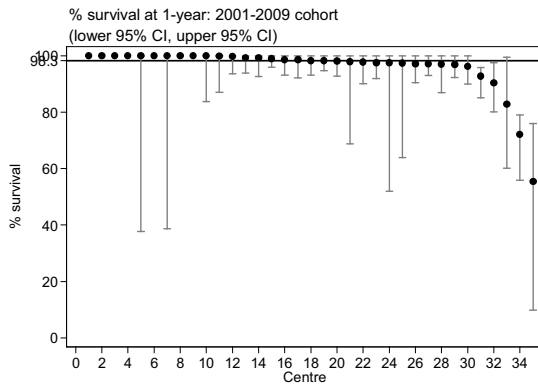
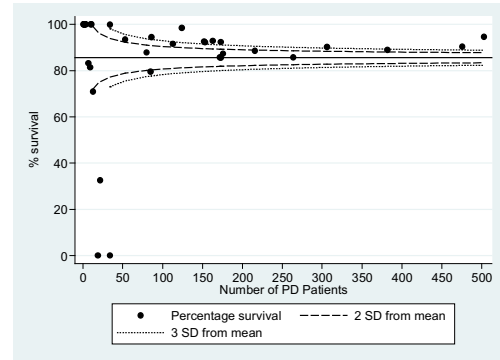


Figure 3.3.2 (b): Funnel plot of 1-year patient survival from the 90th day of dialysis adjusted for age and diabetes among PD centres, 2001-2009 cohort



*Horizontal line represents the median % survival among PD centres

The 5 years median patient survival (adjusted for age and diabetes) among peritoneal centres for the 2001-2005 cohort was 53.0% [Figure 3.3.2(c)]. The 5-year patient survival of the individual peritoneal centres is shown in the funnel plot [Figure 3.3.2(d)]. There was a wide variation in the 5-year survival among PD centres as only 8 out of 28 (28.6%) peritoneal dialysis centres lies within the 2SD of the median survival.

Figure 3.3.2 (c): Variation in patient survival at 5-years among PD centres adjusted for age and diabetes, 2001-2005

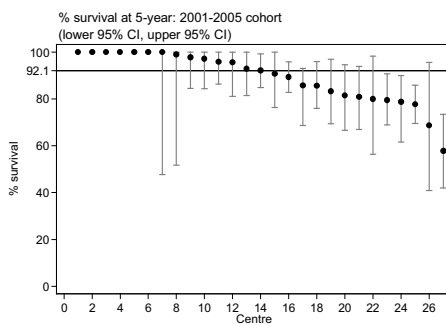
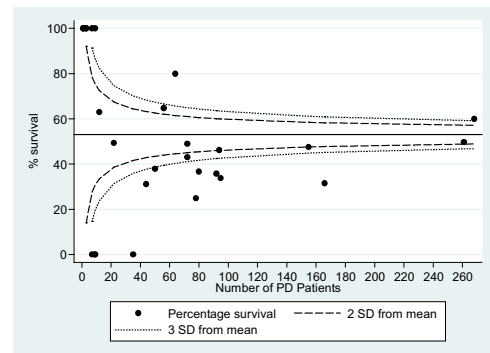


Figure 3.3.2 (d): Funnel plot for 5-year patient survival from 90 days of dialysis adjusted for age and diabetes among PD centres, 2001-2005 cohort



*Horizontal line represents the median % survival among HD 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 (2001-2010). The 2001-2010 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, dialysis modality, BMI, diastolic blood pressure and the presence cardiovascular disease. The biochemical risk factors 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)], serum calcium, and serum phosphate [Figure 3.4.1(b)] while negative correlation with BMI, serum albumin, serum cholesterol and haemoglobin concentration [Figure 3.4.1(c)] with mortality. Female patients have 18% lower mortality compared to their male counterpart while patients with diabetic nephropathy as the primary aetiology of renal failure has 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 (2001-2010)

