

CHAPTER 11

HAEMODIALYSIS PRACTICES

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11.1: Vascular Access and Its Complications

94% of patients were dialysed via native vascular access in 2004. There was an increasing trend for BCF as vascular access compared to wrist AVF. In 1997, BCF made up 13% of all vascular access and this increased to 21% in 2004. In 2004 only 2% of patients have artificial grafts and 1% of patient had permanent central venous catheters. The proportion of patients using artificial grafts and permanent central catheters has not increased in recent years. (table 11.1.1)

Table 11.1.1: Vascular Access on Haemodialysis, 1997-2004

Access types	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Wrist AVF	1427	85	1763	84	2406	81	3561	82
BCF*	213	13	273	13	431	14	655	15
Venous graft	4	0	6	0	8	0	11	0
Artificial graft	13	1	20	1	34	1	31	1
Permanent CVC	4	0	8	0	17	1	19	0
Temporary CVC*	20	1	37	2	77	3	77	2
TOTAL	1681	100	2107	100	2973	100	4354	100

Access types	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Wrist AVF	4049	79	4680	78	5253	75	5832	73
BCF*	897	17	1068	18	1360	19	1676	21
Venous graft	19	0	14	0	23	0	39	0
Artificial graft	64	1	78	1	114	2	149	2
Permanent CVC	25	0	43	1	62	1	99	1
Temporary CVC*	90	2	138	2	180	3	230	3
TOTAL	5144	100	6021	100	6992	100	8025	100

* BCF=Brachiocephalic fistula

* CVC= Central venous catheter

Table 11.1.2: Difficulties reported with Vascular Access, 1997-2004

Access difficulty	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Difficulty with needle placement	55	47	82	4	133	5	146	4
Difficulty in obtaining desired blood flow rate	48	41	60	3	112	5	136	4
Other difficulties	12	10	30	2	55	2	32	1
No difficulties	1	1	1778	91	2155	88	3402	92
TOTAL	116	100	1950	100	2455	100	3716	100

Access difficulty	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Difficulty with needle placement	217	5	215	4	217	3	249	3
Difficulty in obtaining desired blood flow rate	239	5	235	4	243	4	300	4
Other difficulties	39	1	57	1	60	1	67	1
No difficulties	4276	90	5073	91	5975	92	6897	92
TOTAL	4771	100	5580	100	6495	100	7513	100

13% reported vascular access complications in 2003 and 2004. Complication rates have remained the same despite an increase in intake of elderly and diabetic patients on dialysis in recent years. (table 11.1.3)

Table 11.1.3: Complications reported with Vascular Access, 1997-2004

Complication	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Thrombosis	71	19	69	3	129	5	148	4
Bleed	23	6	37	2	23	1	30	1
Aneurysmal dilatation	121	33	134	6	159	6	208	5
Swollen limb	35	9	36	2	51	2	44	1
Access related infection, local/systemic	29	8	21	1	34	1	52	1
Distal limb ischaemia	4	1	12	1	9	0	26	1
Venous outflow obstruction	45	12	50	2	71	3	78	2
Carpal tunnel	23	6	19	1	35	1	42	1
Others	18	5	48	2	64	2	37	1
No complications	0	0	1636	79	2119	79	3237	83
TOTAL	369	100	2062	100	2694	100	3902	100

Complication	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Thrombosis	209	4	202	3	220	3	283	4
Bleed	62	1	66	1	54	1	67	1
Aneurysmal dilatation	212	4	211	4	200	3	192	2
Swollen limb	67	1	56	1	55	1	77	1
Access related infection, local/systemic	49	1	52	1	43	1	70	1
Distal limb ischaemia	22	0	17	0	13	0	37	0
Venous outflow obstruction	123	2	101	2	119	2	147	2
Carpal tunnel	41	1	44	1	63	1	47	1
Others	74	1	118	2	118	2	133	2
No complications	4204	83	4988	85	5967	87	6831	87
TOTAL	5063	100	5855	100	6852	100	7884	100

