

## **Chapter 5**

# **PAEDIATRIC RENAL REPLACEMENT THERAPY**

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**SECTION A: RRT PROVISION FOR PAEDIATRIC PATIENTS**

This chapter presents data on paediatric patients less than 20 years of age receiving renal replacement therapy (RRT) for the past 10 years (2005-2014) in Malaysia

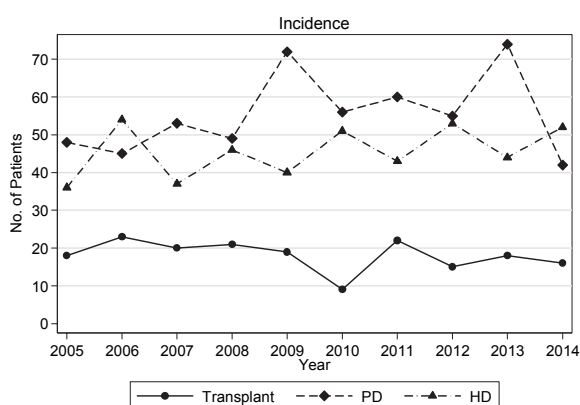
The dialysis acceptance rate for the paediatric population had increased slightly from about 8-10 per million age-related population (pmarp) to about 10 to 11 pmarp over the last 5 years. Unfortunately the number of new transplants had not shown much increase. We are still performing less than 20 transplants annually. The overall incidence rate for all RRT had stabilized to about 10 -11 pmarp over the last five years.

As expected, with increasing number of children on dialysis and improved survival; the number of prevalent patients continued to rise. At the end of 2014, 995 paediatric patients were receiving RRT in Malaysia. Of these, 797 (80%) were on dialysis. The equivalent dialysis prevalence rate almost doubled from 42 pmarp in 2005 to 77 pmarp in 2014..The prevalent HD population continued to expand at a higher rate than the PD population. The dialysis acceptance rate for new PD patients was higher then HD, although the prevalent HD patients were consistently more then the prevalent PD patients. This was probably due to higher technique failure among PD patients.

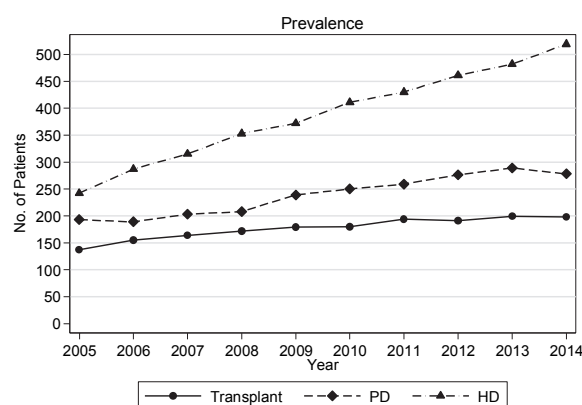
**Table 5.1: Stock and flow of Paediatric Renal Replacement Therapy (RRT), 2005-2014**

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
New HD patients	36	54	37	46	40	51	43	53	44	52
New PD patients	48	45	53	49	72	56	60	55	74	42
New Transplants	18	23	20	21	19	9	22	15	18	16
HD deaths	9	7	11	11	14	15	20	17	19	21
PD deaths	9	17	8	11	11	15	14	11	27	19
Transplant deaths	1	1	3	4	2	2	4	7	2	4
On HD at 31 <sup>st</sup> December	242	287	315	353	372	411	430	461	482	519
On PD at 31 <sup>st</sup> December	193	189	203	208	239	250	259	276	289	278
Functioning transplant at 31 <sup>st</sup> December	137	155	164	172	179	180	194	191	199	198

**Figure 5.1(a): Incidence cases of RRT by modality in children under 20 years old, 2005-2014**



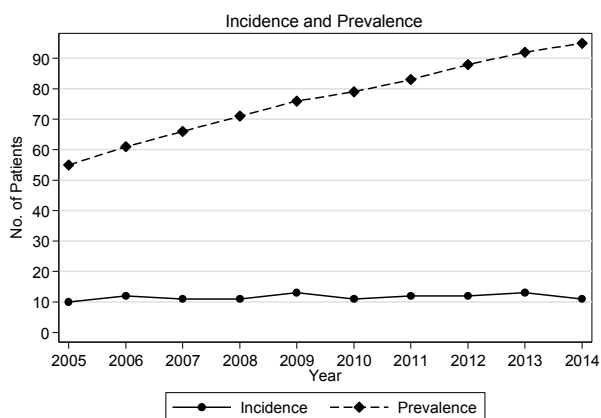
**Figure 5.1(b): Prevalence cases of RRT by modality in children under 20 years old, 2005-2014**



