

# **CHAPTER 13**

## **Chronic Peritoneal Dialysis Practices**

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**SECTION 13.1: PD PRACTICES**

**13.1: Mode of PD (Tables 13.1.1 -13.1.4)**

Peritoneal dialysis utilization in Malaysia has been on the slow rise over the years. In 2008, there is a 15% increment of PD utilization compared to year 2007 with a total number of 2083 patients. The percentage of APD penetration has also been favorable although the number is still small compared to CAPD ((12% vs 88% respectively). DAPD prescription has been static at 6%.

Majority of PD patients are on Baxter disconnect system (94%), and on 4 exchanges per day (86%). The number of patients performing 5 exchanges has increased by 11% compared to the previous year and incremental dialysis practice of initiating 3 exchanges also has slightly increased by 1% in 2008. There is no change in the dwell volume compared to previous year with 2 liter as the common prescription.

**Table 13.1.1:** Chronic Peritoneal Dialysis Regimes, 1999-2008

PD regime	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	588	96	641	97	762	98	861	97	1192	97
DAPD	16	3	16	2	17	2	24	3	34	3
Automated PD/ CCPD	6	1	5	1	2	0	3	0	5	0
TOTAL	610	100	662	100	781	100	888	100	1231	100

PD regime	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	1266	96	1303	93	1397	90	1547	86	1717	82
DAPD	39	3	45	3	67	4	115	6	121	6
Automated PD/ CCPD	12	1	50	4	88	6	144	8	245	12
TOTAL	1317	100	1398	100	1552	100	1806	100	2083	100

**Table 13.1.2:** CAPD Connectology, 1999-2008

CAPD Connectology	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Baxter disconnect	354	100	237	100	439	100	726	99	1048	87
Fresenius disconnect	0	0	0	0	0	0	11	1	154	13
Others	0	0	0	0	1	0	0	0	3	0
TOTAL	354	100	237	100	440	100	737	100	1205	100

CAPD Connectology	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Baxter disconnect	1147	89	1286	92	1425	92	1675	94	1955	94
Fresenius disconnect	145	11	111	8	119	8	116	6	124	6
Others	0	0	0	0	5	0	0	0	4	0
TOTAL	1292	100	1397	100	1549	100	1791	100	2083	100

**Table 13.1.3:** PD Number of Exchanges per day, 1999-2008

No. of Exchanges/ day	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	0	0	2	0	1	0	0	0	4	0
3	4	1	1	0	5	1	11	1	14	1
4	579	97	624	96	735	95	834	96	1136	96
5	13	2	23	4	31	4	28	3	32	3
TOTAL	596	100	650	100	772	100	873	100	1186	100

No. of Exchanges/ day	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	6	0	3	0	4	0	2	0	3	0
3	12	1	25	2	55	4	40	2	54	3
4	1225	95	1280	94	1359	91	1566	90	1729	86
5	52	4	48	4	76	5	123	7	215	11
TOTAL	1295	100	1356	100	1494	100	1731	100	2001	100

**Table 13.1.4:** PD Volume per Exchange, 1999– 2008

Volume per Exchange (L)	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	19	3	25	4	32	4	37	4	41	4
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	557	96	595	95	711	95	793	94	1088	94
>2.0	2	0	5	1	9	1	14	2	31	3
TOTAL	578	100	625	100	752	100	844	100	1160	100

Volume per Exchange (L)	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	42	3	55	4	50	3	46	3	56	3
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	1154	92	1195	89	1315	88	1508	88	1756	88
>2.0	60	5	92	7	135	9	167	10	189	9
TOTAL	1256	100	1342	100	1500	100	1721	100	2001	100

## SECTION 13.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT

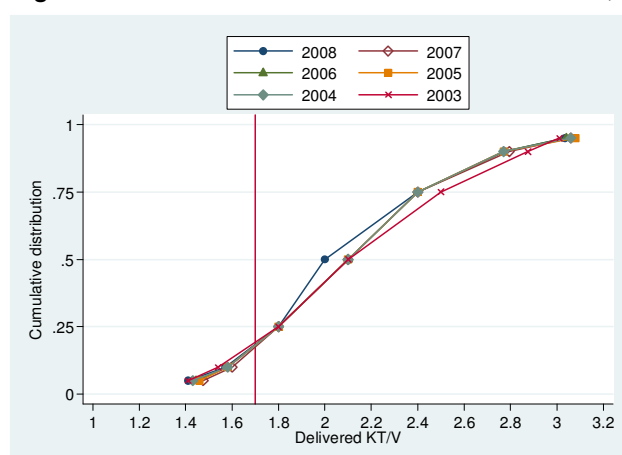
Generally, achievement of solute clearance has dropped by 1% compared to previous year with 82% of total patients achieving Kt/V of  $\geq 1.7$  per week (Tables and figures 13.2.1). Comparison between PD centers according to the percentage of patients in each centre achieving this target Kt/V has shown a 1.8-fold variation between the highest and lowest-performing centers (93.5% vs 50.5%). The median for achievement of targeted Kt/V for all centers is 80% (Tables and figures 13.2.2).

There was variation in the baseline peritoneal transport characteristic among the cohort of PD patients (13% L, 42% LA, 35% HA and 10% H) (Tables 13.2.3). However, longitudinally a proportion of patient developed changes in their peritoneal membrane characteristic over time resulting in an increment in the number of high transporters from 45% to 54% (Table 13.2.4). There is no apparent association between co-morbidity such as cardiovascular disease and diabetes with the peritoneal transport status (Table 13.2.5).

