

Chapter - 8

**BLOOD PRESSURE CONTROL
AND DYSLIPIDAEMIA
IN PATIENTS ON DIALYSIS**

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SECTION 8.1: BLOOD PRESSURE CONTROL ON DIALYSIS

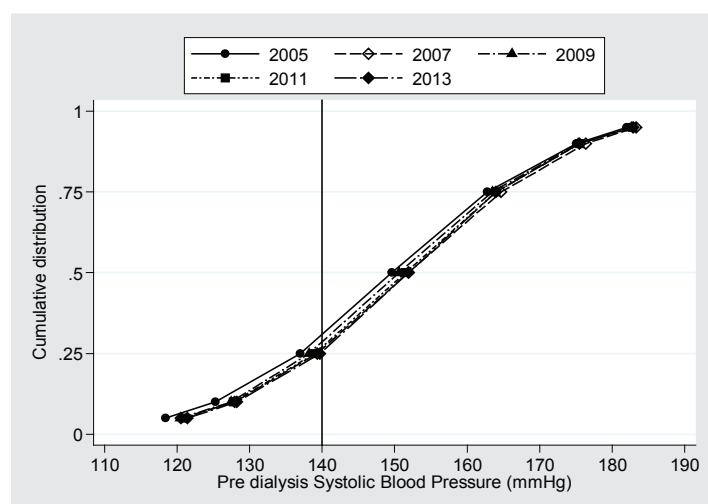
For the first time in the analysis of data on blood pressure and lipid profile in the Malaysian Dialysis and Transplant Registry (MDTR), this year's review will also analyse mortality data in relation to blood pressure and lipid profile in dialysis patients.

In 2013, the difficulty in achieving good control of predialysis systolic blood pressure in haemodialysis patients persisted, with only 25% of haemodialysis patients achieving systolic BP < 140 mmHg (Table 8.1.1). The mean and median predialysis systolic blood pressure in haemodialysis patients in 2013 was similar at a relatively high figure of 151.9 mmHg.

Table 8.1.1: Distribution of pre dialysis systolic blood pressure, HD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmHg)				
							<120	120-<140	140-<160	160-<180	≥180
2004	7936	149.7	20	150	136.6	163.1	7	23	39	25	6
2005	9220	149.9	19.4	149.6	137	162.8	6	24	40	24	6
2006	11525	151.4	19.3	151.1	138.8	164	5	22	41	25	7
2007	12830	152.1	19.1	151.9	139.3	164.7	5	21	40	27	7
2008	15318	152.1	19	152	139.4	164.6	4	21	40	27	7
2009	17878	151	19	150.6	138.2	163.5	5	23	41	25	6
2010	19432	150.8	18.9	150.4	138.3	163.3	5	23	41	25	6
2011	22215	151.6	18.9	151.5	139	164	4	22	41	26	6
2012	25596	151.5	19	151.3	139	164	5	22	41	26	7
2013	28818	151.9	18.7	151.9	139.7	164	4	21	42	26	7

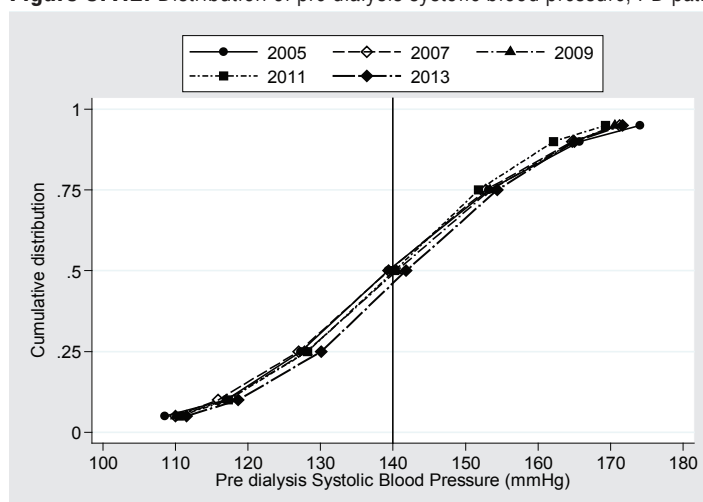
Figure 8.1.1: Cumulative distribution of pre dialysis systolic blood pressure, HD patients 2004-2013



In contrast to haemodialysis patients, predialysis systolic blood pressure was better controlled in peritoneal dialysis patients in 2013, with 45% of PD patients having a predialysis systolic BP < 140 mmHg (Table 8.1.2). The mean and median predialysis systolic BP in PD patients was also lower than haemodialysis patients at 142 mmHg and 141.8 mmHg respectively. There was little discernable change in the mean predialysis systolic blood pressure in PD patients over the past 10 years as illustrated in the data in Table 8.1.2.

Table 8.1.2: Distribution of pre dialysis systolic blood pressure, PD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmHg)				
							<120	120-<140	140-<160	160-<180	≥180
2004	1259	141	19.8	140.9	127.4	154.5	13	34	36	14	3
2005	1351	140.4	20.2	139.3	127.3	153.2	13	38	32	14	3
2006	1523	139.3	19.3	138.4	126.7	151.6	14	40	32	11	2
2007	1753	139.9	19.2	139.4	127	152.8	15	37	33	13	2
2008	2049	139.4	18.7	139.5	126.7	151.4	15	36	35	12	2
2009	2177	140.7	18.7	140.5	128.1	153.4	13	35	35	14	2
2010	2327	140	17.8	140	128.3	151.4	12	37	38	11	2
2011	2517	140	18	140.2	128.2	151.8	13	36	38	11	2
2012	2734	141.1	18.3	141.3	128.7	153.1	12	34	38	14	2
2013	2940	142	18.3	141.8	130.1	154.4	11	34	39	14	2

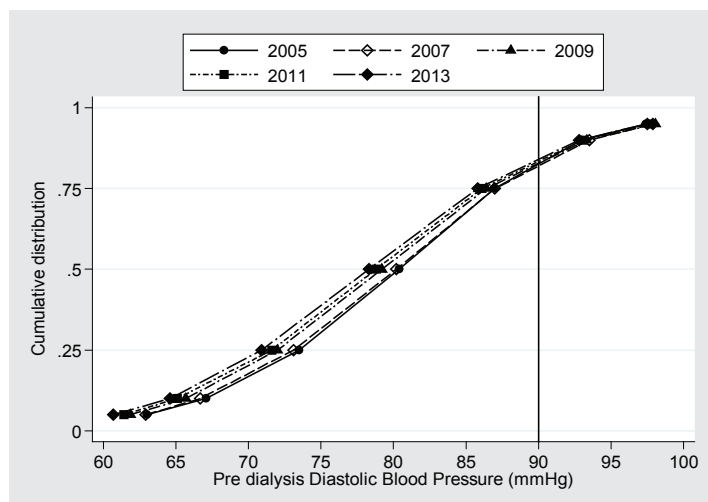
Figure 8.1.2: Distribution of pre dialysis systolic blood pressure, PD patients 2004-2013

Predialysis diastolic blood pressure in haemodialysis patients was better controlled than predialysis systolic blood pressure in 2013, with 84% of such patients achieving predialysis diastolic BP <90 mmHg (Table 8.1.3). The mean and median predialysis diastolic blood pressure in haemodialysis patients was satisfactory at 78.8 mmHg and 78.3 mmHg respectively in 2013. The mean predialysis diastolic blood pressure in haemodialysis patients has decreased slightly from 80.3 mmHg in 2004 to 78.8 mmHg in 2013.

