

## **CHAPTER 3**

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

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**SECTION 3.1: DEATH ON DIALYSIS**

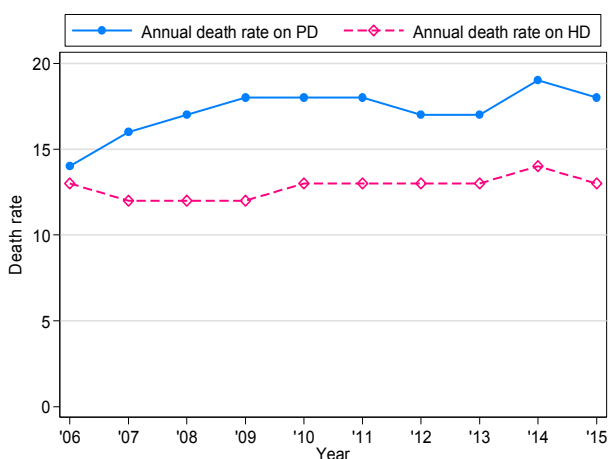
The annual crude death rate on dialysis in 2015 was 13.8% (Table 3.1.1). The crude annual death rate among haemodialysis patients was 13.4% while chronic peritoneal dialysis patients had an annual crude death rate of 18.0%.

The annual crude death rate among haemodialysis (HD) patients remained relatively unchanged over the last 10 years and ranged from 12-14% (Figure 3.1.1). The annual crude death rate of patients on chronic peritoneal dialysis (PD) began to increase in mid 2000's and remained at 17-19% ; 4-5% higher than that of HD patients. The difference in annual death rate between the two modalities persisted over the last 10 years 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 2006-2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of dialysis patients at risk	14224	16090	18246	20500	22664	25043	27823	30728	33537	36044
Dialysis deaths	1820	1988	2191	2602	3048	3292	3647	4011	4712	4976
Dialysis death rate %	13	12	12	13	13	13	13	13	14	14
Number of HD patients at risk	12978	14657	16596	18682	20725	22958	25453	28023	30471	32539
HD deaths	1643	1757	1914	2281	2695	2918	3250	3539	4136	4345
HD death rate %	13	12	12	12	13	13	13	13	14	13
Number of PD patients at risk	1246	1433	1650	1818	1939	2085	2370	2706	3066	3505
PD deaths	177	231	277	321	353	374	397	472	576	631
PD death rate %	14	16	17	18	18	18	17	17	19	18

Figure 3.1.1: Death rates on dialysis 2006-2015



Cardiovascular disease remained the main cause of death and in 2015 accounted for 34% of all death. Death at home accounted for another 18% 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 26% of all death in 2015.

Table 3.1.2: Causes of death on dialysis 2006-2015

Year Causes of Death	2006		2007		2008		2009		2010	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	608	33	631	32	738	34	909	35	1024	34
Died at home	353	19	342	17	424	19	491	19	546	18
Sepsis	352	19	344	17	400	18	586	23	735	24
PD peritonitis	23	1	23	1	30	1	32	1	37	1
GIT bleed	31	2	39	2	47	2	49	2	61	2
Cancer	42	2	41	2	57	3	57	2	79	3
Liver disease	37	2	39	2	45	2	29	1	33	1
Withdrawal	24	1	27	1	24	1	36	1	42	1
Others	107	6	230	12	191	9	103	4	64	2
Unknown	243	13	272	14	235	11	310	12	427	14
Total	1820	100	1988	100	2191	100	2602	100	3048	100

Year Causes of Death	2011		2012		2013		2014		2015	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	1206	37	1279	35	1415	35	1670	35	1676	34
Died at home	542	16	586	16	680	17	659	14	699	14
Sepsis	775	24	953	26	1006	25	1208	26	1304	26
PD peritonitis	28	1	18	0	43	1	50	1	46	1
GIT bleed	54	2	63	2	68	2	81	2	76	2
Cancer	88	3	80	2	86	2	114	2	113	2
Liver disease	35	1	31	1	37	1	55	1	30	1
Withdrawal	43	1	51	1	49	1	53	1	64	1
Others	78	2	70	2	97	2	199	4	283	6
Unknown	443	13	516	14	530	13	623	13	685	14
Total	3292	100	3647	100	4011	100	4712	100	4976	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 (censored when changed in dialysis modality) were 52% and 27% respectively [Table 3.2.1(a)]. 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. At 10 years the unadjusted patient survival on haemodialysis was 28% compared 19% in those on PD; a 9% difference [Table 3.2.1(a) & Figure 3.2.1(b)]. However, when the overall unadjusted patient survival by type of dialysis modality were analysed as per ITT (patient not censored for change in dialysis modality), the difference in the overall unadjusted patient survival by type of dialysis became less marked.

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	10008	100		70906	100		781914	100	
6	8590	93	0	62914	94	0	71504	94	0
12	7190	87	0	55550	88	0	62740	88	0
24	4909	73	0	43689	78	0	48598	77	0
36	3329	61	1	34301	68	0	37630	68	0
48	2236	50	1	26749	60	0	28985	59	0
60	1568	42	1	20755	53	0	22323	52	0
72	1077	36	1	16192	47	0	17269	46	0
84	717	30	1	12366	41	0	13082	40	0
96	462	25	1	9495	36	0	9957	35	0
108	329	22	1	7317	31	0	7644	31	0
120	234	19	1	5617	28	0	5851	27	0

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

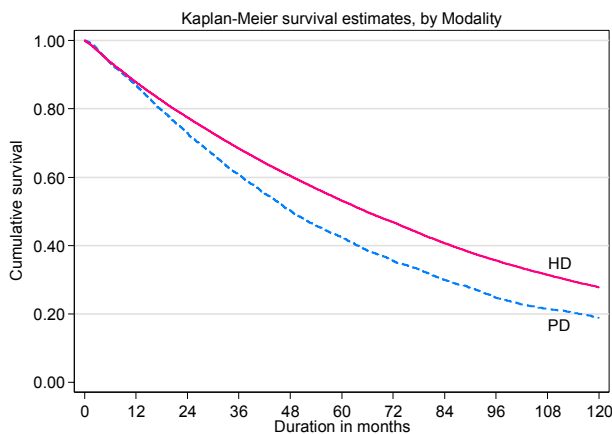


Figure 3.2.1(b): Patient survival by dialysis modality analysis (not censored for change of modality)