**Table 13.2.1:** Distribution of delivered KT/V, PD patients 2003-2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	% patients $\geq 1.7$ per week
2003	763	2.1	0.5	2.1	1.8	2.5	83
2004	1038	2.1	0.5	2.1	1.8	2.4	85
2005	1092	2.1	0.5	2.1	1.8	2.4	83
2006	1266	2.1	0.5	2.1	1.8	2.4	84
2007	1412	2.1	0.5	2.1	1.8	2.4	83
2008	1679	2.1	0.5	2	1.8	2.4	82

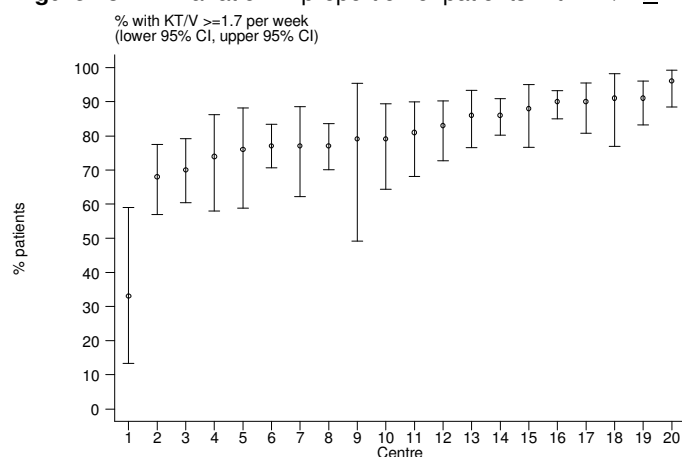
**Figure 13.2.1:** Cumulative distribution of delivered KT/V, PD patients 2003-2008



**Table 13.2.2:** Variation in proportion of patients with KT/V  $\geq 1.7$  per week among PD centres 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2003	14	0	0	75	82.5	88	91	91
2004	17	75	75	79	85	88	100	100
2005	18	56	56	75	85	89	96	96
2006	20	66	66	78	82.5	91.5	100	100
2007	21	25	69	78	85	89	93	93
2008	20	33	50.5	76.5	80	89	93.5	96

**Figure 13.2.2:** Variation in proportion of patients with KT/V  $\geq 1.7$  per week among PD centres 2008



**Table 13.2.3:** Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2008

Year	2003		2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	6	67	15	69	12	105	12	106	10	151	13
Low average	85	51	187	41	246	41	359	42	429	42	500	42
High average	62	37	176	38	227	38	315	37	392	38	415	35
High	11	7	29	6	58	10	75	9	95	9	114	10
TOTAL	168	100	459	100	600	100	854	100	1022	100	1180	100

**Table 13.2.4:** Peritoneal transport status by PET D/P creatinine at 4 hours, prevalent PD patients 2003-2008

Year	2003		2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	3	39	9	44	13	23	8	19	10	19	14
Low average	174	44	180	42	130	39	106	38	65	34	43	31
High average	171	43	168	39	118	35	106	38	78	41	50	36
High	39	10	41	10	42	13	41	15	28	15	25	18
TOTAL	394	100	428	100	334	100	276	100	190	100	137	100

**Table 13.2.5:** Association between peritoneal membrane characteristic and co-morbidity, 2003 – 2008

Co morbidity	Low		Low Average		High Average		High	
	No.	%	No.	%	No.	%	No.	%
No CVD	429	12.5	1438	42	1262	36.9	295	8.6
CVD	79	9.2	368	42.8	321	37.4	91	10.6
No DM	324	13.2	1043	42.6	879	35.9	205	8.4
DM	184	10	763	41.6	704	38.4	181	9.9

### SECTION 13.3: TECHNIQUE SURVIVAL ON PD

Technique survival on PD is poor compared to haemodialysis (HD) modality. The Kaplan-Meier cumulative survival curves diverge as early as 6 months. One-, three- and five-year technique survival for PD and HD was 81% vs 94%, 47% vs 88% and 29% vs 56% respectively. Median technique survival time for PD was less than 36 months. The possible reason for this disparity in technique survival for the two dialysis modalities is that HD patient can continue on HD even when native vascular access is problematic due to availability of temporary catheters. This is not the case with PD.

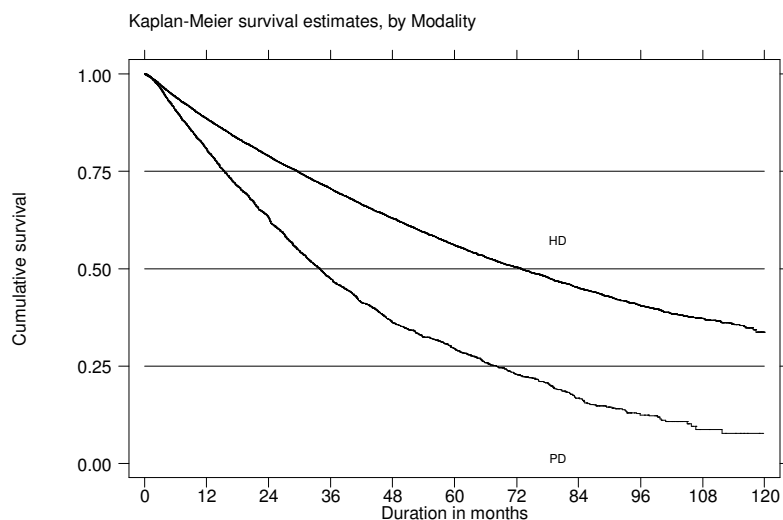
Overall trends in technique survival are unchanged by year of entry (Tables and figures 13.3.1 and 13.3.2). The best technique survival was seen in the age group less than 14 years while the elderly (>65 years) consistently had the worst technique survival (Table and figure 13.3.3). There were no gender differences (Table and figure 13.3.4). Patients with diabetes had poorer technique survival (Table and figure 13.3.5). In relation to solute clearance, there was a clear separation in the survival curve after 24 months. As expected, those who had  $Kt/V > 2.0$  had better technique survival compared to  $Kt/v < 1.7$  (Table and figure 13.3.6).