Table 8.1.3: Distribution of pre dialysis diastolic blood pressure, HD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmHg)				
							<70	70-<80	80-<90	90-<100	≥100
2004	7934	80.3	10.2	80.3	73.6	86.9	15	33	36	14	3
2005	9220	80.3	10.6	80.4	73.5	87	15	32	36	14	3
2006	11524	80.4	11.1	80.4	73.3	87.1	16	32	35	14	3
2007	12830	80.4	11.1	80.2	73.1	87	16	32	34	14	4
2008	15316	79.8	11.1	79.6	72.4	86.7	18	33	33	13	3
2009	17877	79.7	12	79.2	72	86.4	19	33	31	12	4
2010	19430	79.4	11.8	79	71.8	86.2	20	34	31	12	4
2011	22214	79.2	11.9	78.8	71.6	86.1	20	34	30	12	4
2012	25593	78.8	11.8	78.4	71	85.8	22	34	30	11	4
2013	28816	78.8	12	78.3	70.9	85.8	22	33	29	11	4

Figure 8.1.3: Cumulative distribution of pre dialysis diastolic blood pressure, HD patients 2004-2013

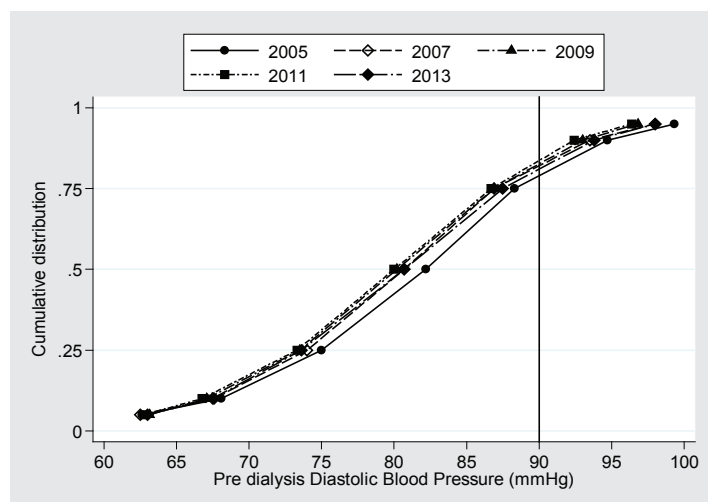


In peritoneal dialysis patients, the predialysis diastolic blood pressure was also well controlled in 2013 with 82% of these patients achieving diastolic BP <90 mmHg (Table 8.1.4). The mean and median predialysis diastolic blood pressure in PD patients was satisfactory at 80.6 mmHg and 80.7 mmHg respectively in 2013. There was a slight trend towards a lower mean predialysis diastolic blood pressure in PD patients over the past 10 years (82.2 mmHg in 2004 versus 80.6 mmHg in 2013).

Table 8.1.4: Distribution of pre dialysis diastolic blood pressure, PD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmHg)				
							<70	70-<80	80-<90	90-<100	≥100
2004	1258	82.2	10.5	83	75.4	89.2	11	28	38	18	4
2005	1351	81.6	10.9	82.2	75	88.3	12	29	40	15	5
2006	1522	81.3	10.6	81.5	74.8	88	13	28	40	15	3
2007	1752	80.6	10.7	80.7	74	86.9	14	32	38	12	3
2008	2049	79.7	10.1	80	73	86.3	16	32	36	13	2
2009	2177	80.2	10.3	80.2	73.5	86.9	15	33	35	14	3
2010	2327	79.9	10.4	80	72.9	86.8	17	33	34	13	3
2011	2517	79.9	10.3	80	73.3	86.7	16	33	36	13	2
2012	2737	81.2	12.1	80.8	73.8	87.8	15	31	35	15	4
2013	2933	80.6	10.9	80.7	73.6	87.5	15	32	35	15	4

Figure 8.1.4: Cumulative Distribution of pre dialysis diastolic blood pressure, PD patients 2004-2013

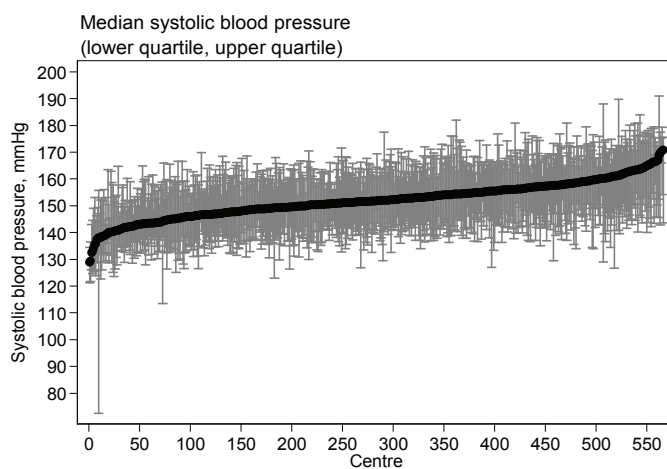


When comparing data among hemodialysis centres in Malaysia, there remained significant centre variation in median systolic blood pressure in haemodialysis patients in 2013 (Figure 8.1.5a). In 2013, the difference between the HD centres with the second lowest (5th percentile) and second highest median systolic blood pressure (95th percentile) was 24.3 mmHg (Table 8.1.5a). Figure 8.1.5a will be more useful for individual dialysis centres to ascertain where their dialysis centre stands in relation to other centres and perhaps remedial action can be instituted if they were identified as “outlier” centres at the extreme end of the variation in median systolic blood pressure control (Figure 8.1.5a & b).

Table 8.1.5(a): Median systolic blood pressure among HD patients, HD centres

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	217	122.1	137.5	145.8	150	155.4	162.8	169.8
2005	239	121.7	137	144.3	150.7	154.9	162.2	171.8
2006	286	130.8	138.8	146.4	151.5	156.5	162.9	180.1
2007	319	131.7	140.5	147.4	152.3	157	164.9	174.1
2008	376	133.5	141.2	147.5	152.5	157	164.3	174.3
2009	426	133.2	139.8	146.8	151.2	155.7	162.6	173.2
2010	460	130.1	140.2	146.3	150.1	155.7	163.2	175
2011	513	125.5	139.7	147.5	151.6	156.6	163.8	175.3
2012	566	128.8	140.8	147.6	151.8	156.2	163.2	170.7
2013	610	124.4	141	148.4	152.5	157	165.3	174.8

Figure 8.1.5(a): Variation in median systolic blood pressure among HD patients, HD centres 2013

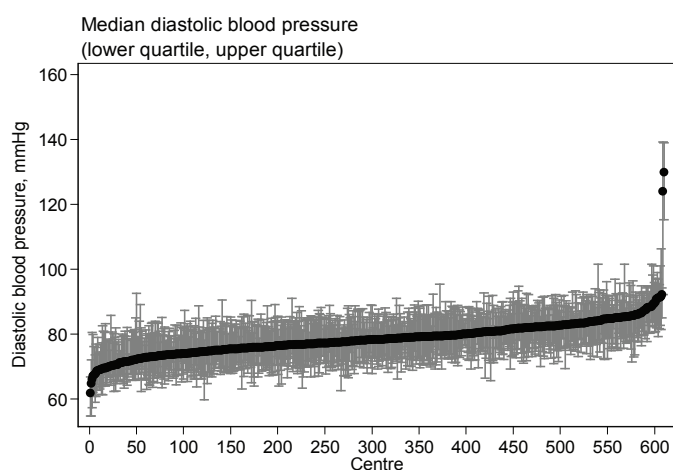


Similarly for median diastolic blood pressure in haemodialysis patients, there was also a wide centre variation among haemodialysis centres in Malaysia in 2013 (Figure 8.1.5b). The difference between the HD centres with the second lowest (5th percentile) and second highest (95th percentile) median diastolic blood pressure was about 15.2 mmHg (Table 8.1.5b).