Factors	n	Hazard Ratio	95% CI	P-value
Age (years):				
• Age 1-14 (ref ⁿ)	375	1.00		
• Age 15-24	1197	1.30	(0.96;1.76)	0.093
• Age 25-34	2241	1.50	(1.12; 2.01)	0.006
• Age 35-44	3969	2.05	(1.55;2.72)	<0.001
• Age 45-54	8512	2.88	(2.18;3.81)	<0.001
• Age 55-64	9985	3.68	(2.78; 4.86)	<0.001
• Age >=65	8319	5.16	(3.9;6.83)	<0.001
Gender:				
• Male (ref ⁿ)	19277	1.00		
• Female	15322	0.82	(0.79; 0.85)	<0.001
Primary diagnosis:				
• Unknown primary	9248	1.30	(1.16;1.47)	<0.001
• Diabetes mellitus	19050	1.87	(1.66;2.1)	<0.001
• GN/SLE (ref ⁿ)	1740	1.00		
• Polycystic kidney	366	1.15	(0.9;1.45)	0.263
• Obstructive nephropathy	866	1.26	(1.07;1.49)	0.006
• Others	3329	1.17	(1.03;1.34)	0.018
Year start dialysis:				
• 2001-2002 (ref ⁿ)	4439	1.00		
• 2003-2004	5501	1.04	(0.99;1.1)	0.142
• 2005-2006	3134	1.08	(1.01;1.15)	0.028
• 2007-2008	8595	1.05	(0.99;1.11)	0.126
• 2009-2010	9261	0.93	(0.86;1.01)	0.086
Modality:				
• HD (ref ⁿ)	30500	1.00		
• PD	4099	1.10	(1.03;1.18)	0.006
BMI:				
• BMI<18.5	2602	1.26	(1.16; 1.37)	<0.001
• BMI 18.5-25	21890	1.15	(1.1;1.21)	<0.001
• >=25 (ref ⁿ)	10107	1.00		

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2001-2010) (cont'd.)

Factors	n	Hazard Ratio	95% CI	P-value
Serum albumin (g/L):				
• <30	2254	3.86	(3.54;4.21)	<0.001
• 30-<35	4838	2.24	(2.09;2.39)	<0.001
• 35-<40	16464	1.79	(1.7;1.88)	<0.001
• ≥40 (ref*)	11043	1.00		
Serum cholesterol (mmol/L):				
• <3.2	1545	1.11	(1.01;1.23)	0.029
• 3.2-<5.2	25175	1.17	(1.11;1.23)	<0.001
• ≥5.2 (ref*)	7879	1.00		
Diastolic BP (mmHg):				
• <70	5201	0.88	(0.83;0.94)	<0.001
• 70-<80	13832	1.11	(1.06;1.16)	<0.001
• 80-<90 (ref*)	11524	1.00		
• 90-<100	3224	1.03	(0.95;1.12)	0.447
• ≥100	818	1.38	(1.19;1.59)	<0.001
Hemoglobin:				
• <8	2655	3.60	(3.3;3.92)	<0.001
• 8-<9	4544	2.42	(2.24;2.62)	<0.001
• 9-<10	10785	2.30	(2.15;2.47)	<0.001
• 10-<11	7628	1.53	(1.42;1.64)	<0.001
• 11-<12 (ref*)	4898	1.00		
• ≥12	2089	1.02	(0.92;1.14)	0.667
Serum calcium (mmol/L):				
• <2.2	14283	1.04	(1;1.09)	0.075
• 2.2-<2.6 (ref*)	19770	1.00		
• ≥2.6	546	1.72	(1.5;1.96)	<0.001
Calcium Phosphate product (mmol²/L²):				
• <3.5	12421	0.85	(0.79;0.91)	<0.001
• 3.5-<4.5 (ref*)	15076	1.00		
• 4.5-<5.5	5030	0.73	(0.67;0.8)	0.000
• ≥5.5	2072	0.77	(0.66;0.91)	0.002
Serum Phosphate (mmol/L):				
• <1.6	12937	0.98	(0.91;1.05)	0.515
• 1.6-<2.0 (ref*)	14309	1.00		
• 2.0-<2.2	3215	0.88	(0.8;0.96)	0.004
• 2.2-<2.4	1897	0.95	(0.84;1.07)	0.395
• 2.4-<2.6	1059	1.08	(0.92;1.27)	0.322
• ≥2.6	1182	1.32	(1.1;1.59)	0.003
HBsAg:				
• Negative (ref*)	33386	1.00		
• Positive	1213	1.02	(0.93;1.12)	0.688
Anti-HCV:				
• Negative (ref*)	33755	1.00		
• Positive	844	1.02	(0.91;1.13)	0.782
Cardiovascular disease (CVD)				
• No CVD (ref*)	28865	1.00		
• CVD	5734	1.33	(1.27;1.39)	<0.001

