

## **CHAPTER 12**

### **Peritoneal Dialysis**

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**SECTION 12.1: PD Modalities and Prescriptions**

There were 4633 patients receiving peritoneal dialysis (PD) at the end of 31 December 2016. This represents a PD growth of 7.3% from the preceding year. Table 12.1.1-12.1.4 illustrates PD practices from 2007-2016.

Overall, 83.8% patients were on CAPD and 13.1% on APD. DAPD patients declined progressively to 3.2% over the 10 years period (Table 12.1.1). Icodextrin usage was not captured in the survey.

In 2016, there were 59% patients on Baxter and 40.8% on Fresenius PD fluids (Table 12.1.2). APD patients were mainly (87.3%) on 10L total dwell volume daily (Table 12.1.3bi). Meanwhile, majority of CAPD patients (90.1%) performed 4 exchanges per day (Table 12.1.3a) and used 8L (86.9%) total dwell volume daily (Table 12.1.3bii).

Assisted care contributed to 21% in CAPD patients compared to 41% in APD (Table 12.1.4).

Table 12.1.1: Peritoneal dialysis regimes, 2007-2016

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	2061	80.9
DAPD	115	6.4	121	5.8	119	5.4	91	3.9	117	4.6
Automated PD/ CCPD	144	8.0	245	11.8	246	11.1	296	12.5	371	14.6
<b>Total</b>	<b>1806</b>	<b>100.0</b>	<b>2083</b>	<b>100.0</b>	<b>2212</b>	<b>100.0</b>	<b>2360</b>	<b>100.0</b>	<b>2549</b>	<b>100.0</b>

PD regime	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
Standard CAPD	2315	81.0	2590	79.7	3014	81.3	3579	82.9	3882	83.8
DAPD	140	4.9	183	5.6	194	5.2	167	3.9	146	3.2
Automated PD/ CCPD	404	14.1	477	14.7	497	13.4	570	13.2	605	13.1
<b>Total</b>	<b>2859</b>	<b>100.0</b>	<b>3250</b>	<b>100.0</b>	<b>3705</b>	<b>100.0</b>	<b>4316</b>	<b>100.0</b>	<b>4633</b>	<b>100.0</b>

Table 12.1.2: CAPD connectology, 2007-2016

CAPD connectology	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
<b>CAPD</b>	<b>1662</b>	<b>100.0</b>	<b>1838</b>	<b>100.0</b>	<b>1966</b>	<b>100.0</b>	<b>2064</b>	<b>100.0</b>	<b>2178</b>	<b>100.0</b>
Baxter disconnect	1532	92.2	1718	93.5	1816	92.4	1911	92.6	1883	86.5
Fresenius disconnect	116	7.0	117	6.4	126	6.4	140	6.8	282	12.9
Others	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0
Unknown	13	0.8	2	0.1	24	1.2	13	0.6	13	0.6
<b>APD</b>	<b>144</b>	<b>100.0</b>	<b>245</b>	<b>100.0</b>	<b>246</b>	<b>100.0</b>	<b>296</b>	<b>100.0</b>	<b>371</b>	<b>100.0</b>
Baxter disconnect	143	99.3	237	96.7	197	80.1	215	72.6	285	76.8
Fresenius disconnect	0	0.0	7	2.9	47	19.1	78	26.4	84	22.6
Others	0	0.0	3	1.2	0	0.0	1	0.3	0	0.0
Unknown	1	0.7	0	0.0	2	0.8	2	0.7	2	0.5

Table 12.1.2: CAPD connectology, 2007-2016 ('cont)

CAPD connectology	2011		2012		2013		2014		2015	
	n	%	n	%	n	%	n	%	n	%
<b>CAPD</b>	<b>2455</b>	<b>100.0</b>	<b>2773</b>	<b>100.0</b>	<b>3208</b>	<b>100.0</b>	<b>3746</b>	<b>100.0</b>	<b>4028</b>	<b>100.0</b>
Baxter disconnect	1942	79.1	2113	76.2	2323	72.4	2455	65.5	2375	59.0
Fresenius disconnect	501	20.4	647	23.3	875	27.3	1274	34.0	1642	40.8
Others	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Unknown	12	0.5	13	0.5	10	0.3	17	0.5	11	0.3
<b>APD</b>	<b>404</b>	<b>100.0</b>	<b>477</b>	<b>100.0</b>	<b>497</b>	<b>100.0</b>	<b>570</b>	<b>100.0</b>	<b>605</b>	<b>100.0</b>
Baxter disconnect	319	79.0	389	81.6	401	80.7	425	74.6	435	71.9
Fresenius disconnect	76	18.8	84	17.6	87	17.5	110	19.3	131	21.7
Others	1	0.2	0	0.0	4	0.8	1	0.2	0	0.0
Unknown	8	2.0	4	0.8	5	1.0	34	6.0	39	6.4

Table 12.1.3a: CAPD Number of Exchanges per day, 2007-2016

Number of exchanges/ day	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
2	2	0.1	3	0.2	3	0.2	8	0.4	2	0.1
3	40	2.4	53	2.9	87	4.4	134	6.5	127	5.8
4	1559	93.8	1725	93.9	1785	90.8	1853	89.8	1954	89.7
5	33	2.0	47	2.6	60	3.1	47	2.3	68	3.1
Unknown	28	1.7	10	0.5	31	1.6	22	1.1	27	1.2
Total	1662	100.0	1838	100.0	1966	100.0	2064	100.0	2178	100.0

Number of exchanges/ day	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
2	11	0.4	21	0.8	22	0.7	19	0.5	26	0.6
3	158	6.4	163	5.9	208	6.5	206	5.5	215	5.3
4	2163	88.1	2477	89.3	2810	87.6	3383	90.3	3631	90.1
5	90	3.7	63	2.3	90	2.8	80	2.1	85	2.1
Unknown	33	1.3	49	1.8	78	2.4	58	1.5	71	1.8
Total	2455	100.0	2773	100.0	3208	100.0	3746	100.0	4028	100.0

Table 12.1.3bi: APD total dwell volumes per day, 2007-2016

Total dwell volumes/ day	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
8	29	20.1	42	17.1	34	13.8	27	9.1	33	8.9
10	99	68.8	194	79.2	185	75.2	252	85.1	320	86.3
12	7	4.9	2	0.8	8	3.3	11	3.7	3	0.8
14	2	1.4	4	1.6	3	1.2	1	0.3	1	0.3
16	0	0.0	0	0.0	8	3.3	0	0.0	8	2.2
Unknown	7	4.9	3	1.2	8	3.3	5	1.7	6	1.6
Total	144	100.0	245	100.0	246	100.0	296	100.0	371	100.0

Table 12.1.3bi: APD total dwell volumes per day, 2007-2016 ('cont)

Total dwell volumes/ day	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
8	39	9.7	26	5.5	24	4.8	35	6.1	29	4.8
10	338	83.7	410	86.0	438	88.1	473	83.0	528	87.3
12	10	2.5	14	2.9	10	2.0	22	3.9	22	3.6
14	7	1.7	8	1.7	9	1.8	19	3.3	8	1.3
16	4	1.0	2	0.4	2	0.4	5	0.9	9	1.5
Unknown	6	1.5	17	3.6	14	2.8	16	2.8	9	1.5
Total	404	100.0	477	100.0	497	100.0	570	100.0	605	100.0

Table 12.1.3bii: CAPD total dwell volumes per day, 2007-2016

Total dwell volumes/ day	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
8	1429	86.0	1590	86.5	1674	85.1	1757	85.1	1837	84.3
10	189	11.4	214	11.6	231	11.7	250	12.1	267	12.3
Unknown	44	2.6	34	1.8	61	3.1	57	2.8	74	3.4
Total	1662	100.0	1838	100.0	1966	100.0	2064	100.0	2178	100.0

