

## Chapter - 3

# **DEATH AND SURVIVAL ON DIALYSIS**

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### SECTION 3.1: DEATH ON DIALYSIS

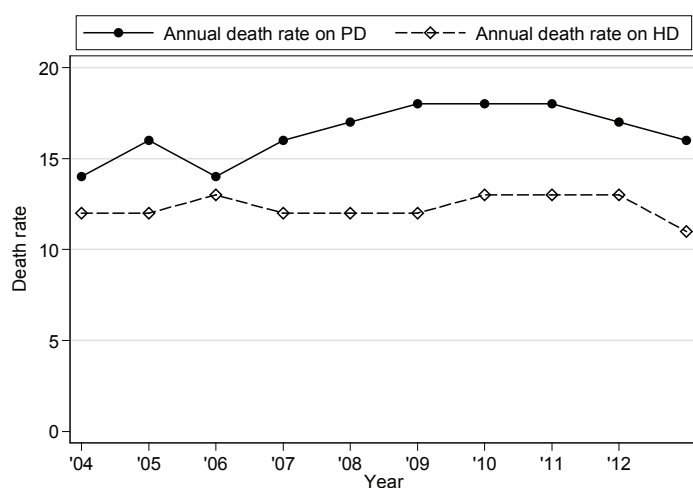
The annual death rate on dialysis in 2013 was 11.3% (Table 3.1.1). In 2013, the death rate was 10.9% among haemodialysis patients while peritoneal dialysis patients had an annual death rate of 15.8%. The trend for death rate among haemodialysis patients remained relatively unchanged over the last 10 years, ranging from 11-13% with a slight dip in 2013 (Figure 3.1.1). The annual death rate for those on chronic peritoneal dialysis (PD) demonstrated an increasing trend in the early years peaked in 2010. Since then the death rate of patients on PD appeared to be on a downward trend.

The difference in annual death rate between the two modalities persisted over the last 10 years and was partly contributed by the practice of negative selection of patients for peritoneal dialysis.

**Table 3.1.1:** Deaths on dialysis 2004-2013

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of dialysis patients at risk	11127	12599	14217	16080	18233	20484	22638	24982	27672	30354
Dialysis deaths	1322	1515	1820	1987	2191	2600	3045	3287	3598	3437
Dialysis death rate %	12	12	13	12	12	13	13	13	13	11
Number of HD patients at risk	10032	11450	12971	14647	16583	18666	20701	22901	25312	27674
HD deaths	1166	1333	1643	1756	1914	2279	2692	2915	3201	3014
HD death rate %	12	12	13	12	12	12	13	13	13	11
Number of PD patients at risk	1095	1149	1246	1433	1650	1818	1938	2082	2360	2681
PD deaths	156	182	177	231	277	321	353	372	397	423
PD death rate %	14	16	14	16	17	18	18	18	17	16

**Figure 3.1.1:** Death rates on dialysis 2004-2013



Cardiovascular disease remained the main cause of death in 2013; accounting for 35%. Death due to cardiovascular disease appeared to be increasing in the last 6 years and this was 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 sepsis had increased over the last 6 years and has now become the second most common cause of death in 2013; accounting for 24% of all death.

**Table 3.1.2:** Causes of death on dialysis 2004-2013

Year Causes of Death	2004		2005		2006		2007		2008	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	344	26	375	25	513	28	517	26	678	31
Died at home	302	23	319	21	353	19	342	17	423	19
Sepsis	189	14	200	13	254	14	248	12	356	16
PD peritonitis	19	1	23	2	23	1	22	1	30	1
GIT bleed	24	2	29	2	27	1	34	2	45	2
Cancer	20	2	31	2	41	2	34	2	56	3
Liver disease	29	2	27	2	35	2	38	2	44	2
Withdrawal	9	1	12	1	23	1	27	1	24	1
Others	306	23	394	26	379	21	528	27	363	17
Unknown	80	6	105	7	172	9	197	10	172	8
<b>TOTAL</b>	<b>1322</b>	<b>100</b>	<b>1515</b>	<b>100</b>	<b>1820</b>	<b>100</b>	<b>1987</b>	<b>100</b>	<b>2191</b>	<b>100</b>
Year Causes of Death	2009		2010		2011		2012		2013	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	879	34	1014	33	1201	37	1249	35	1213	35
Died at home	491	19	544	18	542	16	579	16	642	19
Sepsis	580	22	733	24	767	23	939	26	835	24
PD peritonitis	32	1	37	1	28	1	18	1	40	1
GIT bleed	48	2	59	2	52	2	60	2	57	2
Cancer	57	2	78	3	88	3	81	2	69	2
Liver disease	27	1	33	1	35	1	28	1	30	1
Withdrawal	35	1	39	1	41	1	48	1	40	1
Others	194	7	114	4	117	4	143	4	188	5
Unknown	257	10	394	13	416	13	453	13	323	9
<b>TOTAL</b>	<b>2600</b>	<b>100</b>	<b>3045</b>	<b>100</b>	<b>3287</b>	<b>100</b>	<b>3598</b>	<b>100</b>	<b>3437</b>	<b>100</b>

## SECTION 3.2: PATIENT SURVIVAL ON DIALYSIS

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

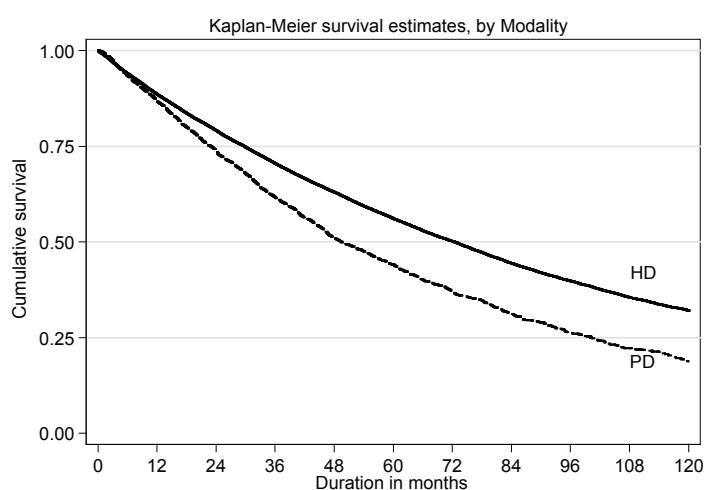
Patient survival by first dialysis modalities (censored for change of modality) was shown in Table & Figure 3.2.1(a). The overall unadjusted 5 years and 10 years patient survival on dialysis (censored for change in modality) were 54% and 30% respectively. The unadjusted patient survival was better for 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 31% compared 20% in those on PD, 11% difference in 10-year survival.

