

CHAPTER - 12
PERITONEAL DIALYSIS

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SECTION 12.1: MODALITIES AND PRESCRIPTION OF PD

The number of patients treated with Peritoneal Dialysis (PD) in Malaysia has grown more than ten-fold over the last decade from 192 in the year 2003 to 2523 patients in 2012 (Table 2.1.1b). The bulk of PD therapy (80%) is in the form of Continuous Ambulatory Peritoneal Dialysis (CAPD). Automated Peritoneal Dialysis (APD) utilization has increased from a mere 1% in 2003 to the present level of 15%. In the last 2 years however, the growth of APD has plateaued (Table 12.1.1).

There has been an increased utilization of the Fresenius Medical Care (FMC) system, with the ratio of FMC to Baxter reaching 20:80 by 2012 (Table 12.1.2). The majority of patients on CAPD (90.2%) are using 4 exchanges per day, while 74% of those on APD are using total dwell volume of 10 litres per day (Tables 12.1.3a and Table 12.1.3b).

Table 12.1.1: Peritoneal dialysis regimes, 1997-2012

PD regime	2003		2004		2005		2006		2007	
	n	%	n	%	n	%	n	%	n	%
Standard CAPD	1192	96.1	1266	96.8	1303	93.2	1397	90	1547	85.7
DAPD	34	3	39	2.8	45	3.2	67	4.3	115	6.4
Automated PD/ CCPD	5	0.9	12	0.4	50	3.6	88	5.7	144	8
TOTAL	1231	100	1317	100	1398	100	1552	100	1806	100

PD regime	2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%
Standard CAPD	1717	82.4	1847	83.5	1973	83.6	2079	79.7	2320	80
DAPD	121	5.8	119	5.4	91	3.9	117	4.5	140	4.8
Automated PD/ CCPD	245	11.8	246	11.1	296	12.5	414	15.9	439	15.1
TOTAL	2083	100	2212	100	2360	100	2610	100	2899	100

Table 12.1.2: PD System, 1997-2012

PD System	2003		2004		2005		2006		2007	
	n	%	n	%	n	%	n	%	n	%
Baxter disconnect	1048	88.8	1147	87	1286	92.1	1425	92	1675	93.5
Fresenius disconnect	154	11.2	145	12.8	111	7.9	119	7.7	116	6.5
Others	3	0	0	0.2	0	0	5	0.3	0	0
TOTAL	1205	100	1292	100	1397	100	1549	100	1791	100

PD System	2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%
Baxter disconnect	1955	93.9	2013	92.1	2126	90.7	2230	85.8	2325	80.1
Fresenius disconnect	124	6	173	7.9	218	9.3	367	14.1	578	19.9
Others	4	0.2	0	0	1	0	1	0	1	0
TOTAL	2083	100	2186	100	2345	100	2598	100	2904	100

Table 12.1.3(a): CAPD Number of Exchanges per day, 1997-2012

Number of exchanges/ day	2003		2004		2005		2006		2007	
	n	%	n	%	n	%	n	%	n	%
2	3	0.5	6	0	3	0.2	3	0.2	2	0.1
3	14	1	12	1.2	20	1.5	52	3.7	29	1.9
4	1104	94.8	1185	95.9	1234	95.1	1296	93.2	1456	95.8
5	30	3.8	47	2.9	40	3.1	39	2.8	33	2.2
TOTAL	1151	100	1250	100	1297	100	1390	100	1520	100

Number of exchanges/ day	2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%
2	3	0.2	2	0.1	7	0.4	1	0	10	0.4
3	47	2.8	79	4.4	125	6.4	113	5.5	139	6.1
4	1611	94.4	1676	92.3	1778	91.1	1874	91.3	2064	90.2
5	46	2.7	59	3.2	42	2.2	65	3.2	75	3.3
TOTAL	1707	100	1816	100	1952	100	2053	100	2288	100

Table 12.1.3(b): APD dwell volumes per day, 1997-2012

Dwell volumes/ day	2003		2004		2005		2006		2007	
	n	%	n	%	n	%	n	%	n	%
8	0	0	0	0	9	47.4	6	12.5	11	10.5
10	1	100	4	100	7	36.8	32	66.7	83	79
12	0	0	0	0	3	15.8	10	20.8	10	9.5
14	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	1	1
TOTAL	1	100	4	100	19	100	48	100	105	100

Dwell volumes/ day	2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%
8	4	2.2	7	5.1	11	14.5	9	3.7	18	12.3
10	164	92.1	119	87.5	56	73.7	222	90.6	108	74
12	10	5.6	8	5.9	8	10.5	11	4.5	17	11.6
14	0	0	0	0	0	0	0	0	0	0
16	0	0	2	1.5	1	1.3	3	1.2	3	2.1
TOTAL	178	100	136	100	76	100	245	100	146	100

SECTION 12.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT

The percentage of patients achieving target solute clearance of > 1.7 per week has declined slightly since the year 2007 following a change in recommended target Kt/V based on landmark studies on PD adequacy¹. This declining pattern highlights the need to target a slightly higher Kt/V in the future in order to achieve the minimum requirement in solute clearance.

There is a 1.6-fold inter-centre variation in the delivered Kt/V in 2012 (59% in 5th percentile and 95% in 95th percentile) (Table 12.2.2). This wide inter-centre variation has been present every year.

In incident PD patients, there is an equal distribution of low/low-average transport with high/high-average transport peritoneal membrane characteristics (Table 12.2.3). Over time (>10 years) approximately two-thirds (69%) of the patients remaining on PD are high/high-average transporter (Table 12.3.4).