Figure 3.4.1 (a): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (2001-2010 cohort)

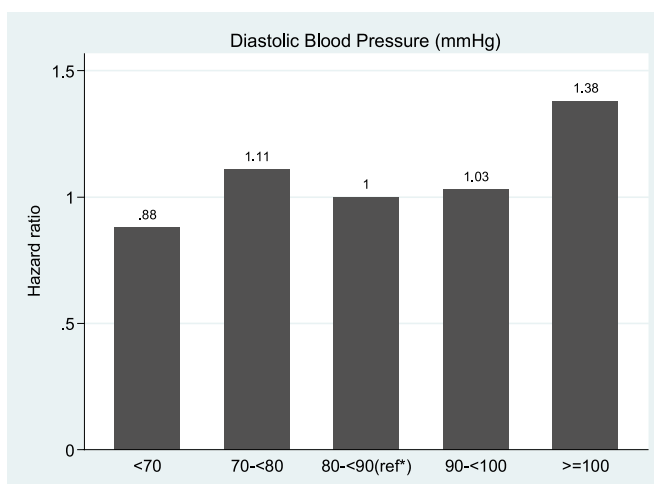


Figure 3.4.1 (b): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (2001-2010 cohort)

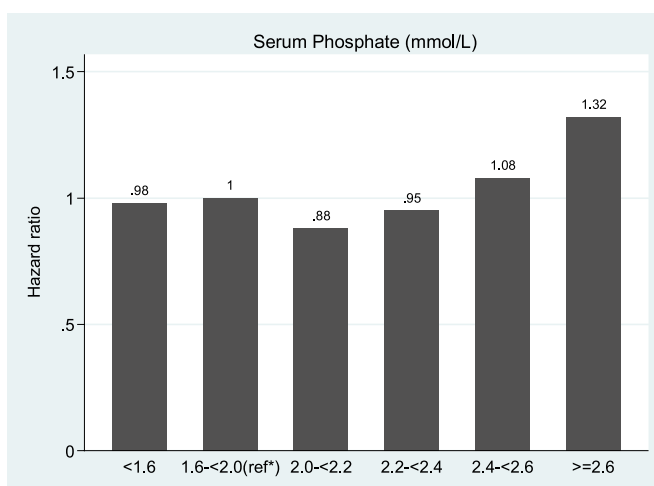
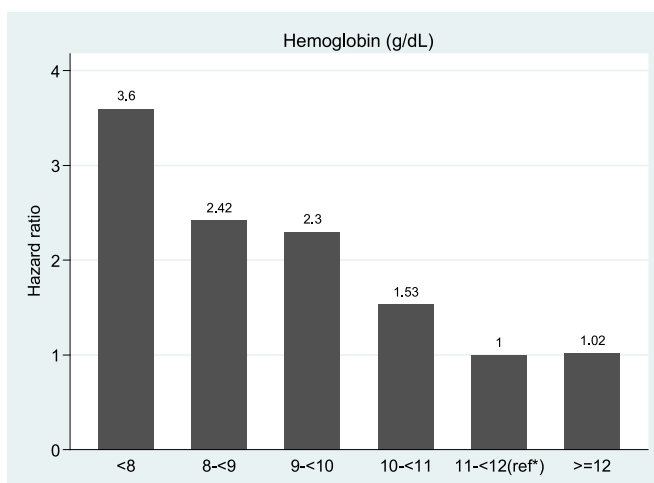


Figure 3.4.1 (c): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by hemoglobin (2001-2010 cohort)