Total dwell volumes/ day	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
8	2083	84.8	2396	86.4	2748	85.7	3283	87.6	3501	86.9
10	301	12.3	287	10.3	310	9.7	337	9.0	378	9.4
Unknown	71	2.9	90	3.2	150	4.7	126	3.4	149	3.7
Total	2455	100.0	2773	100.0	3208	100.0	3746	100.0	4028	100.0

Table 12.1.4: Assistance to Perform PD, 2007-2016

PD regime/Assistance	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
<b>CAPD</b>	<b>1662</b>	<b>100</b>	<b>1838</b>	<b>100</b>	<b>1966</b>	<b>100</b>	<b>2064</b>	<b>100</b>	<b>2178</b>	<b>100</b>
Self-care	1123	68	1164	63	1198	61	1280	62	1388	64
Partial self-care	210	13	266	14	262	13	311	15	290	13
Completely assisted	280	17	362	20	444	23	420	20	442	20
Unknown	49	3	46	3	62	3	53	3	58	3
<b>Automated PD</b>	<b>144</b>	<b>100</b>	<b>245</b>	<b>100</b>	<b>246</b>	<b>100</b>	<b>296</b>	<b>100</b>	<b>371</b>	<b>100</b>
Self-care	33	23	62	25	61	25	78	26	94	25
Partial self-care	24	17	62	25	78	32	98	33	112	30
Completely assisted	77	53	105	43	96	39	111	38	149	40
Unknown	10	7	16	7	11	4	9	3	16	4

Table 12.1.4: Assistance to Perform PD, 2007-2016 ('cont)

PD regime/Assistance	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
<b>CAPD</b>	<b>2455</b>	<b>100</b>	<b>2773</b>	<b>100</b>	<b>3208</b>	<b>100</b>	<b>3746</b>	<b>100</b>	<b>4028</b>	<b>100</b>
Self-care	1531	62	1766	64	2045	64	2371	63	2483	62
Partial self-care	371	15	368	13	403	13	604	16	644	16
Completely assisted	507	21	566	20	715	22	709	19	855	21
Unknown	46	2	73	3	45	1	62	2	46	1
<b>Automated PD</b>	404	100	477	100	497	100	570	100	605	100
Self-care	127	31	157	33	160	32	183	32	192	32
Partial self-care	96	24	129	27	85	17	136	24	149	25
Completely assisted	169	42	181	38	242	49	242	42	248	41
Unknown	12	3	10	2	10	2	9	2	16	3

Figure 12.1.4(a): Assistance to Perform CAPD, 2007-2016

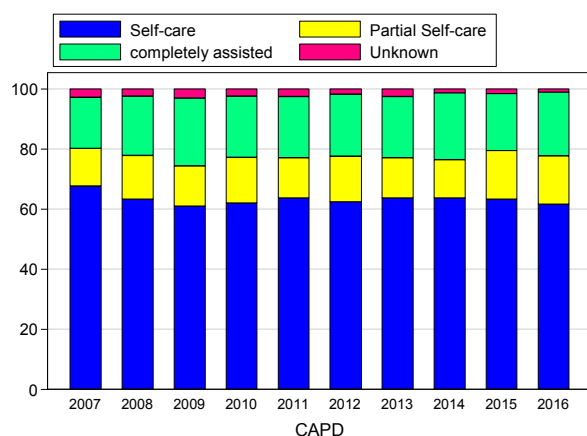
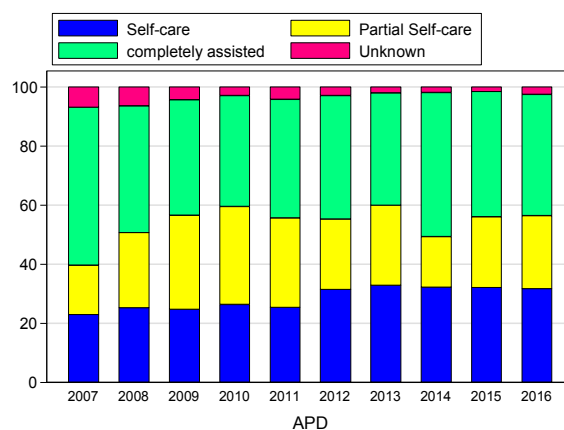


Figure 12.1.4(b): Assistance to Perform APD, 2007-2016



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

Table 12.2.1 to 12.5 illustrates the patient cohort kt/V and peritoneal membrane transport status from 2007-2016.

There were 74% of patients who achieved target solute clearance of  $\geq 1.7$  per week in 2016 (Table 12.2.1). There is a 1.6-fold inter-centre variation in the proportion of patients achieving the delivered Kt/V (54% in 5th percentile and 89% in 95th percentile) (Table 12.2.2).

Incident PD patients were mainly low average (44%) and high average (33.9%) membrane transport status (Table 12.2.3). Table 12.2.4 illustrates the proportion difference of membrane transport over time.

There was a proportionate decline in residual renal volume (RRV) with PD vintage. More than 50% of patients maintain RRV above 400 mls/day despite being on PD more than 2 years (Table and Figure 12.3.5).

Table 12.2.1: Distribution of delivered Kt/V, PD patients 2007-2016

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients $\geq 1.7$ per week
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	1727	2.1	0.5	2	1.8	2.3	79
2012	2278	2.1	0.5	2	1.8	2.4	79
2013	2724	2.1	0.5	2	1.7	2.3	78
2014	3022	2	0.5	1.9	1.7	2.3	74
2015	3477	2	0.5	2	1.7	2.3	74
2016	3809	2	0.5	1.9	1.7	2.3	74

Figure 12.2.1: Cumulative distribution of delivered Kt/V, PD patients 2007-2016

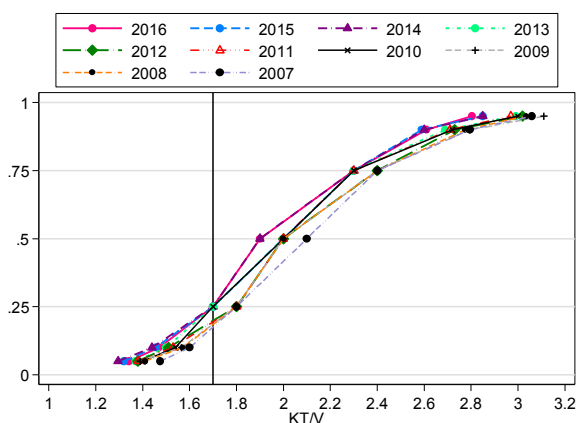


Figure 12.2.2: Variation in proportion of patients with Kt/V  $\geq 1.7$  per week among PD centres 2007-2016

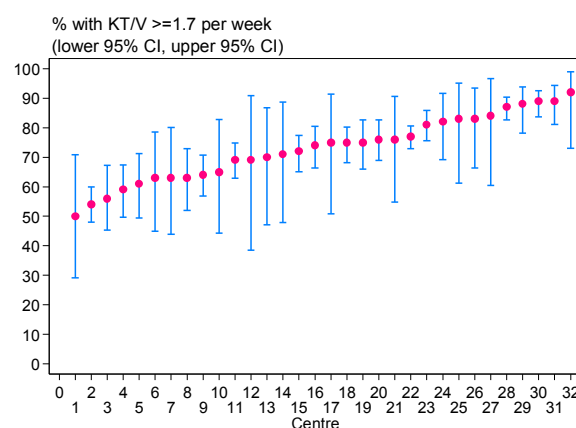


Table 12.2.2: Variation in proportion of patients with Kt/V  $\geq 1.7$  per week among PD centres, 2007-2016

