

## **CHAPTER 12**

# **Chronic Peritoneal Dialysis Practices**

Sunita Bavanandan  
Lily Mushahar

**SECTION 1: PERITONEAL DIALYSIS (PD) PRACTICES**

**12.1: Mode of PD (Tables 12.1.1 to 12.1.4)**

In 2006, CAPD still remained the commonest mode of PD therapy accounting for 90% of the total. Automated peritoneal dialysis (APD) penetration has been steadily increasing from 1% when it was first introduced in 2004 to 6% at present. As compared to PD practice in certain countries where Icodextrin is widely used in high transporter PD patients, a significant 4% of our patients were still practicing DAPD. This is most likely due to our local financial constraints. Most patients (92%) were on the Baxter disconnect system. The majority of patients (91%) were on 4 exchanges per day but there is a trend for an increased percentage of patients on 3 exchanges a day from 1% in 2004 to 4% presently. This may be a reflection of more aggressive management of advanced chronic kidney disease, with earlier initiation of dialysis allowing incremental dialysis. Conversely, up to 5% of patients were doing 5 exchanges per day. Most patients (82%) used a fill volume of 2L but up to 11% were using larger fill volumes while 7%, mainly paediatric, were on smaller exchange volumes than 2L.

**Table 12.1.1:** Chronic Peritoneal Dialysis Regimes, 1997-2006

PD regime	1997		1998		1999		2000		2001	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	440	94	492	93	577	96	633	97	755	98
DAPD	26	6	32	6	16	3	16	2	17	2
Automated PD/ CCPD	4	1	6	1	6	1	5	1	2	0
TOTAL	470	100	530	100	599	100	654	100	774	100

PD regime	2002		2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	837	97	1153	97	1211	96	1271	93	1362	90
DAPD	24	3	33	3	39	3	45	3	68	4
Automated PD/ CCPD	3	0	5	0	12	1	50	4	87	6
TOTAL	864	100	1191	100	1262	100	1366	100	1517	100

**Table 12.1.2:** CAPD Connectology, 1997-2006

CAPD Connectology	1997		1998		1999		2000		2001	
	No.	%	No.	%	No.	%	No.	%	No.	%
UVXD	27	5	10	2	3	1	0	0	0	0
Baxter disconnect	461	93	511	95	347	58	235	39	436	57
B Braun disconnect	10	2	18	3	248	41	370	61	324	43
Fresenius disconnect	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0
TOTAL	498	100	539	100	598	100	605	100	760	100

CAPD Connectology	2002		2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%	No.	%
UVXD	0	0	0	0	0	0	0	0	0	0
Baxter disconnect	719	87	1038	87	1142	88	1252	90	1423	92
B Braun disconnect	93	11	7	1	14	1	1	0	0	0
Fresenius disconnect	11	1	154	13	145	11	111	8	119	8
Others	0	0	1	0	0	0	28	2	6	0
TOTAL	823	100	1200	100	1301	100	1392	100	1548	100

**Table 12.1.3:** CAPD Number of Exchanges per day, 1997-2006

No. of Exchanges/ day	1997		1998		1999		2000		2001	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	0	0	2	0	0	0	2	0	1	0
3	3	1	4	1	4	1	1	0	5	1
4	454	97	508	96	579	97	624	96	735	95
5	12	3	16	3	13	2	23	4	31	4
TOTAL	469	100	530	100	596	100	650	100	772	100

No. of Exchanges/ day	2002		2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	0	0	4	0	6	0	3	0	4	0
3	11	1	14	1	12	1	25	2	55	4
4	834	96	1136	96	1225	95	1280	94	1357	91
5	28	3	32	3	52	4	48	4	74	5
TOTAL	873	100	1186	100	1295	100	1356	100	1490	100

**Table 12.1.4:** CAPD Volume per Exchange, 1997– 2006

Volume per Exchange (L)	1997		1998		1999		2000		2001	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	24	5	35	7	32	5	46	7	51	7
1.5-1.9	0	0	20	4	22	4	25	4	27	4
2.0	444	95	476	90	535	91	570	88	684	89
>2.0	0	0	0	0	2	0	7	1	9	1
TOTAL	468	100	531	100	591	100	648	100	771	100