Table 12.2.1: Distribution of delivered Kt/V, PD patients 2003-2012 [only 2003 onwards data available]

Year	Number of Patients	Mean	SD	Median	LQ	UQ	% patients ≥ 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
2009	1837	2.1	0.5	2	1.8	2.4	81
2010	1913	2.1	0.5	2	1.7	2.3	79
2011	1787	2.1	0.5	2	1.8	2.3	79
2012	2335	2.1	0.5	2	1.8	2.3	79

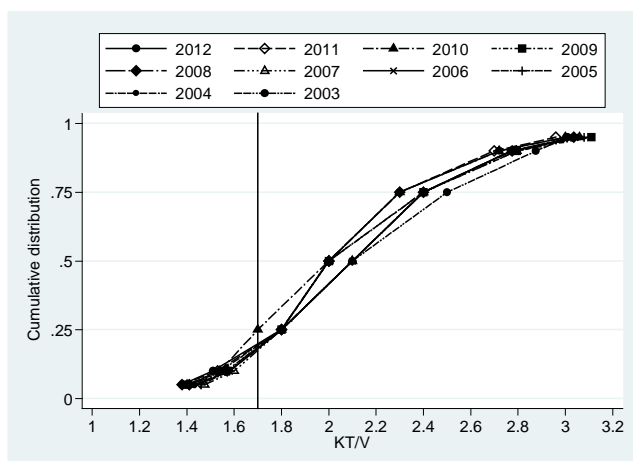
Figure 12.2.1: Cumulative distribution of delivered Kt/V, PD patients 1997-2012

Table 12.2.2: Variation in proportion of patients with Kt/V \geq 1.7 per week among PD centres, 1997-2012

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th 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
2009	21	48	63	76	83	89	97	100
2010	22	48	59	73	79	86	90	94
2011	24	61	64	70.5	78.5	82.5	90	91
2012	25	53	59	70	79	87	95	100

Figure 12.2.2: Variation in proportion of patients with Kt/V \geq 1.7 per week among PD centres

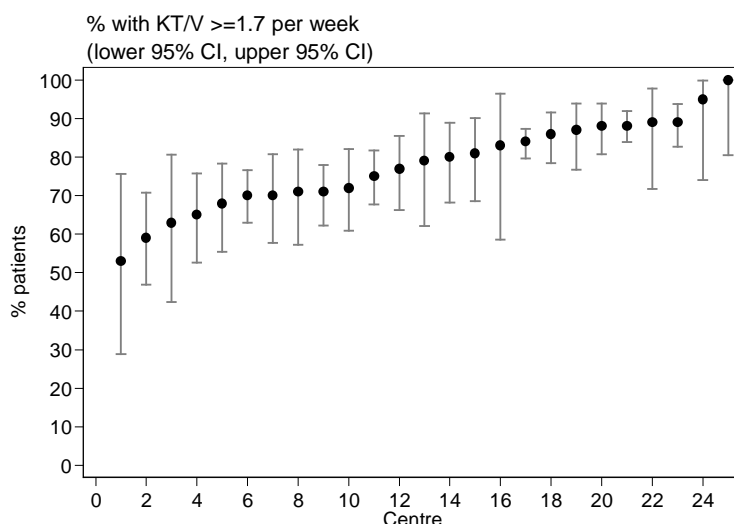


Table 12.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2004-2012

Year	2004		2005		2006		2007		2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Low	31	16	45	11	88	13	92	10	145	13	186	14	190	14	164	10	194	11
Low average	72	36	159	39	285	41	376	41	465	42	530	39	549	39	624	39	749	40
High average	82	41	156	39	256	37	355	39	384	35	455	34	480	34	609	38	713	38
High	14	7	45	11	63	9	88	10	108	10	181	13	180	13	196	12	200	11
TOTAL	199	100	405	100	692	100	911	100	1102	100	1352	100	1399	100	1593	100	1856	100

Table 12.2.4: Peritoneal Transport Status (PET) with dialysis vintage

Duration (Years)	<1		1-<2		2-<3		3-<4		4-<5	
	n	%	n	%	n	%	n	%	n	%
Low	53	12	49	10	34	12	24	10	12	8
Low average	190	43	173	36	116	40	88	37	74	48
High average	157	35	193	41	112	39	103	43	47	31
High	47	11	60	13	28	10	23	10	20	13
TOTAL	447	100	475	100	290	100	238	100	153	100

Duration (Years)	5-<6		6-<7		7-<8		8-<9		9-<10		10 or more	
	n	%	n	%	n	%	n	%	n	%	n	%
Low	6	6	9	13	3	6	4	12	1	3	4	10
Low average	51	49	26	39	21	45	10	29	10	32	9	21
High average	37	35	26	39	19	40	19	56	19	61	20	48
High	11	10	6	9	4	9	1	3	1	3	9	21
TOTAL	105	100	67	100	47	100	34	100	31	100	42	100

SECTION 12.3: PATIENT AND TECHNIQUE SURVIVAL ON PD

The annual death rate on PD has declined steadily over the years. This is supported by the adjusted hazard ratio for mortality of PD patients which has improved longitudinally (refer Chapter 3, Figure 3.1.1 and Table 3.4.3)

Age ≤ 14 years consistently have better technique survival compared to other age groups (censored for death and transplant). This is followed by the elderly age group (≥ 65 years) that appears to perform better than younger patients till 48 month on treatment (Table & Figure 12.3.1b).

Female patient has a better technique survival compared to male (Table & Figure 12.3.2a and b). Diabetic patient has poor technique survival than non-diabetic (uncensored for death and transplant). However, there was no difference in technique failure between diabetes and non-diabetes patient within 48 months of therapy when censored for death and transplant (Table & Figure 12.3.3b).

There was a clear association of technique survival with solute clearance. Patient with $Kt/V < 1.7$ consistently has poorer survival (Table & Figure 12.3.4). However, no difference in technique survival was observed between $Kt/V 1.7-2.0$ and $Kt/V > 2.0$ until 36-months, but starts to diverge after 48 months.

Peritonitis episode, male gender, presence of cardiovascular disease, low serum albumin, low serum calcium and low serum phosphate has an increase risk of technique failure (Table 12.3.5).

The commonest cause of technique failure in 2012 (Table 12.3.6) was peritonitis (11%), followed by membrane failure and patient preference. Majority of the technique failure (70%) occurred > 12 months after PD therapy (Table 12.3.7).