Year	Number of centre	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
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	23	61	64	70	79	83	90	91
2012	24	53	59	70	79.5	87.5	95	100
2013	25	48	52	70	80	84	88	91
2014	28	44	47	66.5	73.5	80	89	89
2015	30	46	55	66	74.5	80	89	91
2016	32	50	54	63.5	74.5	82.5	89	92

Table 12.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2007-2016

Year	2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	%	n	%
Low	64	10.4	117	13.3	161	13.7	174	13.7	153	10.3
Low average	246	40.1	372	42.3	467	39.7	494	39.0	582	39.0
High average	246	40.1	302	34.3	392	33.3	437	34.5	566	37.9
High	57	9.3	89	10.1	156	13.3	163	12.9	191	12.8
Total	613	100	880	100	1176	100	1268	100	1492	100

Year	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
Low	187	10.6	261	12.7	303	13.2	340	12.4	338	11.4
Low average	713	40.5	834	40.5	906	39.4	1157	42.4	1301	44.0
High average	669	38.0	726	35.3	766	33.3	923	33.8	1004	33.9
High	193	11.0	238	11.6	326	14.2	311	11.4	317	10.7
Total	1762	100	2059	100	2301	100	2731	100	2960	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	69	12	80	9	69	13	43	12	32	14
Low average	248	43	373	44	261	49	166	45	97	41
High average	206	35	308	36	158	29	124	33	78	33
High	60	10	95	11	50	9	38	10	28	12
Total	583	100	856	100	538	100	371	100	235	100

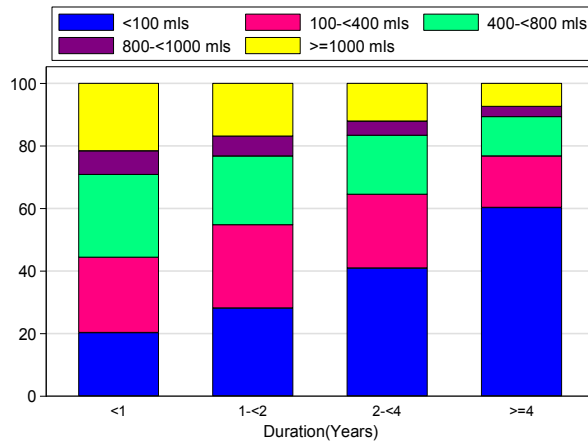
  

Duration (Years)	5-<6		6-<7		7-<8		8-<9		9-<10		10 or more	
	n	%	n	%	n	%	n	%	n	%	n	%
Low	20	14	14	15	6	9	2	6	2	8	5	7
Low average	60	41	42	46	25	38	13	39	11	44	23	32
High average	52	36	22	24	24	37	15	45	10	40	31	42
High	14	10	14	15	10	15	3	9	2	8	14	19
Total	146	100	92	100	65	100	33	100	25	100	73	100

Table 12.2.5: Residual Urine Volume over time

Duration (Years)	<1		1-<2		2-<4		4 or more	
	n	%	n	%	n	%	n	%
<100 ml	108	20	232	28	327	41	310	60
100 - <400 ml	130	24	221	27	189	24	85	17
400 - <800 ml	142	26	182	22	151	19	65	13
800 - <1000 ml	40	7	53	6	35	4	17	3
>=1000 ml	116	22	140	17	98	12	38	7
Total	536	100	828	100	800	100	515	100

Figure 12.2.5: Residual Urine Volume in prevalent PD patients (2016)



**SECTION 12.3: TECHNIQUE SURVIVAL ON PD**

Table and Figure 12.3.1a & b illustrates patient technique survival by era. In general, there is no improvement in technique survival over time.

Table 12.3.2 (a) & (b) show technique survival by age. Younger age group (age <14 years) had better technique survival in the first 5 years (censored for death and transplant) compared to older age group. However, after 5 years on treatment, age ≥ 65 years had better technique survival compared to younger age group. Tables and Figures 12.3.3 (a) & (b) illustrates female consistently had better technique survival than male gender.

Table & Figure 12.3.4(a) show diabetic patients have consistently poor technique survival compared to non-diabetic (uncensored for death and transplant). However, when censored for death and transplant, there was no difference in technique survival between diabetic and non-diabetic patients (Table & Figure 12.3.4(b)).

Table & Figure 12.3.5 illustrates the relationship of Kt/V and technique survival. Patients with Kt/V <1.7 had the worst technique survival. There was no difference in technique survival between Kt/v >2.0 and Kt/V >1.7 -2.0.

Table 12.3.6 illustrates the hazard ratio for change of PD modality to HD. Factors significantly influencing change of dialysis modality were peritonitis, male gender, BMI ≥25, Hb <10.0gm/dl and serum phosphate <0.8mmol/l.

Table 12.3.7(a) illustrates the reasons for PD drop out. In 2016, death (64%) was the commonest cause for PD drop-out but the rate has declined from previous years. This was followed by peritonitis (18%) and membrane failure (6%).

Table 12.3.7(b) shows the PD drop-out rate with time on treatment. A proportion of PD drop-out occurred before 12 months of PD treatment (13%), while majority (75%) occurred after 12 months on PD treatment (Table 12.3.7b). The duration of time spent on PD by prevalent patients is shown in Table 12.3.8. The number has declined proportionately to PD vintage. There were 779 patients maintaining on PD at 5 years and more of PD vintage.



Table 12.3.1(a): Unadjusted technique survival by era 2006–2010 and 2011–2016 (uncensored for death and transplant)

Era Interval (month)	2000-2004			2005-2009			2010-2014			2015-2016		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	1698	100		2726	100		4695	100		2760	100	
6	1529	90	1	2439	90	1	4181	89	0	1925	90	1
12	1354	81	1	2111	78	1	3703	79	1	1168	80	1
24	1033	63	1	1615	61	1	2765	60	1	25		
36	767	48	1	1212	46	1	1527	44	1			
48	581	36	1	895	34	1	772	33	1			
60	450	29	1	664	26	1	330	24	1			
72	349	23	1	493	19	1	102	17	1			
84	245	16	1	366	15	1	1					
96	186	12	1	181	10	1						
108	154	10	1	96	7	1						
120	122	8	1	48	5	1						

Figure 12.3.1a: Unadjusted technique survival by year of entry, 2000-2016

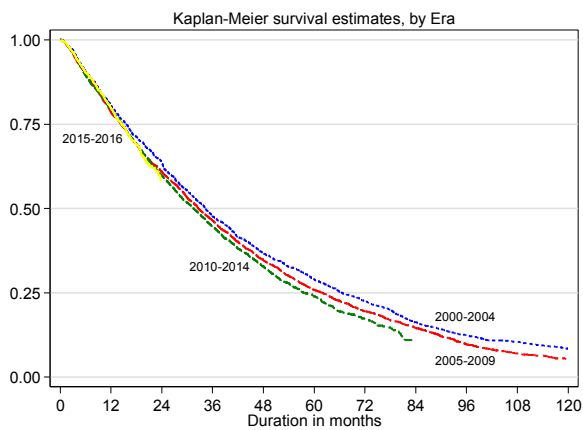


Figure 12.3.1(b): Unadjusted technique survival by year of entry (censored for death & transplant), 2000-2016

