CHAPTER 4

Death and Survival on Dialysis

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SECTION 4.1: DEATH ON DIALYSIS

The number of deaths in dialysis patients for 2008 was 1803 (annual death rate of 10.1%). One thousand five hundred and sixty four haemodialysis patients died in 2008 (annual rate of 9.6%) while 239 died while on continuous ambulatory peritoneal dialysis (annual death rate of 14.5%).

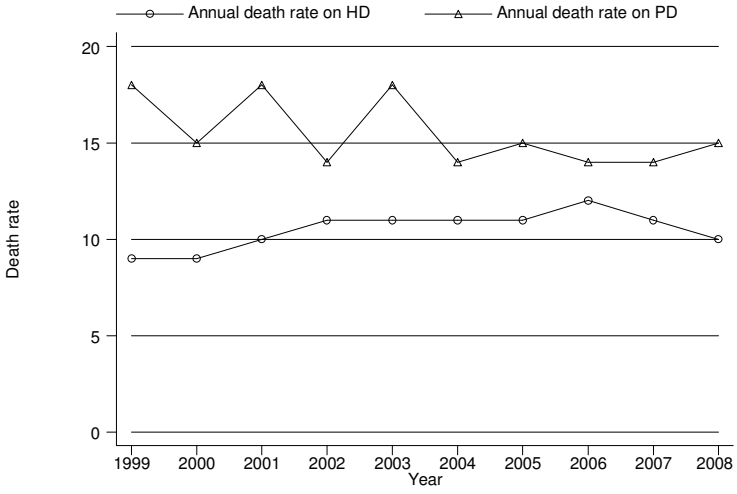
Table 4.1.1: Deaths on Dialysis 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. of dialysis patients at risk	5041	6118	7271	8483	9779	11161	12644	14244	16050	17936
Dialysis deaths	493	597	816	929	1161	1278	1430	1696	1780	1803
Dialysis death rate %	10	10	11	11	12	11	11	12	11	10
No. of HD patients at risk	4473	5490	6557	7640	8791	10074	11504	13010	14624	16290
HD deaths	393	505	686	814	983	1126	1259	1528	1574	1564
HD death rate %	9	9	10	11	11	11	11	12	11	10
No. of PD patients at risk	568	628	714	843	988	1088	1140	1234	1426	1646
PD deaths	100	92	130	115	178	152	171	168	206	239
PD death rate %	18	15	18	14	18	14	15	14	14	15

Figure 4.1.1 shows the annual death rate on dialysis from 1999 till 2008. Despite a higher percentage of diabetics and elderly patients (in 1999, 33% were aged more than 54 years compared with 43% in 2008) 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 PD showed a downward trend in recent years while the annual death rate for those on haemodialysis showed a slight upward trend over the last 10 years. The annual death rate for those on PD in 2008 was 14.5% while the annual death rate for haemodialysis patients in 2008 was 9.6%; a difference of 5% between the two modalities.

Figure 4.1.1: Death Rates on Dialysis 1999-2008



The causes of death on dialysis are shown in Table 4.1.2. Cardiovascular disease remained the main cause of death in 2008; accounting for 29%. This has remained unchanged over the last 10 years. Death at home accounted for another 22% and a majority of these deaths were probably secondary to cardiovascular events. Despite a reduction of the percentage of dialysis patients dying from infection, it remained the third most common cause of death in 2008.

Table 4.1.2: Causes of Death on Dialysis 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	129	26	180	30	210	26	307	33	325	28
Died at home	107	22	135	23	228	28	212	23	290	25
Sepsis	84	18	85	14	128	16	141	15	183	17
PD peritonitis	11	2	21	4	29	4	16	2	14	1
GIT bleed	18	4	18	3	18	2	24	3	28	2
Cancer	6	1	8	1	18	2	18	2	27	2
Liver disease	7	1	14	2	11	1	16	2	23	2
Withdrawal	10	2	17	3	20	2	18	2	26	2
Others	65	13	74	12	88	11	104	10	160	14
Unknown	56	11	45	8	66	8	73	8	85	7
TOTAL	493	100	597	100	816	100	929	100	1161	100

Year	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	333	26	360	25	477	28	459	26	531	29
Died at home	307	24	317	22	351	21	332	19	389	22
Sepsis	154	11	159	11	206	12	177	10	255	14
PD peritonitis	13	1	22	2	22	1	16	1	22	1
GIT bleed	24	2	28	2	26	2	26	1	39	2
Cancer	20	2	28	2	36	2	29	2	50	3
Liver disease	29	2	25	2	32	2	34	2	36	2
Withdrawal	9	1	11	1	23	1	26	1	19	1
Others	318	25	397	27	386	23	534	30	352	20
Unknown	71	6	83	6	137	8	147	8	110	6
TOTAL	1278	100	1430	100	1696	100	1780	100	1803	100

SECTION 4.2: PATIENT SURVIVAL ON DIALYSIS

4.2.1 Patient survival by type of dialysis modality

Patient survival by dialysis modalities (censored for change of modalities) is shown in Table 4.2.1(a) and Figure 4.2.1(a). The overall unadjusted 5 years and 10 years patient survival on dialysis (censored for change in modality) were 58% and 35% respectively. The unadjusted patient survival was better for those on haemodialysis compared to those on PD and this survival difference progressively widened with time. At 5 years the unadjusted patient survival on haemodialysis was 59% compared 47% in those on PD.

However, when patient survival by dialysis modalities was analysed as per ITT (disregarding change of dialysis modality) [Table 4.2.1(b) and Fig 4.2.1(b)], the difference in survival according to dialysis modalities became less evident. The overall unadjusted 5 years and 10 years patient survival on haemodialysis versus PD were 61% vs 56% and 41% and 43% respectively.

Table 4.2.1 (a): Patient survival by dialysis modality (censored for change of modality)

Dialysis Modality Interval (month)	PD			HD			All		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	4619	100	-	30221	100	-	34840	100	-
6	3920	94	0	26571	94	0	30491	94	0
12	3227	87	1	23078	89	0	26305	89	0
24	2114	75	1	17616	81	0	19730	80	0
36	1373	63	1	13476	72	0	14849	71	0
48	911	53	1	10287	65	0	11198	64	0
60	626	47	1	7794	59	0	8420	58	0
72	402	40	1	5936	53	0	6337	52	0
84	246	34	1	4458	48	0	4704	47	0
96	146	28	1	3360	44	0	3503	42	0
108	85	24	2	2526	40	0	2610	38	0
120	51	19	2	1855	36	0	1906	35	0

Figure 4.2.1 (a): Patient survival by dialysis modality analysis (censored for change of modality)