11.2: HD Prescription

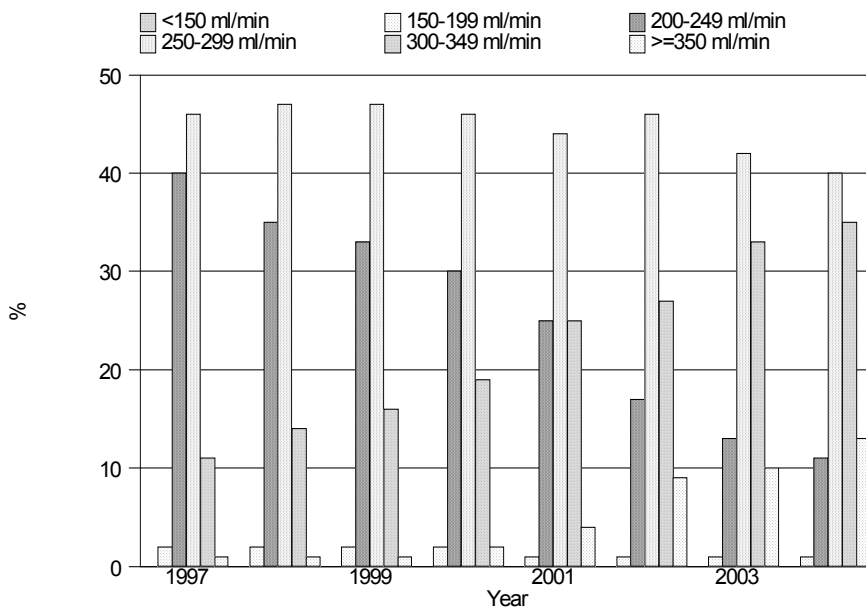
There was increasing use of higher blood flow rates from 1997 to 2004. The proportion of patients with blood flow of 300-349 mls/min had increased from 11% to 35% and those with blood flow ≥ 350 mls/min from 1% to 13%. In 2004, 48% had blood flow rates of ≥ 300 mls/min compared to only 12% in 1997. (Table 11.2.1 and Fig. 11.2.1)

Table 11.2.1: Blood Flow Rates in HD Units, 1997– 2004

Blood flow rates	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
<150 ml/min	2	0	4	0	6	0	9	0
150-199 ml/min	34	2	36	2	65	2	85	2
200-249 ml/min	649	40	735	35	962	33	1282	30
250-299 ml/min	734	46	968	47	1367	47	1938	46
300-349 ml/min	176	11	298	14	455	16	814	19
≥ 350 ml/min	18	1	30	1	31	1	94	2
TOTAL	1613	100	2071	100	2886	100	4222	100

Blood flow rates	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
<150 ml/min	7	0	9	0	4	0	11	0
150-199 ml/min	69	1	69	1	84	1	84	1
200-249 ml/min	1233	25	973	17	882	13	867	11
250-299 ml/min	2229	44	2692	46	2867	42	3071	40
300-349 ml/min	1276	25	1590	27	2242	33	2694	35
≥ 350 ml/min	216	4	505	9	691	10	1018	13
TOTAL	5030	100	5838	100	6770	100	7745	100

Figure 11.2.1: Blood Flow Rates in HD Units, 1997–2004



96% of patients were on 3 HD sessions per week. Four percent were on 2 HD sessions per week. The number of patients on > 3 HD sessions per week remained small.

The majority of patients (97%) were on 4 hours per HD session. One percent of patients received <4 hours dialysis per session and 2% of patients longer than 4 hours. (table 11.2.2, 11.2.3)

Table 11.2.2: Number of HD Sessions per week, 1997 – 2004

HD sessions per week	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
1	1	0	1	0	4	0	8	0
2	6	0	5	0	153	5	341	8
3	1664	99	2110	100	2811	95	3982	92
4	9	1	2	0	3	0	10	0
TOTAL	1680	100	2118	100	2971	100	4341	100