The risk factors associated with poor PD technique survival are older age, diabetes, peritonitis episodes, cardiovascular disease, low BMI, hypoalbuminemia, abnormal lipid profile, serum haemoglobin less than 11 g/dL, high calcium phosphate level and assisted PD (Table 13.3.7).

**Table 13.3.1:** Unadjusted technique survival by Dialysis modality, 1999-2008

Year Interval (month)	PD			HD			All dialysis		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	3934	100	-	25469	100	-	29403	100	-
6	3284	91	0	22373	94	0	25657	94	0
12	2634	81	1	19142	88	0	21776	87	0
24	1645	63	1	13975	79	0	15620	77	0
36	997	47	1	10115	70	0	11112	67	0
48	630	36	1	7175	63	0	7805	59	0
60	398	29	1	4919	56	0	5317	53	0
72	225	23	1	3271	50	0	3495	47	0
84	108	17	1	2015	45	1	2123	41	0
96	44	12	1	1108	40	1	1151	37	1
108	11	9	1	481	37	1	491	34	1
120	-	-	-	-	-	-	-	-	-

**Figure 13.3.1:** Unadjusted technique survival by Dialysis modality, 1999-2008



**Table 13.3.2:** Unadjusted technique 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	210	100	-	227	100	-	337	100	-	373	100	-
6	189	90	2	206	91	2	303	90	2	342	92	1
12	175	84	3	185	81	3	266	80	2	293	80	2
24	117	58	3	138	63	3	198	61	3	228	64	3
36	78	39	3	101	46	3	152	47	3	165	47	3
48	57	29	3	78	36	3	108	34	3	126	37	3
60	50	25	3	67	31	3	79	26	2	96	29	2
72	37	19	3	47	22	3	65	21	2	79	24	2
84	27	15	3	36	18	3	47	15	2	-	-	-
96	17	9	2	28	14	2	-	-	-	-	-	-
108	11	6	2	-	-	-	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-	-	-	-

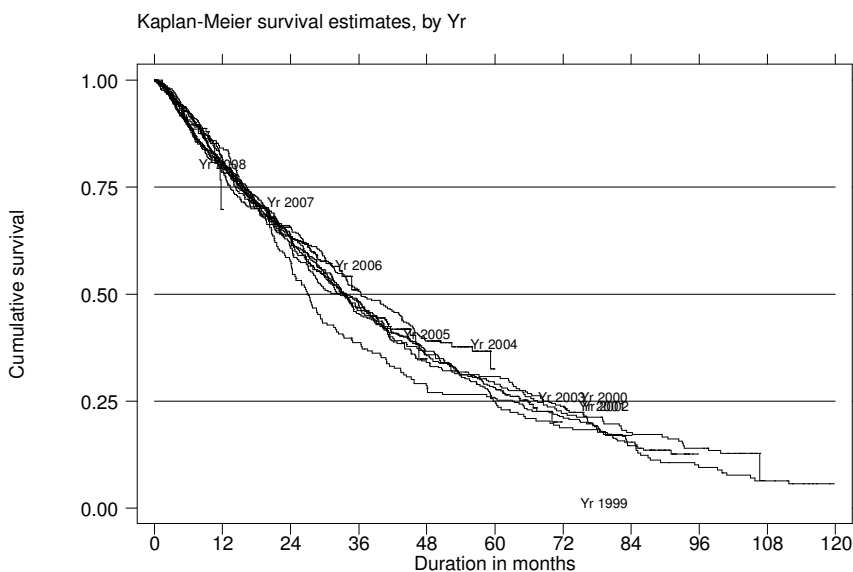
  

Year Interval (month)	2003			2004			2005			2006		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	418	100	-	340	100	-	362	100	-	463	100	-
6	369	89	2	302	89	2	322	89	2	428	93	1
12	332	80	2	267	79	2	280	79	2	372	81	2
24	254	63	2	213	65	3	220	63	3	282	63	2
36	182	45	2	162	51	3	163	48	3	-	-	-
48	141	36	2	125	39	3	-	-	-	-	-	-
60	110	28	2	3	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2007			2008		
	No	% Survival	SE	No	% Survival	SE
0	591	100	-	613	100	-
6	529	90	1	301	93	1
12	469	80	2	-	-	-
24	-	-	-	-	-	-

**Figure 13.3.2:** Unadjusted technique survival by year of entry, 1999-2008



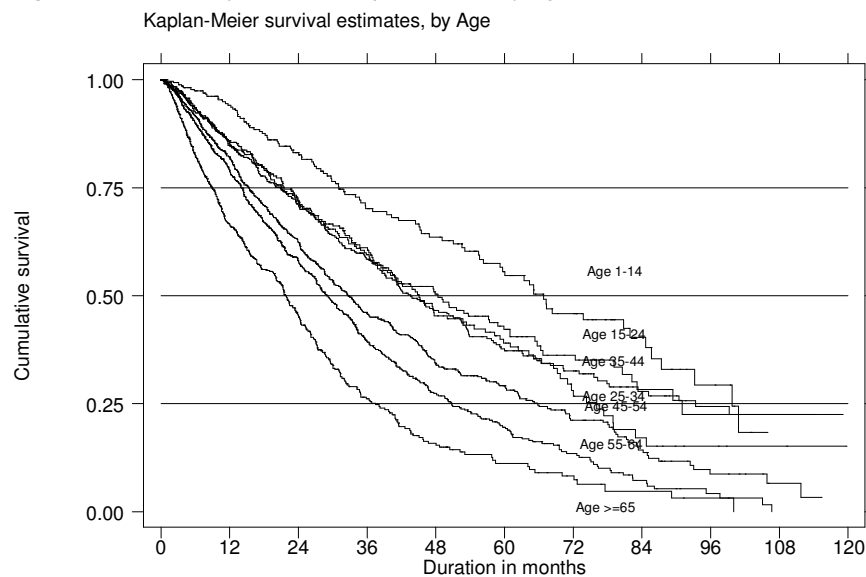
**Table 13.3.3:** Unadjusted technique survival by age, 1999-2008