3.4.2: Adjusted hazard ratio for mortality of haemodialysis patients

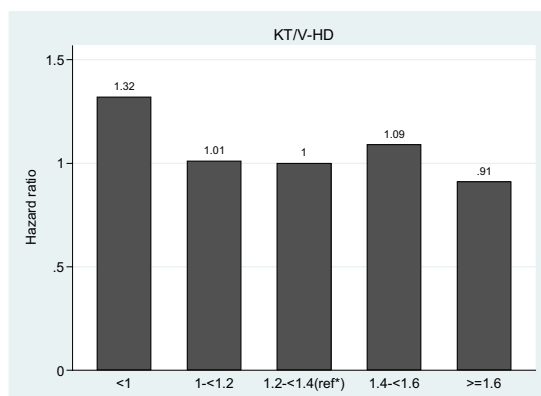
The adjusted hazard ratio for mortality for hemodialysis patients [Table 3.4.2] in this cohort demonstrated identical pattern with the whole cohort of 2001-2010 dialysis patients since more than 90% of this dialysis population consisted of haemodialysis patients. The dose of dialysis treatment (Kt/V) [Figure 3.4.2] was negatively correlation with mortality with hemodialysis patients with Kt/V of ≥ 1.6 having the lowest adjusted hazard ratio for mortality.

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2001-2010 cohort)

Factors	n	Hazard Ratio	95% CI	P-value
Age (years):				
• Age 1-14 (ref ⁿ)	72	1.00		
• Age 15-24	838	1.05	(0.53;2.07)	0.899
• Age 25-34	1,895	1.15	(0.59;2.23)	0.689
• Age 35-44	3,494	1.54	(0.79;2.98)	0.203
• Age 45-54	7,642	2.14	(1.11;4.13)	0.024
• Age 55-64	8,988	2.75	(1.42;5.31)	0.003
• Age ≥ 65	7,570	3.80	(1.97;7.35)	<0.001
Gender:				
• Male (ref ⁿ)	17,215	1.00		
• Female	13,285	0.84	(0.8;0.88)	<0.001
Primary diagnosis:				
• Unknown primary (ref ⁿ)	8,334	1.00		
• Diabetes mellitus	17,062	1.40	(1.33;1.47)	<0.001
• GN/SLE	1,224	0.73	(0.64;0.84)	<0.001
• Polycystic kidney	327	0.90	(0.72;1.13)	0.362
• Obstructive nephropathy	698	0.97	(0.84;1.11)	0.663
• Others	2,855	0.92	(0.85;1)	0.064
Year start dialysis:				
• 2000-2001 (ref ⁿ)	14	1.00		
• 2002-2003	4,840	1.05	(0.99;1.11)	0.085
• 2004-2005	2,820	1.11	(1.03;1.19)	0.004
• 2006-2007	7,512	1.05	(0.99;1.12)	0.129
• 2008-2009	8,213	0.96	(0.88;1.04)	0.289
BMI:				
• BMI<18.5	2,054	1.38	(1.25;1.52)	<0.001
• BMI 18.5-25	19,801	1.20	(1.14;1.27)	<0.001
• ≥ 25 (ref ⁿ)	8,645	1.00		
Serum albumin (g/L):				
• <30	1,049	4.43	(4.01;4.9)	<0.001
• 30-<35	3,266	2.23	(2.07;2.4)	<0.001
• 35-<40	15,444	1.81	(1.72;1.91)	<0.001
• ≥ 40 (ref ⁿ)	10,741	1.00		
Serum cholesterol (mmol/L):				
• <3.2	1,476	1.13	(1.02;1.26)	0.016
• 3.2-<5.2	23,168	1.22	(1.15;1.29)	<0.001
• ≥ 5.2 (ref ⁿ)	5,856	1.00		
Kt/V				
• <1	786	1.32	(1.15;1.52)	<0.001
• 1-<1.2	2,718	1.01	(0.93;1.09)	0.865
• 1.2-<1.4 (ref ⁿ)	5,836	1.00		
• 1.4-<1.6	8,643	1.09	(1.02;1.15)	0.008
• ≥ 1.6	12,517	0.91	(0.85;0.97)	0.004

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2001-2010 cohort) (cont'd.)