HD sessions per week	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
1	8	0	10	0	15	0	10	0
2	337	7	369	6	343	5	281	4
3	4761	92	5603	93	6562	95	7628	96
4	50	1	18	0	10	0	30	0
TOTAL	5156	100	6000	100	6930	100	7949	100

Table 11.2.3: Duration of HD, 1997 – 2004

Duration of HD per session	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
<=3 hours	7	0	3	0	4	0	8	0
-3.5 hours	3	0	18	1	9	0	12	0
-4 hours	1594	95	1993	94	2735	92	4053	93
-4.5 hours	69	4	91	4	160	5	189	4
-5 hours	8	0	8	0	61	2	77	2
>5 hours	1	0	3	0	0	0	13	0
TOTAL	1682	100	2116	100	2969	100	4352	100

Duration of HD per session	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
<=3 hours	6	0	19	0	20	0	87	1
-3.5 hours	33	1	15	0	7	0	16	0
-4 hours	4956	96	5844	97	6757	98	7685	97
-4.5 hours	106	2	68	1	76	1	119	1
-5 hours	59	1	48	1	66	1	47	1
>5 hours	0	0	0	0	0	0	3	0
TOTAL	5160	100	5994	100	6926	100	7957	100

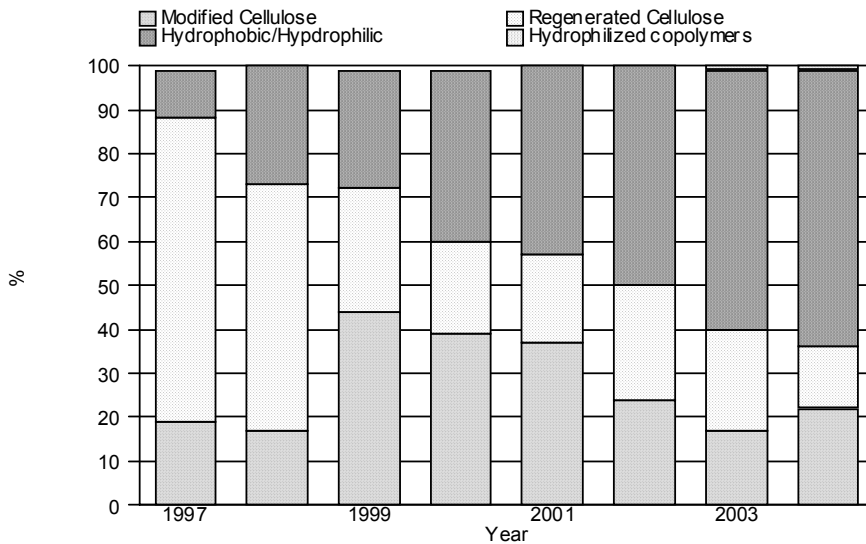
Use of synthetic membranes (hydrophobic/hydrophilic and hydrophilised copolymers) had increased markedly from 11% in 1997 to 64% in 2004. The usage of regenerated cellulose membrane had decreased from 69% in 1997 to 14% in 2004. Modified cellulose membrane usage rose from 19% in 1997 to a peak of 39% in 2000 but thereafter the usage decreased to 22% in 2004. (table 11.2.4, fig. 11.2.4)

Table 11.2.4: Dialyser membrane types in HD Units, 1997 – 2004

Dialyser membrane	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Modified Cellulose	317	19	338	17	1215	44	1600	39
Regenerated Cellulose	1136	69	1113	56	776	28	871	21
Hydrophobic/Hydrophilic	184	11	524	27	754	27	1586	39
Hydrophilized copolymers	1	0	2	0	1	0	0	0
TOTAL	1638	100	1977	100	2746	100	4057	100

Dialyser membrane	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Modified Cellulose	1666	37	1376	24	1114	17	1717	22
Regenerated Cellulose	890	20	1470	26	1480	23	1087	14
Hydrophobic/Hydrophilic	1944	43	2828	50	3745	59	4817	63
Hydrophilized copolymers	0	0	1	0	35	1	74	1
TOTAL	4500	100	5675	100	6374	100	7695	100