However, when patient survival by dialysis modalities was analysed as per ITT (disregarding change of dialysis modality) (Table & Figure 3.2.1b), the difference in survival according to dialysis modalities was less apparent. The overall unadjusted 10 years patient survival on haemodialysis and peritoneal dialysis were 32% and 28% respectively, 4% difference between the modalities.

**Table 3.2.1(a):** Patient survival by dialysis modality analysis (censored for change of modality) 2004-2013

Dialysis Modality Interval (month)	PD			HD			All		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	7846	100		57005	100		64851	100	
6	6773	94	0	50395	94	0	57168	94	0
12	5641	87	0	44189	89	0	49830	88	0
24	3804	74	1	34307	79	0	38111	78	0
36	2550	62	1	26590	70	0	29140	69	0
48	1725	52	1	20614	62	0	22339	61	0
60	1162	44	1	15869	55	0	17031	54	0
72	783	37	1	12283	49	0	13065	48	0
84	499	31	1	9315	43	0	9813	42	0
96	322	26	1	7077	39	0	7396	37	0
108	228	23	1	5438	34	0	5665	33	0
120	144	20	1	4157	31	0	4301	30	0

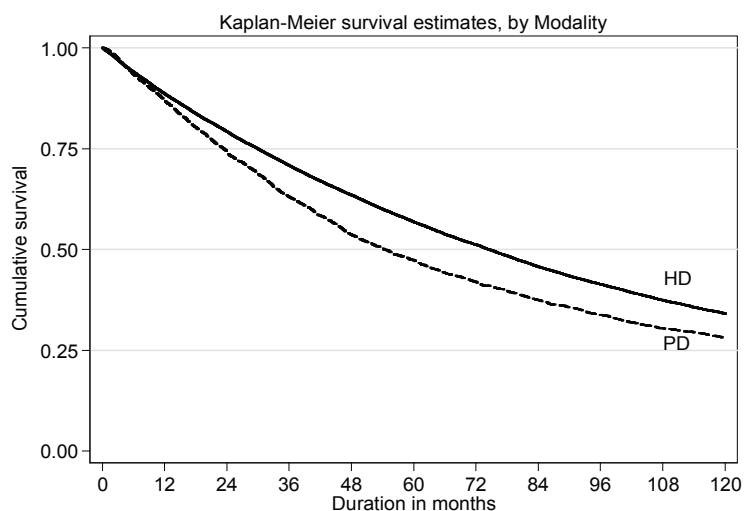
**Figure 3.2.1(a):** Patient survival by dialysis modality analysis (censored for change of modality) 2004-2013



**Table 3.2.1(b):** Patient survival by dialysis modality analysis (not censored for change of modality) 2004-2013

Dialysis Modality Interval (month)	PD			HD			All		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	7846	100		57005	100		64851	100	
6	7013	94	0	51074	94	0	58087	94	0
12	6147	87	0	45294	89	0	51441	88	0
24	4653	74	1	35654	79	0	40303	78	0
36	3542	63	1	28188	70	0	31730	69	0
48	2739	54	1	22201	63	0	24940	62	0
60	2118	47	1	17428	56	0	19546	55	0
72	1663	41	1	13751	50	0	15413	49	0
84	1317	37	1	10686	44	0	12002	43	0
96	1071	33	1	8336	40	0	9406	39	0
108	882	30	1	6605	36	0	7486	35	0
120	726	28	1	5222	32	0	5948	32	0

**Figure 3.2.1(b):** Patient survival by dialysis modality analysis (not censored for change of modality) 2004-2013



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

Despite increasing number of older patients and diabetes initiating dialysis (Table 2.3.2 & Table 2.4), 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 51-53% (Table & Figure 3.2.2).

**Table 3.2.2:** Unadjusted patient survival by year of entry, 2004-2013

Year Interval (month)	2004			2005			2006			2007		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	3085	100		3323	100		3883	100		4282	100	
6	2875	94	0	3055	93	0	3571	93	0	3984	94	0
12	2644	88	1	2805	87	1	3289	87	1	3681	88	0
24	2288	79	1	2414	77	1	2841	77	1	3185	78	1
36	1955	69	1	2092	68	1	2466	68	1	2737	69	1
48	1694	60	1	1800	59	1	2163	60	1	2340	60	1
60	1469	53	1	1552	52	1	1875	53	1	2027	53	1
72	1272	47	1	1361	46	1	1634	47	1	1755	46	1
84	1090	41	1	1164	40	1	1388	41	1	30		
96	935	35	1	996	35	1	26					
108	827	32	1	9								
120	2											

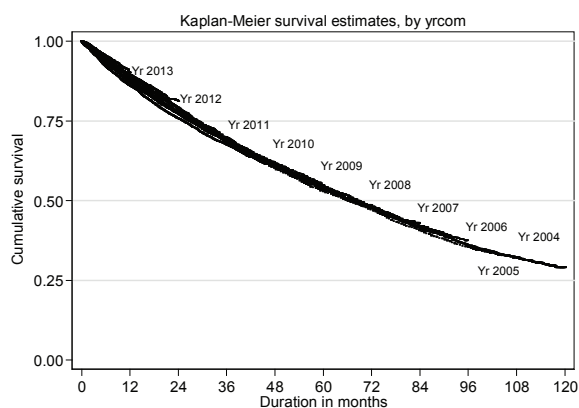
  

Year Interval (month)	2008			2009			2010			2011		
	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	4862	100		5226	100		5606	100		6408	100	
6	4515	94	0	4851	94	0	5091	92	0	5865	93	
12	4175	88	0	4471	88	0	4689	86	0	5411	87	0
24	3536	76	1	3834	77	1	3975	75	1	4678	77	0
36	3055	67	1	3304	68	1	3449	67	1	132		0
48	2624	59	1	2864	60	1	60					1
60	2261	51	1	64								
72	63											

Year Interval (month)	2012			2013		
	n	% survival	SE	n	% survival	SE
0	6966	100		6683	100	
6	6444	94	0	3463	95	0
12	6010	89	0	194		
24	150					

**Figure 3.2.2:** Unadjusted patient survival by year of entry, 2004-2013



### 3.2.3: 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. Unadjusted 9 years survival of patients in this age group (15-24) was 6 fold better than those who were 65 years and above. Patients aged less than 15 years have similar survival with those in the age group of 33 to 44 and probably reflect the challenges and difficulties in dialyzing young children.