Volume per Exchange (L)	2002		2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	64	7	64	5	73	6	85	6	67	4
1.5-1.9	24	3	36	3	36	3	38	3	45	3
2.0	769	88	1051	85	1117	84	1153	83	1262	82
>2.0	14	2	80	6	101	8	113	8	168	11
TOTAL	871	100	1231	100	1327	100	1389	100	1542	100

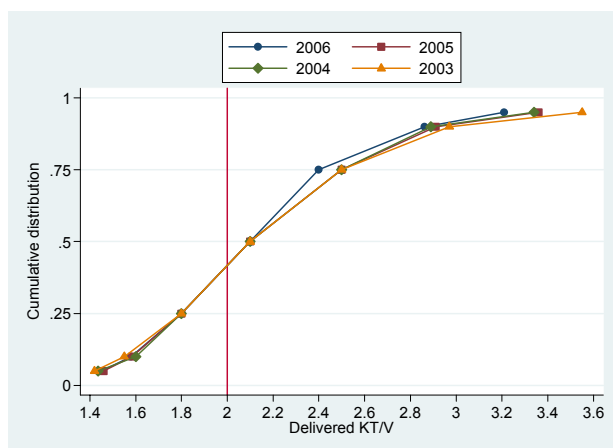
**SECTION 2: SOLUTE CLEARANCE ACHIEVEMENT AND PERITONEAL TRANSPORT**

The median delivered weekly Kt/V has remained unchanged at 2.1 since 2003, with 59% of patients achieving K/DOQI recommended Kt/V of more than or equal to 2.0. Comparison between PD centres has shown a narrowing of the gap between the highest- and lowest- performing centers, with less than 3-fold variation in terms of the percentage of patients in each center achieving a Kt/V of > 2.0 per week. Half of the centers were able to have at least 58% of their patients achieving the K/DOQI target (Tables and figures 12.2.1 and 12.2.2).

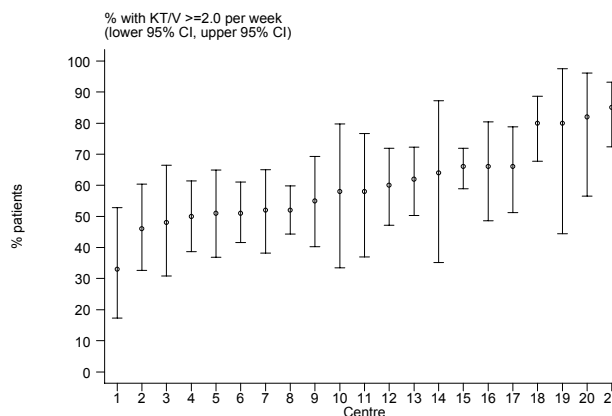
**Table 12.2.1:** Distribution of delivered KT/V, CAPD patients 2003-2006

Year	No of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥2.0 per week
2003	789	3.7	19.9	2.1	1.8	2.5	59
2004	1068	2.8	9.9	2.1	1.8	2.5	61
2005	1124	3.3	13.7	2.1	1.8	2.5	58
2006	1290	2.4	3.6	2.1	1.8	2.4	59

**Figure 12.2.1:** Cumulative distribution of delivered KT/V, CAPD patients 2003-2006



**Figure 12.2.2:** Variation in proportion of patients with KT/V ≥ 2.0 per week among CAPD centres 2006



**Table 12.2.2:** Variation in proportion of patients with KT/V ≥ 2.0 per week among CAPD

Year	No. of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2003	14	0	0	51	59	62	73	73
2004	17	43	43	53	56	67	85	85
2005	18	11	11	50	53.5	63	92	92
2006	21	33	46	51	58	66	82	85

Among incident PD patients low average transport status was commonest (42%) followed by high average transport status (37%). However, a proportion of patients developed changes in their membrane characteristics over time. There was high PET status in 15% of prevalent patients compared to 9% in new PD patients.