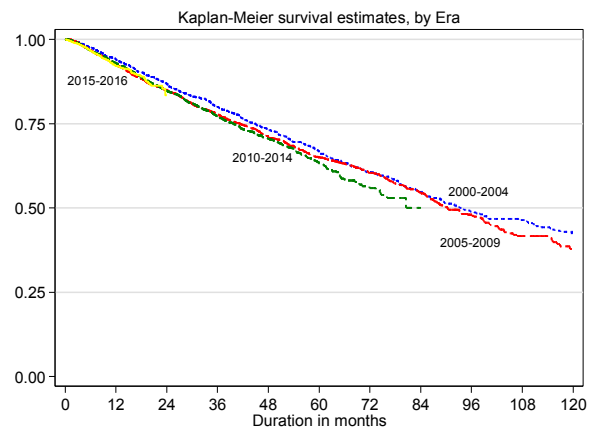


Table 12.3.1(b): Unadjusted technique survival by era 2006–2010 and 2011–2016 (censored for death and transplant)

Era Interval (month)	2000-2004			2005-2009			2010-2014			2015-2016		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	1698	100		2726	100		4695	100		2760	100	
6	1529	98	0	2439	97	0	4181	97	0	1925	97	0
12	1354	94	1	2111	92	1	3703	93	0	1168	92	1
24	1033	87	1	1615	85	1	2765	85	1	25		
36	767	80	1	1212	78	1	1527	77	1			
48	581	73	1	895	71	1	772	70	1			
60	450	66	2	664	65	1	330	63	1			
72	349	61	2	493	60	1	102	56	2			
84	245	55	2	366	55	1	1					
96	186	49	2	181	48	2						
108	154	46	2	96	42	2						
120	122	42	2	48	38	2						

Table 12.3.2(a): Unadjusted technique survival by age (uncensored for death and transplant)

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	659	100		909	100		1176	100		1591	100	
6	604	96	1	796	93	1	1021	92	1	1396	93	1
12	559	91	1	691	85	1	871	85	1	1172	83	1
24	427	79	2	503	72	2	635	72	1	841	68	1
36	333	68	2	384	62	2	477	61	2	608	55	1
48	254	58	2	270	52	2	354	51	2	419	43	1
60	181	49	2	191	42	2	260	42	2	311	35	1
72	119	40	2	149	36	2	193	34	2	214	27	1
84	81	32	2	114	30	2	133	27	2	156	21	1
96	48	24	2	75	22	2	87	20	2	112	17	1
108	34	20	2	59	19	2	61	16	2	83	14	1
120	25	16	2	42	16	2	43	13	2	60	11	1

Age group (years) Interval (month)	45-54			55-64			>=65		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	2868	100		3506	100		2681	100	
6	2502	91	1	2971	89	1	2127	83	1
12	2105	82	1	2444	78	1	1677	70	1
24	1415	62	1	1540	56	1	939	47	1
36	918	46	1	918	39	1	505	30	1
48	607	34	1	550	26	1	256	17	1
60	416	27	1	323	18	1	125	11	1
72	273	19	1	187	12	1	74	7	1
84	177	13	1	113	8	1	40	4	1
96	102	9	1	63	5	1	19	2	0
108	65	6	1	39	3	0	10	1	0
120	40	4	1	25	2	0	6	1	0

Figure 12.3.2(a): Unadjusted technique survival by age (uncensored for death and transplant)

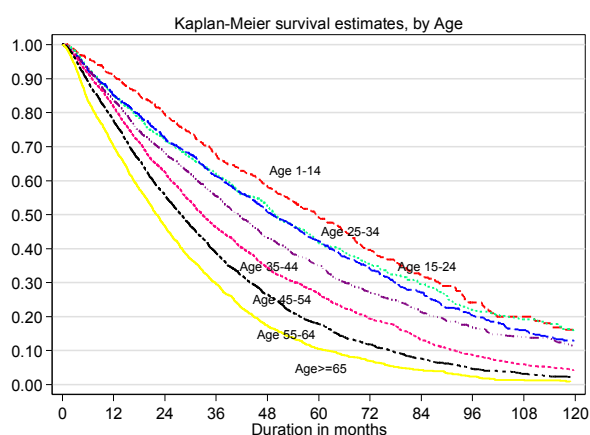


Figure 12.3.2(b): Unadjusted technique survival by age (censored for death and transplant)

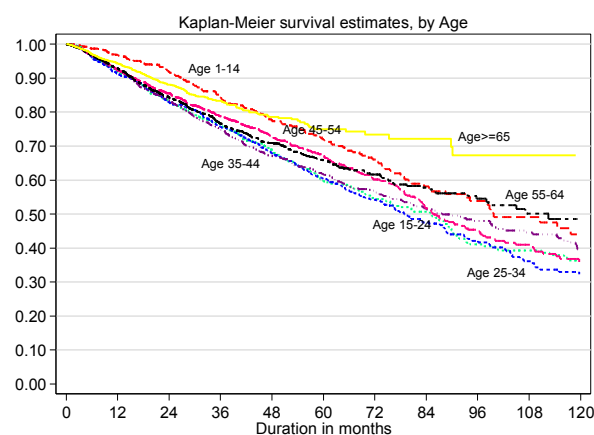


Table 12.3.2(b): Unadjusted technique survival by age (censored for death and transplant)

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	659	100		909	100		1176	100		1591	100	
6	604	99	0	796	96	1	1021	96	1	1396	97	0
12	559	97	1	691	92	1	871	91	1	1172	92	1
24	427	92	1	503	83	1	635	83	1	841	83	1
36	333	84	2	384	76	2	477	76	2	608	75	1
48	254	77	2	270	68	2	354	68	2	419	67	2
60	181	72	2	191	60	2	260	60	2	311	62	2
72	119	66	3	149	55	2	193	54	2	214	56	2
84	81	58	3	114	51	3	133	48	2	156	52	2
96	48	54	3	75	41	3	87	42	2	112	48	2
108	34	49	4	59	39	3	61	36	3	83	45	2
120	25	44	4	42	36	3	43	32	3	60	40	3

Age group (years) Interval (month)	45-54			55-64			>=65		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	2868	100		3506	100		2681	100	
6	2502	97	0	2971	97	0	2127	97	0
12	2105	92	1	2444	93	0	1677	94	0
24	1415	86	1	1540	84	1	939	88	1
36	918	79	1	918	77	1	505	83	1
48	607	73	1	550	71	1	256	79	1
60	416	67	1	323	66	1	125	75	2
72	273	60	2	187	62	2	74	73	2
84	177	52	2	113	58	2	40	72	2
96	102	45	2	63	55	2	19	67	4
108	65	41	2	39	50	3	10	67	4
120	40	36	3	25	49	3	6	67	4

Table 12.3.3(a): Unadjusted technique survival by gender (uncensored for death and transplant)

Gender Interval (months)	Male			Female		
	n	% survival	SE	n	% survival	SE
0	6829	100		6561	100	
6	5820	90	0	5596	89	0
12	4830	79	1	4687	80	1
24	3115	59	1	3185	62	1
36	1977	43	1	2163	48	1
48	1244	31	1	1465	37	1
60	790	23	1	1013	29	1
72	507	17	1	699	22	1
84	317	12	1	492	17	1
96	185	8	0	316	12	1
108	125	6	0	221	10	1
120	82	4	0	154	8	1

Figure 12.3.3(a): Unadjusted technique survival by gender (uncensored for death and transplant)