Table 8.1.5(b): Median diastolic blood pressure among HD patients, HD centres

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	217	70.2	74	78.3	80.7	82.5	86.8	88.4
2005	239	69	73.1	78.1	80.8	82.7	86.3	90.1
2006	286	68	74.4	77.8	80.3	83.2	86.7	101
2007	319	70.1	73.3	77.8	80.1	82.9	87.3	124.6
2008	376	66.8	73.4	77.2	79.5	82.5	86.8	92.3
2009	426	68.5	72.8	76.7	79.4	82	86.1	133.8
2010	460	68.6	72.5	76.6	79.3	82.1	86	142.2
2011	513	67.8	72.8	76.3	78.6	81.5	86.2	143
2012	566	66.3	71.3	75.9	78.5	81.3	86.3	122.8
2013	610	61.8	70.8	75.5	78.3	81.8	86	129.8

Figure 8.1.5(b): Variation in median diastolic blood pressure among HD patients, HD centres 2013

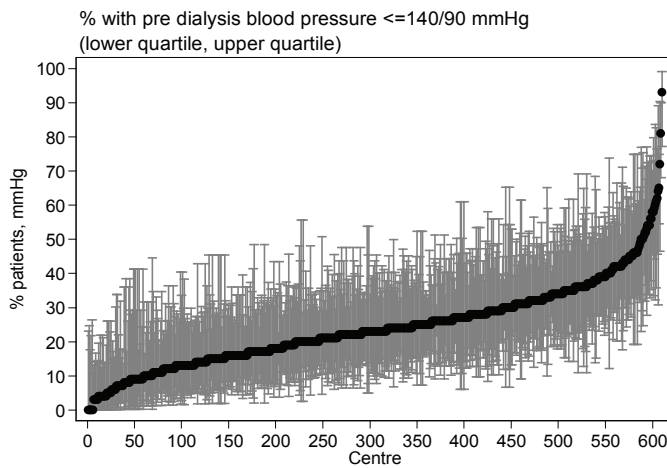


There was also a wide centre variation amongst haemodialysis centres in 2013 in the proportion of patients achieving BP \leq 140/90 (Table & Figure 8.1.5c).

Table 8.1.5(c): Proportion of HD patients with pre dialysis blood pressure \leq 140/90 mmHg, HD centres

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	217	0	8	20	29	38	57	82
2005	239	5	11	20	28	38	56	95
2006	286	0	9	17	24	34	52	76
2007	319	0	7	17	26	33	48	75
2008	376	0	7	17	24.5	32.5	46	69
2009	426	0	10	18	26.5	34	50	80
2010	460	0	8	18	26	36	50	87
2011	513	0	7	17	24	33	50	94
2012	566	0	8	18	25	33	46	80
2013	610	0	7	16	23	31	46	93

Figure 8.1.5(c): Variation in proportion of HD patients with pre dialysis blood pressure $\leq 140/90$ mmHg, HD



While the number of PD centres in Malaysia were significantly less than the number of haemodialysis centres, there was still a significant centre variation in median systolic blood pressure in PD patients in 2013 (Figure 8.1.6a). The difference between the PD centres with the second lowest (5th percentile) and the second highest median systolic blood pressure (95th percentile) was 43.2 mmHg in 2013 (Table 8.1.6a). Similarly there was also a significant centre variation in median diastolic blood pressure in PD patients in 2013 (Table & Figure 8.1.6b).

Table 8.1.6(a): Median systolic blood pressure among PD patients, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	122.9	122.9	134.5	139.8	143.3	149.7	149.7
2005	19	122.6	122.6	133.3	136.6	142	158	158
2006	22	112.7	118.3	130.2	136.3	140.4	146	154.9
2007	22	115.9	116.3	135.2	138.2	142.5	148	153.5
2008	23	115.6	118.1	136	138.9	142.1	147.7	147.8
2009	24	113.5	116.3	135.3	138.3	144.3	149.9	161.5
2010	26	114.3	115.6	133.3	138.6	143.3	146.3	147.9
2011	27	112.5	114.2	132.2	140.3	142.3	146.5	147.8
2012	28	114	114.3	132.4	140.9	143.5	149.8	156.7
2013	27	112	115.5	135	142	145.4	158.7	161.5

Figure 8.1.6(a): Variation in median systolic blood pressure among PD patients, PD centres 2013

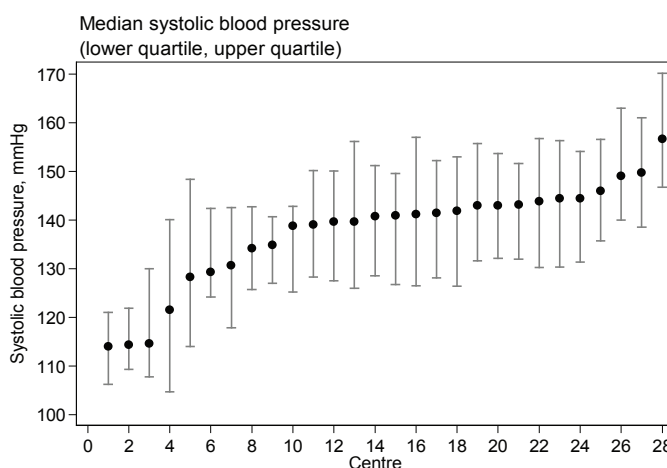
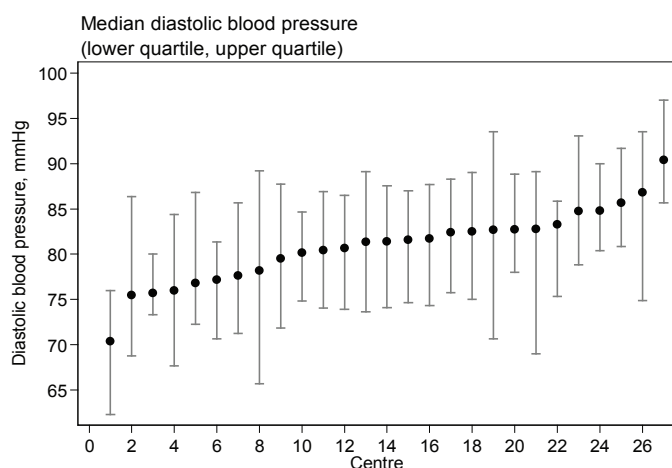


Table 8.1.6(b): Median diastolic blood pressure among PD patients, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	77.5	77.5	80.8	83.4	84.3	87	87
2005	19	74.4	74.4	80.3	82.9	84.2	86	86
2006	22	71.6	74	78.9	81.5	82.4	86.3	88.4
2007	22	68.8	77.3	78.9	80.4	82.1	83.2	86.9
2008	23	73.4	76	77.9	80	82.1	85.5	86.6
2009	24	72.9	73.3	78.5	79.2	82.3	84.4	87.8
2010	26	72.8	75.7	77.3	79.5	81.7	86.3	87.4
2011	27	72	74.1	78.3	79.8	81.9	85.1	86.9
2012	28	72.1	73	78.6	80.1	83.4	86.6	91
2013	27	70.4	75.5	77.6	81.4	82.8	86.8	90.4