**Table 5.2: Paediatric dialysis and transplant rates per million age related population, 2005-2014**

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Incidence Rate										
New HD	3	5	4	4	4	5	4	5	4	5
New PD	5	4	5	5	7	5	6	5	7	4
New Transplant	2	2	2	2	2	1	2	1	2	2
All RRT	8	10	9	9	11	10	10	10	11	9
Prevalence Rate at 31 <sup>st</sup> December										
On HD	23	28	30	34	36	39	41	44	46	50
On PD	19	18	20	20	23	23	24	26	28	27
Functioning Graft	13	15	16	17	17	17	18	18	19	19
All RRT	54	60	65	70	76	78	83	87	91	94

**Figure 5.2: Incidence and prevalence rate per million age related population, 2005-2014**



## SECTION B: DISTRIBUTION OF PAEDIATRIC DIALYSIS PATIENTS

The treatment gap between West Malaysia and East Malaysia had become less obvious over the years with the establishment of new paediatric and adult nephrology centres in these regions particularly in the east coast of West Malaysia and East Malaysia.

**Table 5.3(a): Dialysis treatment rate by state, per million state age related population, 2005-2014**

State	2005-2009	2010-2014
Pulau Pinang	15	9
Melaka	10	13
Johor	9	12
Perak	9	11
Selangor & Putrajaya	9	8
Kuala Lumpur	12	11
Negeri Sembilan	9	13
Kedah	7	13
Perlis	8	4
Terengganu	11	13
Pahang	10	10
Kelantan	7	10
Sarawak	8	7
Sabah & WP Labuan	6	8

**Table 5.3(b): New dialysis patients by state, 2005-2014**

State	2005-2009	2010-2014
Pulau Pinang	39	23
Melaka	15	19
Johor	56	75
Perak	43	48
Selangor & Putrajaya	80	78
Kuala Lumpur	33	28
Negeri Sembilan	17	25
Kedah	26	49
Perlis	4	2
Terengganu	26	30
Pahang	31	30
Kelantan	27	35
Sarawak	40	35
Sabah & WP Labuan	42	52

There had been consistently more males compared to females among the population of children on dialysis and transplant. This is probably a reflection of the higher incidence of ESRD among the males; however this gender disparity appears to be less marked in recent years.

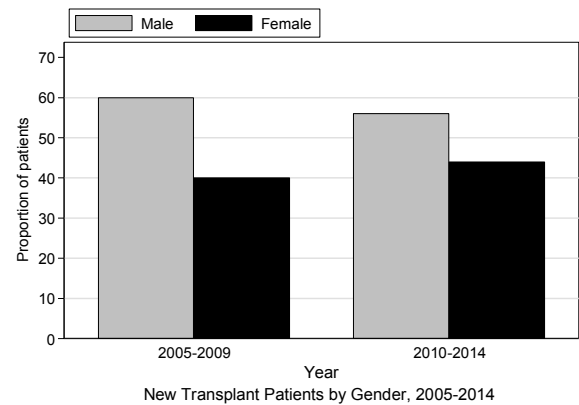
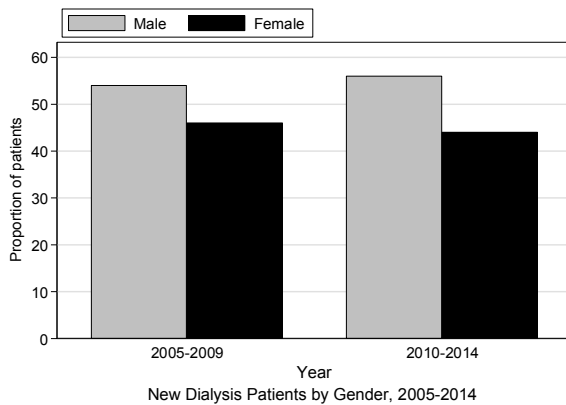
**Table 5.4: Number of new dialysis and transplant patients by gender, 2005-2014****a) New Dialysis**