**Table 12.2.3:** Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2006

PET	2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%
Low	10	6	67	15	69	12	105	12
Low average	85	51	187	41	246	41	360	42
High average	62	37	176	38	223	37	314	37
High	11	7	29	6	62	10	75	9
TOTAL	168	100	459	100	600	100	854	100

\* New PD patients=patients commencing dialysis since 2003

**Table 12.2.4:** Peritoneal transport status by PET D/P creatinine at 4 hours, prevalent PD patients 2003-2006

PET	2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%
Low	10	3	39	9	44	13	23	8
Low average	174	44	180	42	130	39	106	38
High average	171	43	168	39	118	35	106	38
High	39	10	41	10	42	13	41	15
TOTAL	394	100	428	100	334	100	276	100

\*Prevalent PD patients=patients commencing dialysis before 2003

### SECTION 3: TECHNIQUE SURVIVAL ON PD

In terms of technique survival, CAPD fared worse compared to haemodialysis with Kaplan-Meier cumulative survival curves diverging as early as 6 months. One-, three- and five-year technique survival for CAPD was 81%, 47% and 29% as compared to haemodialysis at 89%, 71% and 56% respectively. Median technique survival time was less than 36 months. Overall these trends in technique survival remained unchanged by year of entry (Tables and figures 12.3.1 and 12.3.2).

The youngest age group between 1-14 years has the best technique survival rate while the oldest age group aged >65years consistently had the worst technique survival (Table and figure 12.3.3). Diabetics have a poorer technique survival than the non-diabetics (Table and figure 12.3.4). However, there was no gender difference (Table and figure 12.3.5).

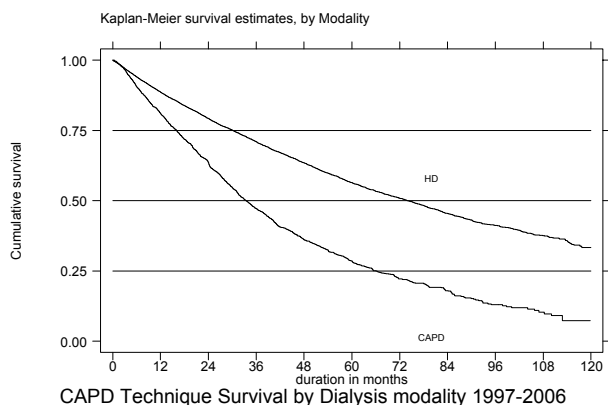
The commonest factor for PD drop-out between 1997-2006 was peritonitis (44%), followed by membrane failure (19%) and technical problems (19%) (Table 12.3.9). Patient preference contributed to a further 13% of conversions to HD.

**Table 12.3.1:** Unadjusted technique survival by Dialysis modality, 1997-2006

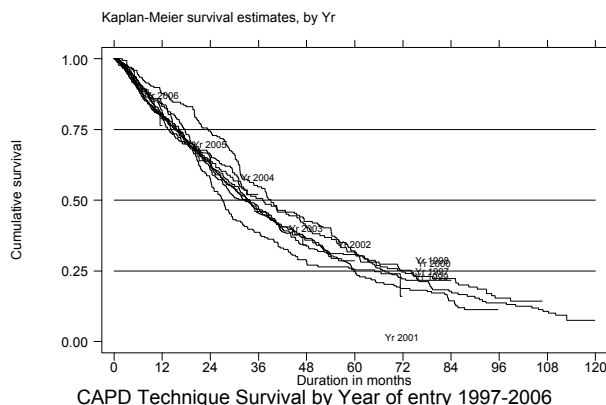
Dialysis modality Interval (months)	CAPD			HD			All Dialysis		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	2537	91	1	17560	94	0	20097	94	0
12	2087	81	1	14950	89	0	17037	88	0
24	1376	64	1	10955	79	0	12331	77	0
36	847	47	1	7895	71	0	8742	68	0
48	497	36	1	5592	63	0	6089	60	0
60	293	29	1	3809	56	0	4102	53	0
72	160	22	1	2536	51	1	2695	47	0
84	88	18	1	1578	45	1	1666	42	1
96	44	13	1	884	41	1	927	37	1
108	19	10	1	372	38	1	390	34	1
120	4	7	2	54	33	1	57	30	1

\* No. = Number at risk SE=standard error

**Figure 12.3.1:** Unadjusted technique survival by Dialysis modality, 1997-2006



**Figure 12.3.2:** Unadjusted technique survival by year of entry, 1997-2006



**Table 12.3.2:** Unadjusted technique survival by year of entry, 1997-2006

Year Interval (months)	1997			1998			1999			2000		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	187	94	2	144	92	2	189	90	2	206	91	2
12	170	88	2	128	83	3	175	84	3	185	81	3
24	141	74	3	96	65	4	117	58	3	138	63	3
36	101	55	4	75	51	4	78	39	3	101	46	3
48	76	42	4	59	40	4	57	29	3	78	36	3
60	57	32	3	45	32	4	50	25	3	67	31	3
72	44	25	3	35	25	4	37	19	3	47	22	3
84	32	18	3	31	22	3	27	15	3	1	-	-
96	24	14	3	21	15	3	1	-	-	1	-	-
108	19	11	2	1	-	-	1	-	-	1	-	-
120	4	8	2	1	-	-	1	-	-	1	-	-