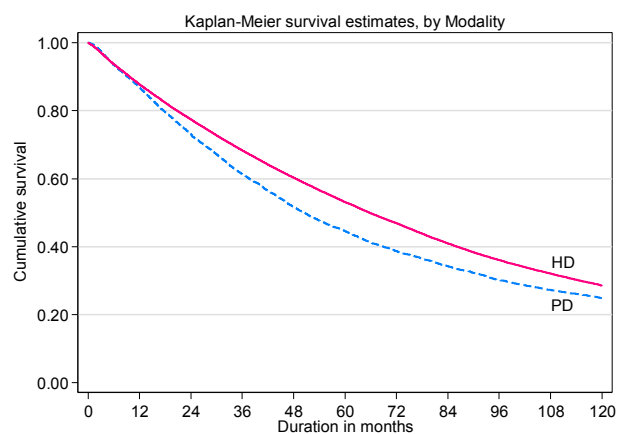


Table 3.2.1(b): Patient survival by dialysis modality analysis (not censored for change of modality)

Dialysis Modality Interval (month)	PD			HD			All		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	10008	100		70906	100		781914	100	
6	8873	93	0	63511	94	0	72380	94	0
12	7745	87	0	56566	88	0	64311	88	0
24	5818	73	0	45028	77	0	50846	77	0
36	4397	61	1	35702	68	0	40099	67	0
48	3357	52	1	28156	60	0	31513	59	0
60	2631	45	1	22154	53	0	24778	52	0
72	2090	39	1	17561	47	0	19651	46	0
84	1660	34	1	13700	41	0	15359	40	0
96	1312	30	1	10739	36	0	12051	35	0
108	1080	27	1	8513	32	0	9592	31	0
120	901	25	1	6730	29	0	7631	28	0

### 3.2.2. Patient survival by year of starting dialysis

Patient survival by year of starting dialysis remained unchanged over the last 10 years with a 1 year and 5 years patient survival of 86-88% and 50-53% (Table 3.2.2 and Figure 3.2.2).

Table 3.2.2: Unadjusted patient survival by year of entry, 2006-2015

Year Interval (month)	2006			2007			2008			2009		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	3884	100		4282	100		4863	100		5227	100	
6	3572	93	0	3984	94	0	4515	94	0	4852	94	0
12	3292	87	1	3681	88	0	4176	88	0	4475	88	0
24	2844	77	1	3186	78	1	3538	76	1	3839	77	1
36	2469	68	1	2737	69	1	3056	67	1	3315	68	1
48	2166	60	1	2341	60	1	2625	59	1	2871	60	1
60	1879	53	1	2030	53	1	2239	51	1	2470	52	1
72	1640	47	1	1747	46	1	1916	44	1	2112	45	1
84	1386	40	1	1475	39	1	1620	38	1	48		
96	1179	35	1	1243	33	1	47					
108	1004	30	1	23								
120	21											

Year Interval (month)	2010			2011			2012			2013		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	5620	100		6435	100		7109	100		7475	100	
6	5107	92	0	5892	93	0	6540	94	0	6869	93	0
12	4703	86	0	5441	87	0	6069	88	0	6328	87	0
24	3997	75	1	4685	76	1	5151	76	1	5407	76	0
36	3455	66	1	4028	66	1	4358	66	1	144		
48	2966	58	1	3422	57	1	119					
60	2548	50	1	96								
72	42											

Year Interval (month)	2014			2015		
	n	% survival	SE	n	% survival	SE
0	8140	100		8275	100	
6	7431	93	0	4035	94	0
12	6761	87	0	326		
24	249					

Figure 3.2.2: Unadjusted patient survival by year of entry, 2006-2015

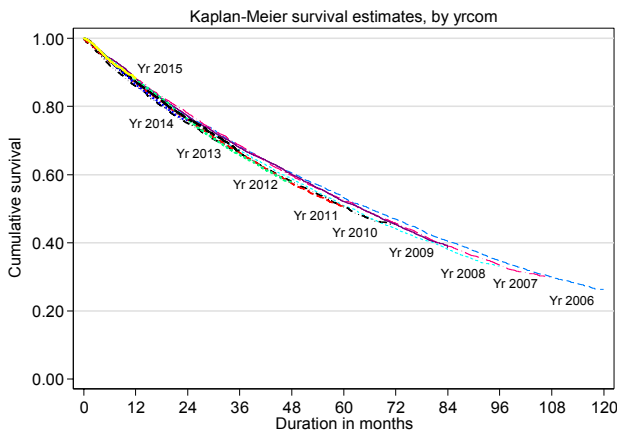
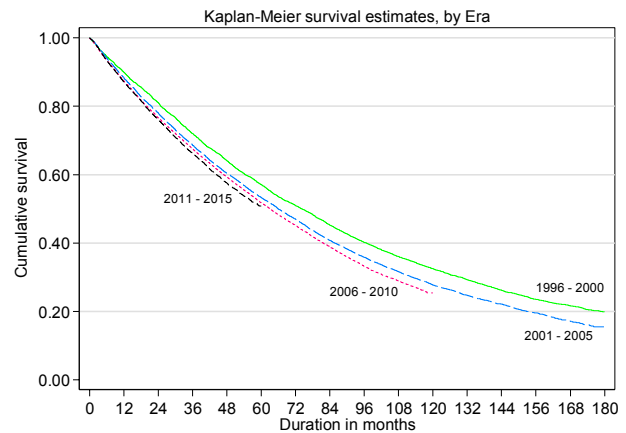


Figure 3.2.3: Unadjusted patient survival by 4 Era, 1996-2015



**3.2.3. Patient survival by 5 years era of starting dialysis**

Eventhough there was no difference in unadjusted patient survival by year of starting dialysis, when unadjusted patient survival was analysed by 5years 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 3.2.3 and Figure 3.2.3). This is partly contributed by increased in percentage of elderly patients and diabetic patients starting dialysis over the last 2 decade.