Year	Male		Female	
	n	%	n	%
2005-2009	261	54	219	46
2010-2014	295	56	235	44

**b) New Transplant**

Year	Male		Female	
	n	%	n	%
2005-2009	61	60	40	40
2010-2014	45	56	35	44

**Figure 5.4: Number of new dialysis and transplant patients by gender, 2005-2014**

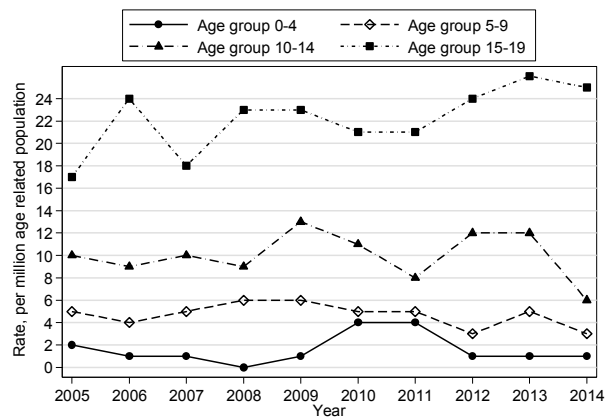


The dialysis treatment rate had levelled off over the last 10 years for the age age groups 5-14 years old. However it still showed slight increase for the oldest age group; 15-19 years old while the treatment rate remained very low for children under 5.

**Table 5.5: New RRT rate, per million age related population by age group, 2005-2014**

Year	New RRT rate, pmp Age group (years)			
	0-4	5-9	10-14	15-19
2005	2	5	10	17
2006	1	4	9	24
2007	1	5	10	18
2008	0	6	9	23
2009	1	6	13	23
2010	4	5	11	21
2011	4	5	8	21
2012	1	3	12	24
2013	1	5	12	26
2014	1	3	6	25

**Figure 5.5: New RRT rate by age group, 2005-2014**

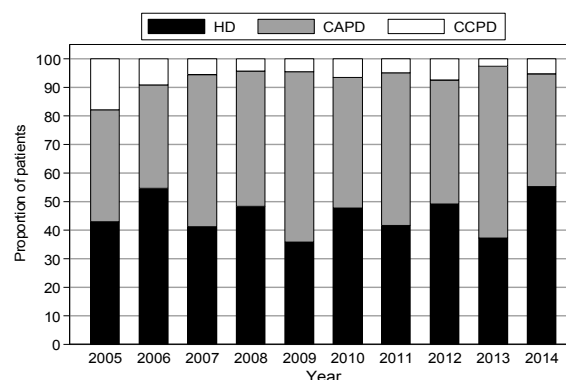


PD was the first modality of dialysis in about two thirds (63%) of patients in 2013. However data for 2014 showed that HD was the first modality of dialysis in about 55% of patients compared to 44% for PD (CAPD and CCPD).

**Table 5.6: New dialysis by treatment modality, 2005-2014**

Year	HD		CAPD		CCPD	
	n	%	n	%	n	%
2005	36	43	33	39	15	18
2006	54	55	36	36	9	9
2007	37	41	48	53	5	6
2008	46	48	45	47	4	4
2009	40	36	67	60	5	4
2010	51	48	49	46	7	7
2011	43	42	55	53	5	5
2012	53	49	47	44	8	7
2013	44	37	71	60	3	3
2014	52	55	37	39	5	5

**Figure 5.6: New dialysis by treatment modality, 2005-2014**

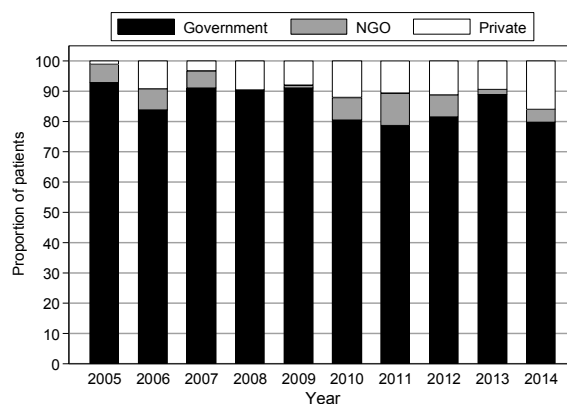


Most of the children (80%) received their dialysis treatment from government centres and hence were government funded.

