

**CHAPTER 12**

**PERITONEAL DIALYSIS**

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**SECTION 12.1: MODALITIES AND PRESCRIPTION OF PD**

The number of patients treated with PD has been steadily increasing each year, reaching a total of 2610 patients in 2011. The PD growth rate was 10.5% from the previous year and reflects a remarkable improvement compared to only 6-6.7% in 2008/2009 and 2009/2010.

There were 2196 patients (84.2%) treated with CAPD/DAPD in 2011 whilst APD treatment has doubled to 414 patients (15.9%) in 2011 compared to previous 5 years.

The majority of patients are on the Baxter disconnect system (85.8%) with most patients (91.3%) performing 4 exchanges per day for CAPD treatment. Meanwhile in APD, most patients (90.6%) were using 10L dwell volume and only 5.7% using more than 10L dwell volume.

The annual stock and flow during the period 2002-2011 is shown in Table 12.1.1, 12.1.2, 12.1.3a and 12.1.3b.

**Table 12.1.1:** Peritoneal dialysis regimes, 2002-2011

PD regime	2002		2003		2004		2005		2006	
	n	%	n	%	n	%	N	%	n	%
Standard CAPD	861	97	1192	96.8	1266	96.1	1303	93.2	1397	90
DAPD	24	2.7	34	2.8	39	3	45	3.2	67	4.3
Automated PD/ CCPD	3	0.3	5	0.4	12	0.9	50	3.6	88	5.7
Total	888	100	1231	100	1317	100	1398	100	1552	100

PD regime	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	N	%	n	%
Standard CAPD	1547	85.7	1717	82.4	1847	83.5	1973	83.6	2079	79.7
DAPD	115	6.4	121	5.8	119	5.4	91	3.9	117	4.5
Automated PD/ CCPD	144	8	245	11.8	246	11.1	296	12.5	414	15.9
Total	1806	100	2083	100	2212	100	2360	100	2610	100

**Table 12.1.2:** CAPD connectology, 2002-2011

CAPD connectology	2002		2003		2004		2005		2006	
	n	%	n	%	n	%	n	%	n	%
Baxter disconnect	726	98.5	1048	87	1147	88.8	1286	92.1	1425	92
Fresenius disconnect	11	1.5	154	12.8	145	11.2	111	7.9	119	7.7
Others	0	0	3	0.2	0	0	0	0	5	0.3
Total	737	100	1205	100	1292	100	1397	100	1549	100

CAPD connectology	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
Baxter disconnect	1675	93.5	1955	93.9	2013	92.1	2126	90.7	2230	85.8
Fresenius disconnect	116	6.5	124	6	173	7.9	218	9.3	367	14.1
Others	0	0	4	0.2	0	0	1	0	1	0
Total	1791	100	2083	100	2186	100	2345	100	2598	100

**Table 12.1.3(a): CAPD Number of Exchanges per day, 2002-2011**

Number of exchanges/ day	2002		2003		2004		2005		2006	
	n	%	n	%	n	%	n	%	n	%
2	0	0	3	0.3	6	0.5	3	0.2	3	0.2
3	10	1.2	14	1.2	12	1	20	1.5	52	3.7
4	813	95.9	1104	95.9	1185	94.8	1234	95.1	1296	93.2
5	25	2.9	30	2.6	47	3.8	40	3.1	39	2.8
Total	848	100	1151	100	1250	100	1297	100	1390	100

Number of exchanges/ day	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
2	2	0.1	3	0.2	2	0.1	7	0.4	1	0
3	29	1.9	47	2.8	79	4.4	125	6.4	113	5.5
4	1456	95.8	1611	94.4	1676	92.3	1778	91.1	1874	91.3
5	33	2.2	46	2.7	59	3.2	42	2.2	65	3.2
Total	1520	100	1707	100	1816	100	1952	100	2053	100

**Table 12.1.3(b): APD dwell volumes per day, 2002-2011**

Dwell volumes/ day	2002		2003		2004		2005		2006	
	n	%	n	%	n	%	n	%	n	%
8	0	0	0	0	0	0	9	47.4	6	12.5
10	0	0	1	100	4	100	7	36.8	32	66.7
12	1	100	0	0	0	0	3	15.8	10	20.8
14	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
Total	1	100	1	100	4	100	19	100	48	100

Dwell volumes/ day	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
8	11	10.5	4	2.2	7	5.1	11	14.5	9	3.7
10	83	79	164	92.1	119	87.5	56	73.7	222	90.6
12	10	9.5	10	5.6	8	5.9	8	10.5	11	4.5
14	0	0	0	0	0	0	0	0	0	0
16	1	1	0	0	2	1.5	1	1.3	3	1.2
Total	105	100	178	100	136	100	76	100	245	100

**SECTION 12.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT**

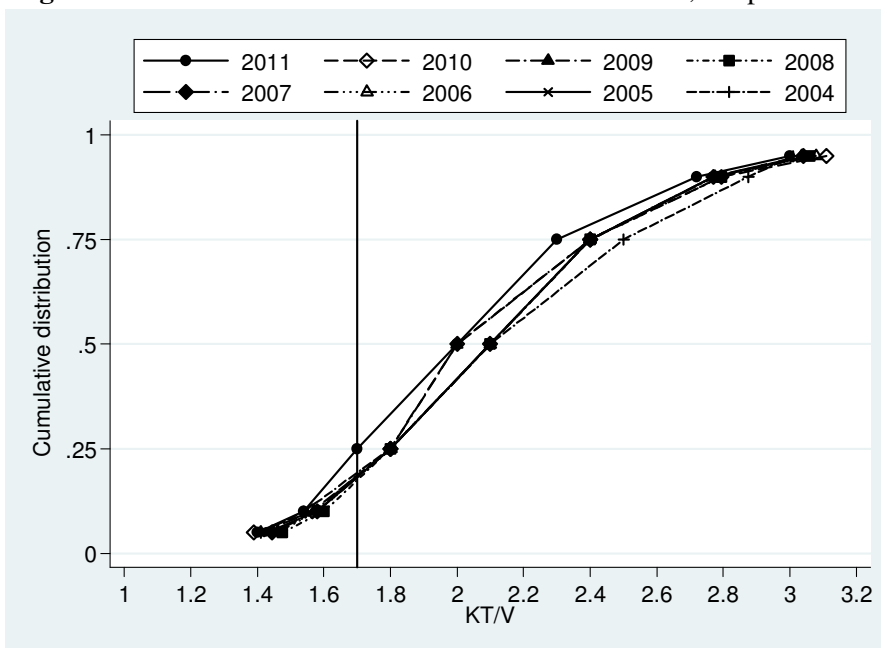
The number of patients achieving the K/DOQI target recommendation of Kt/V of  $\geq 1.7$  per week has been static at 79% in 2011 and 2010 with median delivered weekly Kt/V of 2.0. On comparison amongst PD centres, the percentage of patients in each centre achieving this target Kt/V has shown a 1.4-fold variation between the highest- and lowest-performing centers (90% vs. 64%). Half of the centers were able to have up to 78.5% of their patients achieving this target in 2011. (Tables & Figures 12.2.1 and 12.2.2)