Year Interval (months)	2001			2002			2003			2004		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	303	90	2	341	92	1	370	89	2	301	89	2
12	265	80	2	292	80	2	333	80	2	266	80	2
24	198	61	3	227	63	3	254	63	2	213	66	3
36	151	47	3	164	47	3	183	46	2	5	-	-
48	107	34	3	125	36	3	1	-	-	5	-	-
60	78	25	2	1	-	-	1	-	-	5	-	-

Year Interval (months)	2005			2006		
	No.	% Survival	SE	No.	% Survival	SE
6	321	89	2	183	92	2
12	280	79	2	2	-	-

\* No. = Number at risk SE=standard error

**Table 12.3.3:** Unadjusted technique survival by age, 1997-2006

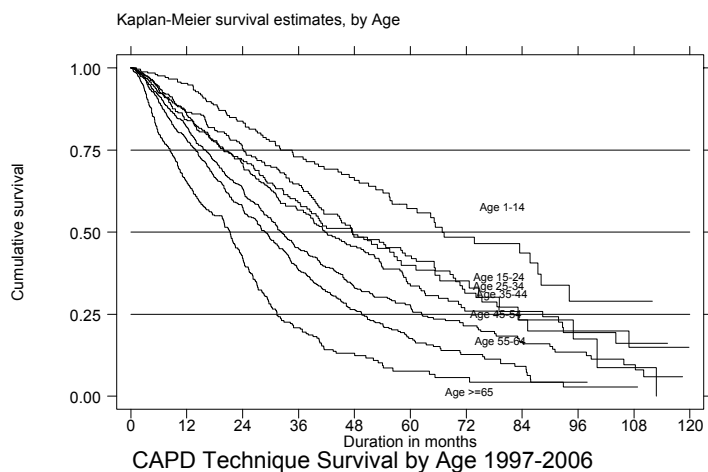
Age group (years) Interval (months)	<=14			15-24			25-34			35-44		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	229	98	1	253	93	2	238	93	2	355	94	1
12	204	95	1	210	84	2	203	86	2	298	86	2
24	142	84	3	139	72	3	150	75	3	208	71	2
36	106	73	3	95	59	3	112	65	3	144	57	3
48	76	66	4	55	48	4	68	49	4	96	46	3
60	46	57	4	30	40	4	50	43	4	50	34	3
72	29	48	5	17	35	5	27	31	4	27	26	3
84	15	44	6	7	23	6	19	26	4	15	23	4
96	7	29	7	4	17	7	12	19	4	8	20	4
108	4	29	7	2	9	7	5	16	5	4	15	5
120	1	-	-	1	-	-	1	-	-	3	-	-

Age group (years) Interval (months)	45-54			55-64			>=65		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	615	92	1	543	90	1	310	80	2
12	513	82	1	428	78	2	236	65	2
24	338	63	2	274	58	2	131	42	3
36	192	45	2	155	39	2	49	21	2
48	104	33	2	83	26	2	21	13	2
60	73	28	2	40	18	2	9	8	2
72	41	21	2	20	13	2	5	6	2
84	23	17	2	11	9	2	4	4	2
96	14	14	2	3	3	2	2	4	2
108	7	10	3	2	3	2	1	-	-
120	2	6	3	1	-	-	1	-	-