Factors	n	Hazard Ratio	95% CI	P-value
Diastolic BP (mmHg):				
• <70	4,680	0.85	(0.79;0.91)	<0.001
• 70-<80	12,348	1.11	(1.06;1.17)	<0.001
• 80-<90 (ref*)		1.00		
• 90-<100	2,750	1.03	(0.94;1.12)	0.544
• ≥100	753	1.41	(1.21;1.65)	<0.001
Hemoglobin:				
• <8	2,460	4.01	(3.64;4.4)	<0.001
• 8-<9	4,079	2.69	(2.47;2.94)	<0.001
• 9-<10	9,845	2.60	(2.4;2.81)	<0.001
• 10-<11	8,334	1.63	(1.5;1.76)	<0.001
• 11-<12 (ref*)	4,103	1.00		
• ≥12	1,679	1.02	(0.89;1.16)	0.811
Serum calcium (mmol/L):				
• <2.2	12,589	1.05	(1;1.1)	0.048
• 2.2-<2.6 (ref*)	17,461	1.00		
• ≥2.6	450	1.79	(1.55;2.08)	<0.001
Calcium Phosphate product (mmol²/L²):				
• <3.5	10,050	0.80	(0.75;0.87)	<0.001
• 3.5-<4.5 (ref*)	13,905	1.00		
• 4.5-<5.5	4,614	0.73	(0.66;0.8)	<0.001
• ≥5.5	1,931	0.76	(0.64;0.9)	0.001
Serum Phosphate (mmol/L):				
• <1.6	10,480	0.97	(0.9;1.05)	0.476
• 1.6-<2.0 (ref*)	13,203	1.00		
• 2.0-<2.2	2,983	0.83	(0.75;0.91)	<0.001
• 2.2-<2.4	1,742	0.92	(0.81;1.05)	0.216
• 2.4-<2.6	981	1.03	(0.87;1.22)	0.736
• ≥2.6	1,111	1.27	(1.05;1.55)	0.014
HBsAg:				
• Negative (ref*)	29,431	1.00		
• Positive	1,069	1.02	(0.92;1.13)	0.712
Anti-HCV:				
• Negative (ref*)	29,723	1.00		
• Positive	777	1.01	(0.9;1.13)	0.889
Cardiovascular disease (CVD)				
• No CVD (ref*)	25,653	1.00		
• CVD	4,847	1.30	(1.24;1.36)	<0.001

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (2001-2010 cohort)

3.4.3: Adjusted hazard ratio for mortality of peritoneal dialysis patients

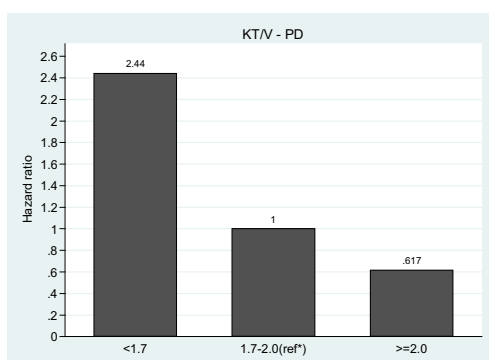
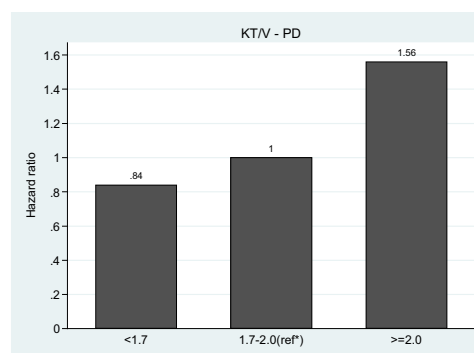
The adjusted hazard ratio for peritoneal dialysis patients [Table 3.4.3] showed similarity to the whole cohort of 2001-2010 dialysis patients. However correlations of gender and serum cholesterol with mortality were not demonstrated in peritoneal dialysis patients. This difference could be partly contributed by the smaller number of peritoneal dialysis patients in this cohort. The unadjusted hazard ratio for mortality in peritoneal dialysis patients for Kt/V less than 1.7 was 2.44 when compared to Kt/V of 1.7-2.0 [Figure 3.4.3 (a)]. However the negative correlation of Kt/V with mortality was reversed when adjusted for the various confounding variables but it did not reached statistical significant [Table 3.4.3 & Figure 3.4.3 (b)].