Figure 11.2.4: Dialyser membrane types in HD Units, 1997 – 2004



In 1997, 63% of patients reused their dialysers 3 times and 98% reused up to 6 times. In comparison in 2004, 78% reused 7 times or more and 48% of patient reused 12 times or more. Four percent of patients were on single use in 2004 and the trend has not changed in recent years. (table 11.2.5)

Table 11.2.5: Dialyser Reuse Frequency in HD Units, 1997- 2004

Dialyser reuse frequency	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
1*	21	1	16	1	65	2	116	3
2	9	1	5	0	13	0	17	0
3	996	63	215	11	191	7	205	5
4	174	11	113	6	250	9	477	12
5	194	12	137	7	264	10	312	8
6	154	10	1072	55	1414	51	1730	43
7	2	0	37	2	46	2	69	2
8	4	0	66	3	122	4	357	9
9	30	2	109	6	179	6	101	2
10	0	0	84	4	96	3	246	6
11	0	0	23	1	6	0	4	0
12	0	0	64	3	118	4	333	8
>=13	0	0	0	0	0	0	91	2
TOTAL	1584	100	1941	100	2764	100	4058	100

Dialyser reuse frequency	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
1*	152	3	197	4	251	4	318	4
2	15	0	41	1	19	0	42	1
3	232	5	316	6	350	5	190	3
4	416	9	337	6	339	5	192	3
5	357	7	318	6	267	4	192	3
6	1413	29	1216	22	916	14	745	10
7	85	2	124	2	71	1	89	1
8	793	16	866	16	852	13	809	11
9	132	3	59	1	87	1	50	1
10	400	8	538	10	880	14	1160	16
11	43	1	36	1	25	0	42	1
12	470	10	879	16	1512	24	1904	26
>=13	331	7	644	12	820	13	1644	22
TOTAL	4839	100	5571	100	6389	100	7377	100

1* is single use i.e. no reuse

Almost 100% of patients used bicarbonate dialysate buffer in 2004 compared to 67% in 1997. (table 11.2.6)

Table 11.2.6: Dialysate Buffer used in HD Units, 1997 – 2004

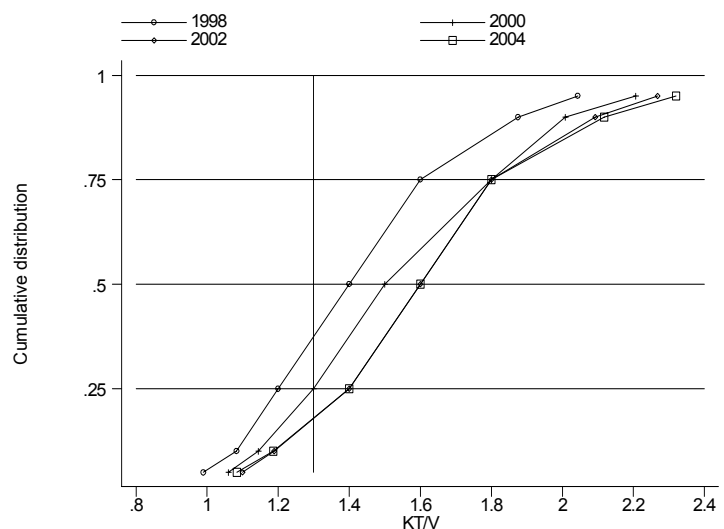
Dialysate buffer	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Acetate	551	33	627	30	552	19	393	9
Bicarbonate	1123	67	1492	70	2429	81	3969	91
TOTAL	1674	100	2119	100	2981	100	4362	100
Dialysate buffer	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Acetate	240	5	138	2	77	1	33	0
Bicarbonate	4920	95	5880	98	6819	99	7876	100
TOTAL	5160	100	6018	100	6896	100	7909	100