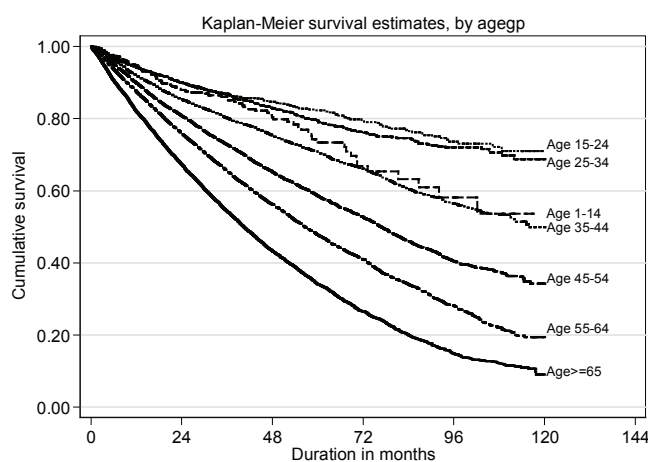
**Table 3.2.3:** Unadjusted patient survival by age, 2004-2013

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	489	100		1673	100		3245	100		5457	100	
6	443	97	1	1490	97	0	2891	97	0	4866	96	0
12	389	95	1	1286	94	1	2506	94	0	4204	92	0
24	282	88	2	995	90	1	1948	90	1	3218	85	1
36	190	86	2	782	86	1	1520	87	1	2485	80	1
48	133	80	2	619	85	1	1137	83	1	1888	75	1
60	80	73	3	458	82	1	833	79	1	1404	71	1
72	46	67	4	347	80	1	588	76	1	969	66	1
84	31	63	5	228	77	2	387	75	1	638	60	1
96	18	58	5	136	74	2	232	72	1	369	57	1
108	10	54	7	69	72	2	110	71	2	175	53	1
120	1			1			1			1		

Age group (years) Interval (month)	45-54			55-65			≥65		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	12113	100		14880	100		12467	100	
6	10682	95	0	12879	94	0	10461	91	0
12	9267	90	0	10919	87	0	8605	82	0
24	6929	81	0	7753	76	0	5768	67	0
36	5099	73	0	5369	65	0	3743	54	1
48	3675	65	1	3639	56	1	2402	43	1
60	2590	59	1	2406	48	1	1446	34	1
72	1753	53	1	1538	41	1	839	27	1
84	1068	46	1	889	34	1	430	20	1
96	534	40	1	458	28	1	196	15	1
108	231	38	1	161	22	1	81	12	1
120	2			1			1		

**Figure 3.2.3:** Unadjusted patient survival by age, 2004-2013



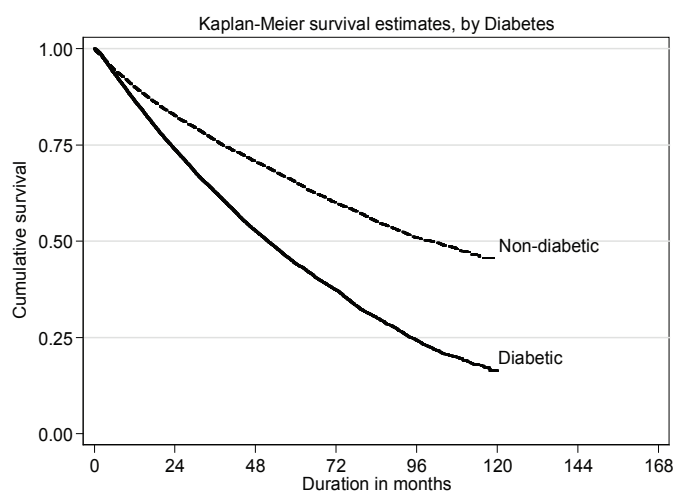
### 3.2.4: Patient survival by diabetic status

The presence of diabetes mellitus has major impact on patient survival (Table & Figure 3.2.4). The difference in the unadjusted patient survival diverged as early as first year after initiation of dialysis. The 9 years unadjusted patient survival among diabetics and non-diabetics were 48% and 20% respectively, a two and a half fold difference in patient survival.

**Table 3.2.4:** Unadjusted patient survival by year of entry, 2004-2013

Diabetes status Interval (month)	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	20818	100		29506	100	
6	18207	94	0	25504	93	0
12	15753	90	0	21422	86	0
24	11918	83	0	14975	74	0
36	8895	76	0	10293	63	0
48	6564	71	0	6916	53	0
60	4733	65	0	4448	44	0
72	3273	60	0	2806	37	0
84	2121	55	1	1549	30	0
96	1213	51	1	717	24	1
108	556	48	1	273	20	1
120	2			2		

**Figure 3.2.4:** Unadjusted patient survival by diabetes mellitus status, 2004-2013



## SECTION 3.3: SURVIVAL OF INCIDENCE PATIENTS BY CENTRE

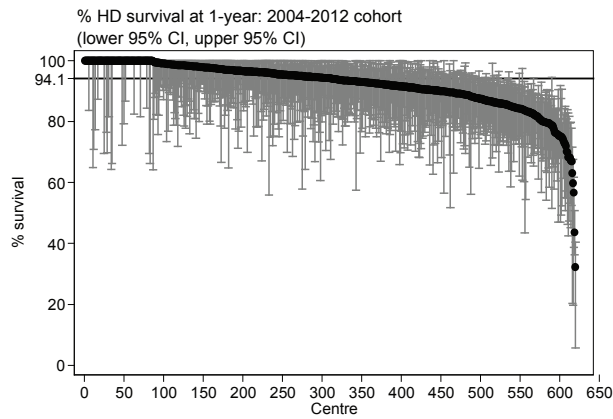
### 3.3.1: Survival of incident haemodialysis patients 2004-2012 by centre

The mean patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2004-2012 cohort was 94.1% (Figure 3.3.1a). There was marked centre variation and when the 1 year patient survival of the individual haemodialysis centres were illustrated in the funnel plots (Figure 3.3.1b), only 24.7% and 35.5% of the haemodialysis centres lies within the 2SD and 3SD of the mean 1 year patient survival respectively.

The 5 years mean patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2004-2008 cohort was 67.3% (Figure 3.3.1c). Similar to the 1 year patient survival, there was marked centre variation with respect to 5 years patient survival with only 29.0% and 42.4% of haemodialysis centres lie within 2SD and 3SD respectively (Figure 3.3.1d).