**Table 5.7: New dialysis by sector, 2005-2014**

Year	Government		NGO		Private	
	n	%	N	%	n	%
2005	78	93	5	6	1	1
2006	83	84	7	7	9	9
2007	82	91	5	6	3	3
2008	86	91	0	0	9	9
2009	102	91	1	1	9	8
2010	86	80	8	7	13	12
2011	81	79	11	11	11	11
2012	88	81	8	7	12	11
2013	105	89	2	2	11	9
2014	75	80	4	4	15	16

**Figure 5.7: New dialysis by sector, 2005-2014**



The most common primary renal disease identified was glomerulonephritis, which accounted for about 23% of the patients. FSGS on its own accounted for about 9% of the ESRD population. SLE was the second most common cause of ESRD in girls (10%). Unfortunately in a significant proportion (42%) of children the primary renal disease is unknown.

## SECTION C: PRIMARY RENAL DISEASE

**Table 5.8: Primary renal disease by sex among new dialysis patients, 2005-2014**

Primary Renal Disease	Male		Female		All	
	n	%	n	%	n	%
Glomerulonephritis	156	22	136	23	292	23
FSGS	71	10	44	8	115	9
Reflex nephropathy	40	6	25	4	65	5
SLE	8	1	56	10	64	5
Obstructive uropathy	47	7	40	7	87	7
Renal dysplasia	29	4	26	4	55	4
Hereditary nephritis	15	2	2	0	17	1
Cystic kidney disease	6	1	9	2	15	1
Metabolic	4	1	7	1	11	1
Others	12	2	12	2	24	2
Unknown	320	45	228	39	548	42

## SECTION D: TYPES OF RENAL TRANSPLANTATION

Living related renal transplant used to be the commonest type of transplantation done among children in Malaysia. However the trend had changed in that cadaveric renal transplant is now the most common transplantation done accounting for about 54% compared to 39% for living related renal transplant. The number of transplant from overseas commercial program had reduced significantly over the last 5 years.

**Table 5.9: Types of renal transplantation, 2005-2014**

Year	2005-2009		2010-2014	
	n	%	n	%
Commercial cadaver	16	16	2	3
Commercial living donor	2	2	2	3
Living related donor	34	34	31	39
Cadaver	48	48	43	54
Living emotionally related	1	1	1	1
TOTAL	101	101	79	100

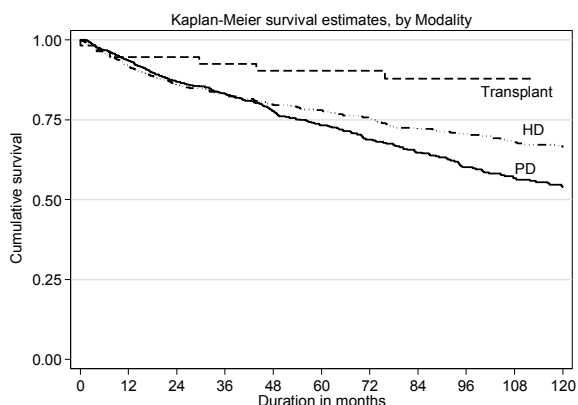
## SECTION E: SURVIVAL ANALYSIS

Renal transplantation had the best patient survival with 90% survival at 5 years and 88% at 10 years. HD patients generally showed better survival (78% at 5 years) compared to PD patients (73% at 5 years) and this disparity becomes more marked when censored for change of dialysis modality. The separation of the survival curve became more obvious after about 4 to 5 years of dialysis with PD patients showing a poorer outcome compared to HD (Figure 5.10b).

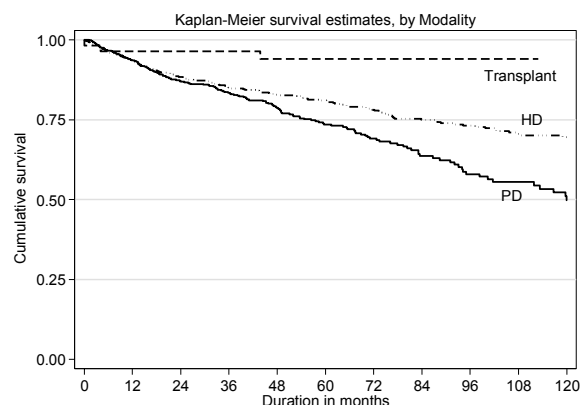
**Table 5.10(a): Patient survival by dialysis modality analysis (not censored with change of modality), 2005-2014**