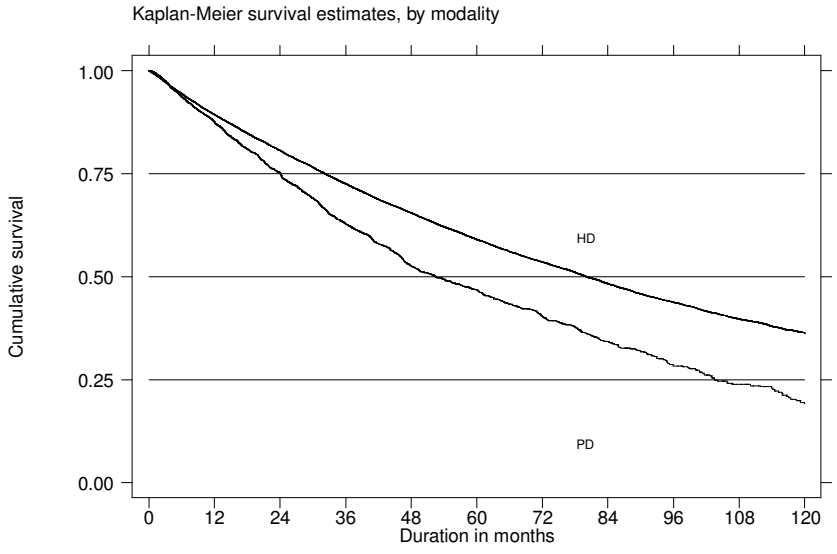
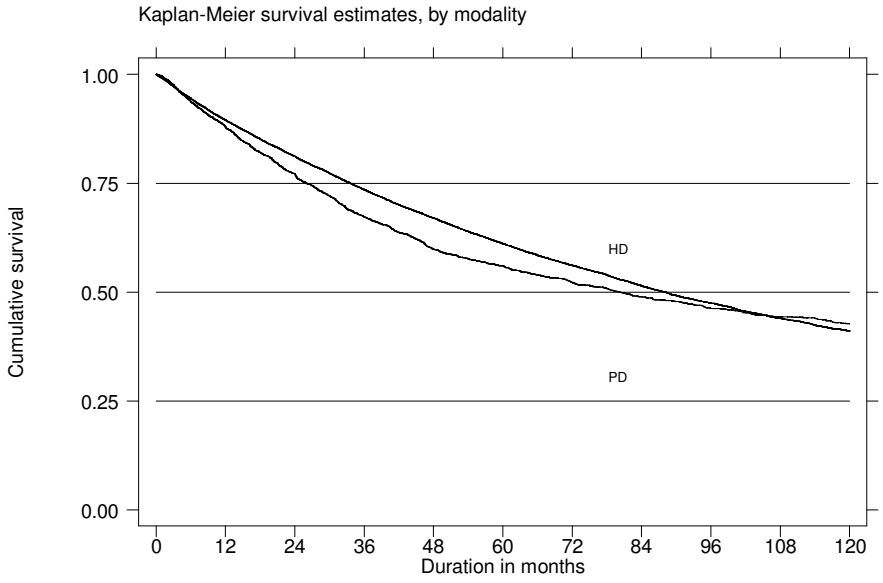


Table 4.2.1 (b): Patient survival by dialysis modality (not censored for change of modality)

Dialysis modality Interval (month)	PD			HD			All		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	4619	100	-	30221	100	-	34840	100	-
6	4061	94	0	27022	94	0	31080	94	0
12	3513	88	1	23891	89	0	27404	89	0
24	2592	77	1	18727	81	0	21319	81	0
36	1948	67	1	14638	74	0	16586	73	0
48	1493	60	1	11429	67	0	12922	66	0
60	1188	56	1	8876	61	0	10063	60	0
72	927	52	1	6938	56	0	7863	56	0
84	704	49	1	5356	51	0	6060	51	0
96	528	46	1	4165	47	0	4691	47	0
108	404	44	1	3237	44	0	3640	44	0
120	316	43	1	2487	41	0	2803	41	0

Figure 4.2.1 (b): Patient survival by dialysis modality analysis (not censored for change of modality)



4.2.2 Patient survival by year of starting dialysis

Table 4.2.2 and Fig 4.2.2 show the unadjusted patient survival by year of entry. The unadjusted 6 months survival of those starting dialysis in 2008 was 95%. 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 88-90% and 55-57% respectively.

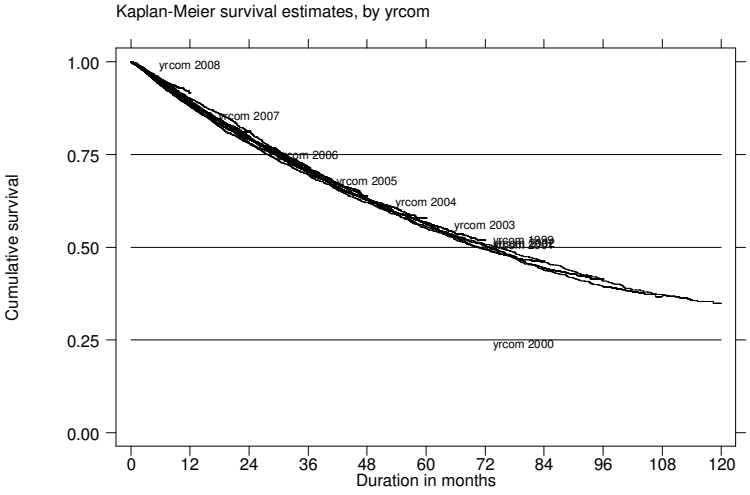
Table 4.2.2: Unadjusted patient survival by year of entry, 1999-2008

Year Interval (month)	1999			2000			2001			2002		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	1623	100	-	1945	100	-	2237	100	-	2521	100	-
6	1513	95	1	1808	95	1	2071	94	1	2356	95	0
12	1413	90	1	1668	90	1	1888	89	1	2178	90	1
24	1216	81	1	1416	80	1	1602	78	1	1846	80	1
36	1040	72	1	1226	71	1	1386	70	1	1600	70	1
48	896	63	1	1059	63	1	1203	62	1	1397	63	1
60	789	56	1	918	56	1	1037	55	1	1218	56	1
72	703	51	1	798	50	1	917	49	1	1073	50	1
84	622	46	1	691	44	1	809	44	1	-	-	-
96	544	41	1	607	39	1	-	-	-	-	-	-
108	491	37	1	-	-	-	-	-	-	-	-	-

Year Interval (month)	2003			2004			2005			2006		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	2754	100	-	3074	100	-	3295	100	-	3816	100	-
6	2535	94	0	2860	95	0	3017	94	0	3497	94	0
12	2338	89	1	2632	89	1	2772	88	1	3226	88	1
24	2021	79	1	2283	80	1	2385	78	1	2806	79	1
36	1743	70	1	1965	70	1	2113	71	1	-	-	-
48	1528	63	1	1726	63	1	-	-	-	-	-	-
60	1351	57	1	-	-	-	-	-	-	-	-	-

Year Interval (month)	2007			2008		
	No.	% survival	SE	No.	% survival	SE
0	4083	100	-	4055	100	-
6	3784	94	0	2224	95	0
12	3507	89	1	157	-	-