Among incident PD patients in 2011, there was no significant difference between peritoneal transport status i.e. high transport status (49%) and low transport status (50%). (Table 12.2.3) This observation is also noted in the previous years. However, over time, more than 50% of patients develop fast transport characteristics especially after 8 years of dialysis vintage. (Table 12.2.4)

**Table 12.2.1:** Distribution of delivered Kt/V, PD patients 2004-2011

Year	Number of Patients	Mean	SD	Median	LQ	UQ	% patients $\geq 1.7$ per week
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

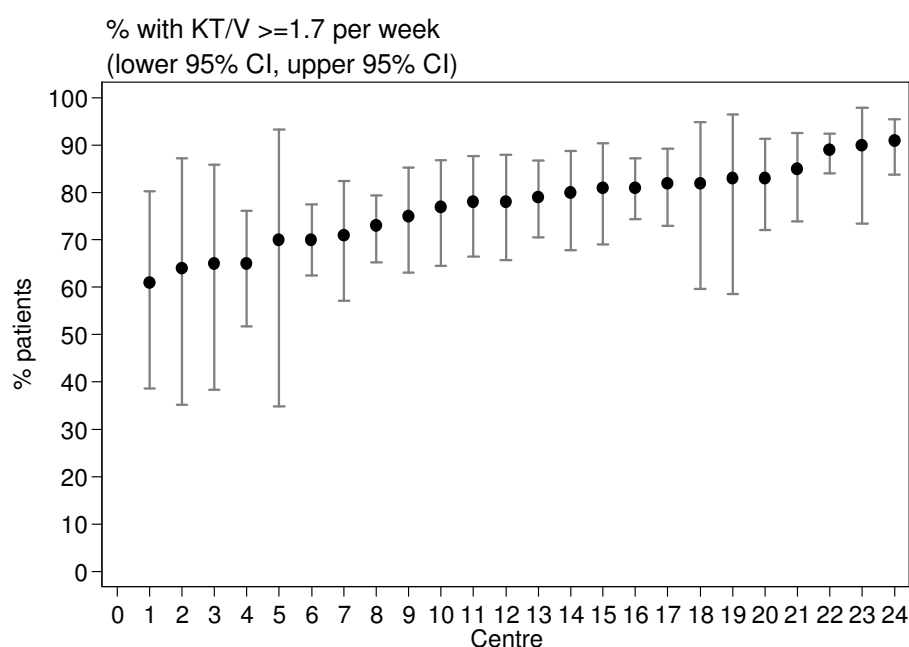
**Figure 12.2.1:** Cumulative distribution of delivered Kt/V, PD patients 2004-2011



**Table 12.2.2:** Variation in proportion of patients with Kt/V  $\geq 1.7$  per week among PD centres, 2004-2011

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
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

**Figure 12.2.2:** Variation in proportion of patients with Kt/V  $\geq 1.7$  per week among PD centres 2011



**Table 12.2.3:** Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2004-2011

Year	2004		2005		2006		2007		2008		2009		2010		2011	
	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
Low average	72	36	159	39	285	41	376	41	465	42	530	39	549	39	624	39
High average	82	41	156	39	256	37	355	39	384	35	455	34	480	34	609	38
High	14	7	45	11	63	9	88	10	108	10	181	13	180	13	196	12
Total	199	100	405	100	692	100	911	100	1102	100	1352	100	1399	100	1593	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	32	9	38	9	34	11	22	12	16	11
Low average	157	42	153	38	98	32	76	41	57	40
High average	143	38	143	36	129	43	65	35	56	39
High	40	11	67	17	41	14	23	12	15	10
Total	372	100	401	100	302	100	186	100	144	100

Duration (Years)	5-<6		6-<7		7-<8		8-<9		9-<10		10 or more	
	n	%	n	%	n	%	n	%	n	%	n	%
Low	12	13	4	7	6	16	2	5	3	25	2	6
Low average	42	44	26	47	15	39	13	34	2	17	8	25
High average	34	36	22	40	17	45	22	58	7	58	15	47
High	7	7	3	5	0	0	1	3	0	0	7	22
Total	95	100	55	100	38	100	38	100	12	100	32	100

**SECTION 12.3: TECHNIQUE SURVIVAL ON PD**

The one-, three-and five-year PD technique survival (uncensored for death and transplant) was 78%, 46% and 27% in 2007-2011. Median PD technique survival time was 34 months. (Table & Figure 12.3.1a) When censored for death and transplant, the PD technique survival was 92%, 75% and 64% at one-, three - and five-year with median PD technique survival time at 94 months. (Table & Figure 12.3.1b) The PD technique survival did not show any improvement comparing the era between 2002-2006 and 2007-2011.

Age was a significant influence on PD technique survival with the elderly (age > 65 years) having the worst technique survival compared to younger age groups (age < 25 years). (Table & Figure 12.3.2a) However when censored for death and transplant, (Table & Figure 12.3.2b), the trend is actually reversed. Gender did not show any influence on technique survival during the early period of treatment (<24 months) but the Kaplan Meier curve starts to diverge after 24 months with female having better technique survival compared to male. (Table & Figure 12.3.3a and 12.3.3b)

Diabetics have poorer PD technique survival compared to non-diabetics when uncensored for death and transplant (Table & Figure 12.3.4a). However, the PD technique survival showed no difference between diabetic and non-diabetic patients when censored for death and transplant. (Table & Figure 12.3.4b)

There was a clear association of technique survival with solute clearance. As expected, those with Kt/v ≥2.0 demonstrated the best technique survival compared to those with Kt/V ≥1.7. (Table & Figure 12.3.5)