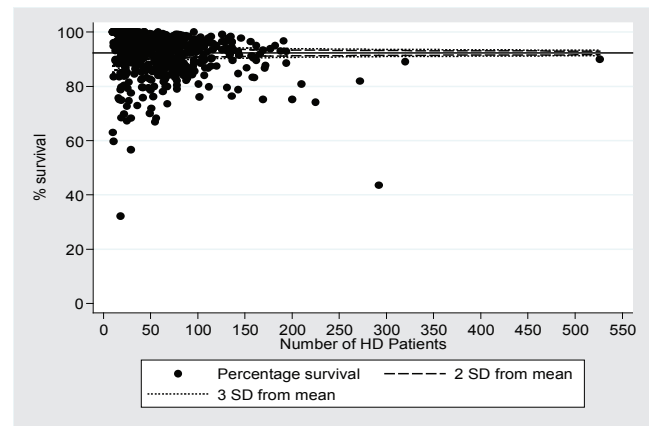


**Figure 3.3.1(a):** Variation in patient survival at 1-year among HD centres adjusted for age and diabetes mellitus status, 2008-2012



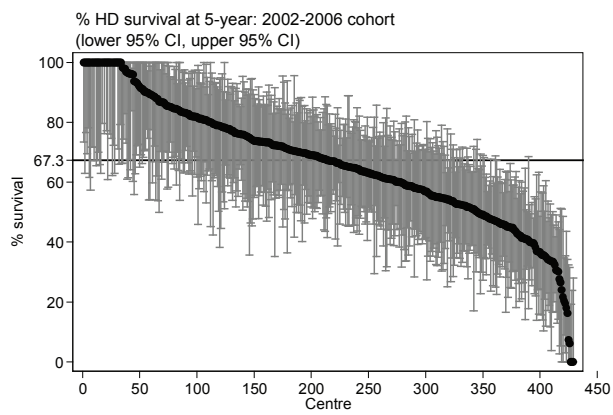
\*Horizontal line represents the median % survival among HD centres

**Figure 3.3.1(b):** Funnel plot at 1-year among HD centres adjusted for age and diabetes mellitus status, 2008-2012 cohort



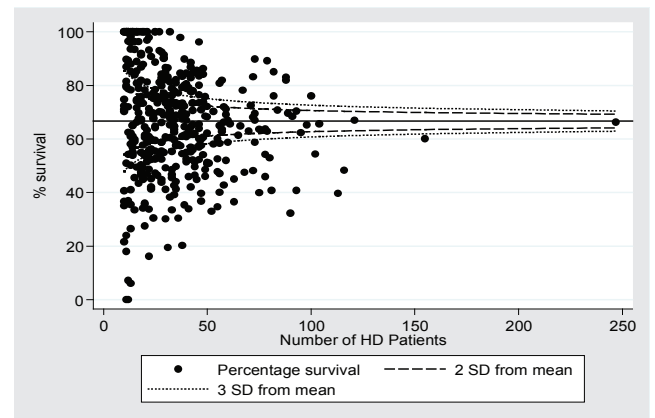
\*Horizontal line represents the median % survival among HD centres

**Figure 3.3.1(c):** Variation in patient survival at 5-years among HD centres adjusted for age and diabetes mellitus status, 2004-2008



\*Horizontal line represents the median % 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, 2004-2008 cohort



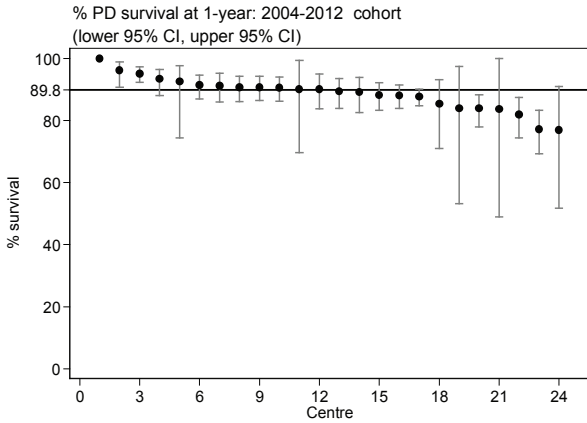
\*Horizontal line represents the median % survival among HD centres

**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 2008-2012 cohort was 89.8% (Figure 3.3.2a). Similar to haemodialysis centres, there was marked centre variation of 1-year patient survival among the peritoneal dialysis centres with only 16.7% and 25.0% of the peritoneal dialysis centres lies within the 2SD and 3SD of the mean 1 year patient survival respectively (Figure 3.3.2b).

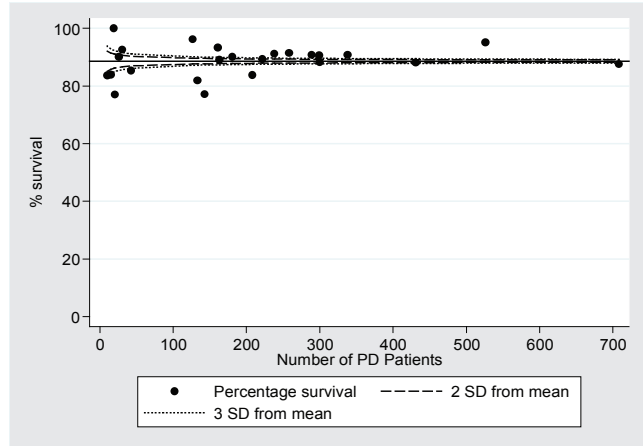
The 5 years mean patient survival (adjusted for age and diabetes mellitus) among peritoneal centres for the 2004-2008 cohort was 45% (Figure 3.3.2c). Similar to the 1 year survival, there was a wide variation in the 5-year survival among PD centres with only 15.8% and 21% of PD centres lied within 2SD and 3SD respectively (Figure 3.3.2d).