Figure 4.2.2: Unadjusted patient survival by year of entry, 1999-2008



4.2.3 Patient survival by Age at starting dialysis

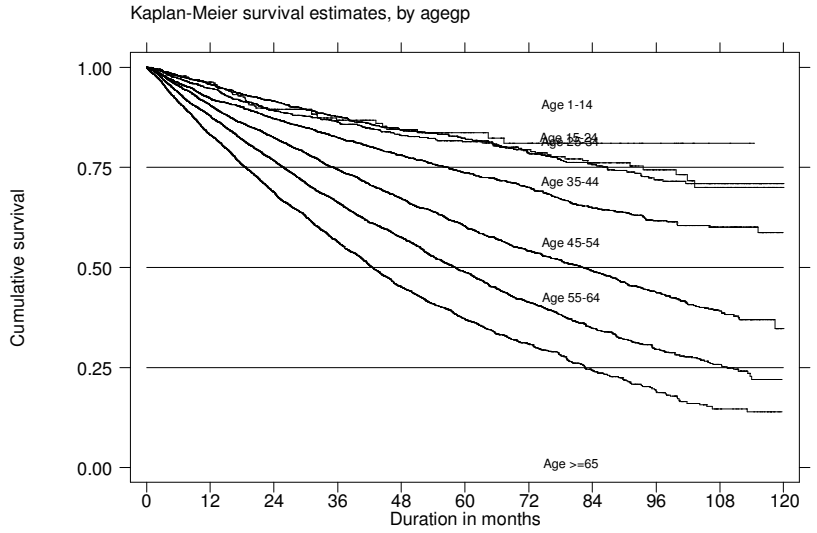
The unadjusted survival for age groups <15 years, 15-24 years and 25-34 years at the start of dialysis were similar, with a 5-year survival of 81-84%. Beyond the age of 34 years old, the unadjusted survival progressively worsens with increasing age. The 9-year unadjusted survival for those who started dialysis at the age of less than 15 years was 81 % compared with 15% in those more than 64 years of age at the time of initiation of dialysis.

Table 4.2.3: Unadjusted patient survival by age, 1999-2008

Age group (years) Interval (month)	1-14			15-24			25-34			35-44		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	381	100	-	1237	100	-	2147	100	-	3723	100	-
6	345	98	1	1110	97	0	1914	98	0	3309	96	0
12	299	96	1	967	95	1	1661	96	0	2843	92	0
24	214	89	2	702	89	1	1254	92	1	2209	87	1
36	148	87	2	530	86	1	973	88	1	1706	82	1
48	109	85	2	402	83	1	758	84	1	1309	78	1
60	75	84	3	290	81	1	586	82	1	964	74	1
72	53	81	3	203	79	2	411	79	1	710	70	1
84	26	81	3	132	76	2	270	76	1	466	65	1
96	14	81	3	74	74	2	179	72	2	271	62	1
108	4	81	3	36	70	3	90	71	2	111	60	2

Age group (years) Interval (month)	45-54			55-64			>=65		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	7318	100	-	8134	100	-	6463	100	-
6	6498	95	0	7077	94	0	5405	91	0
12	5576	90	0	6012	88	0	4419	83	0
24	4120	82	0	4203	77	1	2918	69	1
36	2972	74	1	2914	66	1	1870	56	1
48	2126	67	1	1977	57	1	1135	45	1
60	1474	60	1	1255	49	1	675	37	1
72	982	54	1	750	41	1	389	31	1
84	619	49	1	421	35	1	194	24	1
96	332	44	1	211	29	1	75	19	1
108	143	39	1	89	26	1	27	15	1

Figure 4.2.3: Unadjusted patient survival by age, 1999-2008



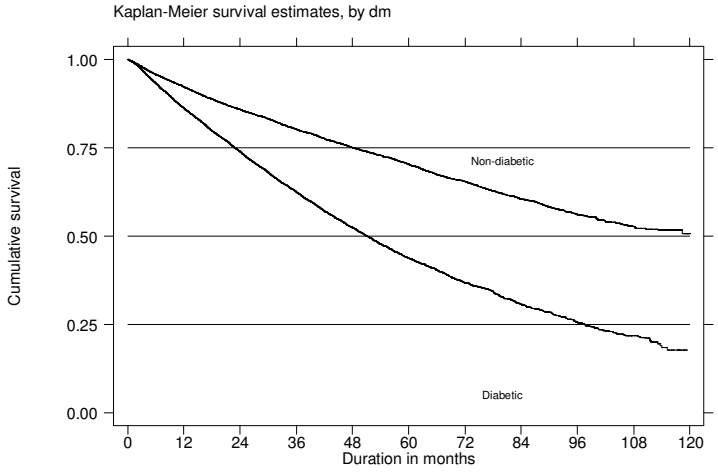
4.2.4 Patient survival by Diabetic status

The unadjusted patient survival among diabetic and non-diabetic patients are shown in Table 4.2.4 and Figure 4.2.4. The presence of diabetes mellitus has major impact on patient survival. The difference in the unadjusted patient survival appeared as early as 6 months after initiation of dialysis and increased with the time on dialysis. The 9 years unadjusted patient survival among diabetics and non-diabetics were 53% and 22% respectively, a two and a half fold difference.

Table 4.2.4: Unadjusted patient survival by Diabetes status, 1999-2008

Diabetes status	Non-diabetic			Diabetic		
Interval (month)	No.	% survival	SE	No.	% survival	SE
0	13798	100	-	15605	100	-
6	12176	96	0	13481	93	0
12	10573	92	0	11203	86	0
24	7956	86	0	7664	74	0
36	6078	80	0	5034	62	0
48	4594	75	0	3211	52	1
60	3358	70	1	1959	44	1
72	2349	65	1	1146	37	1
84	1511	60	1	612	31	1
96	863	56	1	288	25	1
108	397	53	1	96	22	1

Figure 4.2.4: Unadjusted patient survival by Diabetes status, 1999-2008



SECTION 4.3 SURVIVAL OF INCIDENT DIALYSIS PATIENTS BY CENTRE

4.3.1. Survival of incident haemodialysis patients by centre

The median patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 1999-2007 cohort was 96.8% [Figure 4.3.1(a)]. There was wide centre variation and when the 1 year patient survival of the individual heamodialysis centres were illustrated in the funnel plots [Figure 4.3.1 (b)], a third (167/499) of the haemodialysis centres lies outside the 3SD of the median 1 year patient survival.