Age group (years) Interval (month)	<=14			15-24			25-34			35-44		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	275	100	-	353	100	-	329	100	-	496	100	-
6	252	97	1	306	94	1	279	93	1	442	93	1
12	224	94	1	258	86	2	229	85	2	367	85	2
24	159	83	2	172	72	3	154	72	3	248	71	2
36	108	70	3	120	59	3	108	61	3	166	58	3
48	83	64	4	84	50	3	66	45	4	114	47	3
60	58	56	4	54	42	4	47	39	4	76	37	3
72	40	46	4	31	36	4	21	28	4	53	33	3
84	18	40	5	17	28	4	10	17	4	29	28	3
96	9	29	6	6	22	5	5	15	4	14	24	3
108	-	-	-	3	22	5	3	15	4	5	22	4
120	-	-	-	-	-	-	-	-	-	-	-	-

Age group (years) Interval (month)	45-54			55-64			>=65		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	880	100	-	935	100	-	666	100	-
6	746	92	1	773	90	1	495	82	2
12	612	82	1	606	79	1	342	67	2
24	401	62	2	346	58	2	170	45	2
36	241	46	2	185	39	2	75	26	2
48	148	34	2	106	27	2	37	16	2
60	92	29	2	61	20	2	17	11	2
72	46	21	2	30	13	2	10	8	2
84	24	14	2	12	7	2	4	5	2
96	9	9	2	5	4	2	2	3	2
108	3	6	2	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-

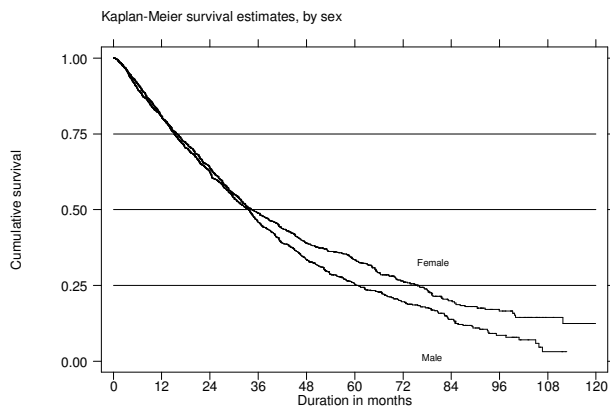
**Figure 13.3.3:** Unadjusted technique survival by age, 1999-2008



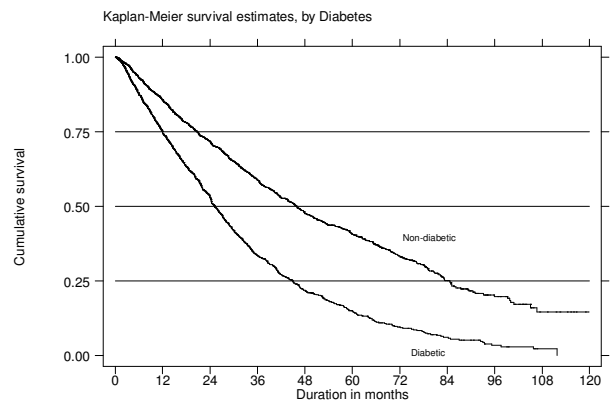
**Table 13.3.4:** Unadjusted technique survival by Gender, 1999-2008

Gender Interval (months)	Male			Female		
	No	% survival	SE	No	% survival	SE
0	1985	100	-	1946	100	-
6	1660	91	1	1627	90	1
12	1316	80	1	1319	81	1
24	804	62	1	841	64	1
36	488	46	1	510	49	1
48	291	33	1	340	39	1
60	179	25	1	220	33	1
72	100	20	1	126	26	2
84	45	14	1	64	20	2
96	15	8	1	30	16	2
108	3	3	2	9	14	2
120	-	-	-	-	-	-

**Figure 13.3.4:** Unadjusted technique survival by Gender, 1999-2008



**Figure 13.3.5:** Unadjusted technique survival by Diabetes status, 1999-2008



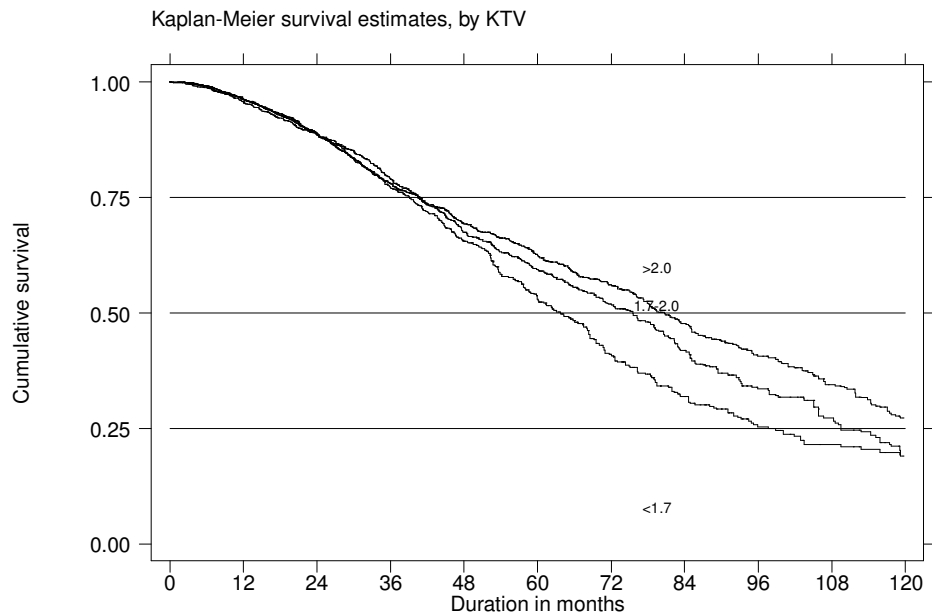
**Table 13.3.5:** Unadjusted technique survival by Diabetes status, 1999-2008