Table 3.2.3: Unadjusted patient survival by 4 Era, 1996-2015

Year Interval (month)	1996-2000			2001-2005			2006-2010			2011-2015		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	7142	100		13933	100		23876	100		37434	100	
6	6645	95	0	12906	94	0	22029	93	0	30767	93	0
12	6203	90	0	11868	88	0	20327	87	0	24599	87	0
24	5389	81	0	10163	78	0	17395	77	0	15243	76	0
36	4665	72	1	8750	69	0	15031	68	0	8386	66	0
48	4041	64	1	7568	60	0	12965	59	0	3422	58	0
60	3532	57	1	6542	53	0	11166	52	0	96		
72	3085	51	1	5696	47	0	7408	45	0			
84	2691	45	1	4871	41	0	4480	39	0			
96	2353	40	1	4226	36	0	2419	33	0			
108	2084	36	1	3688	32	0	1004	29	0			
120	1851	32	1	3193	28	0	21					

**3.2.4. 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 3.2.4 and Figure 3.2.4). Unadjusted 10 years survival of patients in this age group (15-24) was 10 fold better that those who were 65years and above.

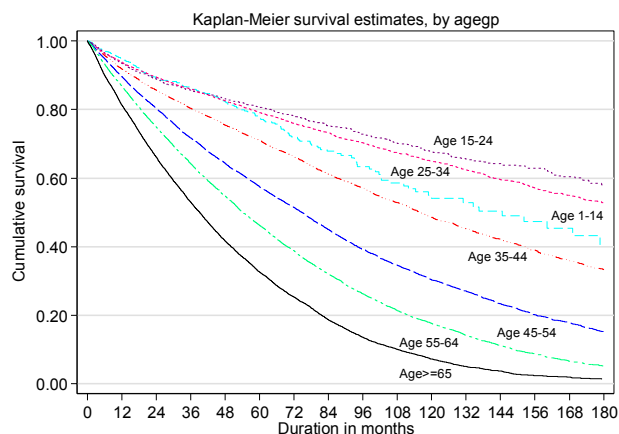
Table 3.2.4: Unadjusted patient survival by age

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	891	100		3172	100		6501	100		10527	100	
6	803	97	1	2798	97	0	5780	96	0	9437	96	0
12	725	95	1	2488	94	0	5143	94	0	8410	92	0
24	565	89	1	1991	89	1	4252	89	0	6923	86	0
36	433	86	1	1658	86	1	3608	86	0	5752	80	0
48	330	82	2	1393	83	1	3032	83	1	4801	75	0
60	241	78	2	1192	81	1	2565	79	1	4050	71	1
72	179	72	2	1019	78	1	2174	76	1	3396	66	1
84	127	68	2	854	75	1	1866	73	1	2798	61	1
96	95	63	3	718	73	1	1580	70	1	2320	57	1
108	71	59	3	595	70	1	1333	67	1	1942	53	1
120	57	54	4	495	68	1	1146	65	1	1569	49	1

Age group (years) Interval (month)	45-54			55-64			≥65		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	20703	100		24857	100		19836	100	
6	18529	95	0	21750	93	0	16723	90	0
12	16388	90	0	18890	87	0	14052	81	0
24	12974	80	0	14195	75	0	9946	66	0
36	10239	72	0	10555	64	0	6937	53	0
48	8088	64	0	7792	55	0	4675	42	0
60	6319	57	0	5657	46	0	3129	33	0
72	4978	51	0	4093	39	0	2110	25	0
84	3809	45	0	2896	32	0	1307	19	0
96	2868	39	0	2034	26	0	809	14	0
108	2187	35	0	1417	21	0	501	10	0
120	1629	30	0	989	18	0	300	7	0

Figure 3.2.4: Unadjusted patient survival by age



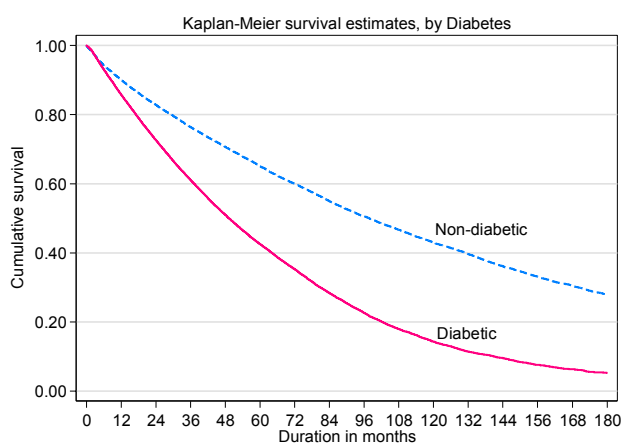
### 3.2.5. Patient survival by Diabetic status

Similar to age at starting dialysis, the presence of diabetes mellitus has major impact on patient survival (Table 3.2.5 and Figure 3.2.5). 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 3.2.5: Unadjusted patient survival by diabetes mellitus status

Diabetes status Interval (month)	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	38592	100		47895	100	
6	34146	94	0	41674	93	0
12	30319	90	0	35777	86	0
24	24571	83	0	26273	73	0
36	20175	76	0	19007	61	0
48	16442	71	0	13669	51	0
60	13427	65	0	9725	43	0
72	11037	60	0	6904	35	0
84	8967	55	0	4667	28	0
96	7294	51	0	3126	23	0
108	6006	47	0	2044	18	0
120	4862	43	0	1311	14	0

Figure 3.2.5: Unadjusted patient survival by diabetes mellitus status



## SECTION 3.3: Survival of incidence patients by centre

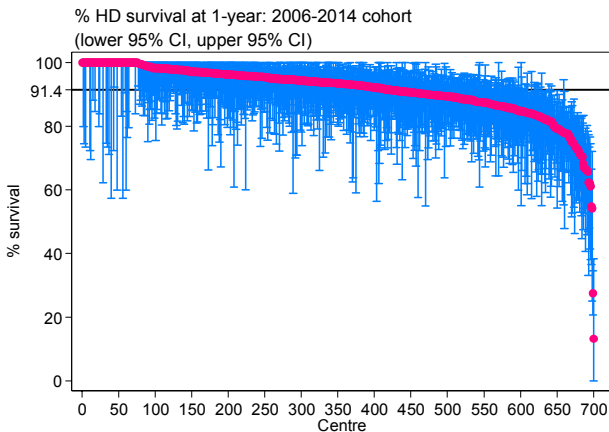
### 3.3.1. Survival of incident haemodialysis patients 2006-2014 by centre

The mean patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2006-2014 cohort was 91.4% [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)], only 160 haemodialysis centres (22.9%) and 252 haemodialysis centres (36.0%) lie within the 2SD and 3SD of the mean respectively.