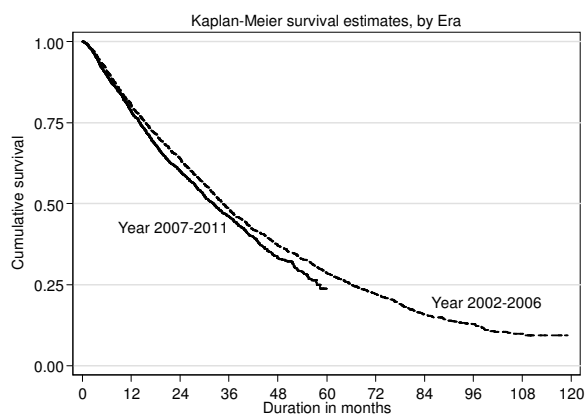
In multivariate analysis, male gender, presence of CVD, poor nutritional indices (low serum albumin and cholesterol), obesity, anaemia, high serum calcium, low phosphate and poor BP control were associated with increased risk of drop-out from PD modality. (Table 12.3.6) Peritonitis was the major factor for conversion to HD accounting for 13% in year 2011. (Table 12.3.7a) The proportion of patient dropping out from PD at less than 12 months after commencing PD was much lower (28%) compared to after 12 months (73%) each year. (Table 12.3.7b)

Of the 5256 patients who have ever received peritoneal dialysis from year 2002-2011, 7% had experienced at least 5 years of continuous peritoneal dialysis. (Table 12.3.8)

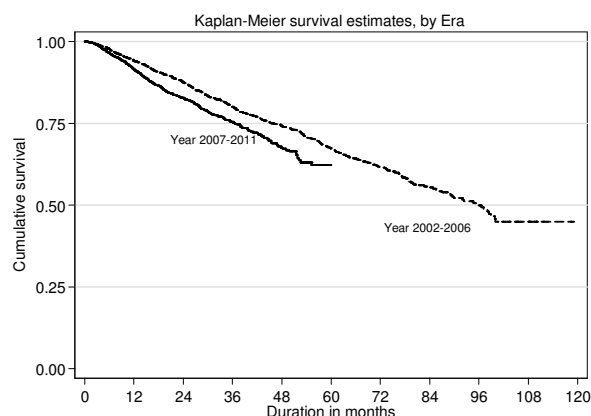
**Table 12.3.1(a):** Unadjusted technique survival by era 2002–2006 and 2007–2011 (uncensored for death and transplant)

Era Interval (month)	2002–2006			2007–2011		
	n	% Survival	SE	n	% Survival	SE
0	1959	100		3297	100	
6	1771	91	1	2622	89	1
12	1551	80	1	1958	78	1
24	1201	64	1	1108	60	1
36	892	48	1	529	46	1
48	679	37	1	188	33	1
60	517	29	1	-	-	-
72	310	22	1	-	-	-
84	163	16	1	-	-	-
96	85	13	1	-	-	-
108	27	10	1	-	-	-
120	-	-	-	-	-	-

**Figure 12.3.1(a):** Unadjusted technique survival by era 2002–2006 and 2007–2011 (uncensored for death and transplant)



**Figure 12.3.1(b):** Unadjusted technique survival by era 2002–2006 and 2007–2011 (censored for death and transplant)



**Table 12.3.1(b):** Unadjusted technique survival by era 2002–2006 and 2007–2011 (censored for death and transplant)

Era Interval (month)	2002–2006			2007–2011		
	n	% Survival	SE	n	% Survival	SE
0	1959	100		3297	100	
6	1771	98	0	2622	96	0
12	1551	94	1	1958	92	1
24	1201	87	1	1108	83	1
36	892	80	1	529	75	1
48	679	74	1	188	68	2
60	517	67	1	-	-	-
72	310	62	2	-	-	-
84	163	55	2	-	-	-
96	85	50	2	-	-	-
108	27	45	3	-	-	-
120	-	-	-	-	-	-

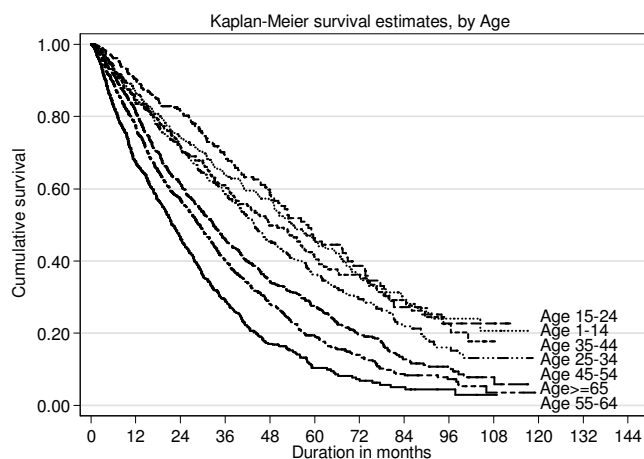
**Table 12.3.2(a):** Unadjusted technique survival by age (uncensored for death and transplant), 2002-2011

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	329	100		424	100		434	100		604	100	
6	296	96	1	376	93	1	373	93	1	525	93	1
12	254	90	2	318	87	2	307	84	2	438	85	2
24	184	82	2	229	74	2	210	72	2	321	72	2
36	116	69	3	160	64	3	146	61	3	219	59	2
48	80	58	4	118	57	3	97	50	3	145	45	2
60	51	46	4	74	45	3	62	41	3	90	36	3
72	31	39	4	48	36	3	42	36	3	60	29	3
84	16	27	5	29	29	4	22	29	4	34	22	3
96	10	23	5	14	24	4	12	22	4	19	16	3
108	7	23	5	6	21	5	2	18	4	8	13	3
120	-	-	-	-	-	-	-	-	-	-	-	-

Age group (years) Interval (month)	45-54			55-64			≥65		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	1119	100		1307	100		1039	100	
6	955	92	1	1081	89	1	795	83	1
12	775	81	1	840	77	1	584	67	2
24	512	61	2	524	57	2	330	46	2
36	317	46	2	305	40	2	159	29	2
48	196	34	2	164	28	2	73	17	2
60	131	27	2	86	19	2	28	10	1
72	70	19	2	48	14	1	17	7	1
84	36	13	2	23	9	1	9	5	1
96	18	11	2	14	7	1	4	4	1
108	5	8	2	3	4	2	2	3	1
120	-	-	-	-	-	-	-	-	-