Diabetes status Interval (month)	Non-Diabetic			Diabetic		
	No	% survival	SE	No	% survival	SE
0	2062	100	-	1872	100	-
6	1782	93	1	1502	88	1
12	1495	86	1	1139	75	1
24	1032	72	1	613	53	1
36	697	59	1	302	33	1
48	476	48	1	155	22	1
60	319	41	1	80	15	1
72	186	33	2	40	10	1
84	88	25	2	21	6	1
96	37	20	2	8	3	1
108	10	15	2	2	2	1
120	-	-	-	-	-	-

**Table 13.3.6** Unadjusted technique survival by Kt/V, 1999-2008

KT/V Interval (months)	<1.7			1.7-2.0			>2.0		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	1142	100	-	1598	100	-	3506	100	-
6	1115	99	0	1561	99	0	3417	99	0
12	1049	96	1	1472	96	0	3200	96	0
24	870	89	1	1247	89	1	2659	89	1
36	671	77	1	993	79	1	2028	78	1
48	506	65	2	747	67	1	1562	69	1
60	334	53	2	564	59	1	1134	62	1
72	197	41	2	368	52	2	792	56	1
84	109	32	2	224	42	2	522	48	1
96	64	25	2	116	34	2	334	41	1
108	47	21	2	73	27	2	211	35	1
120	32	19	2	45	19	2	135	27	2

**Figure 13.3.6** Unadjusted technique survival by Kt/V, 1999 -2008



**Table 13.3.7:** Adjusted hazard ratio for technique survival, 1999-2008

Factors	N	Hazard Ratio	95% CI		p value
<b>Age (years):</b>					
Age 1-14 (ref)	276	1.00			
Age 15-24	352	1.90	(1.43;	2.51)	0.000
Age 25-34	329	2.21	(1.65;	2.95)	0.000
Age 35-44	496	2.15	(1.63;	2.84)	0.000
Age 45-54	880	2.52	(1.93;	3.30)	0.000
Age 55-64	935	2.80	(2.15;	3.65)	0.000
Age >=65	666	3.80	(2.89;	4.99)	0.000
<b>Peritonitis</b>					
No (ref)	3,662	1.00			
Yes	272	2.30	(2.01;	2.63)	0.000
<b>Diabetes Mellitus</b>					
Non-diabetic (ref)	2,062	1.00			
Diabetic	1,872	1.52	(1.35;	1.70)	0.000
<b>Gender</b>					
Male (ref)	1,985	1.00			
Female	1,949	0.81	(0.73;	0.89)	0.000
<b>Year start dialysis:</b>					
Year 1999-2000 (ref)	437	1.00			
Year 2001-2002	710	1.06	(0.93;	1.22)	0.371
Year 2003-2004	758	1.07	(0.93;	1.24)	0.336
Year 2005-2006	825	1.02	(0.87;	1.20)	0.789
Year 2007-2008	1,204	0.97	(0.80;	1.17)	0.723
<b>Cardiovascular Disease:</b>					
No CVD (ref)	3,009	1.00			
CVD	925	1.27	(1.14;	1.42)	0.000
<b>BMI:</b>					
<18.5	575	1.23	(1.06;	1.43)	0.007
18.5-<25 (ref)	2,074	1.00			
>=25	1,285	0.88	(0.79;	0.97)	0.014
<b>Serum Albumin:</b>					
<30	1,012	1.84	(1.61;	2.09)	0.000
30-<35	1,496	1.33	(1.18;	1.50)	0.000
35-<45 (ref)	1,053	1.00			
>=45	373	1.05	(0.84;	1.31)	0.657
<b>Serum Cholesterol:</b>					
<3.2	78	1.65	(1.22;	2.24)	0.001
3.2-<5.2 (ref)	1,928	1.00			
>=5.2	1,928	1.16	(1.05;	1.27)	0.003
<b>Diastolic BP:</b>					
<70	483	1.06	(0.91;	1.24)	0.455
70-<80	1,294	0.93	(0.84;	1.04)	0.224
80-<90 (ref)	1,610	1.00			
90-<100	469	1.29	(1.11;	1.51)	0.001
>=100	78	1.94	(1.43;	2.62)	0.000
<b>Hemoglobin:</b>					
<8	221	1.99	(1.60;	2.47)	0.000
8-<9	458	1.88	(1.58;	2.23)	0.000
9-<10	937	1.45	(1.24;	1.68)	0.000
10-<11	1,248	1.23	(1.07;	1.42)	0.004
11-<12 (ref)	690	1.00			
>=12	380	1.09	(0.90;	1.33)	0.388
<b>Serum Calcium:</b>					
<2.2	1,311	0.98	(0.88;	1.10)	0.776
2.2-<2.6 (ref)	2,483	1.00			
>=2.6	140	1.85	(1.47;	2.33)	0.000
<b>Calcium Phosphate product:</b>					
<3.5	2,157	1.42	(1.21;	1.66)	0.000
3.5-<4.5 (ref)	1,172	1.00			
4.5-<5.5	456	0.84	(0.68;	1.03)	0.099
>=5.5	149	0.57	(0.38;	0.86)	0.007