Table 12.3.1(a): Unadjusted technique survival by age (uncensored for death and transplant), 1997-2012

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	518	100		592	100		681	100		953	100	
6	483	97	1	527	93	1	591	93	1	844	93	1
12	437	93	1	447	85	2	511	86	1	727	85	1
24	327	83	2	322	72	2	383	74	2	527	70	2
36	237	70	2	243	61	2	287	64	2	387	56	2
48	173	62	3	176	52	2	205	52	2	274	45	2
60	122	53	3	123	41	3	153	44	2	197	37	2
72	85	44	3	89	35	3	108	36	2	133	28	2
84	54	35	3	60	28	3	75	28	2	97	23	2
96	35	27	3	40	22	3	47	22	2	70	18	2
108	22	22	3	27	20	3	34	18	2	54	16	2
120	15	16	3	15	15	3	21	14	2	35	12	2

Age group (years) Interval (month)	45-54			55-64			≥ 65		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	1725	100		1973	100		1478	100	
6	1490	92	1	1636	89	1	1140	82	1
12	1228	81	1	1312	77	1	848	67	1
24	832	62	1	823	57	1	481	44	1
36	563	46	1	506	39	1	260	28	1
48	367	34	1	297	26	1	120	16	1
60	260	27	1	167	18	1	59	10	1
72	176	20	1	101	13	1	30	7	1
84	103	14	1	54	8	1	20	5	1
96	63	10	1	30	5	1	10	3	1
108	36	7	1	15	3	1	5	2	1
120	16	4	1	7	2	1	3	1	1

Figure 12.3.1(a): Unadjusted technique survival by age (uncensored for death and transplant), 1997-2012

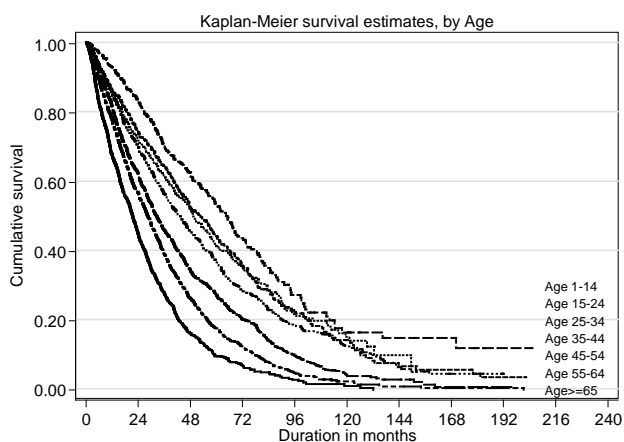


Figure 12.3.1(b): Unadjusted technique survival by age (censored for death and transplant), 1997-2012

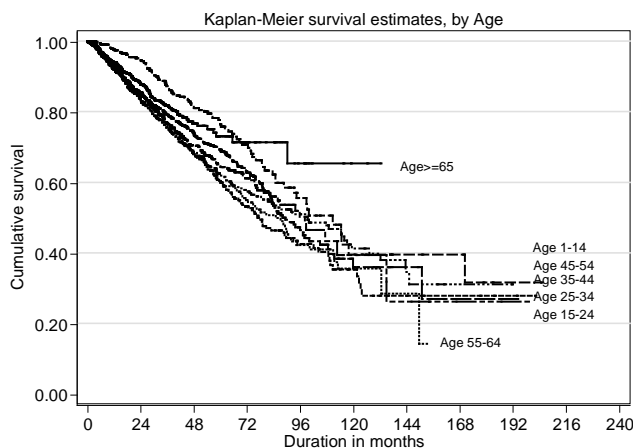


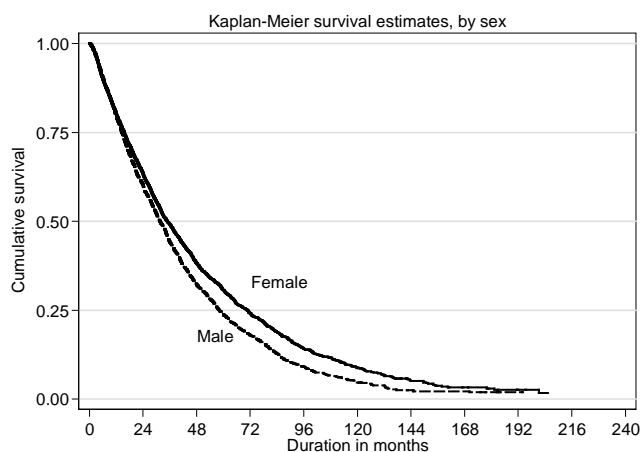
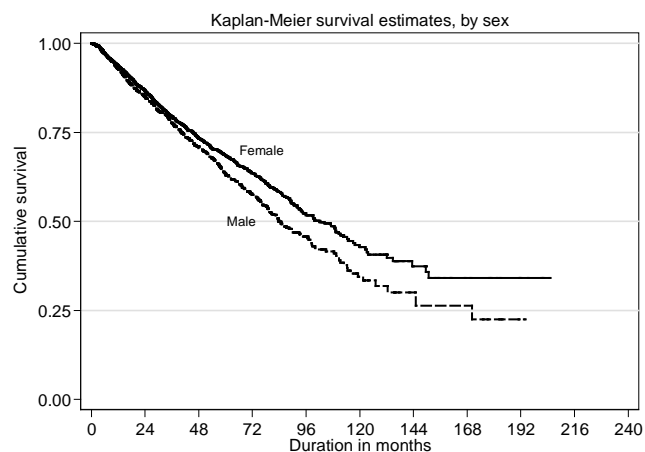
Table 12.3.1(b): Unadjusted technique survival by age (censored for death and transplant), 1997-2012

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	518	100		592	100		681	100		953	100	
6	483	99	0	527	97	1	591	96	1	844	97	1
12	437	98	1	447	92	1	511	91	1	727	92	1
24	327	95	1	322	83	2	383	83	2	527	83	1
36	237	87	2	243	76	2	287	77	2	387	75	2
48	173	81	2	176	68	2	205	68	2	274	69	2
60	122	76	3	123	60	3	153	60	3	197	62	2
72	85	71	3	89	55	3	108	53	3	133	57	2
84	54	62	4	60	51	3	75	46	3	97	54	3
96	35	56	4	40	42	4	47	43	3	70	51	3
108	22	51	5	27	41	4	34	40	3	54	48	3
120	15	40	6	15	36	4	21	35	4	35	41	4

Age group (years) Interval (month)	45-54			55-64			>=65		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	1725	100		1973	100		1478	100	
6	1490	97	0	1636	97	0	1140	97	0
12	1228	93	1	1312	93	1	848	94	1
24	832	86	1	823	85	1	481	88	1
36	563	79	1	506	77	1	260	82	2
48	367	74	1	297	71	2	120	77	2
60	260	69	2	167	65	2	59	73	3
72	176	63	2	101	61	2	30	72	3
84	103	54	3	54	56	3	20	72	3
96	63	47	3	30	50	4	10	66	6
108	36	42	3	15	44	5	5	66	6
120	16	36	4	7	40	6	3	66	6

Table 12.3.2(a): Unadjusted technique survival by gender (uncensored for death and transplant), 1997-2012