**Figure 12.3.2(a):** Unadjusted technique survival by age (uncensored for death and transplant), 2002-2011





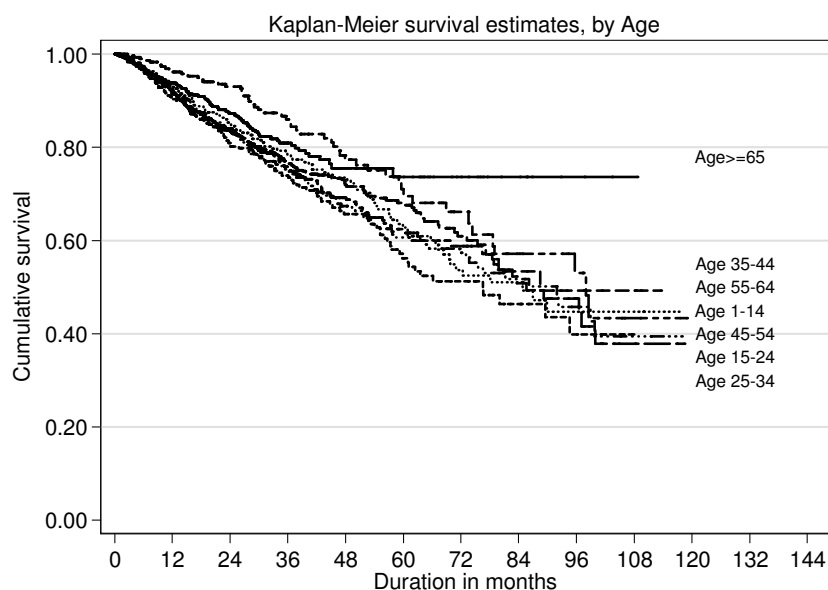
**Table 12.3.2(b):** Unadjusted technique survival by age (censored for death and transplant), 2002-2011

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	329	100		424	100		434	100		604	100	
6	296	99	1	376	97	1	373	96	1	525	97	1
12	254	97	1	318	93	1	307	90	2	438	92	1
24	184	93	2	229	85	2	210	81	2	321	84	2
36	116	86	2	160	78	2	146	74	3	219	75	2
48	80	77	3	118	73	3	97	66	3	145	67	3
60	51	71	4	74	63	3	62	56	4	90	61	3
72	31	66	5	48	54	4	42	51	4	60	57	3
84	16	53	6	29	51	4	22	46	4	34	52	4
96	10	49	7	14	45	5	12	40	6	19	46	5
108	7	49	7	6	45	5	2	40	6	8	39	6
120	-	-	-	-	-	-	-	-	-	-	-	-

Age group (years) Interval (month)	45-54			55-64			≥65		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	1119	100		1307	100		1039	100	
6	955	97	1	1081	97	1	795	97	1
12	775	92	1	840	92	1	584	94	1
24	512	84	1	524	84	1	330	87	1
36	317	77	2	305	76	2	159	81	2
48	196	72	2	164	69	2	73	76	3
60	131	68	2	86	62	3	28	74	3
72	70	61	3	48	59	3	17	74	3
84	36	51	4	23	57	3	9	74	3
96	18	47	4	14	53	5	4	74	3
108	5	38	6	3	43	7	2	74	3
120	-	-	-	-	-	-	-	-	-

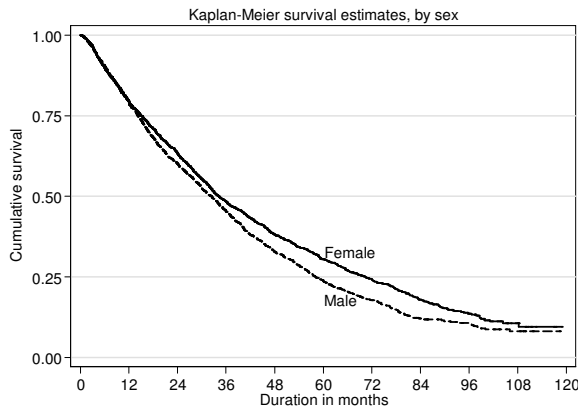
**Figure 12.3.2(b):** Unadjusted technique survival by age (censored for death and transplant), 2002-2011



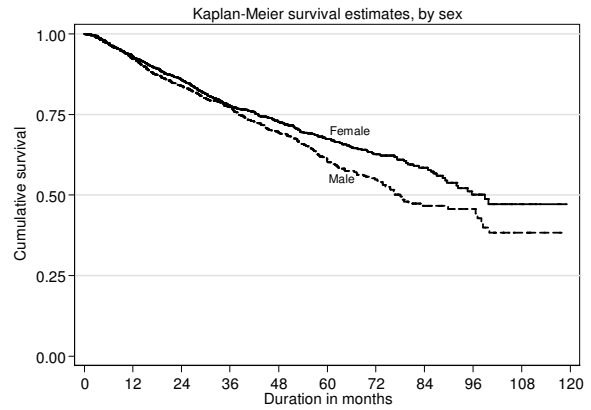
**Table 12.3.3(a):** Unadjusted technique survival by gender (uncensored for death and transplant), 2002-2011

Gender Interval (months)	Male			Female		
	n	% survival	SE	n	% survival	SE
0	2647	100		2609	100	
6	2218	90	1	2172	90	1
12	1760	79	1	1749	79	1
24	1141	60	1	1165	63	1
36	697	45	1	721	48	1
48	401	33	1	466	38	1
60	227	24	1	291	30	1
72	132	18	1	179	24	1
84	62	12	1	102	18	1
96	37	11	1	49	14	1
108	14	8	1	14	11	1
120	-	-	-	-	-	-

**Figure 12.3.3(a):** Unadjusted technique survival by gender (uncensored for death and transplant), 2002-2011



**Figure 12.3.3(b):** Unadjusted technique survival by gender (censored for death and transplant), 2002-2011



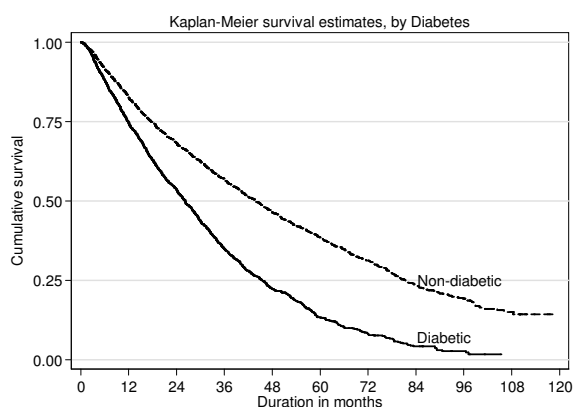
**Table 12.3.3(b):** Unadjusted technique survival by gender (censored for death and transplant), 2002-2011