Table 11.2.7: Distribution of prescribed KT/V, HD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients ^a ≥1.3
1997	1558	1.4	.3	1.4	1.2	1.6	60
1998	2022	1.5	.3	1.4	1.2	1.6	68
1999	2831	1.5	.3	1.5	1.3	1.7	73
2000	4087	1.6	.4	1.5	1.3	1.8	75
2001	4908	1.6	.4	1.5	1.3	1.8	78
2002	5496	1.6	.4	1.6	1.4	1.8	81
2003	6520	1.6	.4	1.6	1.4	1.8	82
2004	7428	1.6	.4	1.6	1.4	1.8	81

Median prescribed KT/V was 1.6. 81% had prescribed KT/V of ≥ 1.3 . The trend of increasing prescribed KT/V since 1997 has reached a plateau. (table 11.2.7)

Figure 11.2.7: Cumulative distribution of prescribed KT/V, HD patients 1997-2004



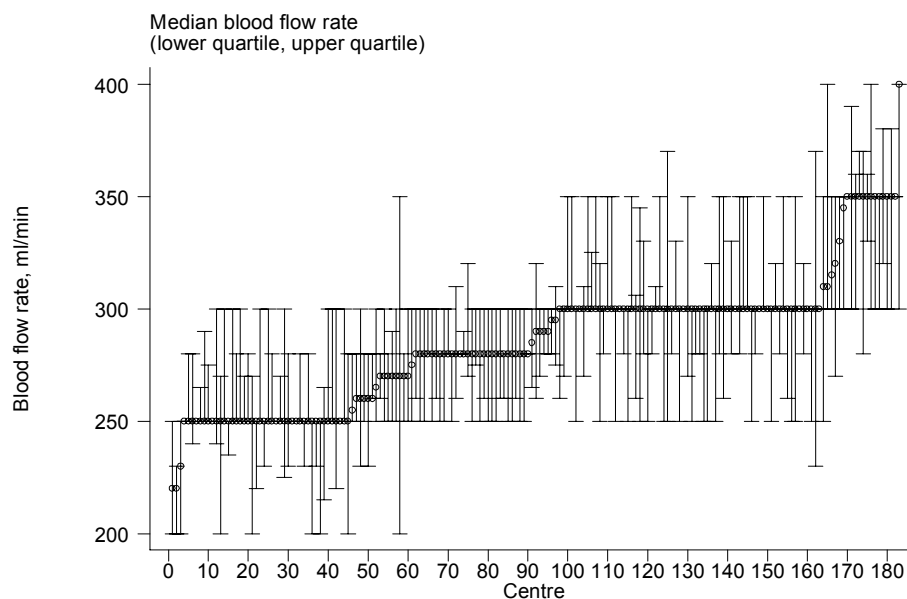
Median blood flow rates among centres had increased from 250mls/min in 1997 to 290 mls/min in 2004. There was a wide variation in practice among centers. The centre median blood flow rates ranged from a minimum of 200 mls/min to a maximum of 400 mls/min. (table 11.2.8a)

Table 11.2.8: Variation in HD prescription among HD centres 2004

(a) Median blood flow rates in HD patients

Year	No. of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
1997	44	200	200	222.5	250	250	280	300
1998	46	200	200	230	250	250	300	300
1999	67	200	200	230	250	250	300	300
2000	100	200	200	240	250	275	300	300
2001	116	200	220	250	252.5	300	300	350
2002	137	200	230	250	280	300	300	350
2003	155	200	240	250	280	300	325	350
2004	183	220	250	255	290	300	350	400

Figure 11.2.8(a): Variation in median blood flow rates in HD patients among HD centres 2004



In 2004, half the centers had at least 73% of their patients with blood flow rate of >250 mls/min in contrast to 1997 when it was only 15% of patients. (table 11.2.8b)

Table 11.2.8(b): Proportion of patients with blood flow rates > 250 ml/min

Year	No. of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
1997	44	0	0	3.5	15	28	60	63
1998	46	0	2	9	20.5	38	79	100
1999	67	0	2	8	28	49	85	100
2000	100	0	0	10.5	31.5	59.5	85.5	91
2001	116	0	0	22.5	49.5	73.5	92	100
2002	137	0	2	36	61	82	95	100
2003	155	0	4	42	70	85	98	100
2004	183	0	17	50	73	86	96	100

There was a wide variation in the proportion of patients with blood flow rates > 250 ml/min among HD centers in 2004 as reflected in fig. 11.2.8 (b). There was a center where no patients were reported to have blood flow rates > 250 ml/min. In contrast in 6 centres, 100% of their patients had blood flow rates of > 250 ml/min.