Gender Interval (months)	Male			Female		
	n	% survival	SE	n	% survival	SE
0	4014	100		3906	100	
6	3395	90	0	3315	90	0
12	2753	79	1	2755	80	1
24	1798	60	1	1895	63	1
36	1181	44	1	1300	49	1
48	741	32	1	868	38	1
60	468	24	1	608	31	1
72	305	18	1	412	24	1
84	183	13	1	275	19	1
96	111	9	1	179	14	1
108	69	7	1	119	12	1
120	37	5	1	70	9	1

Figure 12.3.2(a): Unadjusted technique survival by gender (uncensored for death and transplant), 1997-2012**Figure 12.3.2(b):** Unadjusted technique survival by gender (censored for death and transplant), 1997-2012**Table 12.3.2(b):** Unadjusted technique survival by gender (censored for death and transplant), 1997-2012

Gender Interval (months)	Male			Female		
	n	% survival	SE	n	% survival	SE
0	4014	100		3906	100	
6	3395	97	0	3315	97	0
12	2753	93	0	2755	94	0
24	1798	85	1	1895	87	1
36	1181	78	1	1300	79	1
48	741	71	1	868	73	1
60	468	63	1	608	68	1
72	305	57	1	412	64	1
84	183	50	2	275	58	2
96	111	46	2	179	52	2
108	69	42	2	119	49	2
120	37	34	3	70	43	2

Table 12.3.3(a): Unadjusted technique survival by diabetes status (uncensored for death and transplant), 1997-2012

Diabetes status Interval (month)	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	4729	100		3191	100	
6	4035	92	0	2675	88	1
12	3369	83	1	2139	75	1
24	2351	68	1	1342	52	1
36	1688	56	1	790	33	1
48	1175	45	1	432	22	1
60	845	37	1	231	14	1
72	598	30	1	119	9	1
84	395	23	1	63	5	1
96	259	17	1	33	3	1
108	173	14	1	15	2	0
120	101	11	1	6	1	0

Figure 12.3.3(a): Unadjusted technique survival by Diabetes status (uncensored for death and transplant), 1997-2012

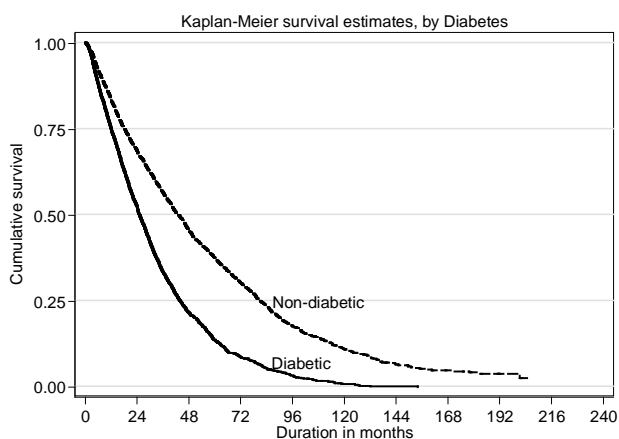


Figure 12.3.3(b): Unadjusted technique survival by diabetes status (censored for death and transplant), 1997-2012

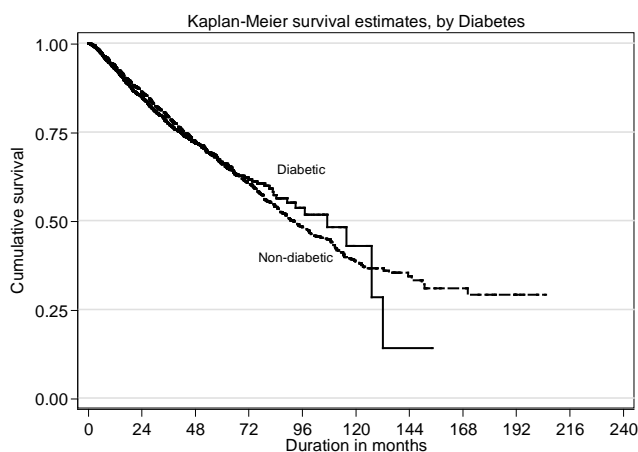
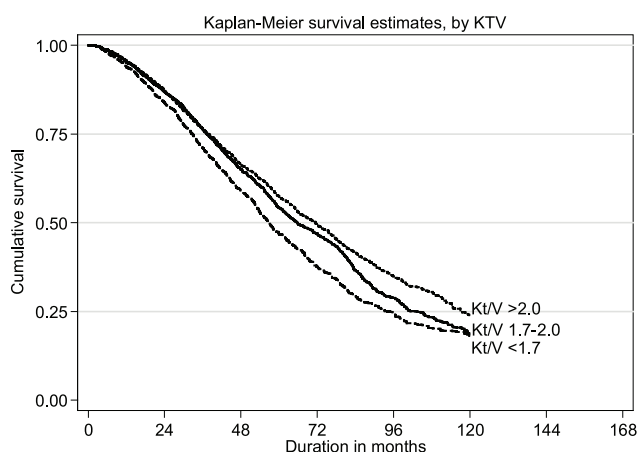


Table 12.3.3(b): Unadjusted technique survival by diabetes status (censored for death and transplant), 1997-2012

Diabetes status Interval (month)	Non- diabetes			Diabetic		
	n	% survival	SE	n	% survival	SE
0	4729	100		3191	100	
6	4035	97	0	2675	97	0
12	3369	93	0	2139	93	0
24	2351	86	1	1342	85	1
36	1688	79	1	790	77	1
48	1175	72	1	432	72	1
60	845	66	1	231	67	2
72	598	61	1	119	62	2
84	395	54	1	63	57	3
96	259	48	1	33	54	3
108	173	45	2	15	48	5
120	101	38	2	6	43	7

Table 12.3.4: Unadjusted technique survival by Kt/V, 1997-2012

Kt/V Interval (months)	<1.7			1.7-2.0			>2.0		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	2796	100		3975	100		8131	100	
6	2713	98	0	3877	98	0	7963	99	0
12	2528	94	0	3666	95	0	7514	96	0
24	2104	84	1	3162	87	1	6393	87	0
36	1663	71	1	2625	76	1	5171	77	0
48	1228	59	1	2038	65	1	3996	66	1
60	858	47	1	1515	54	1	3093	57	1
72	616	38	1	1150	47	1	2305	50	1
84	415	29	1	779	37	1	1629	42	1
96	309	25	1	503	29	1	1190	35	1
108	202	20	1	345	23	1	846	30	1
120	135	18	1	205	18	1	481	24	1