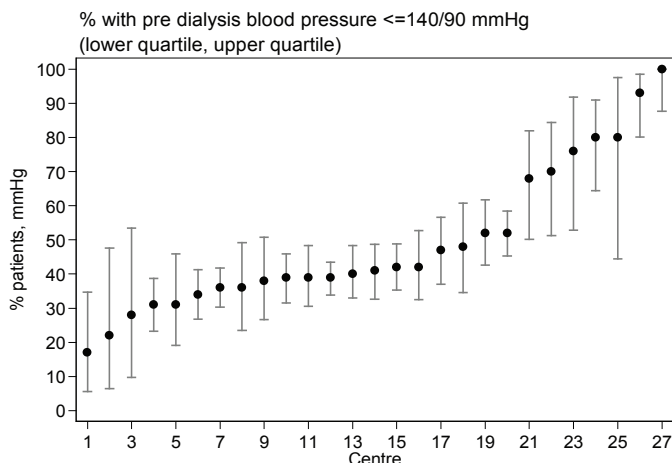
Figure 8.1.6(b): Variation in median diastolic blood pressure among PD patients, PD centres 2013

Similar to haemodialysis centres, there was also a wide variation amongst PD centres in the proportion of patients achieving BP <140/90 in 2013 (Table & Figure 8.1.6c). Figure 8.1.6c shown that there were 2 exemplary peritoneal dialysis centres where more than 90% of their patients were able to achieve target blood pressure of less than 140/90.

Table 8.1.6(c): Proportion of PD patients with pre dialysis blood pressure \leq 140/90 mmHg, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	30	30	38	47	56	73	73
2005	19	23	23	43	55	62	92	92
2006	22	18	36	43	59	67	100	100
2007	22	27	27	44	54.5	67	91	91
2008	23	28	29	43	53	58	85	100
2009	24	10	29	40	52	57	92	96
2010	26	30	34	38	50.5	63	88	100
2011	27	29	31	41	45	71	97	100
2012	28	5	26	40	44.5	63.5	90	100
2013	27	17	22	36	41	68	93	100

Figure 8.1.6(c): Variation in proportion of PD patients with pre dialysis blood pressure $\leq 140/90$ mmHg, PD centres 2013



The new data analysing the correlation of blood pressure profile and death as well as cardiovascular death and ischaemic heart disease in all dialysis patients for the period 2004 to 2013 were detailed in Table 8.1.7a. Dialysis patients with low blood pressure (BP <120/70) were at the highest risk of death compared to all other blood pressure categories. Dialysis patients with highest blood pressure (BP >180/100) were the group with the second highest risk of death. Hence there was a "U" shaped curve in the relationship between blood pressure and death in dialysis patients as illustrated in Figure 8.1.7a. Table 8.1.7b details the hazard ratio for death in each of the blood pressure categories, utilising the BP category of <120/70 as the reference standard. It was noted that the hazard ratio of all other categories were less than 1 compared to the reference standard emphasising the highest risk of death associated with dialysis patients with low blood pressure.

Table 8.1.7(a): Correlation of blood pressure profile and death, cardiovascular death and ischaemic heart disease, dialysis patients 2004-2013

	SBP<120 and DBP<70 (I)		SBP 120-140 and DBP 70-80 (II)		SBP 140-160 and DBP 80-90 (III)		SBP 160-180 and DBP 90-100 (IV)		SBP>=180 and DBP>=100 (V)	
	n	%	n	%	n	%	n	%	n	%
Men										
n	601	100	2269	100	4088	100	1105	100	186	100
Death	299	50	826	36	1156	28	326	30	71	38
CVD/IHD	99	16	223	10	208	5	42	4	9	5
Women										
n	608	100	1781	100	2460	100	531	100	111	100
Death	254	42	509	29	637	26	162	31	46	41
CVD/IHD	50	8	112	6	98	4	17	3	5	5

Figure 8.1.7(a): Relationship between blood pressure and death in dialysis patients 2004-2013

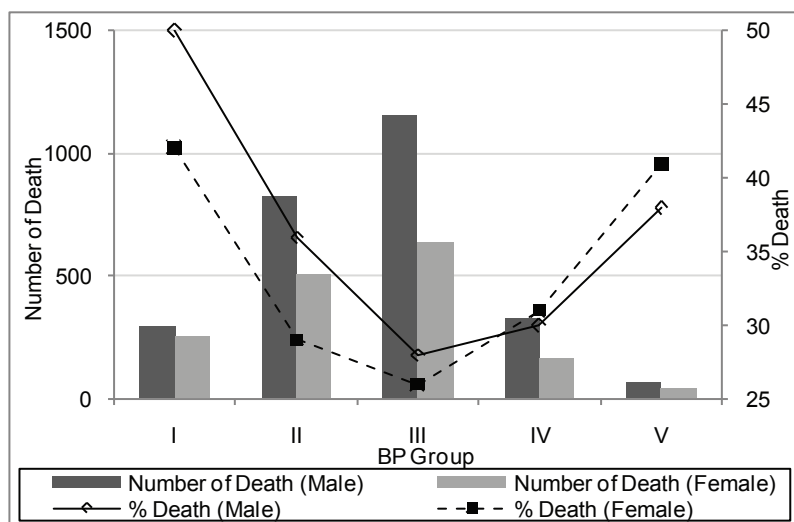


Table 8.1.7(b): Hazard ratio for death in each of the blood pressure categories, 2004-2013

	SBP<120 and DBP<70 (Ref.)	SBP 120-140 and DBP 70-80	SBP 140-160 and DBP 80-90	SBP 160-180 and DBP 90-100	SBP >=180 and DBP >=100
Men					
n	601	2269	4088	1105	186
Hazard ratio	1.00	0.509	0.308	0.345	0.745
95% CI		(0.445 ; 0.581)	(0.271 ; 0.35)	(0.295 ; 0.404)	(0.575 ; 0.965)
p-value		<0.001	<0.001	<0.001	0.026
Women					
n	608	1781	2460	531	111
Hazard ratio	1.00	0.526	0.407	0.551	1.76
95% CI		(0.452 ; 0.611)	(0.352 ; 0.471)	(0.452 ; 0.671)	(1.285 ; 2.411)
p-value		<0.001	<0.001	<0.001	<0.001

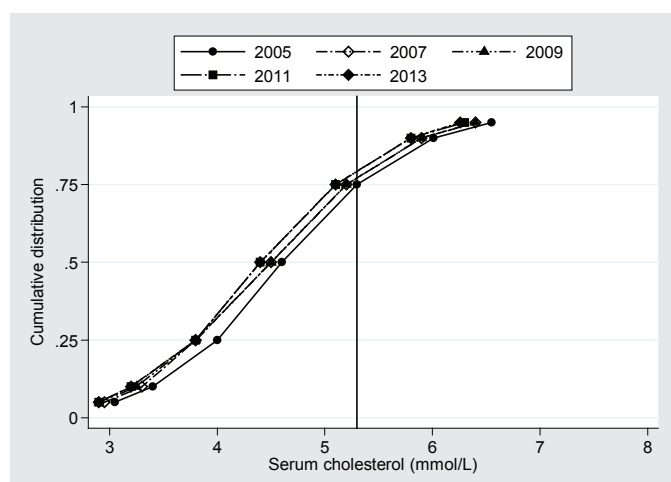
SECTION 8.2: DYSLIPIDAEMIA IN DIALYSIS PATIENTS

The optimal target for cholesterol and triglyceride levels in dialysis patients were still open to debate. However there was no doubt that cardiovascular disease was the major cause of death in dialysis patients and correction of reversible risk factors for CVD should be attempted in most dialysis patients.