**Figure 3.3.2(a):** Variation in patient survival at 1-year among PD centres adjusted for age and diabetes mellitus, 2008-2012



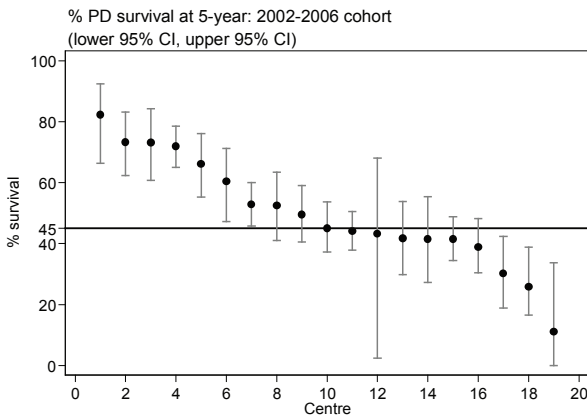
\*Horizontal line represents the median % survival among PD centres

**Figure 3.3.2(b):** Funnel plot at 1-year among PD centres adjusted for age and diabetes mellitus status, 2008-2012 cohort



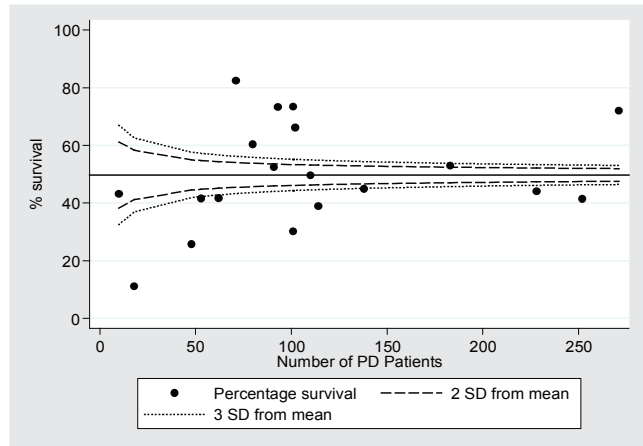
\*Horizontal line represents mean of % survival among PD centres

**Figure 3.3.2(c):** Variation in patient survival at 5-years among PD centres adjusted for age and diabetes mellitus, 2004-2008



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

**Figure 3.3.2(d):** Funnel plot for patient survival at 5-years among HD centres adjusted age and diabetes mellitus, 2004-2008 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

Table 3.4.1 shows the adjusted hazard ratio for mortality of dialysis patients (2004-2013). The 2004-2013 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 variables associated with a significant risk factor for mortality were serum albumin, serum cholesterol, haemoglobin, calcium, calcium phosphate product, phosphate and viral hepatitis status.

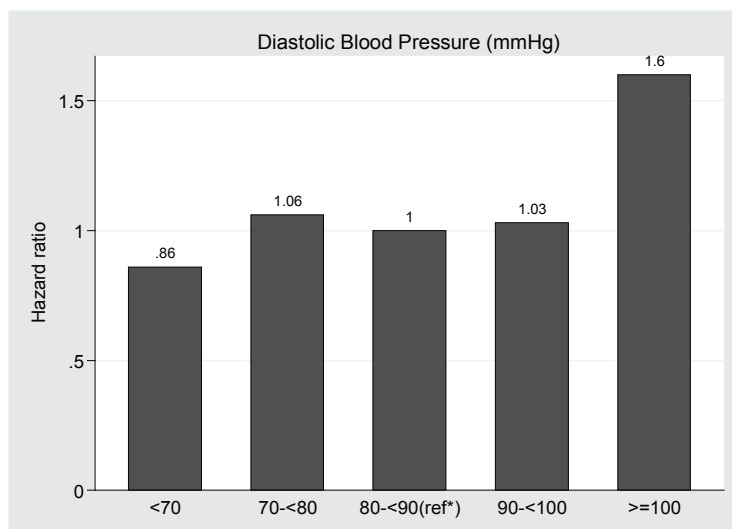
There were positive correlation between mortality and age of patient, serum cholesterol, diastolic blood pressure (Figure 3.4.1a), while BMI, serum albumin, serum phosphate (Figure 3.4.1b) and haemoglobin concentration (Figure 3.4.1c) were negatively correlated with mortality. Female patients have 18% 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 (2004-2013)

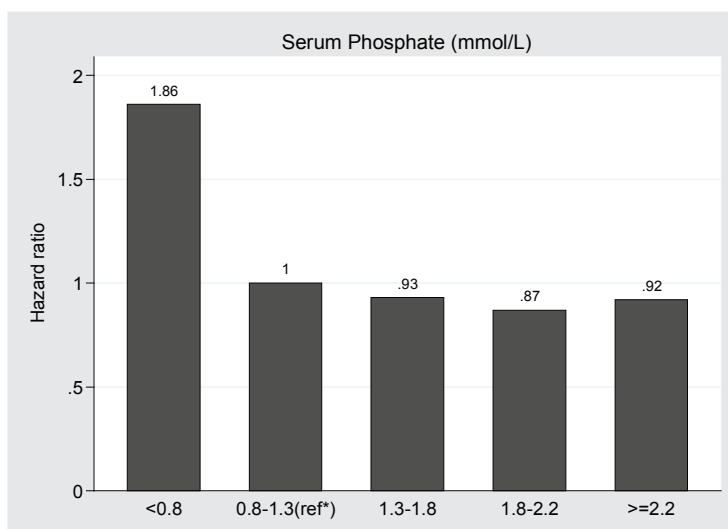
Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14 <sup>(ref*)</sup>	413	1.000		
Age 15-24	1420	0.993	(0.771;1.277)	0.954
Age 25-34	2920	1.048	(0.826;1.331)	0.699
Age 35-44	5026	1.597	(1.27;2.009)	<0.001
Age 45-54	11462	2.266	(1.808;2.84)	<0.001
Age 55-64	14158	2.996	(2.391;3.755)	<0.001
Age >=65	11926	4.155	(3.314;5.209)	<0.001
<b>Gender</b>				
Male <sup>(ref*)</sup>	26277	1.000		
Female	21048	0.822	(0.796;0.848)	<0.001
<b>Primary diagnosis</b>				
Unknown primary	11357	1.452	(1.316;1.602)	<0.001
Diabetes mellitus	27344	1.823	(1.654;2.009)	<0.001
GN/SLE <sup>(ref*)</sup>	2356	1.000		
Polycystic kidney	745	1.304	(1.12;1.518)	0.001
Obstructive nephropathy	145	0.967	(0.699;1.338)	0.84
<b>Others</b>	5378	1.146	(1.029;1.277)	0.013
<b>Year start dialysis</b>				
2003-2004 <sup>(ref*)</sup>	2890	1.000		
2005-2006	6817	1.032	(0.977;1.089)	0.261
2007-2008	8674	1.040	(0.985;1.099)	0.16
2009-2010	10172	1.004	(0.948;1.063)	0.884
2011-2012	12550	0.895	(0.84;0.953)	0.001
<b>Modality</b>				
HD <sup>(ref*)</sup>	42054	1.000		
PD	5271	0.916	(0.866;0.97)	0.002