**Table 13.3.7:** Adjusted hazard ratio for technique survival, 1999-2008 (*cont.*)

Factors	N	Hazard Ratio	95% CI		p value
<b>Serum Phosphate:</b>					
<1.6 (ref)	2,326	1.00			
1.6-<2.0	1,057	1.06	(0.90;	1.25)	0.494
2.0-<2.2	253	1.31	(0.99;	1.75)	0.061
2.2-<2.4	142	1.48	(1.03;	2.11)	0.033
2.4-<2.6	81	1.98	(1.27;	3.10)	0.003
>=2.6	75	2.66	(1.56;	4.52)	0.000
<b>KT/V</b>					
<=1.7 (ref)	487	1.00			
>1.7	3,447	1.47	(1.27;	1.70)	0.000
<b>Assisted PD</b>					
Selfcare (ref)	2,218	1.00			
Assisted	1,625	1.34	(1.20;	1.49)	0.000

**Table 13.3.8** Reasons for change of dialysis modality to HD, 1999-2008

Cause	No.	Percentage
Peritonitis	330	39
Catheter related infection	27	3
Membrane failure	152	18
Technical problem	60	7
Patient preference	157	19
Others	76	9
Unknown	40	5
Total	842	100

Peritonitis remained the commonest cause for PD drop-out (39%), followed by membrane failure (18%) and patient preference (19%).

**SECTION 13.4: Patient Survival on PD**

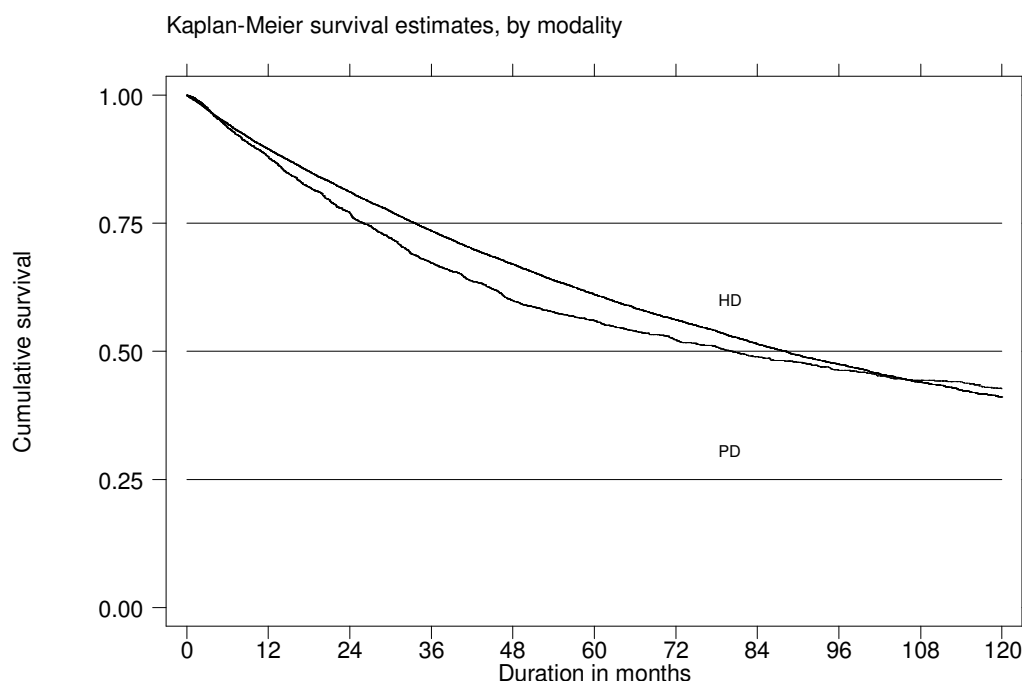
Analyzing patient survival by dialysis modalities as per ITT (disregarding change of dialysis modality) (Table 13.4.1 and Fig 13.4.1), the overall unadjusted 5 years and 10 years patient survival on CAPD versus haemodialysis was 56% vs 61% and 43% vs 41% respectively.

Older age, diabetes, cardiovascular disease, low BMI, low serum albumin, diastolic BP > 100 mmHg, serum haemoglobin <11 g/dL, hypercalcaemia, peritonitis episodes and assisted PD are associated with an increased mortality risk (Table 13.4.1).

**Table 13.4.1:** 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 13.3.6** Patient survival by dialysis modality analysis (not censored for change of modality)