In 2013, it was comforting to know that 79% of haemodialysis patients had total cholesterol <5.3 mmol/L. This was a higher figure than 10 years ago (70% in 2004) (Table 8.2.1). The mean and median serum cholesterol levels in HD patients in 2013 were 4.5mmol/L and 4.4mmol/L respectively.

Table 8.2.1: Distribution of serum cholesterol, HD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmol/L)			
							<3.5	3.5-<5.3	5.3-<6.2	≥6.2
2004	6709	4.7	1.1	4.7	4	5.4	11	59	22	8
2005	7905	4.7	1.1	4.6	4	5.3	12	60	20	8
2006	10138	4.6	1.1	4.6	3.9	5.3	14	61	18	7
2007	11347	4.6	1.1	4.5	3.8	5.2	14	62	18	6
2008	13821	4.5	1.1	4.4	3.8	5.2	15	62	17	6
2009	15911	4.6	1.1	4.5	3.8	5.2	14	62	17	6
2010	17653	4.6	1.1	4.5	3.8	5.2	14	62	18	7
2011	20386	4.5	1.1	4.4	3.8	5.1	16	63	15	6
2012	23348	4.5	1.1	4.4	3.8	5.1	16	63	15	5
2013	26350	4.5	1.1	4.4	3.8	5.1	16	63	15	5

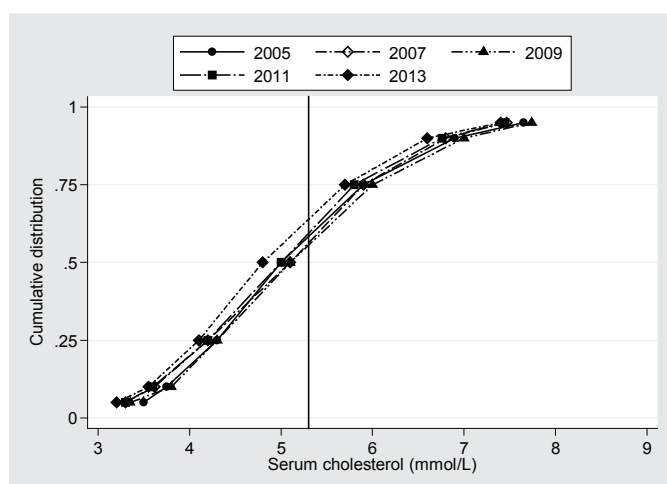
Figure 8.2.1: Cumulative distribution of cholesterol, HD patients 2004-2013

However total cholesterol levels in peritoneal dialysis patients were less optimally controlled in comparison with haemodialysis patients, with only 64% of PD patients achieving total cholesterol ≤ 5.3 mmol/L in 2013 (Table & Figure 8.2.2). The mean and median serum cholesterol levels in PD patients in 2013 were 5.0 mmol/L and 4.8 mmol/L respectively. These figures were slightly lower than 2004 figures (mean 5.3 mmol/L and median 5.2 mmol/L).

Table 8.2.2: Distribution of serum cholesterol, PD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmol/L)			
							<3.5	3.5-<5.3	5.3-<6.2	≥ 6.2
2004	1230	5.3	1.4	5.2	4.4	6.1	5	47	27	21
2005	1242	5.2	1.3	5	4.3	5.9	5	53	24	18
2006	1395	5.2	1.4	5.1	4.3	5.9	6	50	26	18
2007	1629	5.1	1.3	5.1	4.2	5.9	8	48	26	18
2008	1902	5.2	1.4	5	4.3	5.9	7	50	24	18
2009	2016	5.3	1.5	5.1	4.3	6	6	48	26	20
2010	2186	5.2	1.4	5.1	4.3	6	7	48	25	20
2011	2291	5.1	1.3	5	4.2	5.8	8	50	25	17
2012	2628	5.1	1.4	4.9	4.3	5.8	7	52	24	17
2013	2944	5	1.4	4.8	4.1	5.7	9	55	22	15

Figure 8.2.2: Cumulative distribution of cholesterol (mmol/L), PD patients 2004-2013

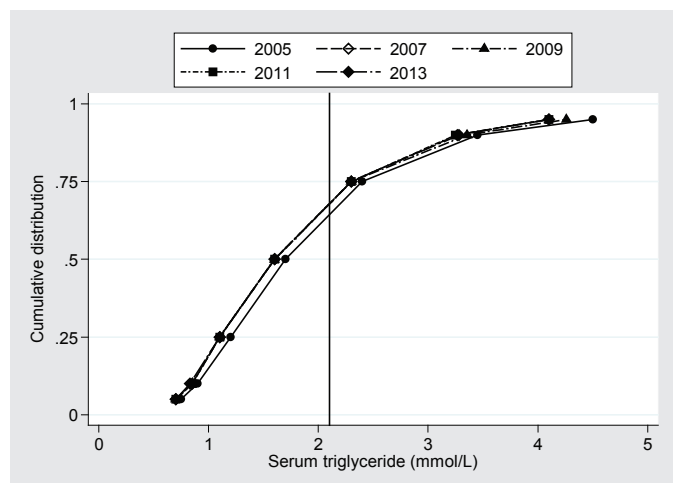


With regards to triglyceride levels, about $\frac{3}{4}$ of haemodialysis patients have a triglyceride level of < 2.3 mmol/L (Table 8.2.3). The mean and median serum triglyceride in haemodialysis patients in 2013 were 1.9 mmol/L and 1.6 mmol/L respectively.

Table 8.2.3: Distribution of serum triglyceride, HD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmol/L)			
							<1.7	1.7-<2.3	2.3-<3.5	≥ 3.5
2004	5607	2	1.2	1.7	1.2	2.4	51	23	17	10
2005	6950	2	1.3	1.7	1.2	2.4	50	22	18	10
2006	9522	2	1.3	1.6	1.2	2.3	54	21	16	9
2007	10882	1.9	1.2	1.6	1.1	2.3	55	21	16	8
2008	12928	1.9	1.2	1.6	1.1	2.3	56	20	15	8
2009	15190	1.9	1.3	1.6	1.1	2.3	54	21	16	9
2010	16970	1.9	1.3	1.6	1.1	2.3	54	21	16	9
2011	19564	1.9	1.2	1.6	1.1	2.3	55	21	16	8
2012	22812	1.9	1.2	1.6	1.1	2.3	54	21	16	9
2013	25741	1.9	1.2	1.6	1.1	2.3	55	20	16	8

Figure 8.2.3: Cumulative distribution of serum triglyceride, HD patients 2004-2013