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2001-2010 cohort)

Factors	n	Hazard Ratio	95% CI	P-value
Age (years):				
• Age 1-14 (ref ⁿ)	303	1.00		
• Age 15-24	359	2.07	(1.2;3.55)	0.008
• Age 25-34	346	2.60	(1.3;5.18)	0.007
• Age 35-44	475	3.77	(1.92;7.41)	<0.001
• Age 45-54	870	5.94	(3.02;11.68)	<0.001
• Age 55-64	997	6.70	(3.43;13.08)	<0.001
• Age >=65	749	10.72	(5.46;21.07)	<0.001
Gender:				
• Male (ref ⁿ)	2,062	1.00		
• Female	2,037	0.90	(0.8;1.02)	0.096
Primary diagnosis:				
• Unknown primary (ref ⁿ)	914	1.00		
• Diabetes mellitus	1,988	1.85	(1.53;2.23)	<0.001
• GN/SLE	516	0.84	(0.65;1.1)	0.206
• Polycystic kidney	39	0.67	(0.35;1.26)	0.212
• Obstructive nephropathy	168	1.06	(0.76;1.49)	0.718
• Others	474	0.88	(0.7;1.09)	0.242
Year start dialysis:				
• 2000-2001 (ref ⁿ)	595	1.00		
• 2002-2003	661	0.97	(0.84;1.12)	0.676
• 2004-2005	314	0.86	(0.7;1.04)	0.123
• 2006-2007	1,083	0.90	(0.77;1.06)	0.201
• 2008-2009	1,048	0.67	(0.53;0.84)	0.001
BMI:				
• BMI<18.5	548	1.44	(1.15;1.8)	0.001
• BMI 18.5-25	2,089	1.12	(1;1.26)	0.052
• >=25 (ref ⁿ)	1,462	1.00		
Serum albumin (g/L):				
• <30	1,205	1.64	(1.24;2.15)	<0.001
• 30-<35	1,572	1.12	(0.86;1.46)	0.416
• 35-<40	1,020	0.83	(0.63;1.09)	0.183
• >=40 (ref ⁿ)	302	1.00		
Serum cholesterol (mmol/L):				
• <3.2	69	1.26	(0.86;1.85)	0.244
• 3.2-<5.2	2,007	0.96	(0.86;1.07)	0.469
• >=5.2 (ref ⁿ)	2,023	1.00		
Kt/V				
• <=1.7	2,848	0.84	(0.67;1.07)	0.161
• 1.7-<=2.0 (ref ⁿ)	853	1.00		
• >2.0	398	1.56	(0.9;2.7)	0.116

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2001-2010 cohort) (cont'd.)

Factors	n	Hazard Ratio	95% CI	P-value
Diastolic BP (mmHg):				
• <70	521	1.21	(1.02;1.44)	0.033
• 70-<80	1,484	1.02	(0.89;1.15)	0.802
• 80-<90 (ref ^a)	1,555	1.00		
• 90-<100	474	1.11	(0.91;1.34)	0.310
• ≥100	65	0.90	(0.54;1.52)	0.697
Hemoglobin:				
• <8	195	1.92	(1.47;2.51)	<0.001
• 8-<9	465	1.58	(1.3;1.94)	<0.001
• 9-<10	940	1.34	(1.14;1.58)	0.001
• 10-<11	1,294	1.16	(0.99;1.35)	0.061
• 11-<12 (ref ^a)	795	1.00		
• ≥12	410	0.96	(0.78;1.19)	0.718
Serum calcium (mmol/L):				
• <2.2	1,694	0.97	(0.86;1.09)	0.594
• 2.2-<2.6 (ref ^a)	2,309	1.00		
• ≥2.6	96	1.55	(1.15;2.1)	0.004
Calcium Phosphate product (mmol²/L²):				
• <3.5	2,371	1.16	(0.96;1.42)	0.131
• 3.5-<4.5 (ref ^a)	1,171	1.00		
• 4.5-<5.5	416	0.85	(0.65;1.11)	0.232
• ≥5.5	141	0.85	(0.51;1.42)	0.539
Serum Phosphate (mmol/L):				
• <1.6	2,457	1.19	(0.97;1.46)	0.097
• 1.6-<2.0 (ref ^a)	1,106	1.00		
• 2.0-<2.2	232	1.71	(1.28;2.29)	0.000
• 2.2-<2.4	155	1.26	(0.85;1.89)	0.254
• 2.4-<2.6	78	1.80	(1.11;2.93)	0.018
• ≥2.6	71	1.80	(0.95;3.39)	0.070
HBsAg:				
• Negative (ref ^a)	3955	1.00		
• Positive	144	0.95	(0.73;1.24)	0.725
Anti-HCV:				
• Negative (ref ^a)	4032	1.00		
• Positive	67	1.18	(0.81;1.72)	0.376
Cardiovascular disease (CVD)				
• No CVD (ref ^a)	3212	1.00		
• CVD	887	1.38	(1.22;1.55)	<0.001