**Table 13.4.2:** Adjusted Hazard Ratio for patient mortality

Factors	N	Hazard Ratio	95% CI		p value
<b>Age (years):</b>					
Age 1-14 (ref)	276	1.00			
Age 15-24	352	2.23	(1.40;	3.56)	0.001
Age 25-34	329	2.24	(1.37;	3.67)	0.001
Age 35-44	496	2.90	(1.86;	4.52)	0.000
Age 45-54	880	4.53	(2.98;	6.90)	0.000
Age 55-64	935	4.82	(3.18;	7.33)	0.000
Age >=65	666	7.00	(4.59;	10.67)	0.000
<b>Diabetes Mellitus</b>					
Non-diabetic (ref)	2,062	1.00			
Diabetic	1,872	1.57	(1.35;	1.82)	0.000
<b>Gender</b>					
Male (ref)	1,985	1.00			
Female	1,949	0.85	(0.76;	0.97)	0.011
<b>Year start dialysis:</b>					
Year 1999-2000 (ref)	437	1.00			
Year 2001-2002	710	1.11	(0.93;	1.33)	0.246
Year 2003-2004	758	1.16	(0.97;	1.40)	0.111
Year 2005-2006	825	1.36	(1.10;	1.67)	0.004
Year 2007-2008	1,204	1.79	(1.39;	2.29)	0.000
<b>Cardiovascular Disease:</b>					
No CVD (ref)	3,009	1.00			
CVD	925	1.44	(1.26;	1.64)	0.000
<b>BMI:</b>					
<18.5	575	1.25	(1.02;	1.54)	0.032
18.5-<25 (ref)	2,074	1			
>=25	1,285	0.91	(0.80;	1.04)	0.150
<b>Serum Albumin:</b>					
<30	1,012	2.15	(1.81;	2.55)	0.000
30-<35	1,496	1.35	(1.15;	1.59)	0.000
35-<45 (ref)	1,053	1.00			
>=45	373	1.19	(0.88;	1.61)	0.271
<b>Diastolic BP:</b>					
<70	483	1.15	(0.95;	1.39)	0.144
70-<80	1,294	0.94	(0.81;	1.08)	0.369
80-<90 (ref)	1,610	1.00			
90-<100	469	1.19	(0.95;	1.48)	0.134
>=100	78	2.21	(1.43;	3.41)	0.000
<b>Hemoglobin:</b>					
<8	221	2.26	(1.69;	3.02)	0.000
8-<9	458	1.71	(1.36;	2.17)	0.000
9-<10	937	1.56	(1.30;	1.88)	0.000
10-<11	1,248	1.29	(1.09;	1.54)	0.004
11-<12 (ref)	690	1.00			
>=12	380	1.15	(0.90;	1.46)	0.268
<b>Serum Calcium:</b>					
<2.2	1,311	0.99	(0.86;	1.14)	0.889
2.2-<2.6 (ref)	2,483	1.00			
>=2.6	140	1.79	(1.35;	2.37)	0.000

**Table 13.4.2:** Adjusted Hazard Ratio for patient mortality (*cont.*)

Factors	N	Hazard Ratio	95% CI	p value
Calcium Phosphate product:				
<3.5	2,157	1.22	(0.99; 1.52)	0.066
3.5-<4.5 (ref)	1,172	1.00		
4.5-<5.5	456	1.01	(0.76; 1.34)	0.945
>=5.5	149	1.16	(0.66; 2.02)	0.607
Serum Phosphate:				
<1.6 (ref)	2,326	1.00		
1.6-<2.0	1,057	0.89	(0.71; 1.11)	0.296
2.0-<2.2	253	1.19	(0.81; 1.75)	0.373
2.2-<2.4	142	1.01	(0.61; 1.69)	0.961
2.4-<2.6	81	1.26	(0.69; 2.31)	0.456
>=2.6	75	0.84	(0.35; 1.97)	0.680
KT/V				
<=1.7	487	1.00		
>1.7 (ref)	3,447	1.35	(1.12; 1.63)	0.001
Peritonitis episode				
No (ref)	940	1.00		
Yes	2,994	0.24	(0.21; 0.27)	0.000
Assisted PD				
No (ref)	2,218	1.00		
Yes	1,625	1.62	(1.41; 1.86)	0.000

### SECTION 13.5: PERITONITIS

The median peritonitis rate dropped to 28.4 pt-months per episode compared from the previous year (Table 13.5.1). This could be explained by the recent adoption of a revised standardized definition of peritonitis by all our PD centres. However, despite this, there is still a wide inter-centre variation with the highest and lowest peritonitis rates of 12 and 132.2 pt-months per episode.

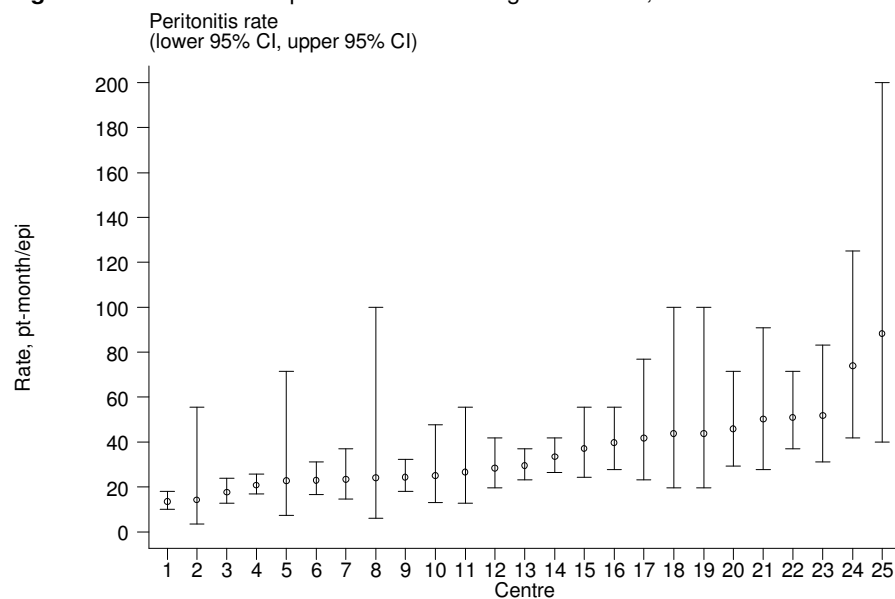
Gram-positive organisms accounted for 27% of peritonitis episodes while 34% were due to gram negative organisms. Staphylococcus aureus (12%) and staphylococcus coagulase negative (11%) were the commonest gram positive organisms. Pseudomonas (15%) was the commonest gram negative. Fungal organisms accounted for 11% of cases. The culture negative rate has been reduced to 29% compared to the previous year (Table 13.5.2).