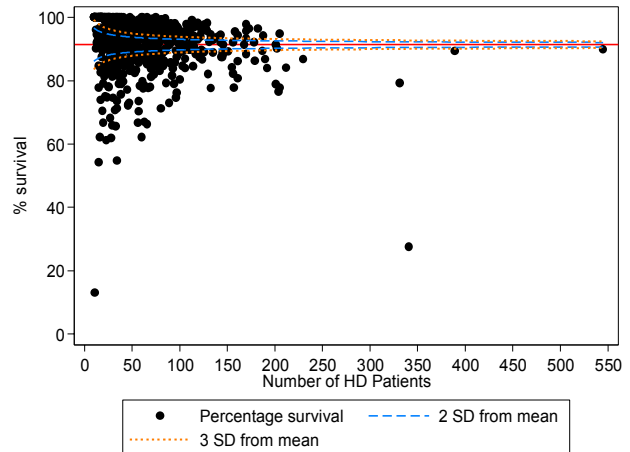
The 5 years mean patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2005-2009 cohort was 65.4% [Figure 3.3.1(c)]. Similar to the 1 year patient survival, there was marked centre variation with only 26.7% and 41.1% of haemodialysis centres lie within 2SD and 3SD of the 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, 2006-2014



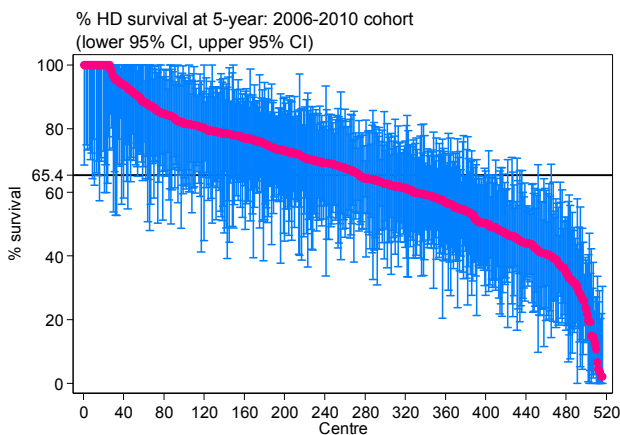
\*Horizontal line represents the mean % survival among HD centres

Figure 3.3.1(b): Funnel plot at 1-year among HD centres adjusted for age and diabetes mellitus status, 2006-2014 cohort



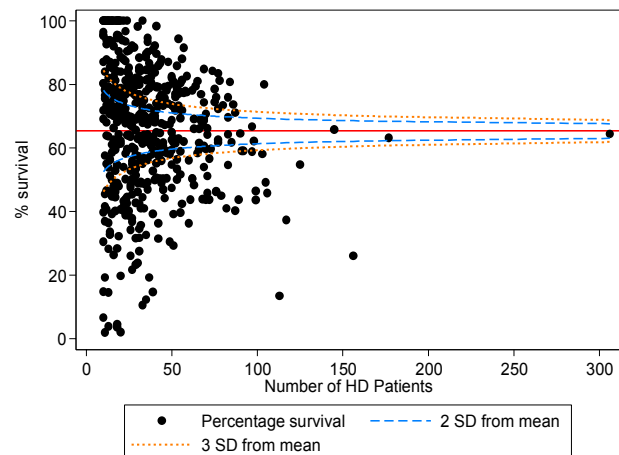
\*Horizontal line represents the mean % survival among HD centres

Figure 3.3.1(c): Variation in patient survival at 5-years among HD centres adjusted for age and diabetes mellitus status, 2006-2010



\*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, 2006-2010 cohort



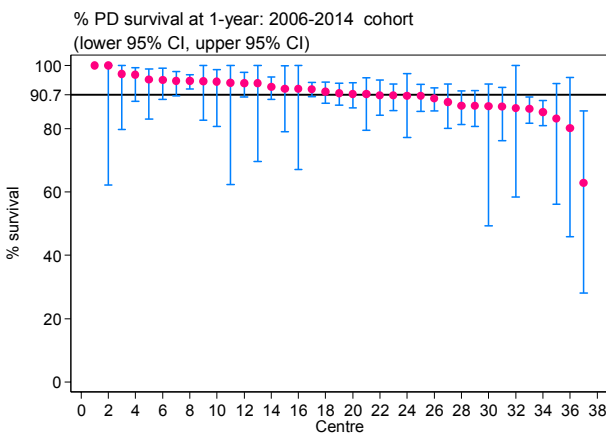
\*Horizontal line represents the mean % survival among HD centres

### 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 2006-2014 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 24.3% and 35.1% of the peritoneal dialysis centres lies within the 2SD and 3SD of the mean respectively [Figure 3.3.2(b)].

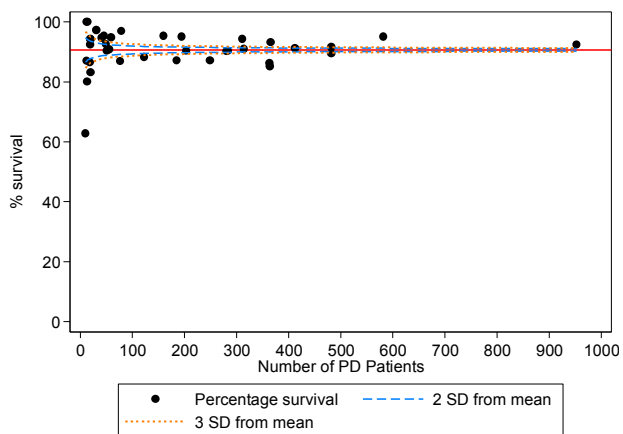
The 5 years mean patient survival (adjusted for age and diabetes mellitus) among peritoneal centres for the 2006-2010 cohort was 59.4% [Figure 3.3.2(c)]. Similar to the 1 year survival, there was a wide variation in the 5-year survival among PD centres with only 8% and 28% of PD centres lied within 2SD 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, 2006-2014