Gender Interval (months)	Male			Female		
	n	% survival	SE	n	% survival	SE
0	2647	100		2609	100	
6	2218	97	0	2172	97	0
12	1760	92	1	1749	93	1
24	1141	84	1	1165	86	1
36	697	77	1	721	78	1
48	401	69	1	466	73	1
60	227	60	2	291	67	2
72	132	55	2	179	63	2
84	62	47	3	102	58	2
96	37	46	3	49	50	3
108	14	38	4	14	47	3
120	-	-	-	-	-	-

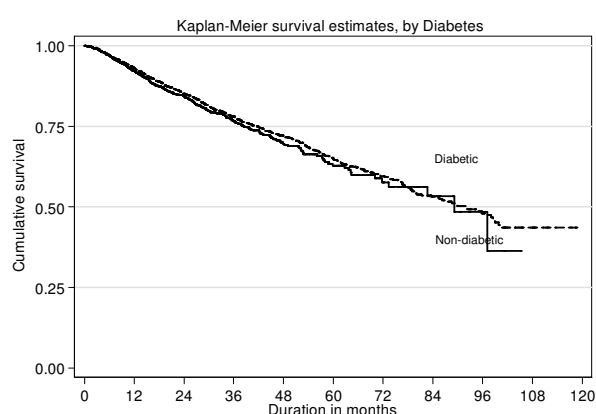
**Table 12.3.4(a):** Unadjusted technique survival by diabetes status (uncensored for death and transplant), 2002-2011

Diabetes status Interval (month)	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	3030	100		2226	100	
6	2549	92	1	1843	88	1
12	2052	83	1	1457	74	1
24	1365	68	1	939	53	1
36	920	57	1	495	35	1
48	616	46	1	252	22	1
60	410	38	1	108	13	1
72	263	31	1	48	8	1
84	147	24	1	17	4	1
96	80	19	1	6	3	1
108	27	15	2	-	-	-
120	-	-	-	-	-	-

**Figure 12.3.4(a):** Unadjusted technique survival by Diabetes status (uncensored for death and transplant), 2002-2011



**Figure 12.3.4(b):** Unadjusted technique survival by diabetes status (censored for death and transplant), 2002-2011



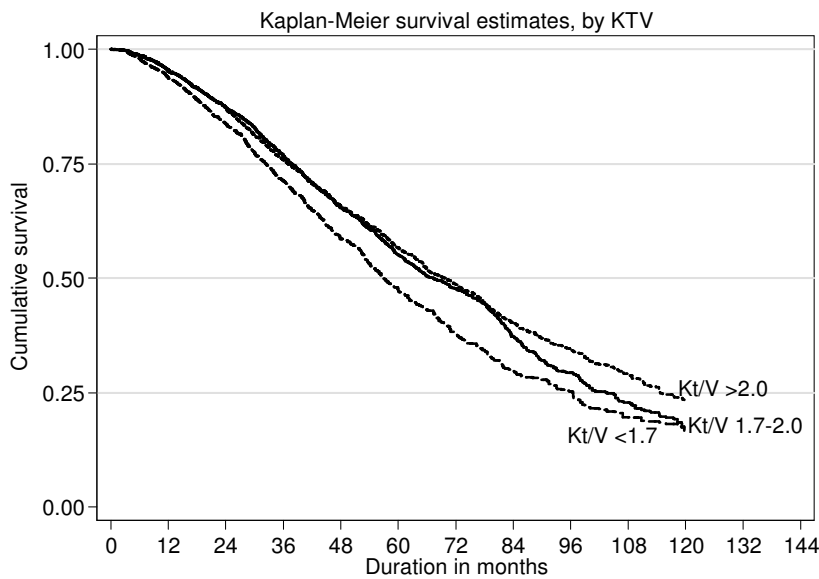
**Table 12.3.4(b):** Unadjusted technique survival by diabetes status (censored for death and transplant), 2002-2011

Diabetes status Interval (month)	Non- diabetes			Diabetic		
	n	% survival	SE	n	% survival	SE
0	3030	100		2226	100	
6	2549	97	0	1843	97	0
12	2052	93	1	1457	92	1
24	1365	85	1	939	84	1
36	920	78	1	495	77	1
48	616	72	1	252	69	2
60	410	65	1	108	63	2
72	263	60	2	48	58	3
84	147	53	2	17	53	4
96	80	48	2	6	48	6
108	27	44	3	-	-	-
120	-	-	-	-	-	-

**Table 12.3.5:** Unadjusted technique survival by Kt/V, 2002-2011

Kt/V Interval (months)	<1.7			1.7-2.0			>2.0		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	2326	100		3392	100		6929	100	
6	2259	98	0	3319	99	0	6776	99	0
12	2107	94	1	3150	95	0	6412	96	0
24	1783	84	1	2742	87	1	5485	87	0
36	1362	71	1	2221	77	1	4312	76	1
48	998	59	1	1690	65	1	3372	66	1
60	706	47	1	1255	55	1	2527	57	1
72	509	38	1	933	48	1	1882	49	1
84	341	30	1	612	37	1	1344	40	1
96	228	25	1	405	29	1	938	34	1
108	145	20	1	239	23	1	603	29	1
120	84	17	1	133	17	1	387	23	1