\* No. = Number at risk SE=standard error

**Figure 12.3.3:** Unadjusted technique survival by age, 1997-2006

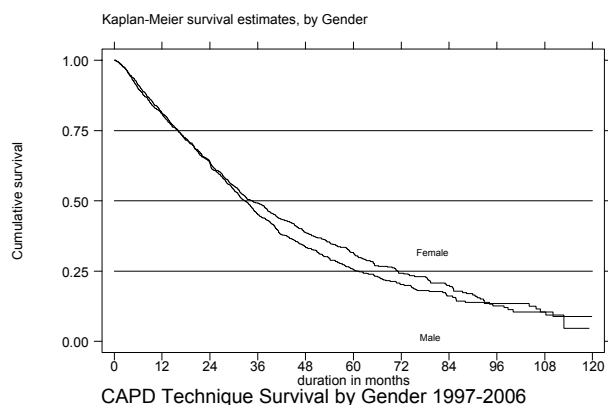


**Table 12.3.4:** Unadjusted technique survival by Gender, 1997-2006

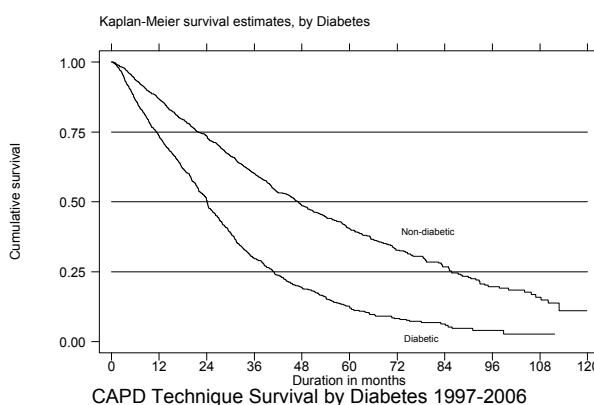
Gender Interval (months)	Male			Female		
	No.	% Survival	SE	No.	% Survival	SE
6	1270	91	1	1267	90	1
12	1040	81	1	1048	81	1
24	682	63	1	695	64	1
36	415	45	2	433	49	1
48	230	34	2	268	39	2
60	131	26	2	163	31	2
72	73	20	2	88	24	2
84	40	16	2	50	20	2
96	22	13	2	23	14	2
108	10	11	2	10	10	2
120	2	5	3	3	9	2

\* No. = Number at risk SE=standard error

**Figure 12.3.4:** Unadjusted technique survival by Gender, 1997-2006



**Figure 12.3.5:** Unadjusted technique survival by Diabetes status, 1997-2006



**Table 12.3.5:** Unadjusted technique survival by Diabetes status, 1997-2006

Diabetes status Interval (months)	Non-Diabetic			Diabetic		
	No.	% Survival	SE	No.	% Survival	SE
6	1497	94	1	1040	86	1
12	1277	87	1	810	74	1
24	909	73	1	469	51	2
36	621	60	1	227	30	2
48	389	49	2	109	20	1
60	236	40	2	58	13	1
72	132	33	2	29	8	1
84	76	27	2	13	6	1
96	39	20	2	6	4	1
108	18	16	2	3	3	1
120	4	11	3	1	-	-

\* No. = Number at risk SE=standard error

**Table 12.3.6:** Reasons for change of dialysis modality to HD, 1997-2006.

Cause	N	Percentage
Peritonitis	287	44
Catheter related infection	21	3
Membrane failure	123	19
Technical problem	55	8
Patient preference	88	13
Others	52	8
Unknown	27	4
Total	653	100



### SECTION 4: PD PERITONITIS

The median peritonitis rate was 33 patient-months per episode (Table 12.4.1). There was a wide variation between centre with the highest and lowest peritonitis rates of 16 vs 103 patient-months per episode. Gram-positive organisms accounted for 32% of peritonitis episodes while 22% were due to gram positive organisms. Fungal organisms accounted for 4% of cases and mycobacterial infection rates remained low (1%). The culture-negative rate increased to 39% compared with 30% in 2005 (Table 12.4.2). There was a trend for increased peritonitis rates with increasing age and diabetic status but gender did not appear to have any influence (Table 12.4.3).