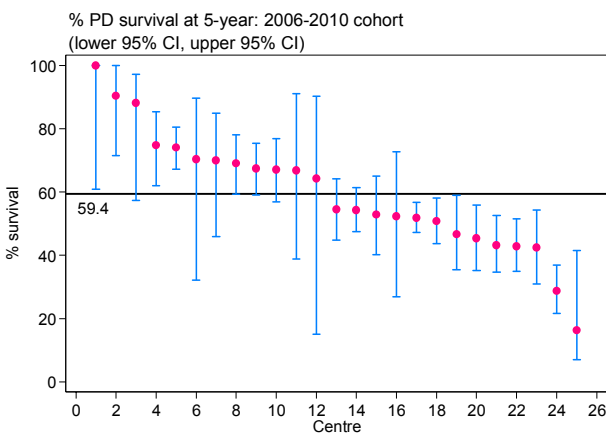
\*Horizontal line represents the mean % survival among PD centres

Figure 3.3.2(b): Funnel plot at 1-year among PD centres adjusted for age and diabetes mellitus status, 2005-2013 cohort



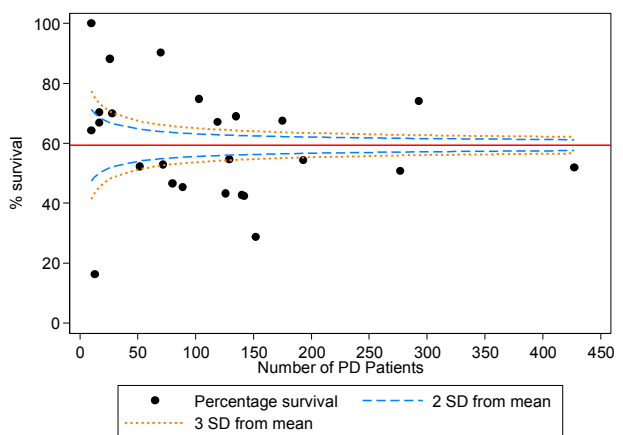
\*Horizontal line represents mean of % survival among PD centres

Figure 3.3.2(c): Variation in patient survival at 5-years among PD centres adjusted for age and diabetes mellitus, 2006-2010



\*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, 2006-2010 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 of the 2006-2015 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 and these adjusted hazard ratio (2005-2014) 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 were positive correlation between mortality and age of patient, serum cholesterol, diastolic blood pressure [Figure 3.4.1(a)], while BMI, serum albumin, serum phosphate [Figure 3.4.1(b)] and haemoglobin concentration [Figure 3.4.1(c)] were negatively correlated with mortality.

Female patients have 17% 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.

After adjustment, patients on peritoneal dialysis have a 5.4% lower mortality risk compared to those on haemodialysis.

Figure 3.4.1(a): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (2006-2015 cohort)

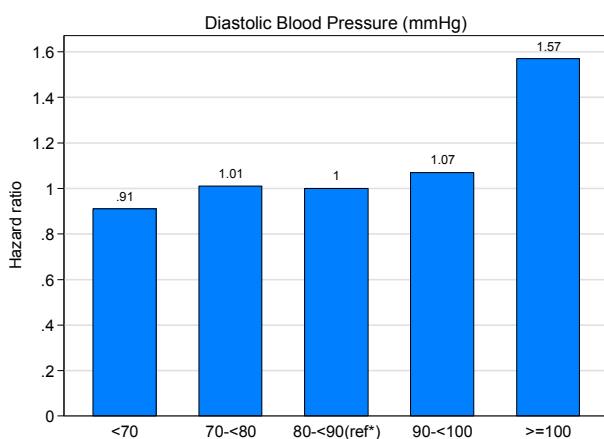


Figure 3.4.1(b): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (2006-2015 cohort)

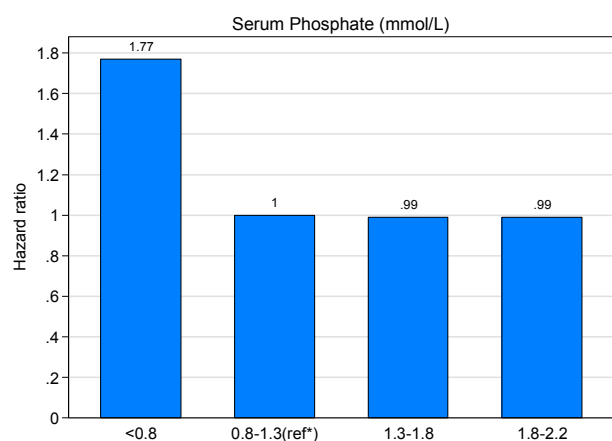
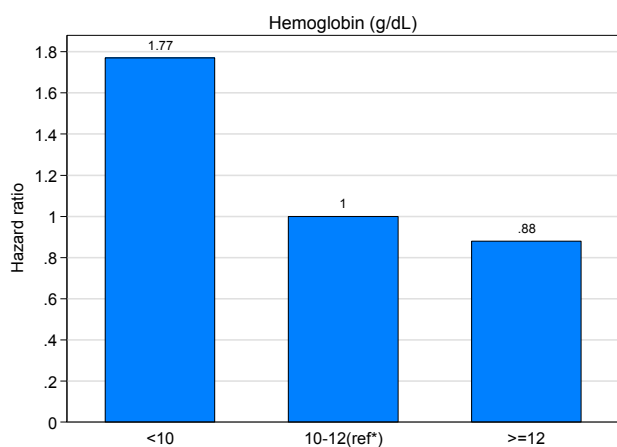


Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2006-2015)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14	394	1.069	(0.869, 1.316)	0.527
Age 15-24	1576	0.900	(0.785, 1.032)	0.132
Age 25-34 <sup>(ref*)</sup>	3,462	1.000		
Age 35-44	5963	1.497	(1.371, 1.634)	<0.0001
Age 45-54	13752	2.045	(1.886, 2.218)	<0.0001
Age 55-64	17616	2.613	(2.408, 2.835)	<0.0001
Age >=65	14911	3.635	(3.345, 3.951)	<0.0001
<b>Gender</b>				
Male <sup>(ref*)</sup>	32011	1.000		
Female	25663	0.831	(0.809, 0.853)	<0.0001
<b>Primary diagnosis</b>				
Unknown primary	11911	1.599	(1.470, 1.738)	<0.0001
Diabetes mellitus	34049	2.028	(1.867, 2.203)	<0.0001
GN/SLE <sup>(ref*)</sup>	2599	1.000		
Polycystic kidney	796	1.357	(1.187, 1.552)	<0.0001
Obstructive nephropathy	199	0.942	(0.721, 1.229)	0.658
Others	8120	1.255	(1.147, 1.372)	<0.0001
<b>Year start dialysis</b>				
2005-2006 <sup>(ref*)</sup>	7595	1.000		
2007-2008	9415	1.026	(0.988, 1.065)	0.182
2009-2010	11293	1.068	(1.027, 1.110)	0.001
2011-2012	13760	1.044	(1.002, 1.089)	0.041
2013-2014	15611	1.020	(0.969, 1.073)	0.453
<b>Modality</b>				
HD <sup>(ref*)</sup>	50649	1.000		
PD	7025	0.946	(0.907, 0.986)	0.009
<b>BMI</b>				
BMI<18.5	3255	1.079	(1.021, 1.141)	0.007
BMI 18.5-25 <sup>(ref*)</sup>	33507	1.000		
25-30	16864	0.925	(0.898, 0.954)	<0.0001
>=30	4048	0.804	(0.761, 0.849)	<0.0001
<b>Serum albumin (g/L)</b>				
<30	4686	4.111	(3.897, 4.336)	<0.0001
30-<35	9754	2.431	(2.327, 2.539)	<0.0001
35-<40	27970	1.833	(1.769, 1.900)	<0.0001
>=40 <sup>(ref*)</sup>	15264	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	6635	0.955	(0.918, 0.992)	0.019
3.5-<5.2 <sup>(ref*)</sup>	40583	1.000		
5.2-<6.2	7439	0.972	(0.934, 1.011)	0.157
>=6.2	3017	1.251	(1.183, 1.324)	<0.0001
<b>Diastolic BP (mmHg)</b>				
<70	11466	0.907	(0.872, 0.944)	0.000
70-<80	22395	1.006	(0.974, 1.039)	0.707
80-<90 <sup>(ref*)</sup>	17215	1.000		
90-<100	5230	1.068	(1.012, 1.127)	0.016
>=100	1368	1.567	(1.429, 1.719)	<0.0001

Factors	n	Hazard ratio	95% CI	P-value
<b>Hemoglobin (g/dL)</b>				
<10	26229	1.770	(1.723, 1.818)	<0.0001
10-<12 (ref*)	28168	1.000		
>=12	3277	0.881	(0.830, 0.935)	<0.0001
<b>Serum calcium (mmol/L)</b>				
<2.1	14743	0.961	(0.931, 0.992)	0.013
2.1-<=2.37 (ref*)	35872	1.000		
>2.37	7059	0.795	(0.761, 0.830)	<0.0001
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	24014	0.902	(0.870, 0.936)	<0.0001
3.5-<4.5 (ref*)	22802	1.000		
4.5-<5.5	8080	0.794	(0.751, 0.840)	<0.0001
>=5.5	2778	1.012	(0.919, 1.114)	0.808
<b>Serum Phosphate (mmol/L)</b>				
<0.8	357	1.776	(1.560, 2.022)	<0.0001
0.8-<1.3 (ref*)	7784	1.000		
1.3-<1.8	28072	0.989	(0.951, 1.029)	0.595
1.8-<2.2	14842	0.945	(0.893, 1.000)	0.051
>=2.2	6619	0.996	(0.912, 1.088)	0.927
<b>HBsAg</b>				
Negative (ref*)	56009	1.000		
Positive	1665	1.109	(1.035, 1.188)	0.003
<b>Anti-HCV</b>				
Negative (ref*)	56679	1.000		
Positive	995	1.011	(0.926, 1.103)	0.813
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	50997	1.000		
CVD	6677	1.305	(1.260, 1.351)	<0.0001

Figure 3.4.1(c): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by hemoglobin (2006-2015 cohort)