Modality Interval (months)	Transplant			PD			HD		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	56	100		836	100		707	100	
6	55	96	2	782	97	1	645	96	1
12	53	95	3	733	93	1	589	92	1
24	48	95	3	603	87	1	496	86	1
36	44	92	4	502	83	1	428	83	2
48	42	90	4	410	78	2	379	80	2
60	39	90	4	348	73	2	326	78	2
72	39	90	4	274	69	2	283	76	2
84	36	88	5	225	65	2	239	72	2
96	36	88	5	177	60	2	210	71	2
108	35	88	5	153	57	2	170	68	2
120	33	88	5	125	54	3	146	66	2

**Figure 5.10(a): Patient survival by dialysis modality analysis (not censored with change of modality), 2005-2014**



**Figure 5.10(b): Patient survival by dialysis modality analysis (censored with change of modality), 2005-2014**



**Table 5.10(b): Patient survival by dialysis modality analysis (censored with change of modality), 2005-2014**

Modality Interval (months)	Transplant			PD			HD		
	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	56	100		836	100		707	100	
6	53	96	3	761	97	1	622	96	1
12	49	96	3	677	94	1	558	94	1
24	45	96	3	503	87	1	471	88	1
36	43	96	3	377	83	1	396	85	1
48	41	94	3	280	79	2	342	83	2
60	38	94	3	213	73	2	293	81	2
72	38	94	3	151	69	2	255	78	2
84	35	94	3	107	64	3	220	75	2
96	35	94	3	76	58	3	187	73	2
108	33	94	3	57	56	3	151	71	2
120	31	94	3	42	50	4	130	70	2



The commonest known causes of death among dialysis patients were sepsis and cardiovascular

**Table 5.11: Causes of death in dialysis patients, 2005-2014**

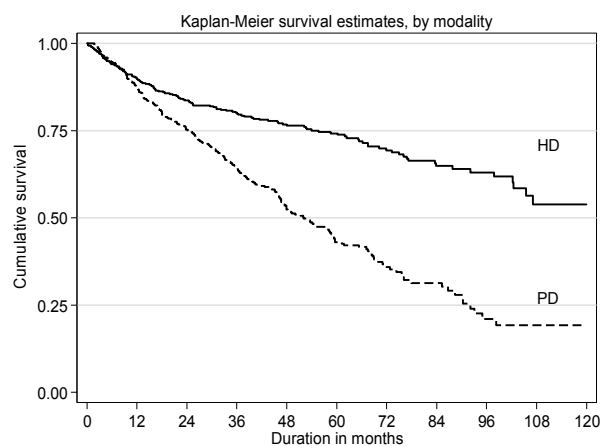
Year Causes of Death	2005-2009		2010-2014	
	n	%	n	%
Cardiovascular	14	27	31	34
Died at home	8	15	10	11
Sepsis	14	27	32	35
PD peritonitis	0	0	0	0
GIT bleed	1	2	2	2
Cancer	0	0	0	0
Liver disease	0	0	0	0
Withdrawal	2	4	1	1
Others	8	15	5	5
Unknown	5	10	11	12
<b>TOTAL</b>	<b>52</b>	<b>100</b>	<b>92</b>	<b>100</b>

After the first year, dialysis technique failure rate was much higher amongst PD patients with progressive widening of the technique survival curve especially after first year on dialysis. Technique survival at 5 years was only 43% for PD compared to 74% for HD.

**Table 5.12: Dialysis technique survival by modality, 2005-2014**

Modality Interval (months)	PD			HD		
	n	% survival	SE	n	% survival	SE
0	588	100		610	100	
6	531	95	1	535	94	1
12	465	88	1	467	90	1
24	324	75	2	367	84	2
36	220	64	2	288	80	2
48	144	52	3	229	76	2
60	98	43	3	169	74	2
72	50	36	3	127	69	3
84	31	31	3	88	65	3
96	13	21	4	56	63	3
108	7	19	4	19	54	5
120	1			1		

**Figure 5.12: Dialysis technique survival by modality, 2005-2014**



The most common causes of drop out from PD program were death (40%), peritonitis (17%), membrane failure (12%), transplant (11%) and technic failure (10%)