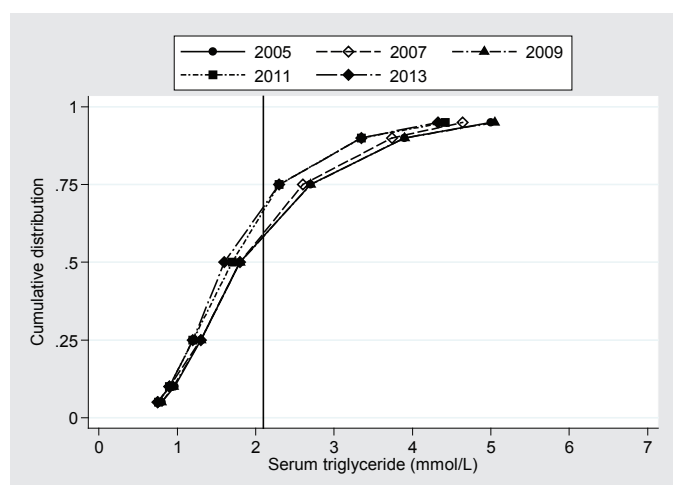


Peritoneal dialysis patients also have a similar level of triglyceride control with 75% of PD patients having triglyceride level <2.3 mmol/L (Table 8.2.4). The mean and median serum triglyceride in PD patients have decreased slightly over the past 10 years from 2.2 mmol/L and 1.8 mmol/L in 2004 to 2.0 mmol/L and 1.6 mmol/L in 2013 respectively.

Table 8.2.4: Distribution of serum triglyceride, PD patients 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (mmol/L)			
							<1.7	1.7-<2.3	2.3-<3.5	≥3.5
2004	1223	2.2	1.6	1.8	1.3	2.6	47	23	17	13
2005	1241	2.2	1.5	1.8	1.3	2.7	43	24	18	14
2006	1391	2.2	1.6	1.7	1.2	2.6	47	21	18	13
2007	1625	2.1	1.4	1.8	1.3	2.6	45	24	19	12
2008	1907	2.2	1.5	1.8	1.3	2.7	45	21	20	14
2009	2017	2.2	1.6	1.8	1.3	2.7	46	21	20	14
2010	2177	2.1	1.4	1.8	1.3	2.5	47	23	18	11
2011	2309	2	1.3	1.7	1.2	2.3	51	23	17	9
2012	2624	2	1.3	1.7	1.2	2.5	48	23	19	10
2013	2962	2	1.3	1.6	1.2	2.3	52	23	17	9

Figure 8.2.4: Cumulative distribution of serum triglyceride, PD patients 2004-2013



There was some centre variation in median serum cholesterol levels and proportion of HD patients with serum cholesterol <5.3mmol/L in HD centers in 2013 (Table 8.2.5a & b). There were some exemplary dialysis centres who reported more than 90% of their patients achieving serum cholesterol <5.2 mmol/L in 2013.

Table 8.2.5(a): Median serum cholesterol level among HD patients, HD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	186	3.9	4.2	4.5	4.7	4.9	5.4	6.1
2005	212	3.8	4.1	4.4	4.6	4.8	5.3	5.6
2006	269	3.3	3.9	4.3	4.6	4.8	5.2	5.9
2007	292	3.6	4	4.3	4.5	4.8	5.1	5.4
2008	346	3.2	3.8	4.2	4.5	4.7	5.1	6.3
2009	383	3.5	3.9	4.3	4.5	4.8	5.2	5.6
2010	423	3.5	4	4.3	4.5	4.8	5.1	5.6
2011	487	3.7	3.9	4.2	4.4	4.6	4.9	5.7
2012	549	3.5	4	4.2	4.4	4.6	4.9	5.8
2013	584	3.4	3.9	4.2	4.4	4.6	4.9	5.5

Figure 8.2.5(a): Variation in median serum cholesterol level among HD patients, HD centres 2013

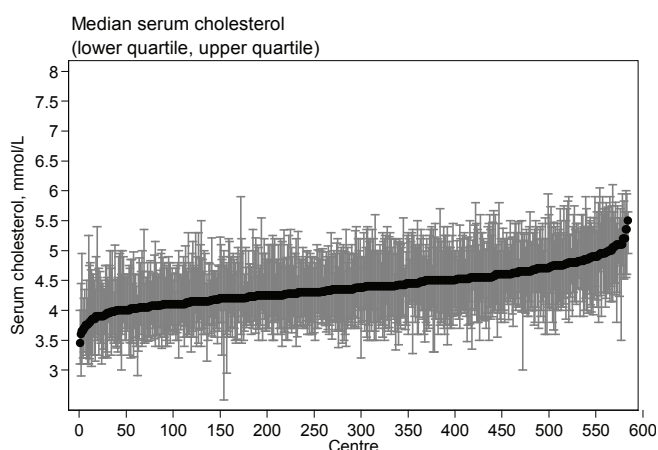
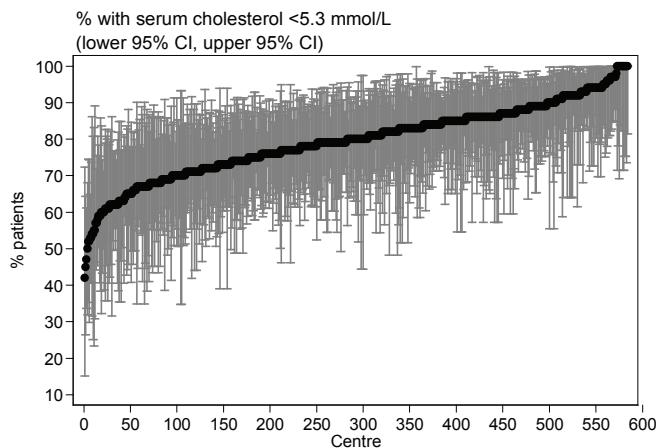


Table 8.2.5(b): Proportion of HD patients with serum cholesterol <5.3mmol/L, HD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	186	25	44	60	69	76	89	97
2005	212	34	48	65	73	80.5	91	100
2006	269	29	52	67	75	83	92	100
2007	292	36	57	69	75	84	93	100
2008	346	29	56	69	77	85	92	100
2009	383	33	50	68	76	84	93	100
2010	423	27	55	68	76	84	92	100
2011	487	27	58	71	79	86	94	100
2012	549	33	63	73	79	86	93	100
2013	584	42	62	73	80	86	94	100

Figure 8.2.5(b): Variation in proportion of patients with serum cholesterol <5.3 mmol/L, HD centres 2013



There appears to be less centre variation in median serum triglyceride levels amongst haemodialysis centres with the difference between the second lowest (5th percentile) and second highest median triglyceride level (95th percentile) being only 0.9 mmol/L (Table & Figure 8.2.5c). There appears to be more centre variation in the proportion of patients with serum triglyceride <2.1 mmol/L in haemodialysis centres in 2013 (Table & Figure 8.2.5d).