Figure 12.3.4: Unadjusted technique survival by Kt/V, 1997-2012**Table 12.3.5:** Adjusted hazard ratio for change of modality, 1997-2012

Factors	n	Hazard ratio	95% CI	p value
Age (years)				
Age 1-14 (ref [†])	518	1.00		
Age 15-24	592	1.28	(0.95;1.74)	0.106
Age 25-34	681	1.25	(0.91;1.73)	0.163
Age 35-44	953	1.18	(0.86;1.61)	0.315
Age 45-54	1725	1.01	(0.74;1.37)	0.960
Age 55-64	1973	1.13	(0.83;1.54)	0.444
Age ≥65	1478	1.22	(0.85;1.74)	0.276
Peritonitis				
No (ref [†])	7275	1.00		
Yes	645	7.96	(6.98;9.08)	<0.001
Diabetes Mellitus				
Non-diabetic (ref [†])	4729	1.00		
Diabetic	3191	1.20	(1.02;1.41)	0.030
Gender				
Male (ref [†])	4014	1.00		
Female	3906	0.77	(0.67;0.89)	<0.001
Cardiovascular Disease				
No CVD (ref [†])	6287	1.00		
CVD	1633	0.73	(0.59;0.9)	0.003

Table 12.3.5: Adjusted hazard ratio for change of modality, 1997-2012 (cont.)

Factors	n	Hazard ratio	95% CI	p value
Body Mass Index (BMI)				
<18.5	966	1.05	(0.85;1.29)	0.642
18.5-<25 (ref*)	4237	1.00		
>=25	2717	1.29	(1.12;1.48)	<0.001
Serum Albumin (g/L)				
<30	2232	1.27	(1.08;1.51)	0.005
30-<35	3252	1.01	(0.87;1.16)	0.923
35-<45 (ref*)	2375	1.00		
>=45	61	0.90	(0.33;2.43)	0.837
Serum cholesterol (mmol/L)				
<3.5	322	1.17	(0.82;1.68)	0.375
3.5-<5.2	3967	0.79	(0.66;0.94)	0.009
5.2-<6.2	2276	0.97	(0.8;1.16)	0.713
>=6.2 (ref*)	1355	1.00		
Diastolic BP (mmHg)				
<70	925	0.88	(0.68;1.15)	0.352
70-<80	2744	0.93	(0.8;1.08)	0.336
80-<90 (ref*)	3182	1.00		
90-<100	923	1.44	(1.2;1.73)	3.860
>=100	146	1.67	(1.1;2.53)	2.400
Hemoglobin (g/dL)				
<10	3179	1.25	(1.1;1.44)	0.001
10-<12 (ref*)	4050	1.00		
>=12	691	1.06	(0.83;1.36)	0.634
Serum calcium (mmol/L)				
<2.1	1732	1.47	(1.25;1.73)	<0.001
2.1-<=2.37 (ref*)	4397	1.00		
>2.37	1791	0.88	(0.74;1.03)	0.104
Calcium Phosphate product (mmol/L²)				
<3.5	4360	1.21	(1;1.46)	0.051
3.5-<4.5 (ref*)	2410	1.00		
4.5-<5.5	848	0.76	(0.58;0.99)	0.042
>=5.5	302	0.89	(0.57;1.4)	0.624
Serum Phosphate (mmol/L)				
<0.8	105	3.04	(1.68;5.49)	<0.001
0.8-<1.3 (ref*)	1991	1.00		
1.3-<1.8	3965	0.84	(0.7;1)	0.052
1.8-<2.2	1284	0.91	(0.68;1.21)	0.515
>=2.2	575	1.29	(0.84;1.99)	0.245
Kt/V				
<1.7	1092	1.20	(1;1.43)	0.047
1.7-2.0 (ref*)	1362	1.00		
<=2	2931	0.98	(0.84;1.14)	0.794
Assisted PD				
Selfcare (ref*)	4167	1.00		
Assisted	3508	1.07	(0.92;1.26)	0.372

Table 12.3.6: Reasons for drop-out from PD program, 2003-2012

Year	2003		2004		2005		2006		2007	
	n	%	n	%	n	%	n	%	n	%
Death	197	78	156	60	182	61	177	58	231	66
Transplant	12	5	13	5	22	7	25	8	18	5
Peritonitis	15	6	38	15	29	10	33	11	35	10
Catheter related infection	0	0	5	2	2	1	2	1	4	1
Membrane failure	8	3	19	7	27	9	18	6	13	4
Technical problem	5	2	2	1	11	4	9	3	4	1
Patient preference	8	3	20	8	10	3	9	3	20	6
Others	6	2	8	3	7	2	16	5	14	4
Unknown	1	0	0	0	8	3	17	6	12	3
Total	252	100	261	100	298	100	306	100	351	100

Year	2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%
Death	277	63	321	65	349	67	363	67	356	70
Transplant	21	5	15	3	12	2	17	3	14	3
Peritonitis	50	11	75	15	76	15	67	12	56	11
Catheter related infection	4	1	11	2	14	3	15	3	14	3
Membrane failure	24	5	18	4	25	5	29	5	30	6
Technical problem	7	2	19	4	12	2	19	4	17	3
Patient preference	50	11	30	6	16	3	23	4	17	3
Others	2	0	3	1	15	3	8	1	8	2
Unknown	2	0	1	0	1	0	1	0	0	0
Total	437	100	493	100	520	100	542	100	512	100

Table 12.3.7: Drop-out rate from PD program with time on treatment, 2003-2012

Year	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
< 3 months	14	6	8	3	16	5	12	4	20	6	31	7	38	8	20	4	28	5	33	6
3-<6 months	27	11	17	7	24	8	25	8	32	9	30	7	39	8	46	9	49	9	48	9
6- <12 months	42	17	37	14	40	13	38	12	58	17	65	15	78	16	67	13	75	14	71	14
>=12 months	169	67	199	76	218	73	231	75	241	69	311	71	338	69	387	74	390	72	360	70
Total	252	100	261	100	298	100	306	100	351	100	437	100	493	100	520	100	542	100	512	100

Table 12.3.8: Time on PD (1997-2012)

	Months													
	0-<6	6-11	12-17	18-23	24-29	30-35	36-41	42-47	48-59	60-71	72-83	84-95	96-107	≥108
1 st Treatment (n=7920)	1223	1189	1000	815	659	556	463	406	531	363	259	169	101	186

SECTION 12.4: PERITONITIS

Peritonitis rates have shown an encouraging improvement, with a median peritonitis rate of 1 in 53.8 patient-month in 2012 compared to 1 in 46 patient-months in the preceding year (Table 12.4.1) The inter-centre variation has lessened at 44.3 versus 73.5 patient-months. This may be a reflection of increased effort to reduce peritonitis rates in respective PD units.