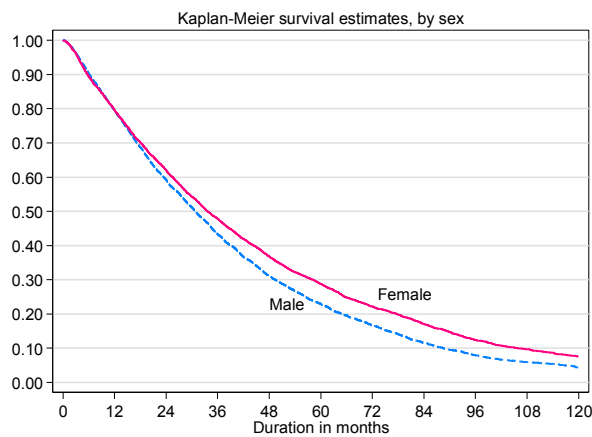


Figure 12.3.3(b): Unadjusted technique survival by gender (censored for death and transplant)

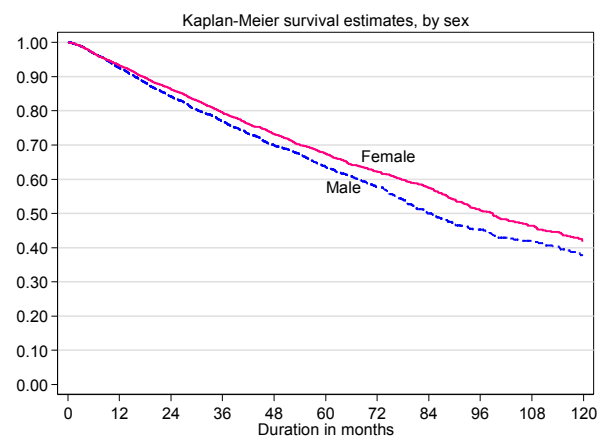


Table 12.3.3(b): Unadjusted technique survival by gender (censored for death and transplant)

Gender Interval (months)	Male			Female		
	n	% survival	SE	n	% survival	SE
0	6829	100		6561	100	
6	5820	97	0	5596	97	0
12	4830	92	0	4687	93	0
24	3115	84	1	3185	86	0
36	1977	77	1	2163	80	1
48	1244	70	1	1465	73	1
60	790	63	1	1013	67	1
72	507	58	1	699	62	1
84	317	50	1	492	58	1
96	185	45	2	316	51	1
108	125	42	2	221	46	2
120	82	38	2	154	42	2

Table 12.3.4(a): Unadjusted technique survival by diabetes status (uncensored for death and transplant), 2007-2016

Diabetes status Interval (month )	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	6586	100		6804	100	
6	5763	92	0	5653	88	0
12	4986	84	0	4531	75	1
24	3584	69	1	2716	52	1
36	2636	57	1	1504	34	1
48	1846	45	1	858	22	1
60	1324	37	1	478	14	1
72	944	30	1	263	9	0
84	663	23	1	146	5	0
96	433	17	1	69	3	0
108	313	14	1	33	2	0
120	222	11	1	14	1	0

Figure 12.3.4(a): Unadjusted technique survival by Diabetes status (uncensored for death and transplant)

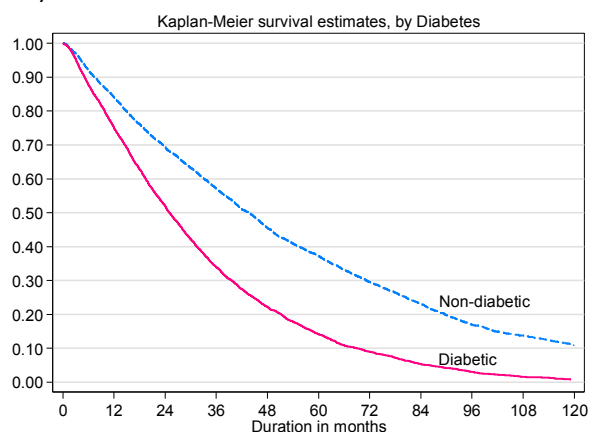


Figure 12.3.4(b): Unadjusted technique survival by diabetes status (censored for death and transplant)

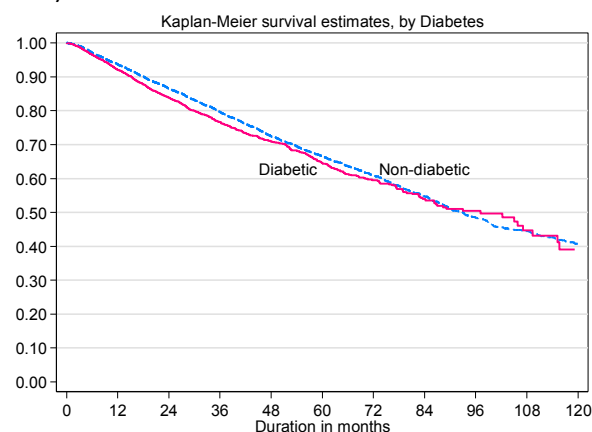


Table 12.3.4(b): Unadjusted technique survival by diabetes status (censored for death and transplant)

Diabetes status Interval (month )	Non-diabetic			Diabetic		
	n	% survival	SE	n	% survival	SE
0	6586	100		6804	100	
6	5763	97	0	5653	97	0
12	4986	94	0	4531	92	0
24	3584	86	0	2716	84	1
36	2636	80	1	1504	77	1
48	1846	72	1	858	71	1
60	1324	66	1	478	65	1
72	944	61	1	263	59	1
84	663	55	1	146	54	2
96	433	48	1	69	50	2
108	313	45	1	33	45	3
120	222	40	1	14	39	4

Table 12.3.5: Unadjusted technique survival by Kt/V, 2007-2016

Kt/V Interval (months)	<1.7			1.7-2.0			>2.0		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	5376	100		6558	100		11796	100	
6	5224	98	0	6413	99	0	11523	99	0
12	4897	94	0	6091	95	0	10930	96	0
24	3910	82	1	5152	86	0	9184	87	0
36	2863	67	1	4081	75	1	7430	77	0
48	2010	53	1	3117	64	1	5709	66	0
60	1399	43	1	2307	54	1	4291	56	1
72	945	33	1	1724	45	1	3224	47	1
84	666	25	1	1251	36	1	2433	40	1
96	414	19	1	831	28	1	1676	31	1
108	298	16	1	589	23	1	1248	27	1
120	235	13	1	411	19	1	916	23	1

Figure 12.3.5: Unadjusted technique survival by Kt/V, 2007-2016

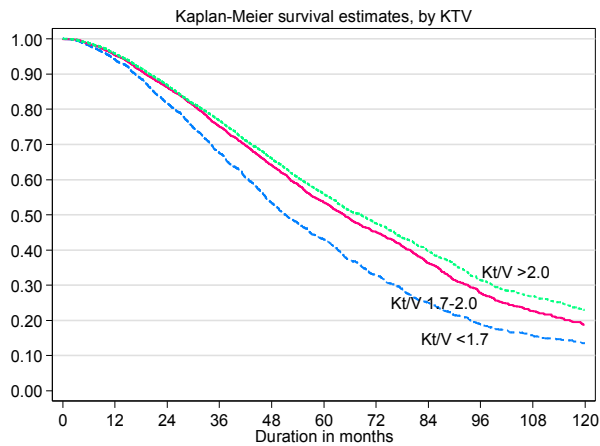


Table 12.3.6: Adjusted hazard ratio for change of PD modality to HD, 2007-2016

Factors	n	Hazard ratio	95% CI	p value
<b>Age (years)</b>				
Age 1-14 (ref*)	349	1.000		
Age 15-24	577	1.040	(0.76, 1.43)	0.808
Age 25-34	774	0.885	(0.64, 1.23)	0.468
Age 35-44	1011	0.804	(0.58, 1.12)	0.192
Age 45-54	1900	0.793	(0.58, 1.09)	0.151
Age 55-64	2607	0.908	(0.67, 1.24)	0.540
Age >=65	2136	0.841	(0.60, 1.17)	0.307
<b>Peritonitis</b>				
No (ref*)	8647	1.000		
Yes	707	7.414	(6.61, 8.31)	<0.001