Figure 3.4.3(a): Unadjusted hazard ratio for mortality of PD patients uncensored for change of modality Kt/V (2001-2010)**Figure 3.4.3(b):** Adjusted hazard ratio for mortality of PD patients uncensored for change of modality by Kt/V (2001-2010 cohort)

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 18.89. There was a marked centre variations in RAMR ranging from 2.05 to 55.19. [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 centres, 2009

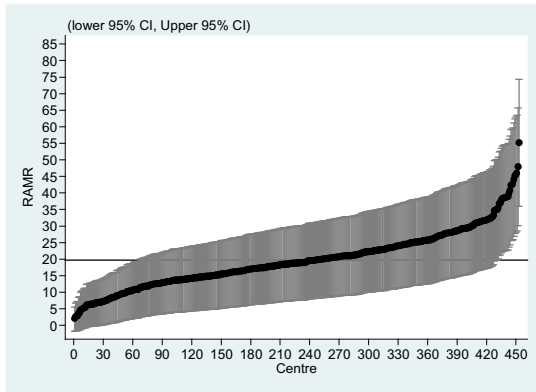
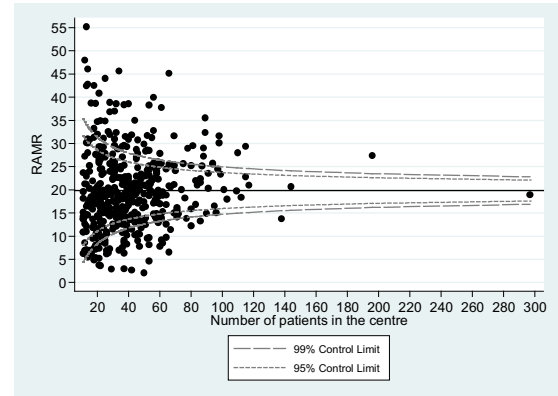


Figure 3.4.4(b): Funnel plot of RAMR by HD centre, 2009



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 24.70. There was a marked centre variations in RAMR ranging from ranging from 11.69 to 44.48 [Figure 3.4.5(a)]. Taking into account of the size of the PD centre, 36% of the PD centres lie outside the 3SD as demonstrated in the funnel plot [Figure 3.4.5(b)].

Figure 3.4.5(a): Variations in RAMR by PD centres, 2009

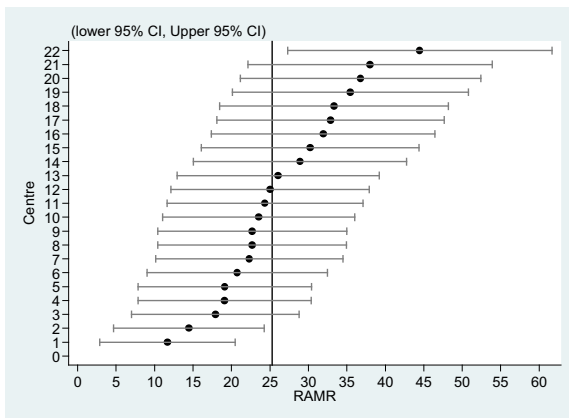


Figure 3.4.5(b): Funnel plot for RAMR by PD centres, 2009