**Figure 12.3.5:** Unadjusted technique survival by Kt/V,2002-2011



**Table 12.3.6:** Adjusted hazard ratio for change of modality, 2002-2011

Factors	n	Hazard ratio	95% CI	p value
<b>Age (years):</b>				
Age 1-14 (ref*)	329	1.00		
Age 15-24	424	1.01	(0.69;1.48)	0.961
Age 25-34	434	1.18	(0.79;1.76)	0.407
Age 35-44	604	1.20	(0.81;1.78)	0.355
Age 45-54	1119	1.03	(0.7;1.51)	0.873
Age 55-64	1307	1.11	(0.76;1.63)	0.596
Age ≥65	1039	1.18	(0.77;1.81)	0.441
<b>Peritonitis</b>				
No (ref*)	4886	1.00		
Yes	670	8.82	(7.58;10.28)	<0.001
<b>Diabetes Mellitus</b>				
Non-diabetic (ref*)	3030	1.00		
Diabetic	2226	1.10	(0.92;1.33)	0.288
<b>Gender:</b>				
Male (ref*)	2647	1.00		
Female	2609	0.82	(0.7;0.97)	0.021
<b>Cardiovascular Disease:</b>				
No CVD (ref*)	4203	1.00		
CVD	1053	0.76	(0.61;0.96)	0.019
<b>BMI:</b>				
<18.5	633	1.14	(0.89;1.47)	0.296
18.5-<25 (ref*)	2732	1.00		
≥25	1891	1.33	(1.13;1.56)	0.001
<b>Serum Albumin:</b>				
<30	1600	1.55	(1.26;1.9)	<0.001
30-<35	1630	1.10	(0.93;1.31)	0.279
35-<45 (ref*)	1991	1.00		
≥45	35	0.89	(0.28;2.81)	0.848
<b>Serum cholesterol (mmol/L):</b>				
<3.5	251	0.88	(0.58;1.33)	0.544
3.5-<5.2	2708	0.71	(0.58;0.87)	0.001
5.2-<6.2	1429	0.84	(0.68;1.05)	0.119
≥6.2 (ref*)	868	1.00		
<b>Diastolic BP:</b>				
<70	735	0.80	(0.59;1.07)	0.131
70-<80	1892	0.94	(0.79;1.13)	0.531
80-<90 (ref*)	1984	1.00		
90-<100	566	1.31	(1.05;1.62)	0.017
≥100	79	1.45	(0.92;2.29)	0.113
<b>Hemoglobin:</b>				
<10	1911	1.37	(1.17;1.6)	0.000
10-<12 (ref*)	2798	1.00		
≥12	547	1.00	(0.75;1.32)	0.978
<b>Serum calcium (mmol/L):</b>				
<2.1	1309	1.27	(1.06;1.52)	0.011
2.1-≤2.37 (ref*)	2862	1.00		
>2.37	1085	0.83	(0.68;1.01)	0.059

**Table 12.3.6:** Adjusted hazard ratio for change of modality, 2002-2011 (cont)

Factors	n	Hazard ratio	95% CI	p value
<b>Calcium Phosphate product:</b>				
<3.5	3023	1.31	(1.05;1.65)	0.019
3.5-<4.5 (ref*)	1491	1.00		
4.5-<5.5	530	0.85	(0.62;1.16)	0.306
>=5.5	212	0.99	(0.61;1.63)	0.980
<b>Serum Phosphate (mmol/L):</b>				
<0.8	69	3.95	(2.1;7.41)	<0.001
0.8-<1.3 (ref*)	1401	1.00		
1.3-<1.8	2522	0.79	(0.64;0.97)	0.025
1.8-<2.2	840	0.83	(0.59;1.17)	0.292
>=2.2	424	1.35	(0.83;2.2)	0.231
<b>Kt/V</b>				
<1.7	837	1.27	(1.03;1.57)	0.026
1.7-2.0 (ref*)	1048	1.00		
<=2	2259	1.10	(0.92;1.32)	0.303
<b>Assisted PD</b>				
Selfcare (ref*)	2687	1.00		
Assisted	2431	0.98	(0.82;1.17)	0.802

**Table 12.3.7(a):** Reasons for drop-out from PD program, 2002-2011

Year	2004		2005		2006		2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Death	156	60	182	61	177	58	230	66	277	63	321	65	333	65	323	64
Transplant	13	5	22	7	25	8	18	5	21	5	15	3	12	2	17	3
Peritonitis	38	15	29	10	33	11	36	10	50	11	76	15	79	15	66	13
Catheter related infection	5	2	2	1	2	1	4	1	4	1	11	2	14	3	17	3
Membrane failure	19	7	27	9	18	6	13	4	24	5	18	4	26	5	31	6
Technical problem	2	1	11	4	9	3	4	1	7	2	19	4	14	3	21	4
Patient preference	20	8	10	3	9	3	20	6	50	11	30	6	17	3	20	4
Others	8	3	7	2	16	5	14	4	2	0	3	1	16	3	7	1
Unknown	0	0	8	3	17	6	12	3	2	0	1	0	1	0	1	0
Total	261	101	298	100	306	101	351	100	437	98	494	100	512	99	503	98

**Table 12.3.7 (b):** Drop-out rate from PD program with time on treatment, 2002-2011

Year	2004		2005		2006		2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
< 3 months	8	3	17	6	12	4	20	6	31	7	38	8	18	4	24	5
3-<6 months	17	7	24	8	25	8	33	9	30	7	39	8	48	9	43	9
6- <12 months	37	14	39	13	38	12	57	16	65	15	78	16	62	12	68	14
≥12 months	199	76	218	73	231	75	241	69	311	71	339	69	384	75	368	73
Total	261	100	298	100	306	100	351	100	437	100	494	100	512	100	503	100

**Table 12.3.8:** Time on PD (2002-2011)

	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 <sup>st</sup> Treatment (n=5256)	868	879	670	535	460	429	299	247	354	206	146	79	58	26	

## SECTION 12.4: PERITONITIS

The median peritonitis rate for the year 2011 has improved remarkably at 48.8 patient-months per episode (pt-month/epi) compared to previous years. (Table & Figure 12.4.1) There was a wide inter-centre variation with the highest and lowest rates of 32.9 and 67.8 patient-months per episode. In 2011, gram positive organisms account for 34% of cases, while gram negative organisms account for 31% of cases.

Staphylococcus aureus was the predominant organism for gram positive bacterial peritonitis each year, while E. coli emerged as the commonest gram negative organism. In 2011, the culture negative rate has improved to 25% compared to previous years. (Table 12.4.2)

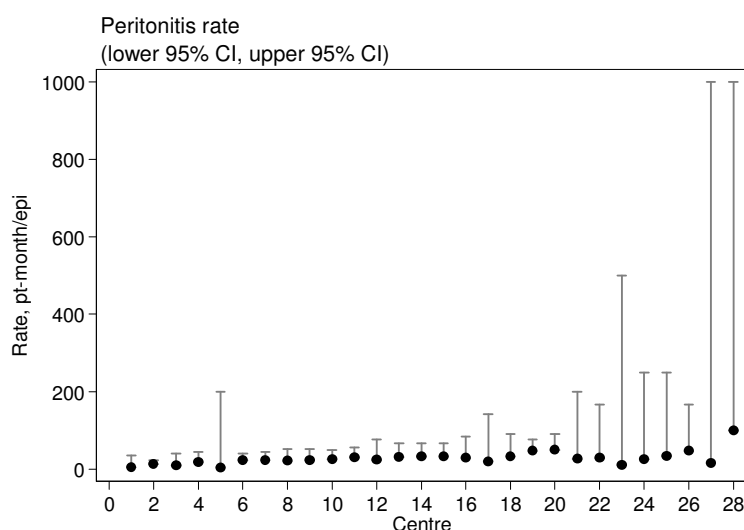
Comparing two eras of PD from 2002-2006 and 2007-2011 and outcomes by causative organisms, there is improvement in the proportion of cases achieving complete resolution and also less mortality. (Table & Figure 12.4.3a,12.4.3b and 12.4.3c) A lowered threshold for catheter removal in peritonitis may account for the improved mortality rate seen.