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

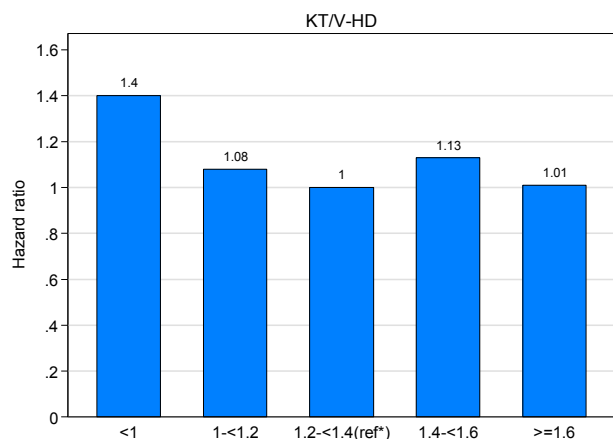
The adjusted hazard ratio for mortality of haemodialysis patients [Table 3.4.2] demonstrated identical pattern with the whole cohort of 2006-2015 dialysis patients since more than 90% of this dialysis population consisted of haemodialysis patients. The dose of dialysis treatment (Kt/V) and patient mortality 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 uncensored for change of modality (2006-2015 cohort)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14	91	1.490	(1.010, 2.198)	0.044
Age 15-24	1064	0.906	(0.767, 1.070)	0.246
Age 25-34 <sup>(ref*)</sup>	2861	1.000		
Age 35-44	5211	1.436	(1.304, 1.582)	<0.0001
Age 45-54	12327	1.990	(1.819, 2.176)	<0.0001
Age 55-64	15725	2.558	(2.338, 2.798)	<0.0001
Age ≥65	13370	3.542	(3.232, 3.882)	<0.0001
<b>Gender</b>				
Male <sup>(ref*)</sup>	28429	1.000		
Female	22220	0.845	(0.821, 0.871)	<0.0001
<b>Primary diagnosis</b>				
Unknown primary	10670	1.620	(1.469, 1.786)	<0.0001
Diabetes mellitus	30327	1.998	(1.814, 2.202)	<0.0001
GN/SLE <sup>(ref*)</sup>	1832	1.000		
Polycystic kidney	622	1.441	(1.235, 1.682)	<0.0001
Obstructive nephropathy	168	0.885	(0.655, 1.194)	0.423
Others	7030	1.255	(1.132, 1.392)	<0.0001
<b>Year start dialysis</b>				
2005-2006 <sup>(ref*)</sup>	6738	1.000		
2007-2008	8362	1.052	(1.010, 1.095)	0.015
2009-2010	10115	1.102	(1.057, 1.149)	<0.0001
2011-2012	12173	1.077	(1.029, 1.126)	0.001
2013-2014	13261	1.056	(0.998, 1.116)	0.058
<b>BMI</b>				
BMI<18.5	2573	1.109	(1.043, 1.179)	0.001
BMI 18.5-25 <sup>(ref*)</sup>	29831	1.000		
BMI 25-30	14771	0.894	(0.864, 0.926)	<0.0001
≥30	3474	0.705	(0.660, 0.753)	<0.0001
<b>Serum albumin (g/L)</b>				
<30	2693	4.242	(3.993, 4.507)	<0.0001
30-<35	7397	2.334	(2.229, 2.445)	<0.0001
35-<40	26042	1.855	(1.788, 1.924)	<0.0001
≥40 <sup>(ref*)</sup>	14517	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	6152	0.945	(0.907, 0.984)	0.006
3.5-<5.2	36495	1.000		
5.2-<6.2	5926	0.927	(0.886, 0.969)	0.001
≥6.2 <sup>(ref*)</sup>	2076	1.203	(1.125, 1.287)	<0.0001
<b>Kt/V</b>				
<1	1272	1.497	(1.360, 1.648)	<0.0001
1-<1.2	3772	1.118	(1.051, 1.189)	<0.0001
1.2-<1.4 <sup>(ref*)</sup>	7964	1.000		
1.4-<1.6	12896	1.110	(1.062, 1.159)	<0.0001
≥1.6	24745	0.996	(0.954, 1.041)	0.874

Factors	n	Hazard ratio	95% CI	P-value
<b>Diastolic BP (mmHg)</b>				
<70	10560	0.881	(0.845, 0.919)	<0.0001
70-<80	19786	0.999	(0.965, 1.035)	0.966
80-<90 (ref*)	14656	1.000		
90-<100	4448	1.062	(1.002, 1.126)	0.042
>=100	1199	1.645	(1.491, 1.814)	<0.0001
<b>Hemoglobin (g/dL)</b>				
<10	23649	1.854	(1.802, 1.908)	<0.0001
10-<12 (ref*)	24349	1.000		
>=12	2651	0.817	(0.763, 0.874)	<0.0001
<b>Serum calcium (mmol/L)</b>				
<2.1	12496	0.946	(0.914, 0.979)	0.001
2.1-<=2.37 (ref*)	32055	1.000		
>2.37	6098	0.770	(0.734, 0.807)	<0.0001
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	19986	0.876	(0.843, 0.910)	<0.0001
3.5-<4.5 (ref*)	20772	1.000		
4.5-<5.5	7387	0.789	(0.744, 0.837)	<0.0001
>=5.5	2504	1.013	(0.915, 1.122)	0.804
<b>Serum Phosphate (mmol/L)</b>				
<0.8	270	1.785	(1.534, 2.077)	<0.0001
0.8-<1.3 (ref*)	6142	1.000		
1.3-<1.8	24663	1.009	(0.966, 1.055)	0.675
1.8-<2.2	13583	0.946	(0.890, 1.007)	0.080
>=2.2	5991	0.979	(0.891, 1.076)	0.663
<b>HBsAg</b>				
Negative (ref*)	49197	1.000		
Positive	1452	1.115	(1.036, 1.201)	0.004
<b>Anti-HCV</b>				
Negative (ref*)	49785	1.000		
Positive	864	1.019	(0.928, 1.119)	0.687
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	45194	1.000		
CVD	5455	1.269	(1.221, 1.318)	<0.0001

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (2006-2015 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 2006-2015 dialysis patients. However there were no significant correlations between gender, 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 a positive correlation between Kt/V and mortality of patients on peritoneal dialysis where peritoneal dialysis patients with Kt/V > 2.0 have a 40% lower hazard ratio compared to those with a Kt/V 1.7-2.0. However a substantial number of these peritoneal dialysis patients with Kt/V > 2.0 were likely to have significant residual renal function and were likely to be on dialysis for a shorter period of time compare to those with a Kt/V of < 2.0.

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2005-2014 cohort)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14	296	1.968	(1.348;2.874)	<u>&lt;0.001</u>
Age 15-24	477	1.412	(1.040;1.917)	0.027
Age 25-34 <sup>(ref*)</sup>	530	1.000		
Age 35-44	672	1.713	(1.338;2.194)	<0.001
Age 45-54	1254	2.372	(1.881;2.993)	<0.001
Age 55-64	1641	2.945	(2.332;3.719)	<0.001
Age >=65	1293	4.255	(3.357;5.393)	<0.001
<b>Gender</b>				
Male <sup>(ref*)</sup>	3136	1.000		
Female	3027	0.978	(0.886;1.080)	0.663
<b>Primary diagnosis</b>				
Unknown primary	1124	1.324	(1.094;1.603)	0.004
Diabetes mellitus	3201	2.063	(1.700;2.505)	<0.001
GN/SLE <sup>(ref*)</sup>	719	1.000		
Polycystic kidney	184	1.149	(0.865;1.525)	0.338
Obstructive nephropathy	29	0.907	(0.442;1.859)	0.790
Others	906	1.203	(0.971;1.489)	0.091
<b>Year start dialysis</b>				
2005-2006 <sup>(ref*)</sup>	691	1.000		
2007-2008	1037	1.013	(0.902;1.136)	0.833
2009-2010	1081	0.871	(0.770;0.986)	0.028
2011-2012	1447	0.887	(0.780;1.008)	0.066
2013-2014	1907	0.667	(0.564;0.789)	<0.001
<b>BMI</b>				
BMI<18.5	649	1.327	(1.130;1.559)	0.001
BMI 18.5-25 <sup>(ref*)</sup>	3218	1.000		
>=25	2296	0.992	(0.910;1.082)	0.863
<b>Serum albumin (g/L)</b>				
<30	1752	2.690	(2.230;3.245)	<0.001
30-<35	2081	1.914	(1.595;2.297)	<0.001
35-<40	1665	1.238	(1.028;1.492)	0.024
>=40 <sup>(ref*)</sup>	665	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	385	1.066	(0.914;1.243)	0.416
3.5-<5.2 <sup>(ref*)</sup>	3492	1.000		
5.2-<6.2	1401	1.082	(0.978;1.197)	0.126
>=6.2	885	1.229	(1.090;1.386)	0.001