Table 12.3.6: Adjusted hazard ratio for change of PD modality to HD, 2007-2016 ('cont)

Factors	n	Hazard ratio	95% CI	p value
<b>Diabetes Mellitus</b>				
Non-diabetic (ref*)	5921	1.000		
Diabetic	3433	1.035	(0.91, 1.18)	0.609
<b>Gender</b>				
Male (ref*)	4791	1.000		
Female	4563	0.794	(0.70, 0.90)	<0.001
<b>Cardiovascular Disease</b>				
No CVD (ref*)	7818	1.000		
CVD	1536	0.991	(0.83, 1.18)	0.917
<b>BMI</b>				
<18.5	773	0.972	(0.78, 1.21)	0.800
18.5-<25 (ref*)	4842	1.000		
>=25	3739	1.354	(1.20, 1.53)	<0.001
<b>Serum Albumin</b>				
<30	2995	1.131	(0.97, 1.32)	0.116
30-<35	3380	1.043	(0.92, 1.19)	0.530
35-<45 (ref*)	2902	1.000		
>=45	77	0.968	(0.52, 1.82)	0.920
<b>Serum cholesterol (mmol/L)</b>				
<3.5	615	0.938	(0.71, 1.24)	0.652
3.5-<5.2	5549	0.738	(0.63, 0.87)	<0.001
5.2-<6.2	1944	0.926	(0.78, 1.10)	0.382
>=6.2 (ref*)	1246	1.000		
<b>Diastolic BP</b>				
<70	1218	0.980	(0.79, 1.22)	0.855
70-<80	3463	0.988	(0.86, 1.13)	0.868
80-<90 (ref*)	3442	1.000		
90-<100	1007	1.242	(1.05, 1.47)	0.013
>=100	224	1.207	(0.86, 1.70)	0.281
<b>Hemoglobin (g/dL)</b>				
<10	3358	1.316	(1.16, 1.49)	<0.001
10-<12 (ref*)	5096	1.000		
>=12	900	0.921	(0.73, 1.16)	0.486
<b>Serum calcium (mmol/L)</b>				
<2.1	3112	1.048	(0.92, 1.20)	0.489
2.1-<=2.37 (ref*)	4980	1.000		
>2.37	1262	1.000	(0.85, 1.18)	0.995
<b>Calcium Phosphate product</b>				
<3.5	5472	1.155	(0.98, 1.37)	0.093
3.5-<4.5 (ref*)	2610	1.000		
4.5-<5.5	928	0.724	(0.56, 0.93)	0.011
>=5.5	344	0.912	(0.63, 1.31)	0.621

Table 12.3.6: Adjusted hazard ratio for change of PD modality to HD, 2007-2016 ('cont)

Factors	n	Hazard ratio	95% CI	p value
<b>Serum Phosphate (mmol/L)</b>				
<0.8	131	3.713	(2.07, 6.68)	<0.001
0.8-<1.3 (ref*)	2254	1.000		
1.3-<1.8	4542	0.912	(0.78, 1.07)	0.252
1.8-<2.2	1595	0.936	(0.73, 1.20)	0.608
>=2.2	832	1.400	(0.97, 2.02)	0.071
<b>Kt/V</b>				
<1.7	1980	1.073	(0.92, 1.25)	0.368
1.7-2.0 (ref*)	1981	1.000		
<=2	3654	1.051	(0.92, 1.21)	0.483
<b>Assisted PD</b>				
Selfcare (ref**)	4371	1.000		
Assisted	4681	0.872	(0.77, 0.99)	0.041

Table 12.3.7(a): Reasons for drop-out from PD program, 2007-2016

Year	2007		2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%	n	%
Death	231	66	277	63	321	66	353	69	374	68	397	73
Transplant	18	5	21	5	15	3	11	2	17	3	14	3
Peritonitis	35	10	51	12	72	15	72	14	64	12	57	10
Catheter related infection	4	1	4	1	11	2	13	3	15	3	13	2
Membrane failure	14	4	24	5	18	4	22	4	27	5	27	5
Technical problem	5	1	7	2	19	4	12	2	21	4	15	3
Patient preference	21	6	50	11	28	6	16	3	23	4	17	3
Others	10	3	1	0	3	1	10	2	4	1	7	1
Unknown	12	3	2	0	1	0	1	0	1	0	0	0
Total	350	100	437	100	488	100	510	100	546	100	547	100

Year	2013		2014		2015		2016	
	n	%	n	%	n	%	n	%
Death	472	71	575	75	630	71	730	64
Transplant	17	3	14	2	10	1	6	1
Peritonitis	81	12	76	10	133	15	207	18
Catheter related infection	20	3	21	3	15	2	38	3
Membrane failure	40	6	34	4	38	4	69	6
Technical problem	7	1	11	1	20	2	35	3
Patient preference	22	3	28	4	30	3	40	3
Others	7	1	5	1	16	2	19	2
Unknown	0	0	0	0	1	0	2	0
Total	666	100	764	100	893	100	1146	100



Figure 12.3.7(a): Reasons for drop-out from PD program, 2007-2016

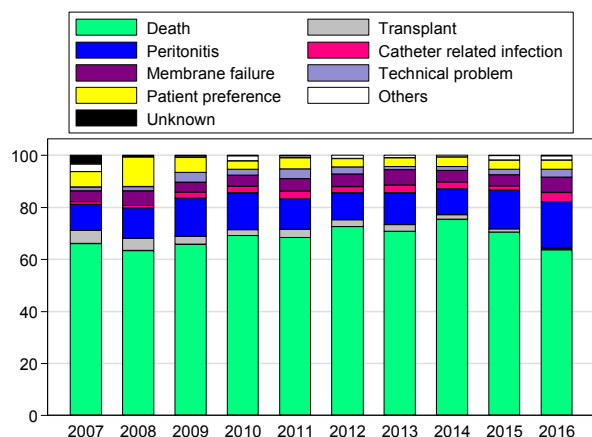


Table 12.3.7(b): Drop-out rate from PD program with time on treatment, 2007-2016

Year	2007		2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%	n	%
< 3 months	19	5	29	7	38	8	19	4	28	5	34	6
3-<6 months	33	9	31	7	38	8	40	8	49	9	52	10
6- <12 months	58	17	66	15	76	16	68	13	74	14	75	14
>=12 months	240	69	311	71	336	69	383	75	395	72	386	71
Total	350	100	437	100	488	100	510	100	546	100	547	100

Year	2013		2014		2015		2016	
	n	%	n	%	n	%	n	%
< 3 months	39	6	39	5	60	7	51	4
3-<6 months	56	8	75	10	84	9	90	8
6- <12 months	80	12	90	12	118	13	144	13
>=12 months	491	74	560	73	631	71	861	75
Total	666	100	764	100	893	100	1146	100

Table 12.3.8: Time on PD (Prevalent PD patients 31 Dec 2016)

	Months							
	0-<6	6-11	12-17	18-23	24-29	30-35	36-41	42-47
1 <sup>st</sup> Treatment (n=9306 )	1560	1464	1291	1134	851	663	509	455

	Months					
	48-59	60-71	72-83	84-95	96-107	≥108
1 <sup>st</sup> Treatment (n=9306 )	600	354	178	151	63	33

**SECTION 12.4: PERITONITIS**

Table 12.4.1 to 12.4 illustrates the peritonitis rates, micro-organism cultured pattern and peritonitis outcomes for the years 2007-2016.