**Table 5.13: Reasons for drop-out from PD program, 2005-2014**

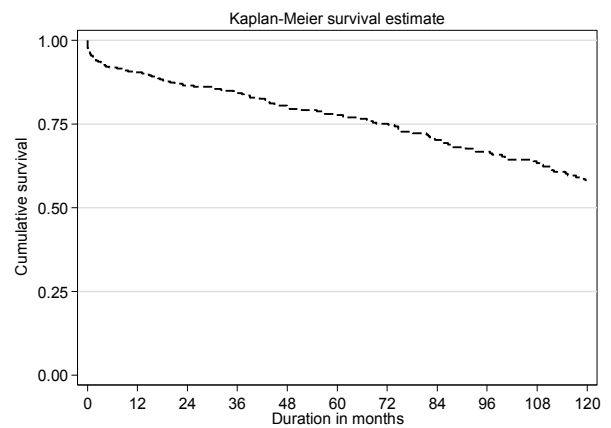
Year	2005-2009		2010-2014	
	N	%	n	%
Death	66	33	37	40
Transplant	54	27	10	11
Peritonitis	39	19	16	17
Catheter related infection	2	1	5	5
Membrane failure	19	9	11	12
Technical problem	8	4	9	10
Patient preference	10	5	1	1
Others	4	2	3	3
Unknown	1	0	0	0

The graft survival for paediatric transplants was 90% at 1 year and 78% at 5 years.

**Table 5.14: Transplant graft survival, 2005-2014**

Interval (month)	n	% survival	SE
0	346	100	
6	314	92	1
12	305	90	2
24	280	86	2
36	263	84	2
48	234	80	2
60	217	78	2
72	195	75	2
84	168	70	3
96	147	67	3
108	125	63	3
120	105	58	3

**Figure 5.14: Transplant graft survival, 2005-2014**



The commonest known cause for graft loss among pediatric transplants was rejection (61%). Unfortunately graft loss due to unknown cause accounted for about 18% of cases, not because the causes of graft loss are unknown but notification of outcome of graft loss was indirect and hence no cause was entered.

**Table 5.15: Causes of graft loss, 2005-2014**

Causes of graft loss	2005-2009		2010-2014	
	n	%	n	%
Rejection	20	61	23	61
Calcineurin toxicity	2	6	1	3
Other drug toxicity	0	0	0	0
Ureteric obstruction	0	0	1	3
Infection	1	3	0	0
Vascular causes	6	18	2	5
Recurrent/ de novo renal disease	0	0	1	3
Others	0	0	3	8
Unknown	4	12	7	18
<b>TOTAL</b>	<b>33</b>	<b>100</b>	<b>38</b>	<b>101</b>

Majority (about 89%) of the paediatric haemodialysis patients had native vascular access. However the percentage of children with cuffed central venous catheter had become more common over the last 5 years.

## SECTION F: HAEMODIALYSIS PRACTICE

**Table 5.16: Vascular access on haemodialysis, 2005-2014**

Access types	2005-2009		2010-2014	
	n	%	n	%
Wrist AVF	880	59.5	1150	52.6
BCF*	443	29.9	735	33.6
Venous graft	1	0.1	4	0.2
Artificial graft	3	0.2	11	0.5
cuffed catheter	78	5.3	214	9.8
non-cuffed catheter	75	5.1	71	3.2
<b>TOTAL</b>	<b>1480</b>	<b>100</b>	<b>2185</b>	<b>100</b>

The median prescribed Kt/V was 2.1 in 2014. Up to 87% of patients achieved the target Kt/V of  $\geq 1.3$  while 92% achieved an average URR of  $\geq 65\%$ .