Table 8.2.5(c): Median serum triglyceride level among HD patients, HD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	160	1.1	1.3	1.5	1.6	1.8	2.2	3
2005	194	0.9	1.3	1.5	1.6	1.8	2.2	2.6
2006	256	1	1.3	1.5	1.6	1.8	2.3	4
2007	278	0.8	1.2	1.4	1.6	1.8	2.1	2.9
2008	319	1	1.2	1.4	1.6	1.7	2	2.5
2009	364	1	1.2	1.4	1.6	1.8	2.1	2.6
2010	405	0.9	1.2	1.5	1.6	1.8	2.2	2.9
2011	468	1	1.2	1.4	1.6	1.8	2	6.5
2012	534	0.8	1.2	1.4	1.6	1.8	2.1	3
2013	572	0.9	1.2	1.4	1.6	1.8	2.1	2.5

Figure 8.2.5(c): Variation in median serum triglyceride level among HD patients, HD centers 2013

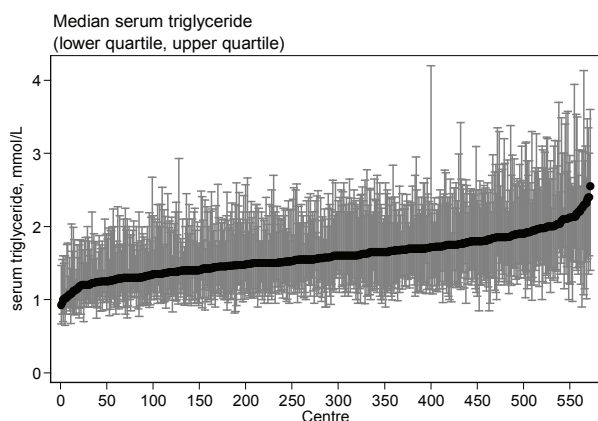
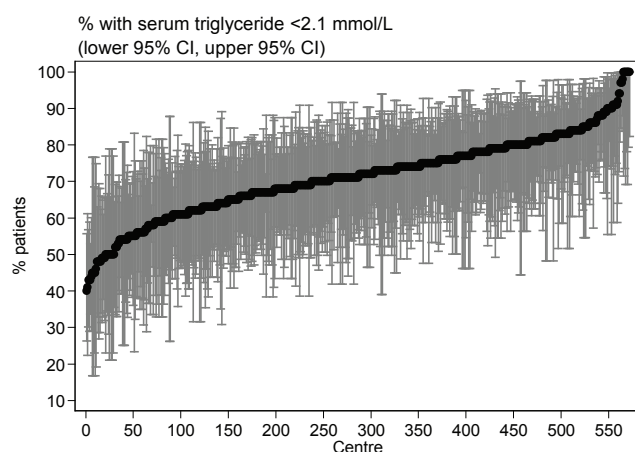


Table 8.2.5(d): Proportion of HD patients with serum triglyceride <2.1 mmol/L, HD centres

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	160	19	50	59	70	79	86.5	97
2005	194	26	47	60	67	74	85	93
2006	256	14	47	64	70	77	88	100
2007	278	36	52	63	70	79	89	100
2008	319	33	54	64	72	80	88	100
2009	364	36	50	62.5	71	78	90	100
2010	405	27	50	63	70	78	88	94
2011	468	0	53	64	71	78	88	100
2012	534	23	50	63	70	78	88	100
2013	572	40	50	64	71	79	88	100

Figure 8.2.5(d): Variation in proportion of patients with serum triglyceride <2.1mmol/L, HD centers 2013

There was some centre variation in median cholesterol levels among PD patients in 2013 with the difference between the second lowest (5th percentile) and second highest (95th percentile) median cholesterol level being 1.3 mmol/L (Table & Figure 8.2.6a). There was also centre variation in proportion of PD patients with serum cholesterol <5.3 mmol/L as illustrated in Figure 8.2.6b.

Table 8.2.6(a): Median serum cholesterol level among PD patients, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	4.6	4.6	4.9	5.3	5.4	6.1	6.1
2005	19	4.4	4.4	4.7	5	5.4	5.9	5.9
2006	21	4.4	4.6	4.8	5	5.3	6.1	6.2
2007	21	4.5	4.5	4.8	5.2	5.4	5.5	6.1
2008	22	4.3	4.5	4.8	5.1	5.4	5.6	5.8
2009	23	4.7	4.7	4.8	5.1	5.4	5.9	6.7
2010	25	4.6	4.6	4.9	5.1	5.4	6	7.3
2011	26	4.3	4.4	4.9	5.1	5.4	5.9	7.2
2012	27	4.4	4.4	4.8	5	5.3	6	7.8
2013	27	4.4	4.4	4.7	4.9	5.2	5.7	7.3

Figure 8.2.6(a): Variation in median serum cholesterol level among PD patients, PD centres 2013

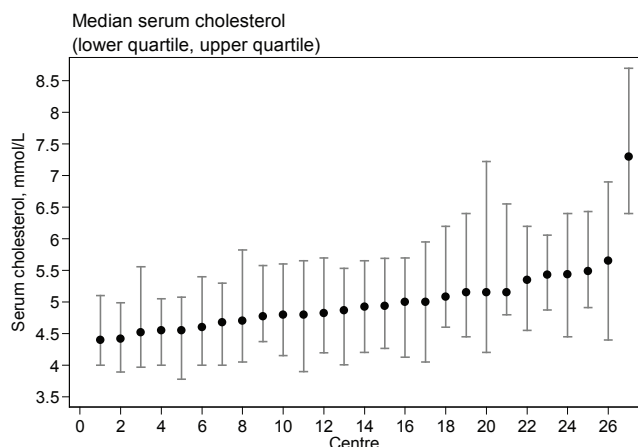
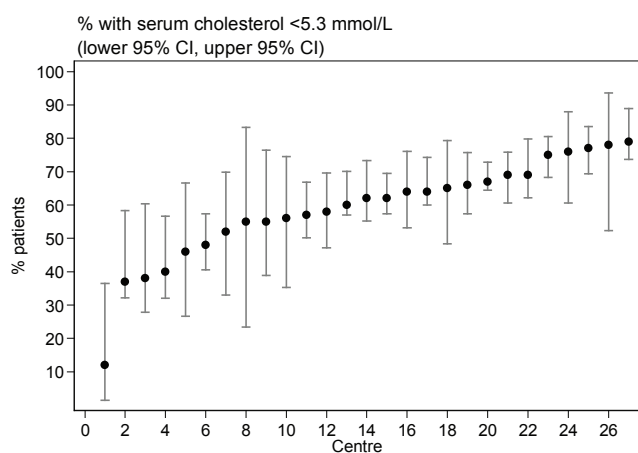


Table 8.2.6(b): Proportion of PD patients with serum cholesterol <5.3 mmol/L, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	29	29	42	49.5	60	69	69
2005	19	27	27	45	57	69	74	74
2006	21	20	25	47	57	64	71	79
2007	21	29	40	45	53	65	74	86
2008	22	30	40	46	55	68	73	73
2009	23	9	33	45	52	66	72	76
2010	25	9	27	43	51	60	71	72
2011	26	0	23	45	53.5	64	73	88
2012	27	11	20	48	60	67	77	81
2013	27	12	37	52	62	69	78	79

Figure 8.2.6(b): Variation in proportion of patients with serum cholesterol <5.3 mmol/L, PD centres 2013



As in previous years, there was only mild centre variation in median triglyceride levels among PD centres, except for 1 “outlier” centre with median serum triglyceride >2.5mmol/L (Figure 8.2.6c). There was some centre variation amongst PD centres in the proportion of patients with serum triglyceride levels < 2.1 mmol/L. (Table & Figure 8.2.6d).