The median peritonitis rate was 1 in 42.3 patient-months in 2016, compared to 1 in 39.9 patient-months in the preceding year (Table 12.4.1). There is wide inter-center variation for PD peritonitis rate from lowest peritonitis rate of 1 in 58.6 patient-months to highest peritonitis rate of 1 in 30.1 patient-months.

In 2016, gram-positive organisms accounted for 32.3% of peritonitis with Staphylococcus coagulase negative (CoNS) as the predominant gram-positive organism (13.5%). Meanwhile, there were 31% of gram negative peritonitis with E. coli being the highest amongst gram-negative pathogen. There were 3.5% of fungal peritonitis and 0.8% of mycobacterium peritonitis. Culture negative rate was 24.5% in 2016 (Table & Figure 12.4.2).

Table & Figure 12.3a and 12.3b illustrates PD peritonitis outcome between 2 different eras (year 2006-2011 vs 2012-2016). Gram positive infections had better outcomes with complete resolution in the latter compared to former era. Gram negative peritonitis had higher rates of catheter removal compared to gram positive peritonitis especially with Pseudomonas infection in the latter era (31%).

Mortality rate has decreased in 2012-2016 compared to the previous era. Incidence of death was higher in gram negative peritonitis compared to gram positive in both time periods. Among gram negative infections, Pseudomonas and Acinetobacter have the highest incidence of deaths. Death from fungal (44%) and mycobacterial (52%) peritonitis remained high (Table & Figure 12.4.3b).

In multivariate analysis (Table 12.4.4) age > 65 years, uneducated status, lower total family income, diabetes and assisted PD contributed to an increased peritonitis risk.

Table 12.4.1: Variation of peritonitis rate (pt-month/epi) among PD centres, 2007-2016

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2007	24	12	12.9	31	43.3	55.2	67	106.7
2008	24	23.8	25	31	41.3	62.5	106	152.8
2009	25	13	17.7	28.8	38.2	52.4	173.6	246.1
2010	26	10.8	15.3	28.7	36.2	57.8	72.5	87.6
2011	28	8.9	12	35	47.9	65.7	101	264.6
2012	27	25.5	29.5	46.2	58.4	72	164.5	249.1
2013	29	15.7	16.2	31.9	48.1	52.6	94	106.2
2014	31	27.2	28	34	42.9	67.6	187.3	338.9
2015	35	3.5	11.6	27.3	39.9	58.9	109.8	119.6
2016	36	10.5	16.8	30.1	42.3	58.6	151.3	267.5

Figure 12.4.1: Variation in peritonitis rate among PD centres, 2016

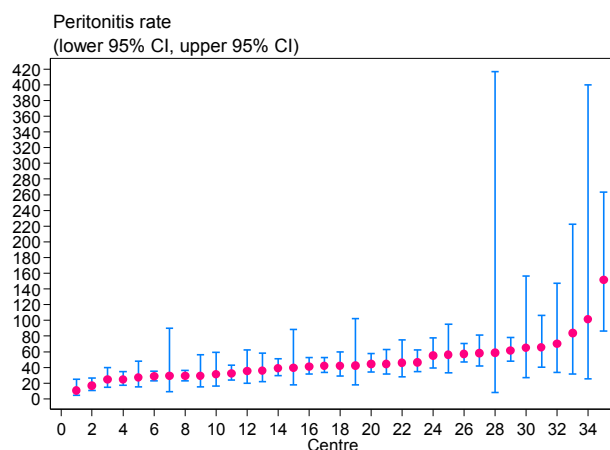


Table 12.4.2: Causative organism in PD peritonitis, 2007-2016

	2007		2008		2009		2010		2011		2012	
	n	%	n	%	n	%	n	%	n	%	n	%
<b>(A) Gram Positives</b>												
<i>Staph. aureus</i>	40	11.3	40	8.9	50	10.6	70	15.0	72	14.3	68	14.8
Staph Coagulase Neg.	29	8.2	48	10.7	50	10.6	53	11.3	46	9.1	48	10.4
Strep	15	4.2	19	4.3	17	3.6	13	2.8	33	6.5	36	7.8
Others	11	3.1	7	1.6	6	1.3	6	1.3	19	3.8	19	4.1
<b>(B) Gram Negatives</b>												
Pseudomonas	29	8.2	38	8.5	34	7.2	33	7.1	44	8.7	18	3.9
Acinetobacter	20	5.6	23	5.1	17	3.6	9	1.9	22	4.4	12	2.6
Klebsiella	17	4.8	23	5.1	27	5.7	30	6.4	27	5.4	26	5.6
Enterobacter	7	2.0	3	0.7	13	2.7	8	1.7	9	1.8	7	1.5
E.Coli	32	9.0	42	9.4	39	8.2	59	12.6	49	9.7	38	8.2
Others	6	1.7	8	1.8	9	1.9	9	1.9	9	1.8	11	2.4
<b>(C) Polymicrobial</b>												
	0	0.0	0	0.0	13	2.7	4	0.9	0	0.0	0	0.0
<b>(D) Others</b>												
Fungal	20	5.6	24	5.4	18	3.8	15	3.2	17	3.4	18	3.9
Mycobacterium	1	0.3	4	0.9	1	0.2	0	0.0	6	1.2	2	0.4
Others	12	3.4	21	4.7	16	3.4	32	6.8	30	6.0	32	6.9
<b>(E) No growth</b>												
	115	32.5	147	32.9	163	34.5	127	27.1	121	24.0	126	27.3
<b>Total</b>	<b>354</b>	<b>100</b>	<b>447</b>	<b>100</b>	<b>473</b>	<b>100</b>	<b>468</b>	<b>100</b>	<b>504</b>	<b>100</b>	<b>461</b>	<b>100</b>

Table 12.4.2: Causative organism in PD peritonitis, 2007-2016 ('cont.)

	2013		2014		2015		2016	
<b>(A) Gram Positives</b>								
<i>Staph. aureus</i>	97	15.0	87	12.0	108	10.5	93	9.7
Staph Coagulase Neg.	59	9.1	73	10.0	136	13.3	130	13.5
Strep	53	8.2	56	7.7	74	7.2	57	5.9
Others	30	4.6	23	3.2	43	4.2	31	3.2
<b>(B) Gram Negatives</b>								
Pseudomonas	37	5.7	44	6.1	60	5.9	57	5.9
Acinetobacter	19	2.9	20	2.8	27	2.6	35	3.6
Klebsiella	35	5.4	51	7.0	58	5.7	53	5.5
Enterobacter	11	1.7	15	2.1	17	1.7	28	2.9
E.Coli	45	6.9	55	7.6	70	6.8	94	9.8
Others	11	1.7	19	2.6	16	1.6	32	3.3
<b>(C) Polymicrobial</b>	18	2.8	25	3.4	31	3.0	24	2.5
<b>(D) Others</b>								
Fungal	28	4.3	16	2.2	40	3.9	34	3.5
Mycobacterium	5	0.8	6	0.8	2	0.2	8	0.8
Others	38	5.9	48	6.6	74	7.2	51	5.3
<b>(E) No growth</b>	162	25.0	189	26.0	269	26.2	236	24.5
<b>Total</b>	648	100	727	100	1025	100	963	100