Factors	n	Hazard ratio	95% CI	P-value
<b>Kt/V</b>				
<1.7	3706	1.106	(0.978;1.251)	0.109
1.7-<2.0 (ref*)	1758	1.000		
>=2.0	699	0.606	(0.478;0.768)	<0.001
<b>Diastolic BP (mmHg)</b>				
<70	816	1.168	(1.029;1.325)	0.016
70-<80	2236	1.029	(0.934;1.134)	0.560
80-<90 (ref*)	2226	1.000		
90-<100	735	1.153	(0.986;1.348)	0.074
>=100	150	0.984	(0.691;1.401)	0.931
<b>Hemoglobin (g/dL)</b>				
<10	2280	1.354	(1.239;1.479)	<0.001
10-<12 (ref*)	3298	1.000		
>=12	585	1.127	(0.982;1.292)	0.088
<b>Serum calcium (mmol/L)</b>				
<2.1	1919	1.113	(1.013;1.223)	0.026
2.1-<=2.37 (ref*)	3333	1.000		
>2.37	911	1.002	(0.886;1.132)	0.977
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	3596	1.156	(1.019;1.312)	0.024
3.5-<4.5 (ref*)	1720	1.000		
4.5-<5.5	623	0.944	(0.773;1.154)	0.577
>=5.5	224	1.039	(0.744;1.452)	0.821
<b>Serum Phosphate (mmol/L)</b>				
<0.8	78	1.993	(1.499;2.650)	<0.001
0.8-<1.3 (ref*)	1510	1.000		
1.3-<1.8	2986	0.980	(0.886;1.084)	0.695
1.8-<2.2	1073	1.013	(0.838;1.223)	0.897
>=2.2	516	1.321	(0.983;1.777)	0.065
<b>HBsAg</b>				
Negative (ref*)	5963	1.000		
Positive	200	0.976	(0.797;1.195)	0.814
<b>Anti-HCV</b>				
Negative (ref*)	6058	1.000		
Positive	105	0.959	(0.723;1.271)	0.77
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	5057	1.000		
CVD	1106	1.323	(1.202;1.456)	<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 centres was 22 [Figure 3.4.4(a)]. When adjusted for the size of haemodialysis centres using funnel plot, only 400 (60.9%) and 485 (73.8 %) 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, 2014

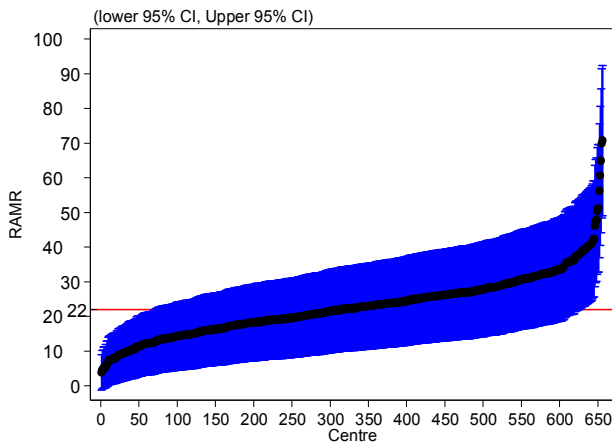
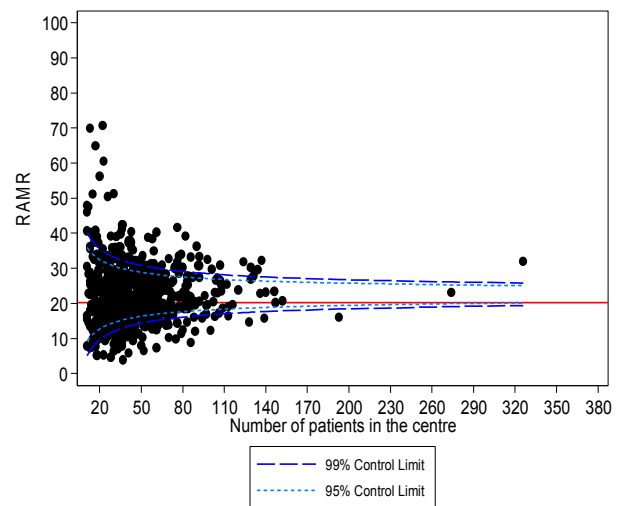


Figure 3.4.4(b): Funnel plot of RAMR by HD centre, 2014



### 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 26 [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 58.8% and 67.7% 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, 2014

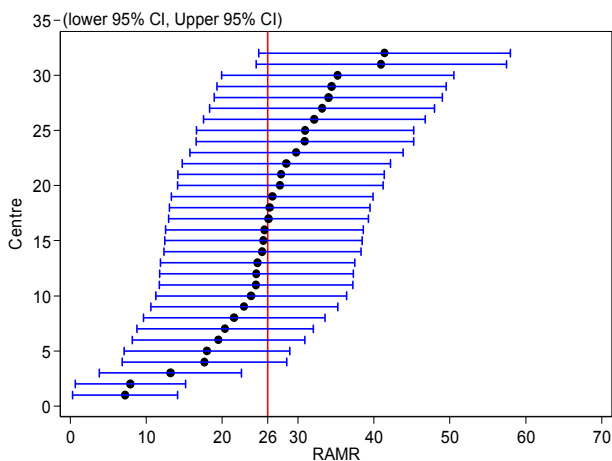


Figure 3.4.5(b): Funnel plot for RAMR by PD centres, 2014