Table 8.2.6(c): Median serum triglyceride level among PD patients, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	1.3	1.3	1.7	1.8	1.8	2.2	2.2
2005	19	1.4	1.4	1.6	1.9	2	2.2	2.2
2006	21	1.1	1.4	1.6	1.8	1.9	2	2.6
2007	21	1.2	1.5	1.7	1.8	1.9	2.1	2.7
2008	22	1.3	1.5	1.7	1.8	2	2.2	2.3
2009	23	1.4	1.5	1.7	1.8	1.9	2.2	2.5
2010	24	1.4	1.5	1.6	1.7	1.9	2.1	2.1
2011	26	1.2	1.4	1.6	1.6	1.8	2.1	2.2
2012	27	1.4	1.4	1.5	1.7	1.9	2.5	2.7
2013	27	1.3	1.4	1.6	1.6	1.8	2.1	2.6

Figure 8.2.6(c): Variation in median serum triglyceride level among PD patients, PD centres 2013

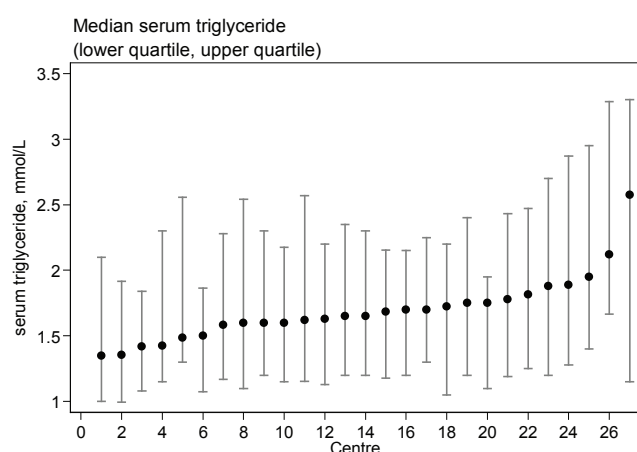


Table 8.2.6(d): Proportion of PD patients with serum triglyceride < 2.1 mmol/L, PD centres 2004-2013

Year	Number of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
2004	18	47	47	60	62	68	88	88
2005	19	40	40	54	60	68	91	91
2006	21	33	52	55	61	63	77	82
2007	21	40	52	58	65	67	80	81
2008	22	48	48	58	61.5	65	83	85
2009	23	27	48	54	60	67	70	71
2010	24	49	50	59.5	62	68.5	74	79
2011	26	41	53	65	69.5	73	81	93
2012	27	29	44	60	64	71	80	86
2013	27	38	50	63	69	73	85	91

Figure 8.2.6(d): Variation in proportion of patients with serum triglyceride <2.1 mmol/L, PD centres 2013

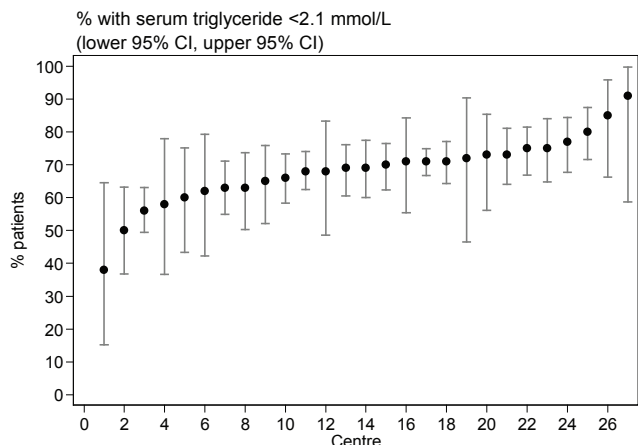


Table 8.2.7a was a new table correlating the relationship of different categories of cholesterol levels with death in dialysis patients for the period 2004 to 2013. The highest rate of death occurs in dialysis patients with low total cholesterol levels (<3.5 mmol/L). This was in contrast to the general population and may reflect unmeasured nutritional issues. Dialysis patients who were malnourished may form a significant part of this cohort of low cholesterol levels and we do know that malnourished dialysis patients were at a higher risk of death. The lowest risk of death were among dialysis patients with total cholesterol levels between 3.5 mmol/L and 6.2 mmol/L. Figure 8.2.7a illustrate the “U” curve relationship between serum cholesterol categories and death.

Table 8.2.7b details the hazard ratio for death in each of the total cholesterol categories, utilising the total cholesterol category of <3.5 mmol/L as the reference standard. It was noted that the hazard ratio of all other categories were less than 1 compared to the reference standard emphasising the highest risk of death associated with dialysis patients with low cholesterol levels.

Table 8.2.7(a): Relationship of different categories of cholesterol levels with death, dialysis patients 2004 -2013

	<3.5 mmol/L		3.5-<5.3 mmol/L		5.3-<6.2 mmol/L		≥6.2 mmol/L	
	n	%	n	%	n	%	n	%
Men								
n	3767	100	15404	100	3188	100	960	100
Death	1474	39	4910	32	1009	32	348	36
CVD/IHD	329	9	1030	7	192	6	59	6
Women								
n	1384	100	11205	100	4412	100	1909	100
Death	619	45	3429	31	1321	30	636	33
CVD/IHD	124	9	611	5	206	5	116	6

Figure 8.2.7(a): Relationship between serum cholesterol categories and death, dialysis patients 2004-2013

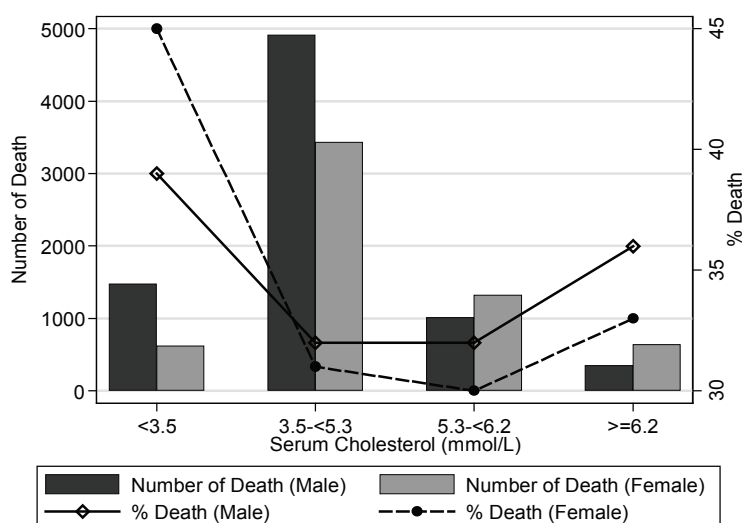


Table 8.2.7(b): Hazard ratio for death in each of the total cholesterol categories, dialysis patient 2004-2013

	<3.5mmol/L (Ref)	3.5-<5.3 mmol/L	5.3-<6.2 mmol/L	>=6.2 mmol/L
Men				
n	3767	15404	3188	960
Hazard ratio	1.00	0.675	0.767	1.227
95% CI		(0.601 ; 0.675)	(0.654 ; 0.767)	(0.971 ; 1.227)
p-value		<0.001	<0.001	0.143
Women				
n	1384	11205	4412	1909
Hazard ratio	1.00	0.523	0.543	0.81
95% CI		(0.44 ; 0.523)	(0.448 ; 0.543)	(0.649 ; 0.81)
p-value		<0.001	<0.001	<0.001

Recommendation:

Malaysian Dialysis and Transplant Registry may consider to high light in its executive summary to the centre for those centres which were either in the top or bottom 5% of variation in important parameters such as BP, lipid profile, Kt/V, mortality data, etc.

It will be interesting to document the exemplary anti-hypertensive practices and lipid lowering strategies employed in some of the “model” haemodialysis centres who reported high proportion of their patients achieved good BP and lipid control and then disseminate such “best practice” to the less well performing centres.