Figure 12.4.2 Causative organism in PD peritonitis, 2007-2016

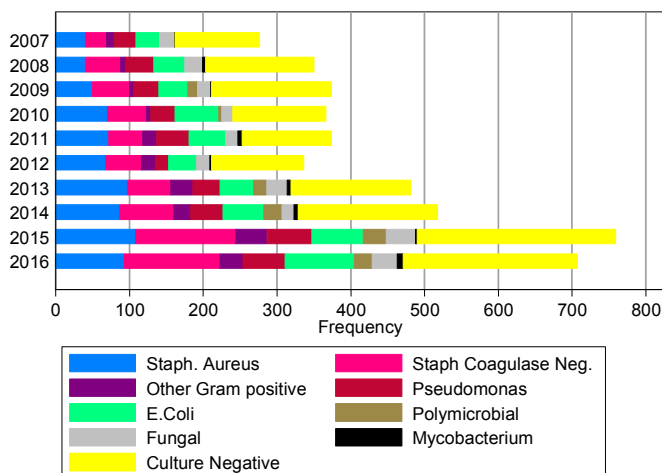


Table 12.4.3(a): Outcome of peritonitis by causative organism, 2007-2011

	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	n	%	n	%	n	%	n	%
<b>(A) Gram Positives</b>								
Staph. Aureus	166	66	43	17	43	17	252	100
Staph Coagulase Neg.	173	80	17	8	26	12	216	100
Strep	76	80	4	4	15	16	95	100
Others	38	84	5	11	2	4	45	100
<b>(B) Gram Negatives</b>								
Pseudomonas	54	33	48	29	61	37	163	100
Acinetobacter	44	54	15	18	23	28	82	100
Klebsiella	64	54	20	17	35	29	119	100
Enterobacter	26	70	1	3	10	27	37	100
E.Coli	130	62	27	13	53	25	210	100
Others	21	55	10	26	7	18	38	100
<b>(C) Polymicrobial</b>	5	29	5	29	7	41	17	100
<b>(D) Others</b>								
Fungal	7	8	29	32	54	60	90	100
Mycobacterium	0	0	4	33	8	67	12	100
Others	68	65	16	15	21	20	105	100
<b>(E) No growth</b>	418	66	78	12	136	22	632	100

Table 12.4.3(b): Outcome of peritonitis by causative organism, 2012-2016

	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	n	%	n	%	n	%	n	%
<b>(A) Gram Positives</b>								
Staph. Aureus	316	71	54	12	72	16	442	100
Staph Coagulase Neg.	360	83	22	5	50	12	432	100
Strep	221	83	16	6	28	11	265	100
Others	96	69	18	13	25	18	139	100
<b>(B) Gram Negatives</b>								
Pseudomonas	95	45	65	31	52	25	212	100
Acinetobacter	62	56	15	14	34	31	111	100
Klebsiella	139	64	30	14	48	22	217	100
Enterobacter	54	69	11	14	13	17	78	100
E.Coli	185	63	33	11	75	26	293	100
Others	53	62	12	14	21	24	86	100
<b>(C) Polymicrobial</b>	45	49	22	24	25	27	92	100
<b>(D) Others</b>								
Fungal	9	7	67	50	59	44	135	100
Mycobacterium	4	17	7	30	12	52	23	100
Others	147	63	36	15	52	22	235	100
<b>(E) No growth</b>	684	71	117	12	165	17	966	100

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

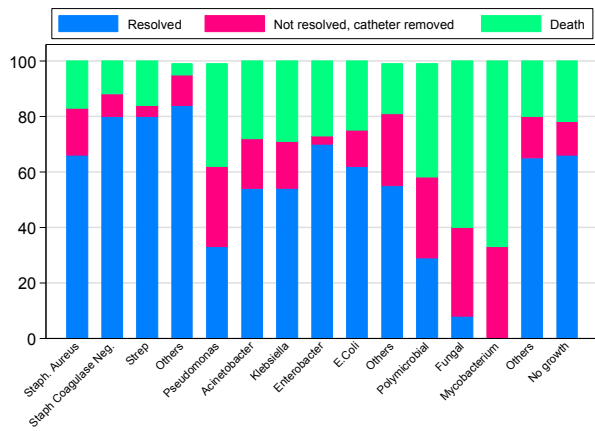


Figure 12.4.3(b): Outcome of peritonitis by causative organism, 2012-2016

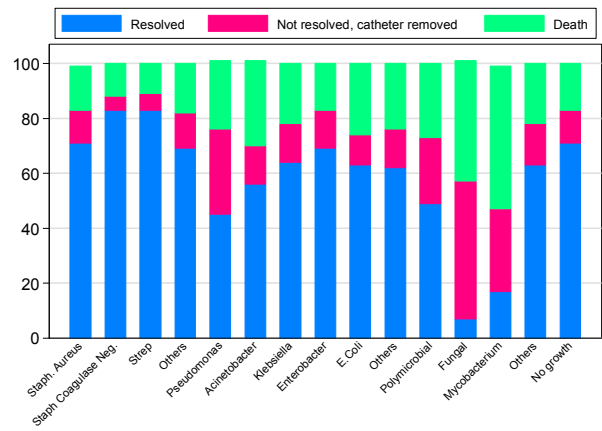
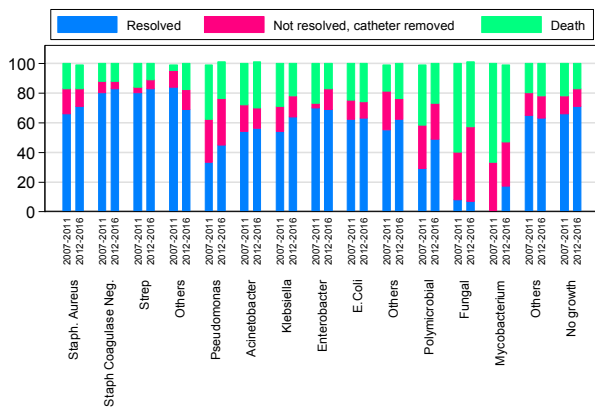


Figure 12.4.3(c): Outcome of peritonitis by causative organism by era, 2007-2011 & 2012-2016



Outcome of peritonitis by causative organism by era

Table 12.4.4: Risk factors influencing peritonitis rate, 2007-2016

Factors	n	Risk Ratio	95% CI	P value
<b>Age (years)</b>				
<=14	326	0.907	(0.77, 1.07)	0.250
15-24	517	0.922	(0.80, 1.06)	0.256
25-34 (ref*)	715	1.000		
35-44	942	1.009	(0.89, 1.14)	0.886
45-54	1738	1.032	(0.92, 1.16)	0.587
55-64	2393	1.175	(1.05, 1.32)	0.006
>=65	1857	1.215	(1.07, 1.38)	0.002
<b>Gender</b>				
Male (ref*)	4359	1.000		
Female	4129	1.036	(0.98, 1.10)	0.218
<b>Diabetes</b>				
No (ref*)	5245	1.000		
Yes	3243	0.939	(0.88, 1.00)	0.049
<b>Income</b>				
<RM 1000 (ref*)	3018	1.000		
RM 1000-3000	4029	0.834	(0.79, 0.89)	<0.001
RM 3001-5000	1218	0.676	(0.61, 0.75)	<0.001
RM 5001-10000	172	0.654	(0.49, 0.87)	0.004
>=RM 10000	51	0.719	(0.45, 1.15)	0.167
<b>Education</b>				
Nil	612	1.138	(1.02, 1.27)	0.022
Primary	2560	1.064	(1.00, 1.14)	0.068
Secondary (ref*)	4296	1.000		
Tertiary	1020	0.939	(0.85, 1.04)	0.228
<b>Assistance to perform CAPD</b>				
Self care (ref*)	4138	1.000		
Partially assisted	1541	1.154	(1.07, 1.25)	<0.001
Completely assisted	2809	1.149	(1.07, 1.24)	<0.001