Gram-positive organisms account for 36% of peritonitis with *Staphylococcus aureus* as the predominant gram-positive organism (40%). *E coli* remains the commonest gram-negative pathogen accounting for 37.3% of gram-negative infections (9% of total peritonitis episodes). Fungal peritonitis remains about 4% with no incidence in mycobacterial peritonitis. The culture negative rate remains at about 28% (Table & Figure 12.4.2a).

In 2012, majority of the peritonitis episodes had resolved (63.5%)(Figure 12.4.3a). When comparing two eras of PD (1993-2002 and 2003-2012) in outcome by causative organisms, there is a slight improvement (2%) in the proportion of cases achieving complete resolution (Figure 12.4.3c). Total mortality rates remain almost the same in the two eras (23.6% versus 22.7%). However, there is an increase in fungal and mycobacterium peritonitis death, which probably attributed to low catheter removal rate.

In multivariate analysis, the higher income level of the patient was the only statistically significant factor associated with peritonitis rates (Table 12.4.4) and this may be attributed to the tendency towards higher level of education.

Table 12.4.1: Variation in peritonitis rate (patient-month/episode) among PD centres, 1997-2012

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
1997	9	6	6	13.5	16.1	23.2	30	30
1998	9	0	0	17.7	23.5	29.1	54.9	54.9
1999	9	14.3	14.3	16.3	19.3	21	31.5	31.5
2000	11	11.7	11.7	17.4	23.2	30.6	71.4	71.4
2001	11	10.8	10.8	19.9	23.6	41.4	60.3	60.3
2002	11	12.6	12.6	17.9	32.7	44.4	219.2	219.2
2003	13	18.2	18.2	21.3	32.9	39.6	312.1	312.1
2004	15	0	0	23.6	32.9	36.6	41.5	41.5
2005	15	18	18	26.3	35.8	43	58	58
2006	21	14.8	18.5	27	37.9	49.8	65.2	97.7
2007	23	12	12.9	31.2	42.1	55.3	66.9	106.7
2008	25	12	13	30	40.4	58.7	105.5	114.6
2009	25	14	17.6	29.5	38.2	55.7	117.7	246.1
2010	26	10.8	19.3	28.1	36	52.3	72.2	84.9
2011	28	8.9	12	33.8	46	63.5	103.9	260.1
2012	27	25.5	34.8	44.3	53.8	73.5	170	249.1

Figure 12.4.1: Variation in peritonitis rate among PD centres, 2012

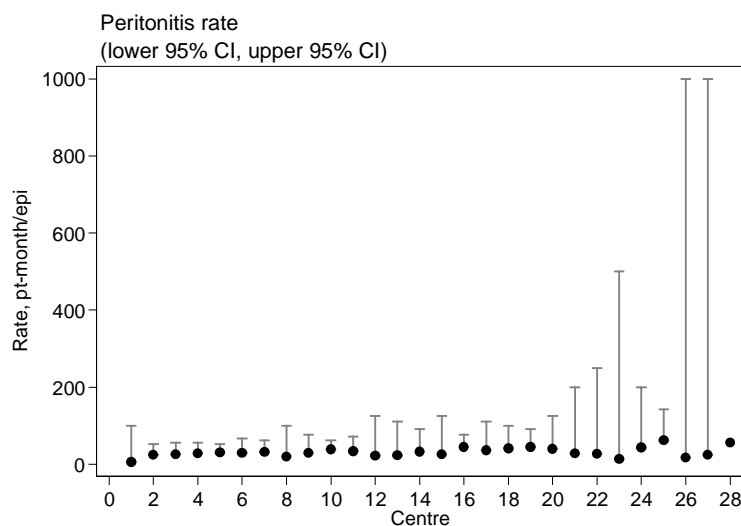


Table 12.4.2: Causative organism in PD peritonitis, 2003-2012

Microorganism	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
(A) Gram Positives																				
Staph. Aureus	45	14	52	12	39	12	51	14	47	13	46	10	53	11	74	15	78	15	70	15
Staph Coagulase Neg.	47	11	41	13	42	13	32	9	29	8	49	11	51	10	54	11	46	9	46	10
Streptococcus	16	4	13	4	10	3	17	5	14	4	19	4	17	4	12	2	34	7	39	8
Others	16	1	4	4	8	3	14	4	11	3	7	2	6	1	6	1	19	4	19	4
(B) Gram Negatives																				
Pseudomonas	20	8	28	6	27	8	23	6	30	8	40	9	34	7	32	7	44	8	17	4
Acinetobacter	27	7	25	7	21	7	8	2	21	6	20	4	17	4	9	2	22	4	13	3
Klebsiella	13	5	19	4	19	6	20	6	17	5	23	5	27	6	31	6	29	6	26	5
Enterobacter	6	2	9	2	13	4	7	2	8	2	3	1	13	3	8	2	9	2	7	2
E.Coli	20	6	23	6	30	9	15	4	32	9	42	9	41	8	60	12	50	10	44	9
Others	9	2	7	3	4	1	7	2	6	2	8	2	9	2	9	2	9	2	11	2
(C) Polymicrobial																				
	3	1	2	1	0	0	1	0	0	0	0	0	13	3	4	1	0	0	0	0
(D) Others																				
Fungal	12	4	15	3	7	2	16	4	20	5	24	5	18	4	15	3	17	3	18	4
Mycobacterium	3	1	4	1	2	1	4	1	1	0	4	1	1	0	0	0	6	1	2	0
Others	12	2	8	3	3	1	10	3	12	3	21	5	16	3	33	7	30	6	34	7
(E) No growth																				
	115	33	123	32	96	30	141	39	122	33	160	34	174	36	147	30	132	25	133	28
TOTAL	364	100	373	100	321	100	366	100	370	100	466	100	490	100	494	100	525	100	479	100