Figure 11.2.8(b): Variation in Proportion of patients with blood flow rates > 250 ml/min among HD centres 2004

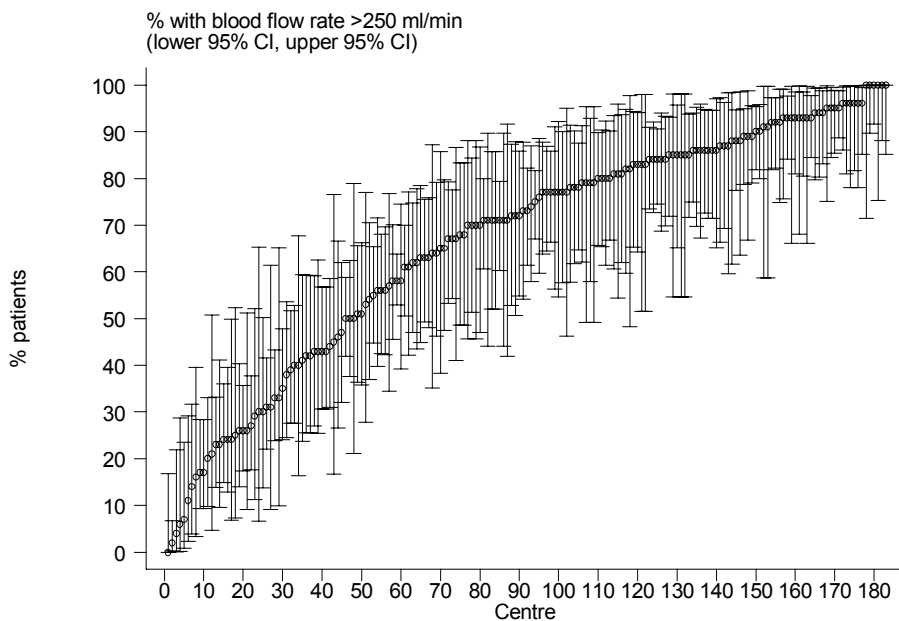
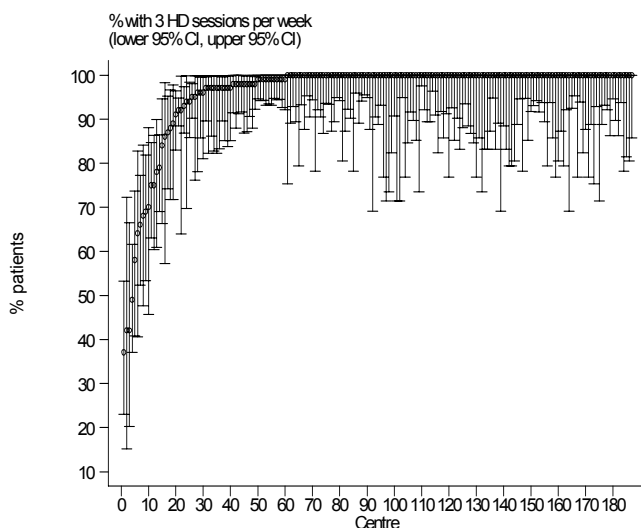


Figure 11.2.8(c): Variation in proportion of patients with 3 HD sessions per week among HD centres 2004