In multivariate analysis, lower household income and education level are associated with an increased risk to develop peritonitis. (Table 12.4.4)

**Table 12.4.1:** Variation in peritonitis rate (pt-month/epi) among PD centres, 2002-2011

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
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	32.7	36.6	41.5	41.5
2005	15	18	18	26.3	35.6	43	57.7	57.7
2006	21	14.8	18.5	26.8	37.7	50.8	65.2	97.7
2007	23	12	12.9	31.2	42.1	56.6	66.9	106.7
2008	25	12	13	30	40.4	58.5	105.5	114.6
2009	25	14	17.6	29.8	37.8	55.3	119.7	245.8
2010	26	10.8	19.3	28.9	35.3	53.4	72.3	82.9
2011	28	13.3	17.3	32.9	48.8	67.8	113.6	258.9

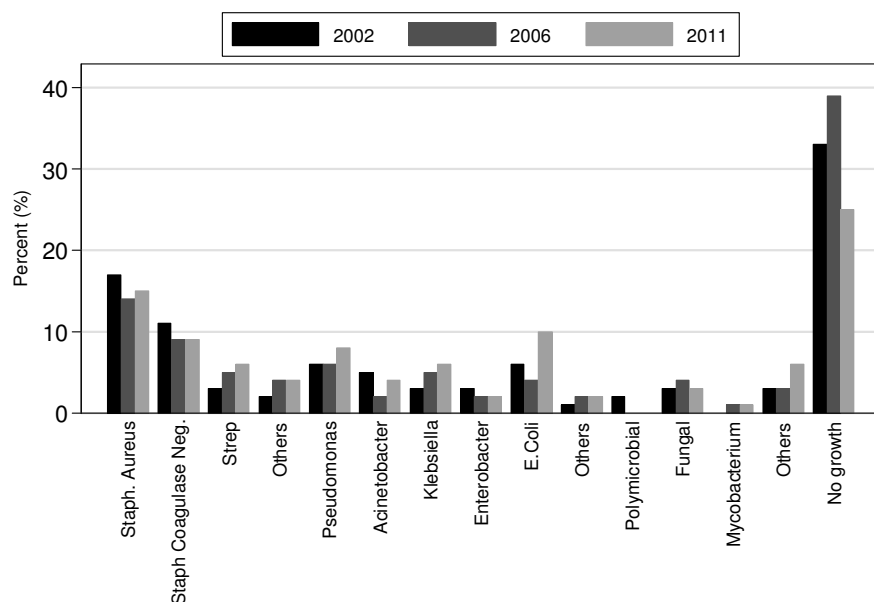
**Figure 12.4.1:** Variation in peritonitis rate among PD centres, 2011



**Table 12.4.2(a):** Causative organism in PD peritonitis, 2002-2011

Microorganism	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<b>(A) Gram Positives</b>																				
Staph. aureus	62	17	45	12	52	14	39	12	51	14	47	13	46	10	53	11	74	15	78	15
Staph Coagulase Neg.	39	11	47	13	41	11	42	13	32	9	29	8	49	11	51	10	54	11	46	9
Strep	12	3	16	4	13	3	10	3	17	5	14	4	19	4	17	3	12	2	34	6
Others	8	2	16	4	4	1	7	2	14	4	11	3	7	2	6	1	6	1	19	4
<b>(B) Gram Negatives</b>																				
Pseudomonas	23	6	20	5	28	8	27	8	23	6	29	8	40	9	34	7	32	6	43	8
Acinetobacter	18	5	27	7	25	7	21	7	8	2	21	6	20	4	17	3	9	2	22	4
Klebsiella	11	3	13	4	19	5	19	6	20	5	17	5	23	5	27	6	31	6	29	6
Enterobacter	12	3	6	2	9	2	13	4	7	2	8	2	3	1	13	3	8	2	9	2
E.Coli	23	6	20	5	23	6	30	9	15	4	32	9	42	9	41	8	60	12	50	10
Others	3	1	9	2	7	2	4	1	7	2	6	2	8	2	9	2	9	2	9	2
<b>(C) Polymicrobial</b>																				
<b>(D) Others</b>																				
Fungal	12	3	12	3	15	4	7	2	16	4	20	5	24	5	18	4	15	3	17	3
Mycobacterium	1	0	3	1	4	1	2	1	4	1	1	0	4	1	1	0	0	0	6	1
Others	11	3	12	3	8	2	3	1	10	3	12	3	21	5	16	3	34	7	30	6
<b>(E) No growth</b>																				
Total	361	100	364	100	373	100	320	100	366	100	369	100	466	100	490	100	495	100	524	100