Figure 4.3.1 (a): Variation in % survival at 1-years adjusted to age and diabetes, 1999-2007

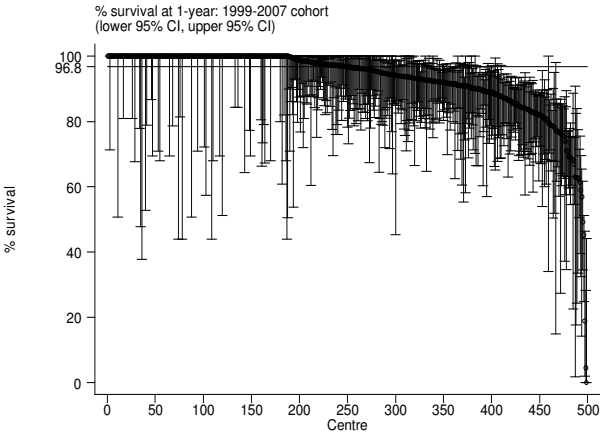
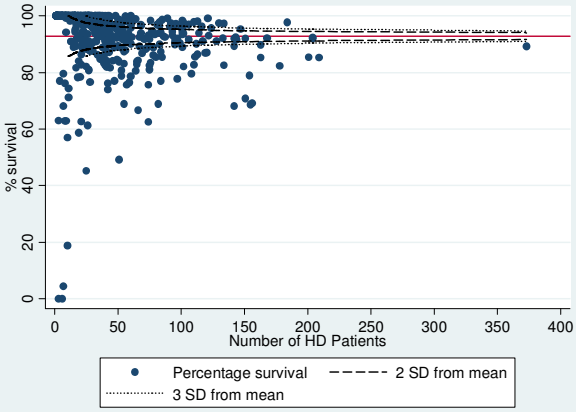
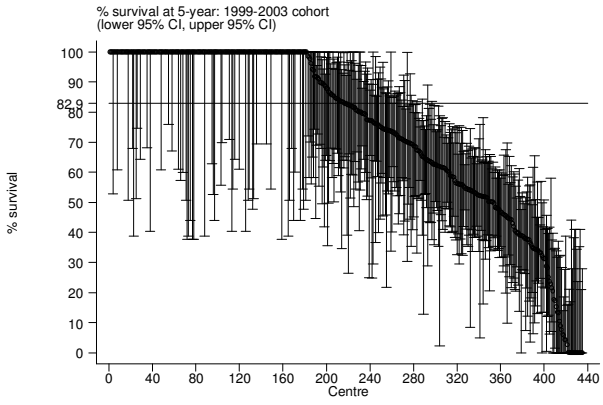


Figure 4.3.1(b): Funnel plot for adjusted age at 60 and diabetes at 1 year, 1999-2007 cohort (HD centres)



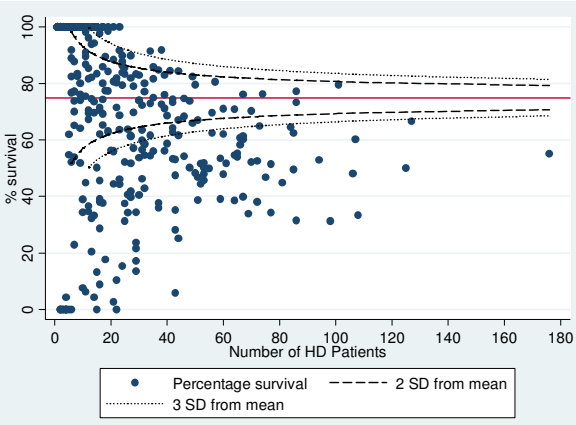
The 5 years median patient survival (adjusted for age and diabetes) among haemodialysis centres for the 1999-2003 cohort was 82.9% [Figure 4.3.1(c)].)]. There was more than 10 fold difference in the centre variation and when the 5 years patient survival of the individual heamodialysis centres were illustrated in the funnel plots [Figure 4.3.1(d)], 33.8% (147/435) of the haemodialysis centres lies outside the 3SD.

Figure 4.3.1(c): Variation in % Survival at 5-years adjusted to age and diabetes, 1999-2003



*Horizontal line represents the median % survival among HD centres

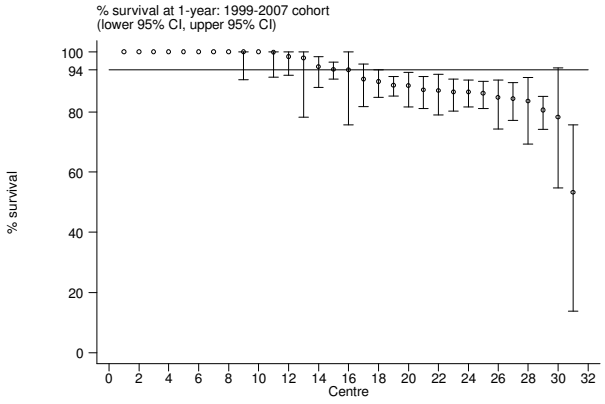
Figure 4.3.1(d): Funnel plot for adjusted age at 60 and diabetes at 5 year, 1999-2003 cohort (HD centres)



4.3.2. Survival of incident PD patients by centre

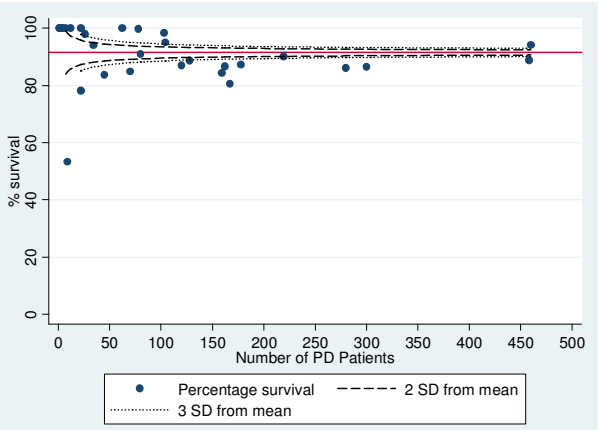
The median patient survival at 1 year (adjusted for age and diabetes) among peritoneal dialysis for the 1999-2007 cohort was 94% [Figure 4.3.2(a)]. There was centre variation and when the patient survival at 1 year in the individual peritoneal dialysis centres were illustrated in the funnel plots [Figure 4.3.1(b)], 12 out of 31 (38.7%) peritoneal dialysis centres lies below the 3SD of the 1 year median survival.

Figure 4.3.2 (a): Variation in % Survival at 1-years adjusted to age and diabetes, 1999-2007



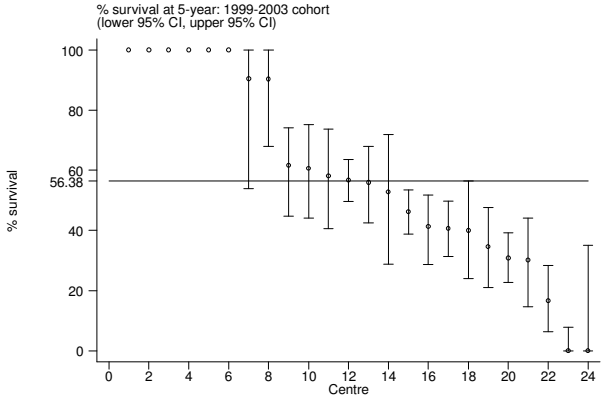
*Horizontal line represents the median % survival among PD centres

Figure 4.3.2 (b): Funnel plot for adjusted age at 60 and diabetes at 1 year, 1999-2007 cohort (PD centres)



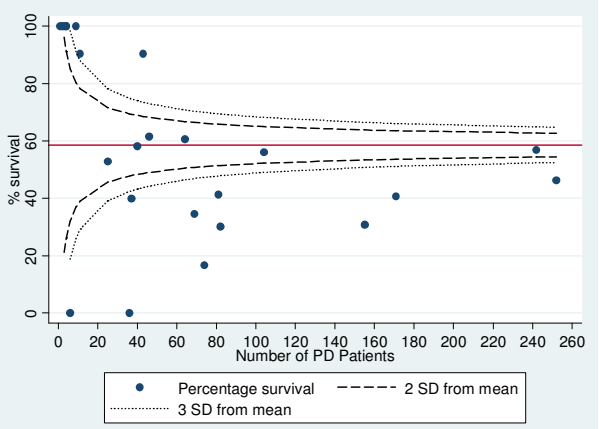
The 5-year median patient survival (adjusted for age and diabetes) among PD centres for the 1999-2003 cohort was 56.38% [Figure 4.3.2(c)].)]. There was more than 10 fold difference in the centre variation and when the 5 year patient survival in the individual PD centres were illustrated in the funnel plots [Figure 4.3.2(d)], 10 out of 24 (41.7%) peritoneal dialysis centres lie below the 3SD of the 5 year median survival.