Factors	n	Hazard ratio	95% CI	P-value
<b>BMI</b>				
BMI<18.5	2878	1.231	(1.15;1.318)	<0.001
BMI 18.5-25	26028	1.078	(1.041;1.115)	<0.001
>=25 (ref*)	18419	1.000		
<b>Serum albumin (g/L)</b>				
<30	3297	4.612	(4.304;4.941)	<0.001
30-<35	7245	2.456	(2.329;2.589)	<0.001
35-<40	23284	1.863	(1.788;1.941)	<0.001
>=40 (ref*)	13499	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	4764	0.857	(0.791;0.929)	<0.001
3.5-<5.2	33306	0.906	(0.847;0.968)	0.004
5.2-<6.2	6525	0.821	(0.761;0.886)	<0.001
>=6.2 (ref*)	2730	1.000		
<b>Diastolic BP (mmHg)</b>				
<70	8520	0.858	(0.818;0.901)	<0.001
70-<80	18678	1.065	(1.025;1.106)	0.001
80-<90 (ref*)	14571	1.000		
90-<100	4397	1.030	(0.966;1.099)	0.363
>=100	1159	1.599	(1.428;1.79)	<0.001
<b>Hemoglobin (g/dL)</b>				
<10	21722	1.770	(1.715;1.827)	<0.001
10-<12 (ref*)	22839	1.000		
>=12	2764	0.831	(0.773;0.892)	<0.001
<b>Serum calcium (mmol/L)</b>				
<2.1	10986	0.962	(0.925;1)	0.051
2.1-<=2.37 (ref*)	29831	1.000		
>2.37	6508	0.812	(0.773;0.853)	<0.001
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	18872	0.834	(0.799;0.871)	<0.001
3.5-<4.5 (ref*)	19081	1.000		
4.5-<5.5	6832	0.763	(0.714;0.815)	<0.001
>=5.5	2540	0.980	(0.874;1.099)	0.73
<b>Serum Phosphate (mmol/L)</b>				
<0.8	301	1.856	(1.597;2.156)	<0.001
0.8-<1.3 (ref*)	6298	1.000		
V1.3-<1.8V	22791	0.933	(0.89;0.979)	0.004
1.8-<2.2	12312	0.870	(0.813;0.932)	<0.001
>=2.2	5623	0.921	(0.828;1.024)	0.128
<b>HBsAg</b>				
Negative (ref*)	45833	1.000		
Positive	1492	1.096	(1.013;1.186)	0.023
<b>Anti-HCV</b>				
Negative (ref*)	46457	1.000		
Positive	868	1.117	(1.013;1.231)	0.027
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	41064	1.000		
CVD	6261	1.281	(1.233;1.332)	<0.001

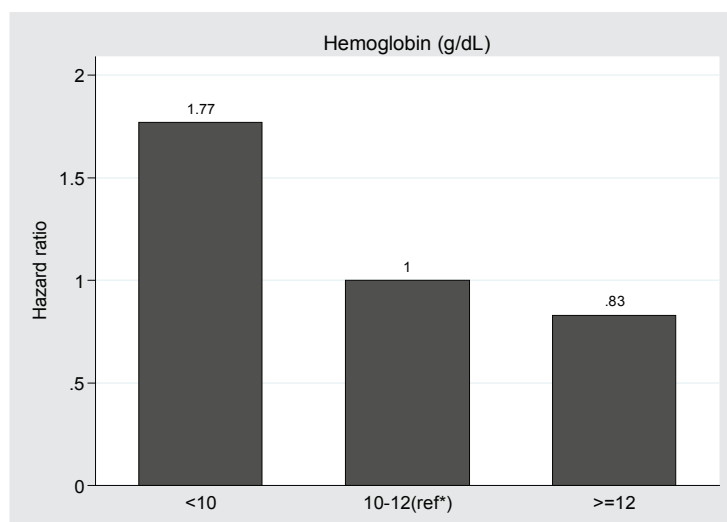
**Figure 3.4.1(a):** Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (2004-2013 cohort)



**Figure 3.4.1(b):** Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (2004-2013 cohort)



**Figure 3.4.1(c):** Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by hemoglobin (2004-2013 cohort)



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

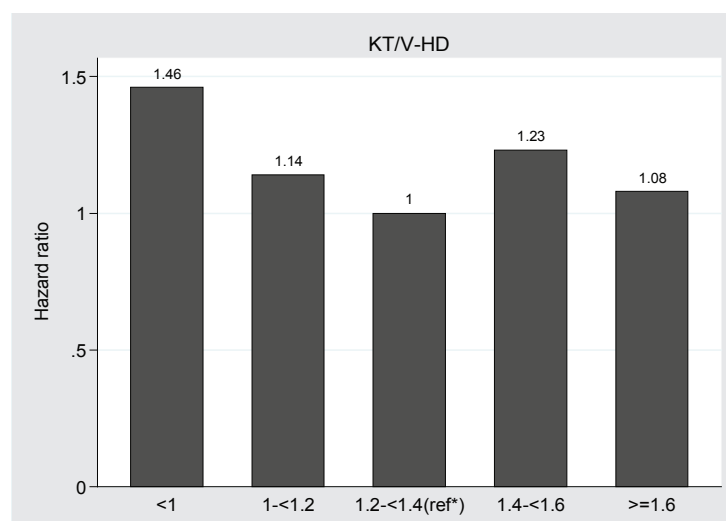
The adjusted hazard ratio for mortality for haemodialysis patients (Table 3.4.2) in this cohort demonstrated identical pattern with the whole cohort of 2004-2013 dialysis patients since more than 90% of this dialysis population consisted of haemodialysis patients. The dose of dialysis treatment (Kt/V) (Figure 3.4.2) and patient survival appeared to have a "U" curve correlation with Kt/V of 1.2 to 1.4 having the best outcome.