**Figure 12.4.2(b):** Causative organism in PD peritonitis, 2002-2011

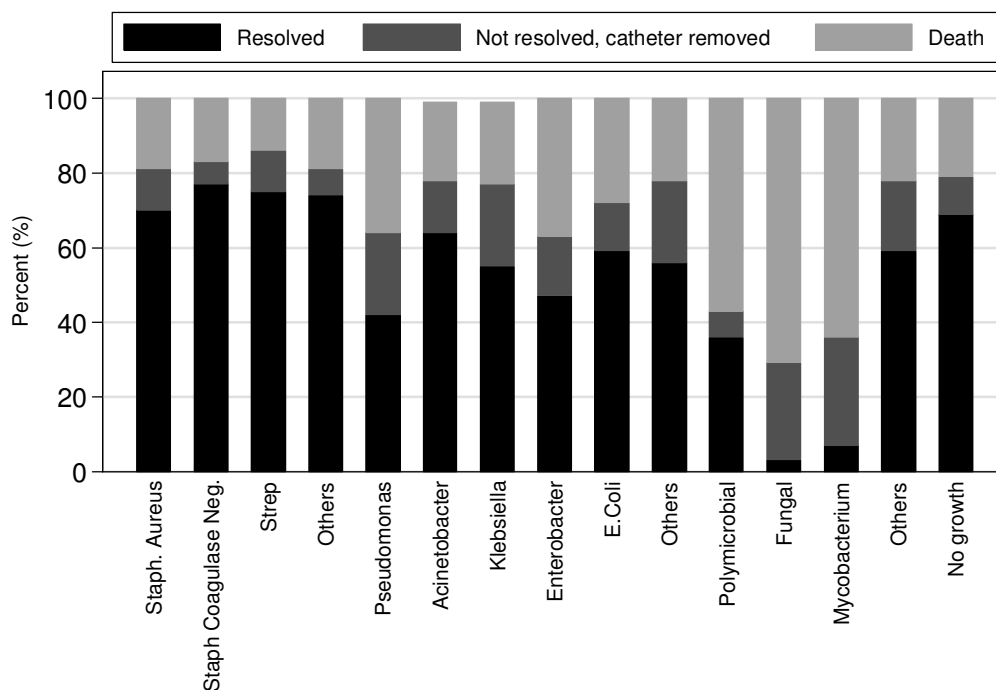




**Table 12.4.3(a):** Outcome of peritonitis by causative organism, 2002-2006

	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	n	%	n	%	n	%	n	%
<b>(A) Gram Positives</b>								
Staph. Aureus	161	70	26	11	44	19	231	100
Staph Coagulase Neg.	142	77	11	6	31	17	184	100
Strep	43	75	6	11	8	14	57	100
Others	31	74	3	7	8	19	42	100
<b>(B) Gram Negatives</b>								
Pseudomonas	47	42	25	22	41	36	113	100
Acinetobacter	58	64	13	14	19	21	90	100
Klebsiella	42	55	17	22	17	22	76	100
Enterobacter	20	47	7	16	16	37	43	100
E.Coli	62	59	14	13	29	28	105	100
Others	15	56	6	22	6	22	27	100
<b>(C) Polymicrobial</b>								
	5	36	1	7	8	57	14	100
<b>(D) Others</b>								
Fungal	2	3	16	26	44	71	62	100
Mycobacterium	1	7	4	29	9	64	14	100
Others	22	59	7	19	8	22	37	100
<b>(E) No growth</b>								
	372	69	54	10	114	21	540	100

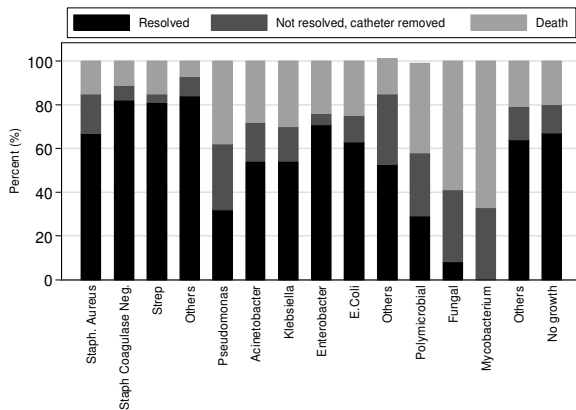
**Figure 12.4.3(a):** Outcome of peritonitis by causative organism, 2002-2006



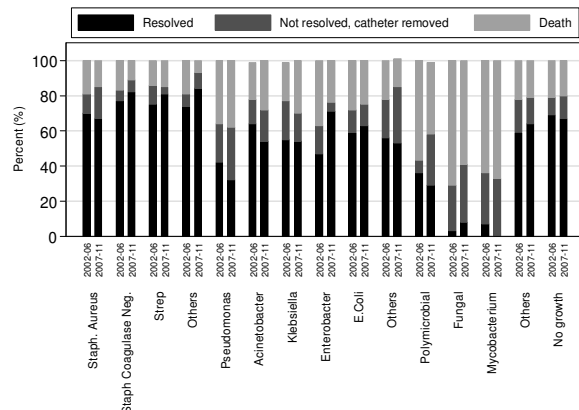
**Table 12.4.3(b): Outcome of peritonitis by causative organism, 2007-2011**

Causative Organism	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	n	%	n	%	n	%	n	%
<b>(A) Gram Positives</b>								
Staph. Aureus	185	67	49	18	41	15	275	100
Staph Coagulase Neg.	180	82	15	7	24	11	219	100
Strep	75	81	4	4	14	15	93	100
Others	38	84	4	9	3	7	45	100
<b>(B) Gram Negatives</b>								
Pseudomonas	52	32	49	30	61	38	162	100
Acinetobacter	44	54	15	18	23	28	82	100
Klebsiella	66	54	20	16	36	30	122	100
Enterobacter	27	71	2	5	9	24	38	100
E.Coli	136	63	25	12	54	25	215	100
Others	20	53	12	32	6	16	38	100
<b>(C) Polymicrobial</b>								
	5	29	5	29	7	41	17	100
<b>(D) Others</b>								
Fungal	7	8	30	33	53	59	90	100
Mycobacterium	0	0	4	33	8	67	12	100
Others	69	64	16	15	22	21	107	100
<b>(E) No growth</b>								
	467	67	88	13	137	20	692	100

**Figure 12.4.3(b): Outcome of peritonitis by causative organism, 2007-2011**



**Figure 12.4.3(c): Comparing outcome of peritonitis by causative organism in 2002-2006 versus 2007-2011**



**Table 12.4.4:** Risk factor influencing peritonitis rate, 2002-2011

Factors	n	Risk Ratio	95% CI	P value
<b>Age (years):</b>				
≤14	392	0.91	(0.74;1.1)	0.326
15-24	288	1.00	(0.85;1.18)	0.961
25-34 (ref*)	390	1.00		
35-44	537	1.13	(0.97;1.31)	0.114
45-54	986	1.10	(0.95;1.27)	0.208
55-64	1167	1.08	(0.93;1.26)	0.313
≥65	859	0.98	(0.83;1.17)	0.849
<b>Gender:</b>				
Male (ref*)	2321	1.00		
Female	2298	1.03	(0.95;1.1)	0.498
<b>Diabetes:</b>				
No (ref*)	2637	1.00		
Yes	1982	1.05	(0.97;1.14)	0.228
<b>Income:</b>				
RM 0-999 (ref*)	1784	1.00		
RM 1000-1999	1542	0.85	(0.79;0.93)	<0.001
RM 2000-2999	723	0.84	(0.75;0.93)	0.001
≥3000	570	0.76	(0.67;0.87)	<0.001
<b>Education:</b>				
Nil	439	1.17	(1.02;1.34)	0.023
Primary	1526	1.09	(1;1.19)	0.040
Secondary (ref*)	2227	1.00		
Tertiary	427	0.94	(0.82;1.08)	0.413
<b>Assistance to perform PD:</b>				
Self care (ref*)	2448	1.00		
Partially assisted	747	0.89	(0.79;0.99)	0.031
Completely assisted	1424	0.94	(0.86;1.04)	0.236