Figure 4.3.2 (c): Variation in % Survival at 5-years adjusted to age and diabetes, PD centres, 1999-2003



*Horizontal line represents the median % survival among PD centres

Figure 4.3.2 (d): Funnel plot for adjusted age at 60 and diabetes at 5 year, 1999-2003 cohort (PD centres)



SECTION 4.4 ADJUSTED MORTALITY OF DIALYSIS PATIENT

4.4.1. Adjusted hazard ratio for mortality of dialysis patients

Table 4.4.1(a) shows the adjusted hazard ratio for mortality of dialysis patients (1998-2008). The 1998-2008 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 characteristics that had significant impact on mortality were age, gender, diabetic nephropathy as primary renal disease, year commencing dialysis, 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, phosphate, and hepatitis B status.

There were positive correlation between age of patient, diabetes mellitus as primary renal disease, diastolic blood pressure [Figure 4.4.1(a)], serum calcium, serum phosphate [Figure 4.4.1(b)] and hepatitis B antigenaemia with mortality while negative correlation was noted between serum albumin, haemoglobin concentration [Figure 4.4.1(c)], and calcium phosphate product with mortality. Patients commencing dialysis in 2007-2008 has 12% lower adjusted hazard ratio for mortality when compared to those started dialysis from 2000-2006

The adjusted hazard ratio for mortality for hemodialysis patients [Table 4.4.1(b)] in this cohort demonstrated identical pattern with the whole cohort of 2000-2008 dialysis patients. The amount of dialysis treatment (Kt/V) [Figure 4.4.1(d)] has a negative correlation with mortality with hemodialysis patients with Kt/V of > 1.6 having the lowest adjusted hazard ratio for mortality.
The adjusted hazard ratio for peritoneal dialysis patients [Table 4.4.1(c)] showed similar picture with the whole cohort of 2000-2008 dialysis patients However correlation between mortality and year commencing peritoneal dialysis, serum cholesterol, and hepatitis B status were not demonstrated in peritoneal dialysis patients. This difference could be partly contributed by the smaller number of peritoneal dialysis patients in this cohort. Peritoneal dialysis patients with Kt/V of 1.7 or less had 20% higher mortality rate compared with those with higher Kt/V but this did not reach statistical significant [Table 4.4.1 (c) & Figure 4.4.1 (e)].

Table 4.4.1: Adjusted hazard ratio for mortality of all dialysis patients (1999-2008)

Factors	N	Hazard ratio	95% CI		P value
Age (years):					
• Age 1-14 (ref*)	381	1.00			
• Age 15-24	1,237	1.57	(1.12;	2.20)	0.009
• Age 25-34	2,147	1.58	(1.14;	2.20)	0.006
• Age 35-44	3,723	2.23	(1.62;	3.07)	0.000
• Age 45-54	7,318	3.03	(2.21;	4.16)	0.000
• Age 55-64	8,134	3.89	(2.83;	5.33)	0.000
• Age >=65	6,463	5.56	(4.05;	7.63)	0.000
Gender:					
• Male (ref*)	16,331	1.00			
• Female	13,072	0.82	(0.78;	0.85)	0.000
Primary diagnosis:					
• Unknown primary (ref*)	7,988	1.00			
• Diabetes mellitus	15,265	1.57	(1.48;	1.66)	0.000
• GN/SLE	2,056	0.93	(0.83;	1.05)	0.238
• Polycystic kidney	374	1.07	(0.86;	1.32)	0.564
• Obstructive nephropathy	882	1.07	(0.94;	1.22)	0.310
• Others	2,838	1.01	(0.92;	1.10)	0.857

Factors	N	Hazard ratio	95% CI		P value
Year start dialysis:					
• 1999-2000 (ref*)	3,568	1.00			
• 2001-2002	4,758	1.02	(0.96;	1.08)	0.598
• 2003-2004	5,828	1.01	(0.95;	1.07)	0.799
• 2005-2006	7,111	1.05	(0.98;	1.13)	0.139
• 2007-2008	8,138	0.88	(0.80;	0.96)	0.004
Modality:					
• HD (ref*)	25,469	1.00			
• PD	3,934	1.28	(1.19;	1.38)	0.000
BMI:					
• BMI<18.5	2,651	1.32	(1.21;	1.44)	0.000
• BMI 18.5-25	19,381	1.22	(1.16;	1.28)	0.000
• >=25 (ref*)	7,371	1.00			
Serum albumin (g/L):					
• <30	1,858	4.28	(3.90;	4.70)	0.000
• 30-<35	3,953	2.44	(2.27;	2.63)	0.000
• 35-<40	13,861	1.86	(1.76;	1.97)	0.000
• >=40 (ref*)	9,731	1.00			
Serum cholesterol (mmol/L):					
• <3.2	1,168	1.17	(1.05;	1.30)	0.006
• 3.2-<5.2	21,388	1.17	(1.11;	1.23)	0.000
• >=5.2 (ref*)	6,847	1.00			
Diastolic BP (mmHg):					
• <70	3,851	0.87	(0.82;	0.94)	0.000
• 70-<80	11,392	1.04	(0.99;	1.10)	0.091
• 80-<90 (ref*)	10,569	1.00			
• 90-<100	2,930	1.05	(0.97;	1.15)	0.222
• >=100	661	1.95	(1.69;	2.26)	0.000
Hemoglobin:					
• <8	2,550	3.59	(3.26;	3.95)	0.000
• 8-<9	4,209	2.42	(2.21;	2.65)	0.000
• 9-<10	10,356	2.37	(2.18;	2.57)	0.000
• 10-<11	7,156	1.43	(1.31;	1.56)	0.000
• 11-<12 (ref*)	3,437	1.00			
• >=12	1,695	1.04	(0.92;	1.18)	0.526
Serum calcium (mmol/L):					
• <2.2	10,553	0.88	(0.84;	0.92)	0.000
• 2.2-<2.6 (ref*)	18,212	1.00			
• >=2.6	638	1.81	(1.60;	2.05)	0.000
Calcium Phosphate product (mmol2/L2):					
<3.5	10,254	0.98	(0.91;	1.06)	0.586
• 3.5-<4.5 (ref*)	13,041	1.00			
• 4.5-<5.5	4,307	0.66	(0.60;	0.72)	0.000
• >=5.5	1,801	0.63	(0.53;	0.75)	0.000
Serum Phosphate (mmol/L):					
• <1.6	10,820	0.84	(0.78;	0.90)	0.000
• 1.6-<2.0 (ref*)	12,354	1.00			
• 2.0-<2.2	2,700	0.92	(0.83;	1.01)	0.088
• 2.2-<2.4	1,602	1.14	(1.00;	1.30)	0.052
• 2.4-<2.6	943	1.27	(1.07;	1.51)	0.007
• >=2.6	984	1.69	(1.39;	2.07)	0.000
HBsAg:					
• Negative (ref*)	28,253	1.00			
• Positive	1,150	1.15	(1.04;	1.27)	0.007
Anti-HCV:					
• Negative (ref*)	28,333	1.00			
• Positive	1,070	0.94	(0.85;	1.04)	0.229
• Cardiovascular disease (CVD)					
• No CVD (ref*)	24,016	1.00			
• CVD	5,387	1.33	(1.27;	1.40)	0.000