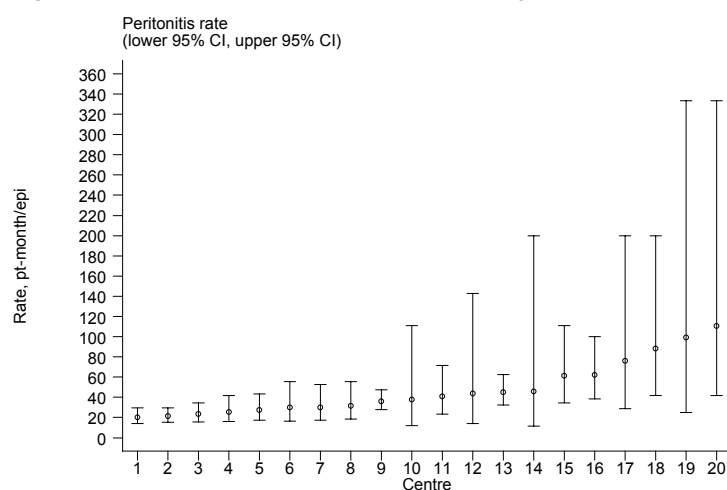
Catheter removal rate was highest in fungal infection (75%), followed by pseudomonas (36%) and staphylococcus aureus (21%) infections. Pseudomonas aeruginosa peritonitis has the highest mortality outcome of 23% compared to other organisms (Table 12.4.4).

**Table 12.4.1:** Variation in peritonitis rate (pt-month/epi) among CAPD centres 2006

Year	No. of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2000	12	10.9	10.9	18	21.5	27.6	1019.7	1019.7
2001	11	13.4	13.4	18.5	22.7	30.9	55.5	55.5
2002	13	14.3	14.3	20.2	25.3	34.4	49	49
2003	13	16.5	16.5	22.8	30.1	41.6	253	253
2004	15	0	0	23.2	32.6	41.8	47.7	47.7
2005	15	23.6	23.6	28	35.7	41.8	66.3	66.3
2006	21	16.1	21	27.7	33	61.4	88.5	102.9

\* Criteria for combination of centre with less than 10 subjects not applied

**Figure 12.4.1:** Variation in peritonitis rate among CAPD centres 2006



**Table 12.4.2:** Causative organism in PD peritonitis, 2000-2006

Microorganism	2000		2001		2002		2003		2004		2005		2006	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives														
• Staph. Aureus	35	11	41	13	62	17	45	12	51	14	40	12	50	14
• Staph Coagulase Neg.	39	13	34	11	41	11	52	14	43	12	47	15	35	10
• Strep	12	4	13	4	9	2	11	3	11	3	6	2	13	4
• Others	4	1	6	2	7	2	15	4	4	1	8	2	13	4
(B) Gram Negatives														
• Pseudomonas	19	6	14	4	23	6	20	5	28	8	27	8	23	6
• Others	45	15	56	18	67	19	75	21	83	22	86	27	58	16
(C) Polymicrobial	9	3	10	3	8	2	3	1	2	1	0	0	1	0
(D) Others														
• Fungal	19	6	21	7	12	3	12	3	15	4	7	2	16	4
• Mycobacterium	6	2	4	1	1	0	3	1	4	1	2	1	4	1
• Others	2	1	14	4	14	4	13	4	8	2	3	1	11	3
(E) No growth	119	39	99	32	118	33	115	32	123	33	96	30	142	39
TOTAL	309	100	312	100	362	100	364	100	372	100	322	100	366	100

**Table 12.4.3:** Factors influencing peritonitis rate, 2000-2006

Factors	N (No. at risk)	Annualised rate: Epi/ pt-year	(95% CI)	
<b>Age (years):</b>				
<=14	69	0.405	(0.33	0.498)
15-24	38	0.465	(0.354	0.612)
25-34	82	0.416	(0.35	0.495)
35-44	94	0.444	(0.373	0.528)
45-54	143	0.523	(0.455	0.6)
55-64	121	0.571	(0.489	0.667)
>=65	51	0.663	(0.52	0.845)
<b>Gender:</b>				
Male	282	0.492	(0.444	0.545)
Female	316	0.482	(0.44	0.528)
<b>Diabetes:</b>				
No	414	0.456	(0.421	0.494)
Yes	184	0.591	(0.519	0.674)

**Table 12.4.4:** Outcome of peritonitis by Causative organism, 2006

Causative Organism	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	No.	%	No.	%	No.	%	No.	%
Gram Positives								
• Staph. Aureus	33	69	10	21	5	10	48	100
• Staph Coagulase Neg.	28	85	1	3	4	12	33	100
Gram Negatives								
• Pseudomonas	9	41	8	36	5	23	22	100
• Others	35	60	11	19	12	21	58	100
Others								
• Fungal	1	6	12	75	3	19	16	100
• Mycobacterium	0	0	2	50	2	50	4	100
No growth	94	68	21	15	23	17	138	100