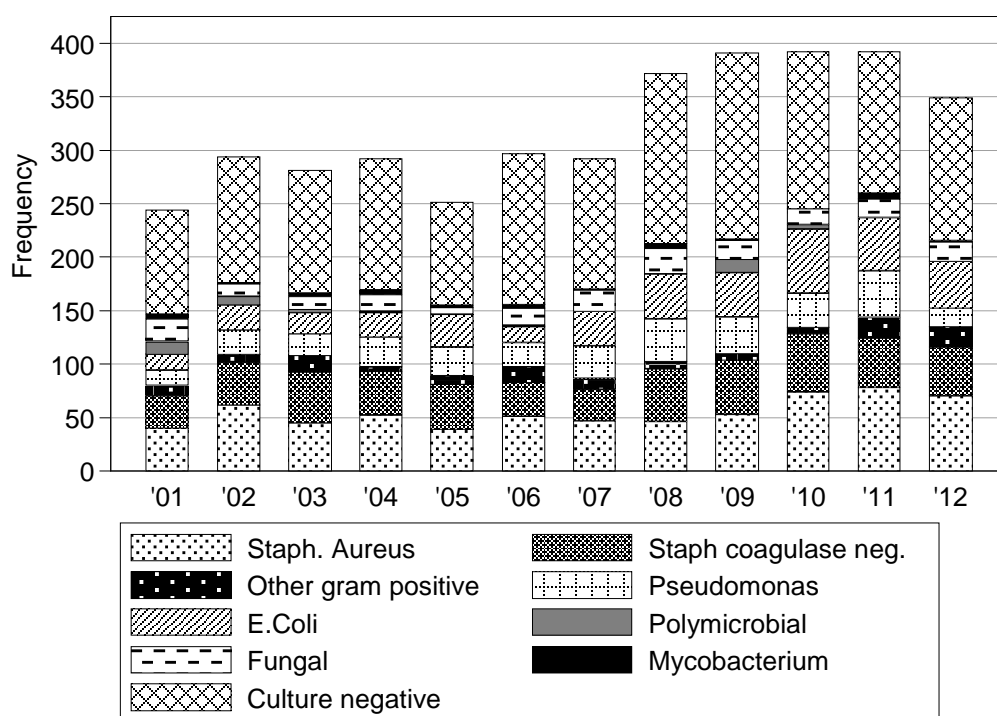
Figure 12.4.2: Causative organism in PD peritonitis, 2001-2012

Table 12.4.3(a): Outcome of peritonitis by causative organism, 1993-2002

	Peritonitis Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	n	%	n	%	n	%	n	%
(A) Gram Positives								
Staph. Aureus	150	69	23	11	44	20	217	100
Staph Coagulase Negative	135	78	11	6	26	15	172	100
Streptococcus	35	66	5	9	13	25	53	100
Others	11	58	2	11	6	32	19	100
(B) Gram Negatives								
Pseudomonas	36	38	28	29	32	33	96	100
Acinetobacter	44	61	10	14	18	25	72	100
Klebsiella	30	45	15	22	22	33	67	100
Enterobacter	27	54	10	20	13	26	50	100
E.Coli	43	61	3	4	24	34	70	100
Others	15	56	3	11	9	33	27	100
(C) Polymicrobial								
	11	25	14	32	19	43	44	100
(D) Others								
Fungal	5	5	44	43	54	52	103	100
Mycobacterium	6	27	6	27	10	45	22	100
Others	7	54	3	23	3	23	13	100
(E) No growth								
	555	71	94	12	133	17	782	100

Figure 12.4.3(a): Outcome of peritonitis by causative organism, 2012

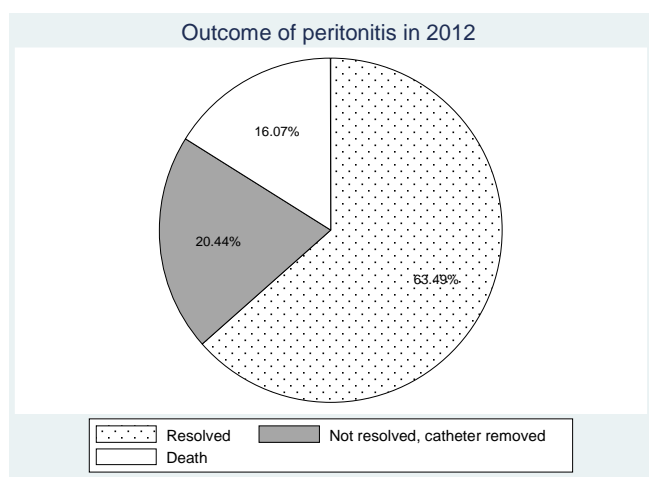


Figure 12.4.3(b): Outcome of peritonitis by causative organism, 1993-2002

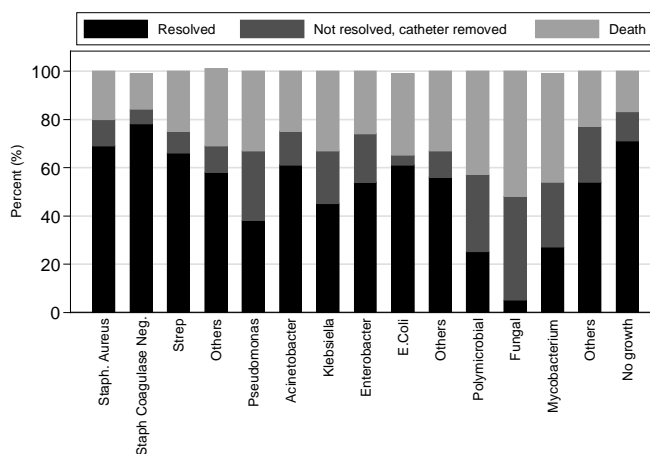


Table 12.4.3(b): Outcome of peritonitis by causative organism, 2003-2012

Causative Organism	Peritonitis Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	n	%	n	%	n	%	n	%
(A) Gram Positives								
Staph. Aureus	386	67	92	16	97	17	575	100
Staph Coagulase Negative	358	80	30	7	59	13	447	100
Streptococcus	153	81	13	7	24	13	190	100
Others	82	78	10	10	13	12	105	100
(B) Gram Negatives								
Pseudomonas	102	35	83	28	109	37	294	100
Acinetobacter	107	58	34	18	45	24	186	100
Klebsiella	126	57	40	18	56	25	222	100
Enterobacter	51	58	11	13	26	30	88	100
E.Coli	222	62	45	13	93	26	360	100
Others	42	55	21	28	13	17	76	100
(C) Polymicrobial	10	32	6	19	15	48	31	100
(D) Others								
Fungal	10	6	53	31	107	63	170	100
Mycobacterium	2	7	8	29	18	64	28	100
Others	108	62	29	17	38	22	175	100
(E) No growth	929	68	166	12	268	20	1363	100