Figure 4.4.1 (a): Adjusted hazard ratio for mortality of dialysis patients by diastolic blood pressure (1999-2008 cohort)

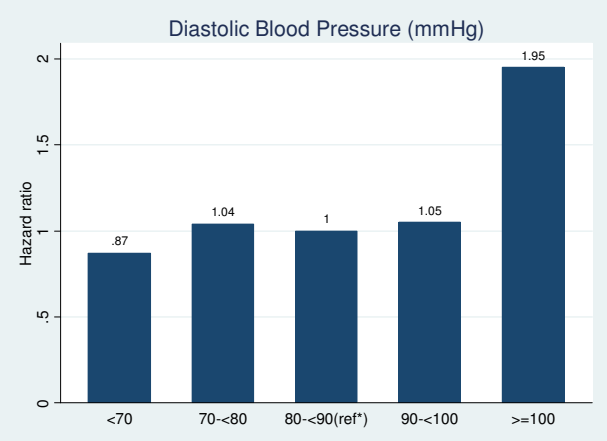


Figure 4.4.1 (b): Adjusted hazard ratio for mortality of dialysis patients by serum phosphate (1999-2008 cohort)

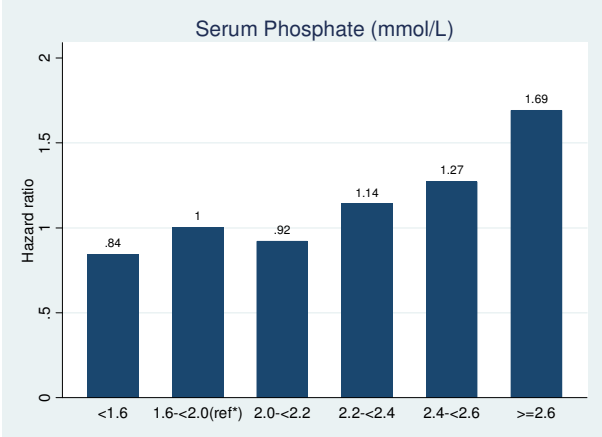


Figure 4.4.1 (c): Adjusted hazard ratio for mortality of dialysis patients by hemoglobin (1999-2008 cohort)

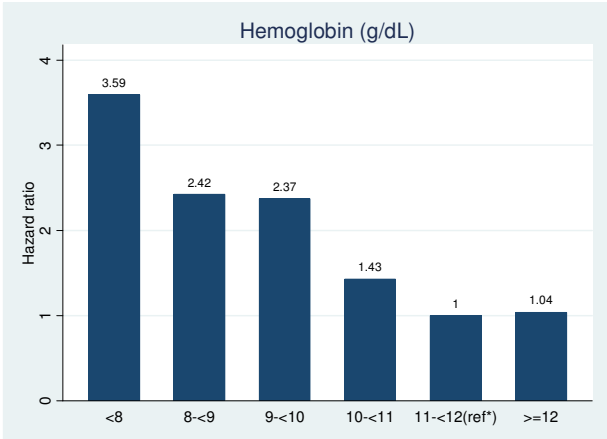


Table 4.4.1 (b): Adjusted hazard ratio for mortality of HD patients (1999-2008 cohort)

Factors	N	Hazard Ratio	95% CI		P value
• Age (years):					
• Age 1-14 (ref*)	106	1			
• Age 15-24	884	0.99	0.53	1.84	0.972
• Age 25-34	1,818	0.87	0.47	1.60	0.657
• Age 35-44	3,227	1.20	0.66	2.20	0.546
• Age 45-54	6,438	1.60	0.88	2.92	0.122
• Age 55-64	7,199	2.03	1.11	3.69	0.021
• Age >=65	5,797	2.94	1.61	5.36	0.000
Gender:					
• Male (ref*)	14,346	1.00			
• Female	11,123	0.85	0.81	0.89	0.000
Primary diagnosis:					
• Unknown primary (ref*)	7,093	1.00			
• Diabetes mellitus	13,432	1.50	1.41	1.59	0.000
• GN/SLE	1,541	0.93	0.82	1.06	0.290
• Polycystic kidney	323	1.00	0.79	1.27	0.978
• Obstructive nephropathy	708	1.08	0.94	1.25	0.274
• Others	2,372	1.04	0.95	1.15	0.384
Year start dialysis:					
• 1999-2000 (ref*)	3,131	1.00			
• 2001-2002	4,048	1.03	0.97	1.10	0.327
• 2003-2004	5,070	1.03	0.97	1.11	0.343
• 2005-2006	6,286	1.06	0.99	1.15	0.096
• 2007-2008	6,934	0.85	0.77	0.94	0.001
BMI:					
• BMI<18.5	2,076	1.50	1.34	1.67	0.000
• BMI 18.5-25	17,307	1.31	1.23	1.40	0.000
• >=25 (ref*)	6,086	1.00			
Serum albumin (g/L):					
• <30	846	4.88	4.38	5.44	0.000
• 30-<35	2,457	2.42	2.24	2.63	0.000
• 35-<40	12,808	1.88	1.77	1.99	0.000
• >=40 (ref*)	9,358	1.00			
Serum cholesterol (mmol/L):					
• <3.2	1,090	1.20	1.06	1.35	0.003
• 3.2-<5.2	19,460	1.23	1.16	1.31	0.000
• >=5.2 (ref*)	4,919	1.00			
Kt/V					
• <1	704	1.52	1.32	1.74	0.000
• 1-<1.2	2,311	1.10	1.00	1.20	0.039
• 1.2-<1.4 (ref*)	5,467	1.00			
• 1.4-<1.6	7,156	1.04	0.98	1.11	0.202
• >=1.6	9,831	0.85	0.79	0.91	0.000
Diastolic BP (mmHg):					
• <70	3,368	0.83	0.77	0.89	0.000
• 70-<80	10,098	1.04	0.98	1.09	0.204
• 80-<90 (ref*)	8,959	1.00			
• 90-<100	2,461	1.04	0.95	1.14	0.412
• >=100	583	1.84	1.57	2.15	0.000