**Table 3.4.2:** Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2004-2013 cohort)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14 <sup>(ref*)</sup>	87	1.000		
Age 15-24	990	0.650	(0.411;1.026)	0.064
Age 25-34	2488	0.659	(0.424;1.026)	0.065
Age 35-44	4442	0.949	(0.614;1.467)	0.814
Age 45-54	10383	1.354	(0.878;2.088)	0.17
Age 55-64	12810	1.799	(1.167;2.774)	0.008
Age >=65	10854	2.497	(1.619;3.851)	<0.001
<b>Gender</b>				
Male <sup>(ref*)</sup>	23629	1.000		
Female	18425	0.825	(0.796;0.854)	<0.001
<b>Primary diagnosis</b>				
Unknown primary	10294	1.000		
Diabetes mellitus	24627	1.239	(1.188;1.292)	<0.001
GN/SLE <sup>(ref*)</sup>	1749	0.663	(0.593;0.742)	<0.001
Polycystic kidney	588	0.941	(0.818;1.083)	0.395
Obstructive nephropathy	120	0.807	(0.572;1.137)	0.22
<b>Others</b>	4676	0.785	(0.733;0.841)	<0.001
<b>Year start dialysis</b>				
2003-2004 <sup>(ref*)</sup>	2599	1.000		
2005-2006	6105	1.033	(0.976;1.094)	0.262
2007-2008	7589	1.035	(0.976;1.097)	0.248
2009-2010	9087	1.017	(0.957;1.081)	0.585
2011-2012	11183	0.884	(0.827;0.946)	<0.001
<b>BMI</b>				
BMI<18.5	2311	1.247	(1.154;1.348)	<0.001
BMI 18.5-25	23357	1.085	(1.042;1.129)	<0.001
>=25 <sup>(ref*)</sup>	16386	1.000		
<b>Serum albumin (g/L)</b>				
<30	1704	5.505	(5.092;5.952)	<0.001
30-<35	5310	2.431	(2.298;2.572)	<0.001
35-<40	21953	1.883	(1.805;1.963)	<0.001
>=40 <sup>(ref*)</sup>	13087	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	4533	0.822	(0.749;0.901)	<0.001
3.5-<5.2	30531	0.889	(0.82;0.963)	0.004
5.2-<6.2	5151	0.799	(0.729;0.876)	<0.001
>=6.2 <sup>(ref*)</sup>	1839	1.000		
<b>Kt/V</b>				
<1	1005	1.462	(1.308;1.633)	<0.001
1-<1.2	3265	1.141	(1.064;1.223)	<0.001
1.2-<1.4 <sup>(ref*)</sup>	6778	1.000		
1.4-<1.6	10895	1.229	(1.168;1.293)	<0.001
>=1.6	20111	1.075	(1.021;1.132)	0.006

Factors	n	Hazard ratio	95% CI	P-value
<b>Diastolic BP (mmHg)</b>				
<70	7825	0.824	(0.783;0.868)	<0.001
70-<80	16725	1.055	(1.013;1.099)	0.01
80-<90 (ref*)	12644	1.000		
90-<100	3792	1.025	(0.956;1.099)	0.489
>=100	1068	1.671	(1.486;1.88)	<0.001
<b>Hemoglobin (g/dL)</b>				
<10	19888	1.841	(1.779;1.905)	<0.001
10-<12 (ref*)	19935	1.000		
>=12	2231	0.791	(0.728;0.859)	<0.001
<b>Serum calcium (mmol/L)</b>				
<2.1	9448	0.950	(0.91;0.99)	0.016
2.1-<=2.37 (ref*)	26927	1.000		
>2.37	5679	0.766	(0.725;0.808)	<0.001
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	15683	0.807	(0.771;0.845)	<0.001
3.5-<4.5 (ref*)	17631	1.000		
4.5-<5.5	6368	0.754	(0.703;0.808)	<0.001
>=5.5	2372	0.979	(0.868;1.104)	0.725
<b>Serum Phosphate (mmol/L)</b>				
<0.8	229	1.787	(1.501;2.128)	<0.001
0.8-<1.3 (ref*)	4903	1.000		
1.3-<1.8	20190	0.947	(0.898;0.999)	0.046
1.8-<2.2	11497	0.863	(0.801;0.929)	<0.001
>=2.2	5235	0.893	(0.797;1.001)	0.051
<b>HBsAg</b>				
Negative (ref*)	40737	1.000		
Positive	1317	1.091	(1.002;1.188)	0.044
<b>Anti-HCV</b>				
Negative (ref*)	41276	1.000		
Positive	778	1.118	(1.008;1.239)	0.034
<b>Cardiovascular disease (CVD)</b>				
No CVD (ref*)	36837	1.000		
CVD	5217	1.267	(1.215;1.322)	<0.001

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (2004-2013 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, serum cholesterol calcium phosphate product and viral hepatitis status with mortality were not demonstrated in peritoneal dialysis patients. As opposed to haemodialysis, there was no correlation between Kt/V and mortality. These differences 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 (2004-2013 cohort)

Factors	n	Hazard ratio	95% CI	P-value
<b>Age (years)</b>				
Age 1-14 (ref*)	326	1.000		
Age 15-24	430	1.239	(0.83;1.85)	0.294
Age 25-34	432	1.470	(0.791;2.733)	0.223
Age 35-44	584	2.802	(1.53;5.133)	0.001
Age 45-54	1079	4.064	(2.23;7.406)	<0.001
Age 55-64	1348	5.235	(2.869;9.551)	<0.001
Age >=65	1072	7.056	(3.918;12.708)	<0.001
<b>Gender</b>				
Male (ref*)	2648	1.000		
Female	2623	0.911	(0.803;1.035)	0.152
<b>Primary diagnosis</b>				
Unknown primary	1063	1.000		
Diabetes mellitus	2717	1.382	(1.202;1.589)	<0.001
GN/SLE (ref*)	607	0.818	(0.658;1.017)	0.071
Polycystic kidney	157	0.868	(0.645;1.168)	0.35
Obstructive nephropathy	25	0.405	(0.19;0.864)	0.019
Others	702	0.787	(0.656;0.943)	0.009
<b>Year start dialysis</b>				
2003-2004 (ref*)	291	1.000		
2005-2006	712	1.031	(0.871;1.22)	0.722
2007-2008	1085	0.993	(0.841;1.171)	0.93
2009-2010	1085	0.905	(0.76;1.078)	0.264
2011-2012	1367	0.932	(0.769;1.128)	0.468
<b>BMI</b>				
BMI<18.5	567	1.527	(1.261;1.85)	<0.001
BMI 18.5-25	2671	1.111	(1.01;1.221)	0.03
>=25 (ref*)	2033	1.000		
<b>Serum albumin (g/L)</b>				
<30	1593	1.761	(1.403;2.21)	<0.001
30-<35	1935	1.218	(0.976;1.521)	0.081
35-<40	1331	0.850	(0.675;1.069)	0.165
>=40 (ref*)	412	1.000		
<b>Serum cholesterol (mmol/L)</b>				
<3.5	231	1.142	(0.915;1.426)	0.24
3.5-<5.2	2775	0.929	(0.817;1.056)	0.259
5.2-<6.2	1374	0.894	(0.777;1.028)	0.115
>=6.2 (ref*)	891	1.000		