A total of 73 deaths related to peritonitis were reported in 2008. Catheter removal rate was highest in gram negative infections, with Klebsiella (36%) being the commonest cause. No statistically significant risk factors for peritonitis were identified.

**Table 13.5.1** Variation in peritonitis rate (pt-month/epi) among PD centres, 2000- 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	12	11.7	11.7	18.7	24.1	32.5	1145.1	1145.1
2001	11	10.7	10.7	19.9	22.8	39.6	60.3	60.3
2002	14	12.6	12.6	20.4	30.5	42.5	219.2	219.2
2003	13	18.3	18.3	21	32.9	39.6	312.1	312.1
2004	15	0	0	23.5	32.6	36.6	41.5	41.5
2005	15	18	18	25.7	35.3	43	57.1	57.1
2006	21	14.8	18.5	27.2	37	49.7	62.2	97.7
2007	23	12	15.3	30.7	41.5	56.9	71.8	106.7
2008	25	12	13.4	21.6	28.4	43.8	73.9	132.2

**Figure 13.5.1** Variation in peritonitis rate among PD centres, 2008



**Table 13.5.2:** Causative organism in PD peritonitis, 2000-2008

Microorganism	2000		2001		2002		2003		2004		2005		2006		2007		2008		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
(A) Gram Positives																			
Staph. Aureus	35	11	40	13	62	17	45	12	52	14	39	12	51	14	47	13	73	12	
Staph Coagulase Neg.	34	11	30	10	39	11	47	13	41	11	43	13	32	9	29	8	69	11	
Strep	17	6	18	6	12	3	16	4	13	3	10	3	17	5	14	4	19	3	
Others	4	1	10	3	8	2	16	4	4	1	8	2	14	4	11	3	9	1	
(B) Gram Negatives																			
Pseudomonas	19	6	14	4	23	6	20	5	28	8	27	8	23	6	30	8	94	15	
Acinetobacter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Klebsiella	10	3	7	2	18	5	27	7	25	7	21	7	8	2	21	6	24	4	
Enterobacter	11	4	16	5	11	3	13	4	19	5	19	6	20	5	17	5	24	4	
E.Coli	15	5	16	5	23	6	20	5	23	6	30	9	15	4	32	9	42	7	
Others	9	3	17	5	15	4	15	4	16	4	17	5	14	4	14	4	22	4	
(C) Polymicrobial	9	3	11	4	8	2	3	1	2	1	0	0	1	0	0	0	0	0	
(D) Others																			
Fungal	19	6	21	7	12	3	12	3	15	4	7	2	16	4	20	5	29	5	
Mycobacterium	6	2	4	1	1	0	3	1	4	1	2	1	4	1	1	0	4	1	
Others	2	1	9	3	11	3	12	3	8	2	3	1	10	3	12	3	30	5	
(E) No growth	119	39	99	32	118	33	115	32	123	33	96	30	142	39	122	33	179	29	
TOTAL	309	100	312	100	361	100	364	100	373	100	322	100	367	100	370	100	618	100	

**Table 13.5.3:** Outcome of peritonitis by Causative organism, 2000-2008

Causative Organism	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives								
Staph. Aureus	223	53	60	15	136	32	419	100
Staph Coagulase Neg.	200	59	25	7	115	34	340	100
Strep	66	52	8	6	53	42	127	100
Others	32	43	7	9	36	48	75	100
(B) Gram Negatives								
Pseudomonas	108	42	76	30	73	28	257	100
Acinetobacter	0		0		0		0	100
Klebsiella	67	45	32	21	50	34	149	100
Enterobacter	55	38	36	25	53	37	144	100
E.Coli	92	45	44	22	68	33	204	100
Others	57	46	33	26	35	28	125	100
(C) Polymicrobial	6	18	6	18	22	64	34	100
(D) Others								
Fungal	10	7	96	64	44	29	150	100
Mycobacterium	1	4	12	43	15	53	28	100
Others	36	41	21	24	31	35	88	100
(E) No growth	546	52	142	13	363	35	1051	100

**Table 13.5.4:** Adjusted Risk factor influencing peritonitis rate, 2000 -2008

Factors	N	Incidence Risk Ratio	95% CI		P value
Age (years):					
<=14	191	0.91	(0.77;	1.08)	0.299
15-24	258	0.97	(0.83;	1.13)	0.691
25-34 ref	227	1.00			
35-44	360	1.03	(0.90;	1.18)	0.675
45-54	592	1.00	(0.88;	1.15)	0.979
55-64	592	0.98	(0.85;	1.14)	0.831
>=65	354	1.02	(0.87;	1.20)	0.806
Gender:					
Male ref	1291	1.00			
Female	1283	0.99	(0.92;	1.06)	0.685
Diabetes:					
No ref	1415	1.00			
Yes	1,159	1.07	(0.99;	1.16)	0.095
Income:					
RM 0-999 ref	1,081	1.00			
RM 1000-1999	866	0.94	(0.87;	1.02)	0.132
RM 2000-2999	373	0.94	(0.84;	1.04)	0.204
>=3000	254	0.99	(0.88;	1.12)	0.903
Education:					
Nil	236	1.02	(0.89;	1.17)	0.754
Primary	892	1.04	(0.96;	1.13)	0.301
Secondary ref	1,224	1.00			
Tertiary	222	0.87	(0.76;	0.99)	0.038
Assistance to perform CAPD:					
Self care ref	1567	1.00			
Partially assisted	331	0.96	(0.86;	1.07)	0.446
Completely assisted	676	1.03	(0.94;	1.12)	0.564