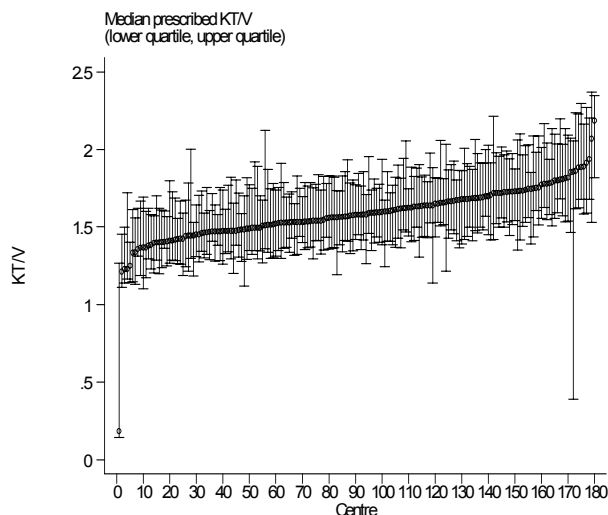


In a small number of centres, a significant proportion of their patients were on less than 3 HD sessions per week in 2004. week.

Table 11.2.8(d): Median prescribed KT/V in HD patients among HD centres

Year	No. of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
1997	44	1.2	1.2	1.3	1.4	1.4	1.5	1.8
1998	45	1.1	1.3	1.4	1.4	1.5	1.6	1.7
1999	67	1.2	1.3	1.4	1.5	1.6	1.7	1.8
2000	99	1.2	1.3	1.4	1.5	1.6	1.8	2.8
2001	114	1.2	1.3	1.5	1.5	1.7	1.8	1.9
2002	132	1.2	1.4	1.5	1.6	1.7	1.8	2.1
2003	150	1.2	1.4	1.5	1.6	1.7	1.9	2.1
2004	180	.2	1.4	1.5	1.6	1.7	1.9	2.2

Figure 11.2.8(d): Variation in median prescribed KT/V in HD patients among HD centres 2004



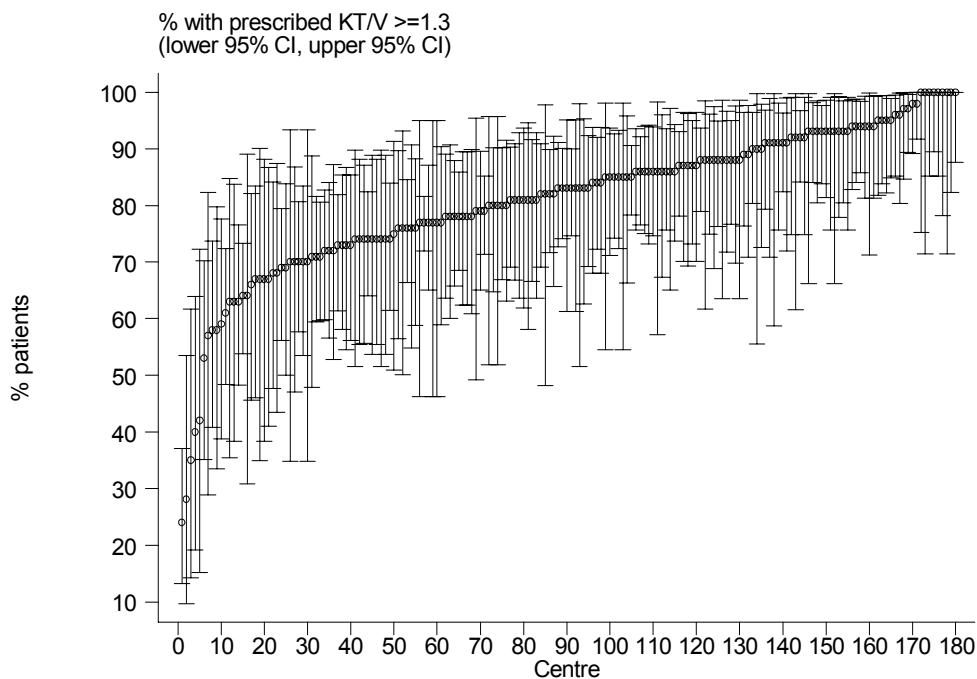
Median prescribed KT/V in HD patients among centers was 1.6 in 2004. With the exception of 1 centre with median prescribed KT/V of <1, the majority of centers had median prescribed KT/V of >1.3. (table and fig 11.2.8d)