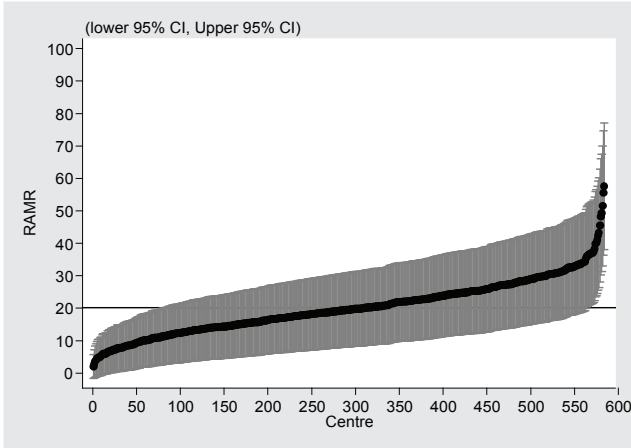


Factors	n	Hazard ratio	95% CI	P-value
<b>Kt/V</b>				
<1.7	3145	1.012	(0.859;1.191)	0.887
1.7-<2.0 <sup>(ref*)</sup>	1556	1.000		
>=2.0	570	1.335	(0.823;2.166)	0.242
<b>Diastolic BP (mmHg)</b>				
<70	695	1.209	(1.05;1.393)	0.008
70-<80	1953	1.065	(0.956;1.187)	0.254
80-<90 <sup>(ref*)</sup>	1927	1.000		
90-<100	605	1.093	(0.92;1.3)	0.313
>=100	91	1.002	(0.646;1.556)	0.992
<b>Hemoglobin (g/dL)</b>				
<10	1834	1.333	(1.207;1.473)	<0.001
10-<12 <sup>(ref*)</sup>	2904	1.000		
>=12	533	0.971	(0.837;1.127)	0.701
<b>Serum calcium (mmol/L)</b>				
<2.1	1538	1.077	(0.969;1.196)	0.169
2.1-<=2.37 <sup>(ref*)</sup>	2904	1.000		
>2.37	829	1.144	(1.007;1.3)	0.039
<b>Calcium Phosphate product (mmol<sup>2</sup>/L<sup>2</sup>)</b>				
<3.5	3189	1.099	(0.957;1.262)	0.181
3.5-<4.5 <sup>(ref*)</sup>	1450	1.000		
4.5-<5.5	464	0.953	(0.759;1.196)	0.679
>=5.5	168	1.059	(0.726;1.545)	0.766
<b>Serum Phosphate (mmol/L)</b>				
<0.8	72	2.032	(1.504;2.746)	<0.001
0.8-<1.3 <sup>(ref*)</sup>	1395	1.000		
1.3-<1.8	2601	0.892	(0.799;0.995)	0.041
1.8-<2.2	815	0.938	(0.759;1.159)	0.555
>=2.2	388	1.318	(0.947;1.833)	0.101
<b>HBsAg</b>				
Negative <sup>(ref*)</sup>	5096	1.000		
Positive	175	1.033	(0.835;1.279)	0.763
<b>Anti-HCV</b>				
Negative <sup>(ref*)</sup>	5181	1.000		
Positive	90	1.110	(0.813;1.514)	0.511
<b>Cardiovascular disease (CVD)</b>				
No CVD <sup>(ref*)</sup>	4227	1.000		
CVD	1044	1.299	(1.173;1.439)	<0.001

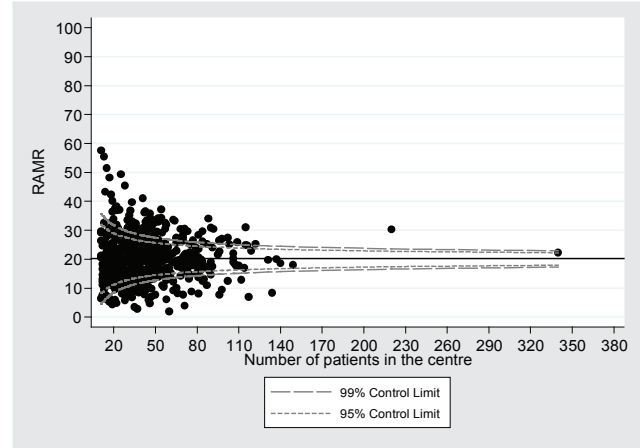
**3.4.4: Risk adjusted mortality rate for haemodialysis patients by haemodialysis centres**

There appeared to a marked centre variations in RAMR and the median risk adjusted mortality rate (RAMR) for haemodialysis patients by HD centres was 19.5 (Figure 3.4.4a). However, after taking into account the size of the haemodialysis centres, there was minimal variation of the RAMR rate among the various haemodialysis centres in this country where 71.2% of the HD centres lies within 3SD as demonstrated in the funnel plot (Figure 3.4.4b).

**Figure 3.4.4(a):** Variations in RAMR by HD centre, 2012



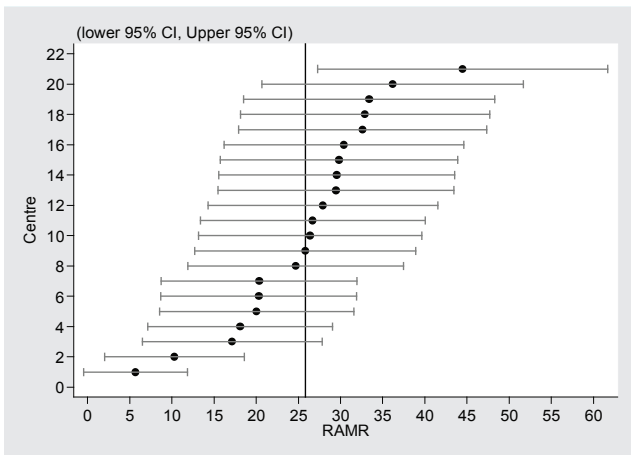
**Figure 3.4.4(b):** Funnel plot of RAMR by HD centre, 2012



**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 26.7 (Figure 3.4.5a). The variation of the RAMR rate among the various PD centres in this country persisted despite taking into account the size of the PD centres where 66.7% and 47.6% of PD centres lie outside the 2SD and 3SD of the mean RAMR respectively (Figure 3.4.5b)

**Figure 3.4.5(a):** Variations in RAMR by PD centres, 2012



**Figure 3.4.5(b):** Funnel plot for RAMR by PD centres, 2012