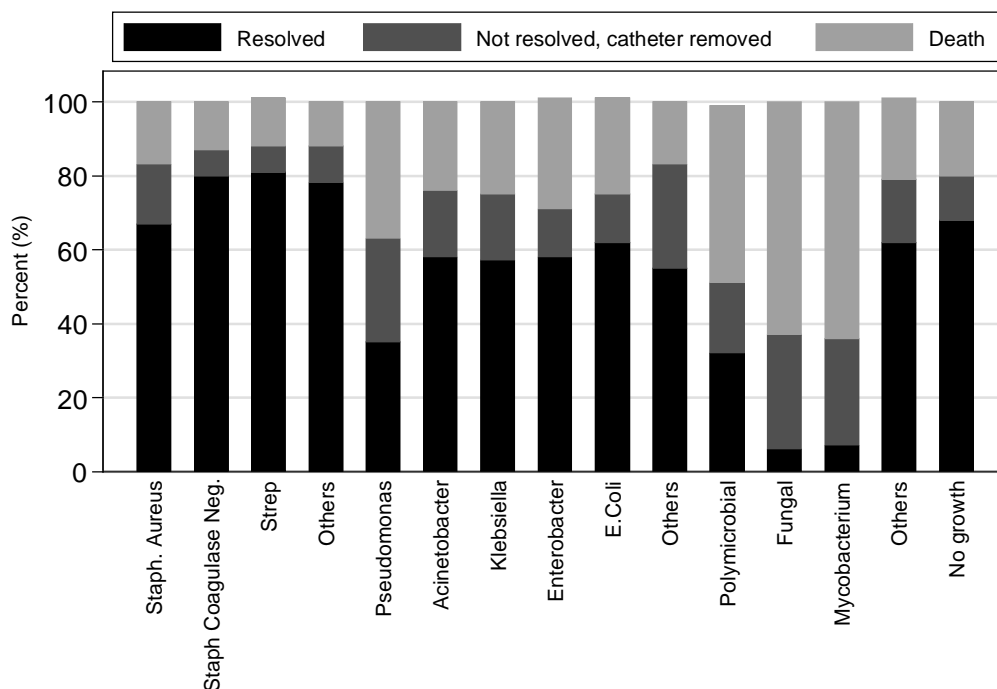
Figure 12.4.3(c): Outcome of peritonitis by causative organism, 2003-2012

Figure 12.4.3(d): Comparing outcome of peritonitis by causative organism in 1993-2002 vs 2003-2012

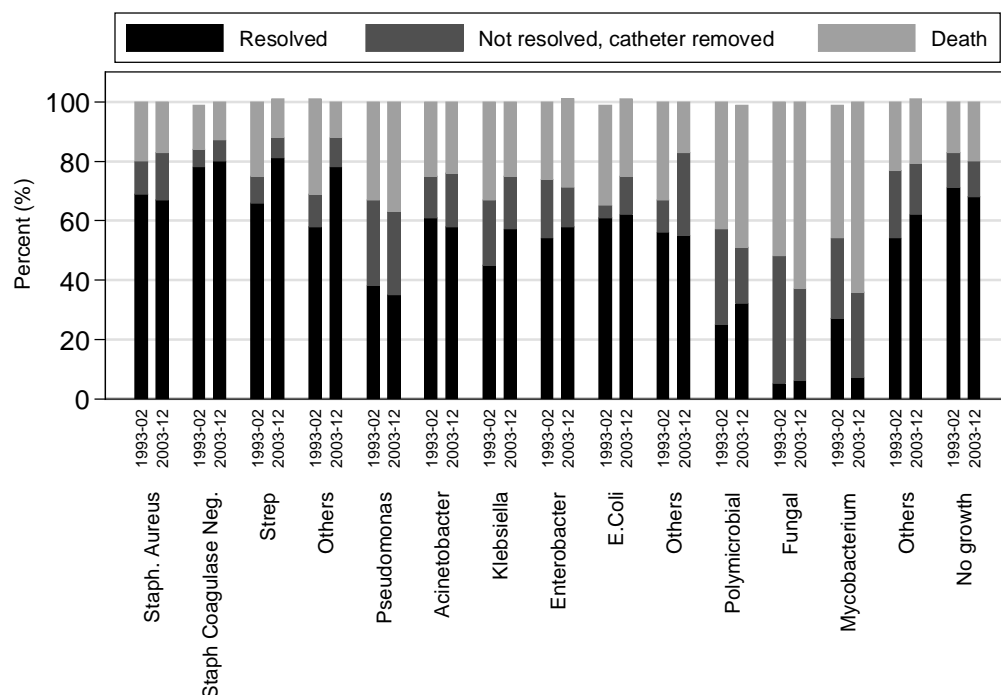


Table 12.4.4: Risk factors influencing peritonitis rate, 1993-2012

Factors	n	Risk Ratio	95% CI	P value
Age (years)				
<=14	603	0.93	(0.82;1.06)	0.815
15-24	446	0.84	(0.74;0.95)	0.741
25-34 (ref*)	527	1.00		
35-44	800	1.00	(0.89;1.11)	0.895
45-54	1444	0.97	(0.88;1.08)	0.877
55-64	1645	0.95	(0.85;1.06)	0.85
>=65	1154	0.87	(0.76;0.98)	0.763
Gender				
Male (ref*)	3334	1.00		
Female	3285	1.01	(0.95;1.07)	0.954
Diabetes				
No (ref*)	3954	1.00		
Yes	2665	1.02	(0.95;1.09)	0.954
Income				
<RM 1000 (ref*)	2524	1.00		
RM 1000-3000	3251	0.84	(0.79;0.89)	0.792
RM 3001-5000	832	0.75	(0.68;0.84)	0.68
RM 5001-10000	11	0.17	(0.02;1.23)	0.024
>=RM 10000	1	0.00		
Education				
Nil	611	1.13	(1.01;1.26)	1.015
Primary	2236	1.14	(1.07;1.21)	1.066
Secondary (ref*)	3162	1.00		
Tertiary	610	0.92	(0.83;1.03)	0.828
Assistance to perform CAPD				
Self care (ref*)	3617	1.00		
Partially assisted	1059	0.91	(0.83;0.99)	0.834
Completely assisted	1943	0.89	(0.83;0.96)	0.828

References :

1. ISPD guidelines/recommendations. Guideline on targets for solute and fluid removal in adult patients on chronic peritoneal dialysis. Perit.Dial. Int 2006;26:520-522