Factors	N	Hazard Ratio	95% CI		P value
Hemoglobin:					
• <8	2,329	3.96	3.55	4.42	0.000
• 8-<9	3,751	2.64	2.38	2.93	0.000
• 9-<10	9,419	2.61	2.37	2.87	0.000
• 10-<11	5,908	1.49	1.34	1.64	0.000
• 11-<12 (ref*)	2,747	1.00			
• >=12	1,315	1.01	0.87	1.18	0.887
Serum calcium (mmol/L):					
• <2.2	9,242	0.90	0.85	0.95	0.000
• 2.2-<2.6 (ref*)	15,729	1.00			
• >=2.6	498	1.73	1.51	1.99	0.000
Calcium Phosphate product (mmol2/L2):					
• <3.5	8,097	0.91	0.84	0.99	0.030
• 3.5-<4.5 (ref*)	11,869	1.00			
• 4.5-<5.5	3,851	0.66	0.60	0.73	0.000
• >=5.5	1,652	0.63	0.52	0.76	0.000
Serum Phosphate (mmol/L):					
• <1.6	8,494	0.85	0.78	0.92	0.000
• 1.6-<2.0 (ref*)	11,297	1.00			
• 2.0-<2.2	2,447	0.86	0.77	0.95	0.003
• 2.2-<2.4	1,460	1.09	0.95	1.25	0.239
• 2.4-<2.6	862	1.18	0.98	1.42	0.076
• >=2.6	909	1.62	1.31	1.99	0.000
HBsAg:					
• Negative (ref*)	24,473	1.00			
• Positive	996	1.13	1.02	1.26	0.023
Anti-HCV:					
• Negative (ref*)	24,531	1.00			
• Positive	938	0.92	0.83	1.02	0.106
• Cardiovascular disease (CVD)					
• No CVD (ref*)	21,007	1.00			
• CVD	4,462	1.29	1.22	1.35	0.000

Figure 4.4.1 (d): Adjusted hazard ratio for mortality of HD patients by Kt/V (1999-2008 cohort)

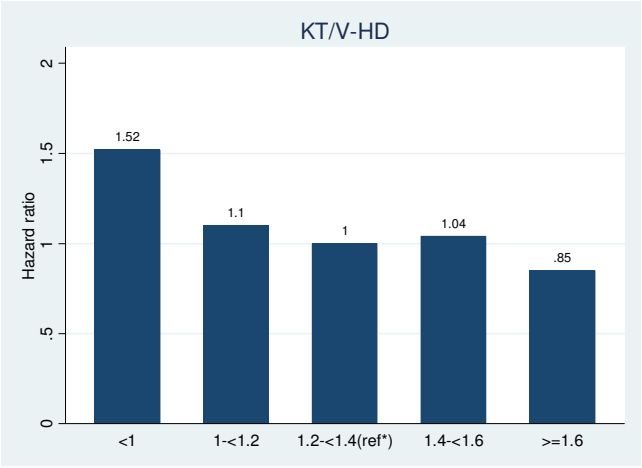
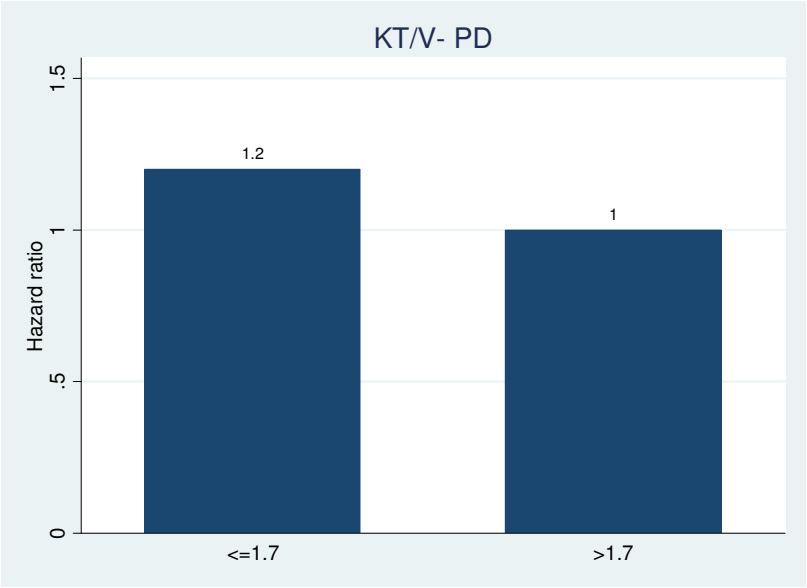


Figure 4.4.1 (c): Adjusted hazard ratio for mortality of PD patients (1999-2008 cohort)

Factors	N	Hazard ratio	95% CI		P value
Age (years):					
• Age 1-14 (ref*)	275	1			
• Age 15-24	353	1.55	0.98	2.44	0.058
• Age 25-34	329	1.70	1.04	2.76	0.033
• Age 35-44	496	2.52	1.57	4.03	0.000
• Age 45-54	880	4.14	2.65	6.49	0.000
• Age 55-64	935	5.00	3.22	7.77	0.000
• Age >=65	666	7.99	5.08	12.56	0.000
Gender:					
• Male (ref*)	1,985	1.00			
• Female	1,949	0.84	0.74	0.96	0.010
Primary diagnosis:					
• Unknown primary (ref*)	895	1.00			
• Diabetes mellitus	1,833	1.98	1.64	2.39	0.000
• GN/SLE	515	0.96	0.73	1.26	0.763
• Polycystic kidney	51	1.41	0.85	2.34	0.186
• Obstructive nephropathy	174	1.08	0.76	1.52	0.670
• Others	466	0.92	0.73	1.17	0.512
Year start dialysis:					
• 1999-2000 (ref*)	437	1.00			
• 2001-2002	710	1.07	0.90	1.28	0.456
• 2003-2004	758	1.03	0.86	1.24	0.750
• 2005-2006	825	1.02	0.83	1.24	0.876
• 2007-2008	1,204	0.96	0.76	1.22	0.761
BMI:					
• BMI<18.5	575	1.67	1.34	2.08	0.000
• BMI 18.5-25	2,074	1.26	1.11	1.43	0.000
• >=25 (ref*)	1,285	1.00			
Serum albumin (g/L):					
• <30	1,012	1.93	1.44	2.59	0.000
• 30-<35	1,496	1.31	0.98	1.75	0.063
• 35-<40	1,053	0.93	0.69	1.26	0.648
• >=40 (ref*)	373	1.00			
Serum cholesterol (mmol/L):					
• <3.2	78	1.43	0.99	2.07	0.057
• 3.2-<5.2	1,928	0.90	0.80	1.02	0.093
• >=5.2 (ref*)	1,928	1.00			
• Kt/V					
• <=1.7	1,113	1.20	0.93	1.56	0.158
• >1.7 (ref*)	2,821				
Diastolic BP (mmHg):					
• <70	483	1.26	1.04	1.52	0.016
• 70-<80	1,294	0.98	0.85	1.12	0.767
• 80-<90 (ref*)	1,610	1.00			
• 90-<100	469	1.22	0.98	1.53	0.075
• >=100	78	2.17	1.42	3.31	0.000
Hemoglobin:					
• <8	221	2.25	1.68	3.00	0.000
• 8-<9	458	1.81	1.44	2.28	0.000
• 9-<10	937	1.59	1.32	1.91	0.000
• 10-<11	1,248	1.21	1.02	1.44	0.031
• 11-<12 (ref*)	690	1.00			
• >=12	380	1.04	0.82	1.32	0.762