**Table 5.17(a): Distribution of prescribed Kt/V, HD patients 2010-2014**

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients $\geq 1.3$	% patients $\geq 1.8$	% patients $\geq 2$
2010	368	2.2	0.6	2.2	1.8	2.6	94	74	66
2011	405	2.2	0.6	2.2	1.8	2.7	95	76	65
2012	444	2.3	0.6	2.3	1.9	2.7	95	77	67
2013	464	2.1	0.6	2.1	1.7	2.4	93	71	58
2014	508	2.1	0.5	2.1	1.7	2.4	93	70	56

**Table 5.17(b): Distribution of delivered Kt/V, HD patients 2010-2014**

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients $\geq 1.3$	% patients $\geq 1.8$	% patients $\geq 2$
2010	306	2.2	0.6	2.2	1.9	2.6	87	32	21
2011	323	2.3	0.6	2.2	1.9	2.7	87	35	24
2012	365	2.3	0.6	2.3	1.9	2.7	88	40	26
2013	396	2.1	0.6	2.1	1.7	2.5	89	37	23
2014	427	2.1	0.5	2.1	1.8	2.4	87	31	18

**Table 5.17(c): Distribution of URR, HD patients 2010-2014**

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients $\geq$ 65%
2010	326	75.4	7.5	76	70.1	81	92
2011	369	76.1	7	76.7	72.1	81.3	92
2012	396	75.8	8.1	77.1	71.2	81.5	91
2013	420	76.4	7.4	77.2	71.6	81.8	94
2014	463	75.7	7.7	76.3	71.4	80.6	92

**SECTION G: ANAEMIA TREATMENT**

The percentage of children treated with erythropoietin had reached a plateau of about 92% to 94% for the last 8 years. Similarly the proportion of children receiving parenteral iron continued to show an upward trend up to 45% in 2014 while the percentage of children on oral iron remained around 54-55%. The percentage of children who received blood transfusion had increased slightly in 2014 to about 17%.

**Table 5.18: Treatment for anaemia, HD patients 2005-2014**

Year	Number of patients	% on Erythropoietin	% received blood transfusion	% on oral iron	% received parenteral iron
2005	219	88	14	76	18
2006	272	89	18	71	27
2007	294	93	14	73	25
2008	340	92	17	59	36
2009	373	92	16	57	39
2010	379	92	13	57	37
2011	421	93	14	56	36
2012	460	92	14	57	38
2013	485	94	12	55	42
2014	524	92	17	54	45

The median transferrin saturation has consistently been above 30%. About 91% of children had transferrin saturation greater than 20%

**Table 5.19: Distribution of transferrin saturation on Erythropoietin, HD patients 2005-2014**

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients $\geq$ 20 %
2005	166	36.7	16.4	32.6	24.4	44.5	89
2006	210	36	15.6	32.7	25	44	88
2007	244	33.7	14.9	31.1	23.4	40	86
2008	286	35	15.7	31.9	24.1	41.9	86
2009	317	35.1	16	31.9	24.9	42.2	86
2010	320	35.2	16.1	31.7	24.3	42.8	85
2011	365	33.2	14.5	30.8	23.5	38	85
2012	385	33	13.4	30.2	24.4	40	88
2013	404	32.7	13.4	30.5	23.9	38.6	87
2014	434	33.4	13.8	30.5	25.1	39	88

**Table 5.20: Distribution of transferrin saturation on Erythropoietin, PD patients 2005-2014**

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2005	169	40.5	15.4	38.9	31.2	46.9	94
2006	176	41.2	16.1	38.8	30.4	49.3	95
2007	182	36.7	16	33.2	26.3	44.3	91
2008	193	38.5	16.6	35.1	28.2	46.7	90
2009	221	38	17.2	34.6	25.5	48.8	88
2010	236	39.1	17.6	35.6	26.1	49.1	92
2011	245	36.3	15.4	34	24.6	47.2	87
2012	253	36	15.3	34.7	25.5	44.4	87
2013	229	37.2	15.2	33.8	26.8	44.6	91
2014	234	35.9	14	33.6	26.2	43.1	91

The median weekly dose of ESA had increased from 4000 units over the last 8 years to 6000 units per week in 2014

**Table 5.21: Distribution of ESA dose (u/kg/wk), 2005-2014**

Year	Number of patients	Mean	SD	Median	LQ	UQ
2005	316	3753.1	2931.3	2000	2000	4000
2006	364	4984.9	2862.9	4000	4000	6000
2007	403	5605.5	4522.5	4000	4000	6000
2008	437	5208.2	3992.7	4000	3000	6000
2009	481	4960.1	2766.7	4000	2000	6000
2010	512	5283.6	3062.5	4000	4000	6000
2011	536	5477.6	3370.8	4000	4000	6000
2012	565	5252	3069.1	4000	4000	6000
2013	602	5648.7	3922.6	4000	3000	6000
2014	624	5905.9	3615.3	6000	4000	8000