Factors	N	Hazard ratio	95% CI		P value
Serum calcium (mmol/L):					
• <2.2	1,311	0.87	0.75	1.00	0.052
• 2.2-<2.6 (ref*)	2,483	1.00			
• >=2.6	140	2.14	1.62	2.82	0.000
Calcium Phosphate product (mmol2/L2):					
• <3.5	2,157	1.33	1.09	1.64	0.006
• 3.5-<4.5 (ref*)	1,172	1.00			
• 4.5-<5.5	456	0.87	0.67	1.14	0.320
• >=5.5	149	0.83	0.48	1.41	0.486
Serum Phosphate (mmol/L):					
• <1.6	2,326	1.02	0.82	1.27	0.840
• 1.6-<2.0 (ref*)	1,057	1.00			
• 2.0-<2.2	253	1.49	1.10	2.02	0.010
• 2.2-<2.4	142	1.38	0.88	2.16	0.159
• 2.4-<2.6	81	1.81	1.05	3.14	0.034
• >=2.6	75	1.43	0.68	3.04	0.347
HBsAg:					
• Negative (ref*)	3,780	1.00			
• Positive	154	1.16	0.88	1.53	0.279
Anti-HCV:					
• Negative (ref*)	3,802	1.00			
• Positive	132	1.23	0.94	1.61	0.128
• Cardiovascular disease (CVD)					
• No CVD (ref*)	3,009	1.00			
• CVD	925	1.53	1.34	1.73	0.000

Figure 4.4.1 (e): Adjusted hazard ratio for mortality of PD patients by KT/V (1999-2008 cohort)



4.4.2. Variation in odds ratio of death by state in 2007

Table 4.4.2 and Fig 4.4.2 show the odd ratio of death according to state. There was variation in the mortality among the dialysis patients in the 14 states in this country, a difference in odds ratio of death of 0.57. The state of Johor has a mortality rate most similar to national mortality rate while dialysis patients in Sabah and Labuan has the highest mortality and patients dialysing in Kuala Lumpur has the lowest mortality;.

Table 4.4.2: Variation in odds ratio of death by centre state 2007

		Variation in odds ratio						
		Min	5th centile	LQ	Median	UQ	95th centile	Max
		0.580	0.580	0.868	0.939	1.095	1.152	1.152
State	Number of centres				Odds ratio			
Pulau Pinang	60				0.868			
Melaka	31				1.110			
Johor	92				1.000			
Perak	74				0.933			
Selangor and WP Putrajaya	123				0.802			
WP Kuala Lumpur	77				0.580			
Negeri Sembilan	26				1.022			
Kedah	36				1.068			
Perlis	3				1.124			
Terengganu	17				0.939			
Pahang	27				1.095			
Kelantan Darul Naim	26				0.886			
Sarawak	40				0.793			
Sabah and WPLabuan	35				1.152			

Figure 4.4.2: Variation in odds ratio of death by state 2007

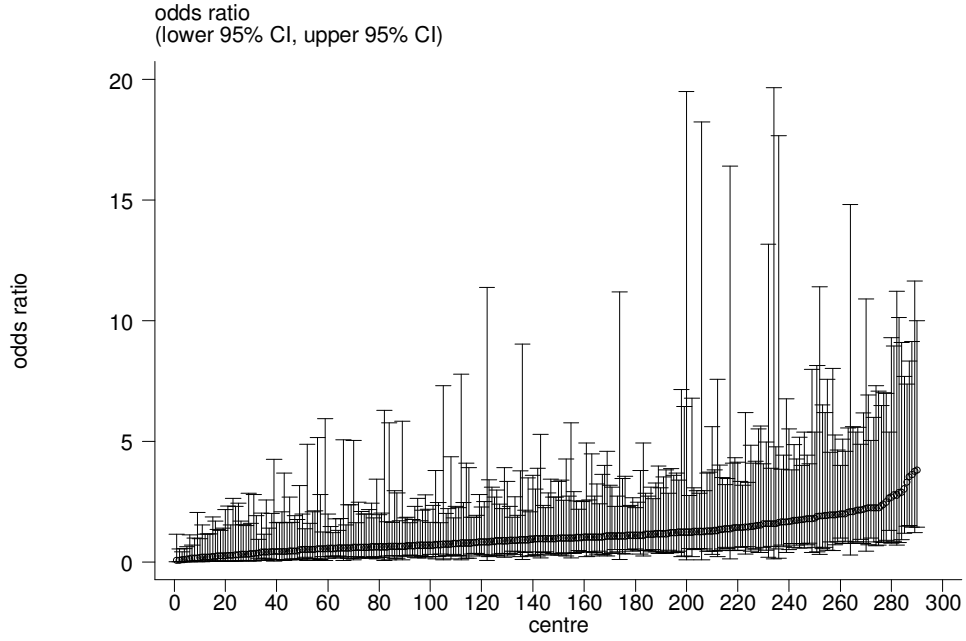
4.4.3. Variation in odds ratio of death by dialysis centre

Table 4.4.3 show the odds ratio of death by all centres in 1998 till 2007. The number of centres has increased from 49 in 1998 to 303 centres in 2007 but centre variations remained wide. In 2007, difference in mortality rate between centres in the lower quartile and centres in the upper quartile was more than two fold (Table 4.4.3 and Fig. 4.4.3).

Table 4.4.3: Variation in odds ratio of death by centre, 1998-2007

Year	Number of Centre	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	49	0.077	0.277	0.96	1.461	2.462	5.337	15.798
1999	52	0.013	0.147	0.562	1.362	2.901	4.471	10.504
2000	81	0.028	0.098	0.314	0.733	1.334	3.05	5.082
2001	119	0.102	0.167	0.555	0.903	1.815	3.42	7.601
2002	145	0.095	0.174	0.668	1.071	1.809	3.841	12.178
2003	176	0.104	0.243	0.748	1.389	2.16	6.525	16.577
2004	203	0.000	0.000	0.497	0.779	1.26	2.866	7.488
2005	239	0.081	0.187	0.494	0.852	1.323	2.64	6.075
2006	272	0.095	0.186	0.497	0.877	1.186	2.226	5.442
2007	303	0.061	0.226	0.608	0.983	1.498	2.87	5.887

Figure 4.4.3: Variations in odds ratio of death by centre, 2007



*from 303 centres, 13 centres have upper OR bound more than 20.