In 1997, half of the centers had 58% of patients with prescribed $KT/V \geq 1.3$. This proportion had increased to 83% in 2004. There is wide variation in the proportion of patients with $KT/V \geq 1.3$ among HD centres ranging from below 30% to 100%.(table 11.2.8e, fig 11.2.8 e)

Table 11.2.8(e): Proportion of patients with prescribed $KT/V \geq 1.3$ among HD centres 2004

Year	No. of centres	Min	5 th Centile	LQ	Median	UQ	95 th Centile	Max
1997	44	23	42	51.5	58.5	69.5	90	100
1998	45	0	46	60	67	74	85	96
1999	67	36	50	67	74	83	94	100
2000	99	26	47	67	79	86	94	100
2001	114	38	50	71	81.5	88	96	100
2002	132	35	58	74.5	82	90	97	100
2003	150	30	55	77	83.5	91	96	100
2004	180	24	58.5	74	83	90.5	99	100

Figure 11.2.8(e): Variation in proportion of patients with prescribed $KT/V \geq 1.3$ among HD centres 2004



11.3: Technique Survival on Dialysis

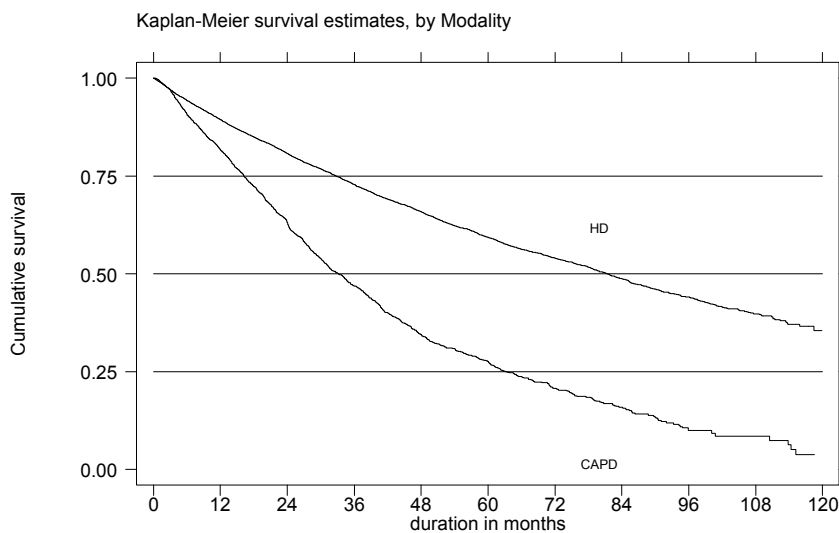
Unadjusted HD technique survival at 1 year, 5 years and 10 years was 89%, 59% and 36% respectively. In comparison, unadjusted CAPD technique survival was 82% at 1 year, 28% at 5 years and negligible at 10 years. (Table 11.3.1 and fig 11.3.1)

Table 11.3.1: Unadjusted technique survival by Dialysis modality, 1995-2004

Dialysis modality Interval (months)	CAPD		HD		All Dialysis	
	% Survival	SE	% Survival	SE	% Survival	SE
6	91	1	94	0	94	0
12	82	1	89	0	88	0
24	63	1	81	0	78	0
36	47	1	73	0	69	0
48	34	1	66	0	61	0
60	28	1	59	1	55	1
72	21	1	54	1	49	1
84	16	1	49	1	44	1
96	10	1	44	1	39	1
108	9	1	40	1	35	1
120	-	-	36	2	30	1

SE=standard error

Figure 11.3.1: Unadjusted technique survival by Dialysis modality, 1995-2004



There was no apparent difference in the unadjusted HD technique survival by year of starting dialysis for the years 1995 to 2004. (Table 11.3.2 and fig 11.3.2)

Table 11.3.2: Unadjusted technique survival by year of entry, 1995-2004

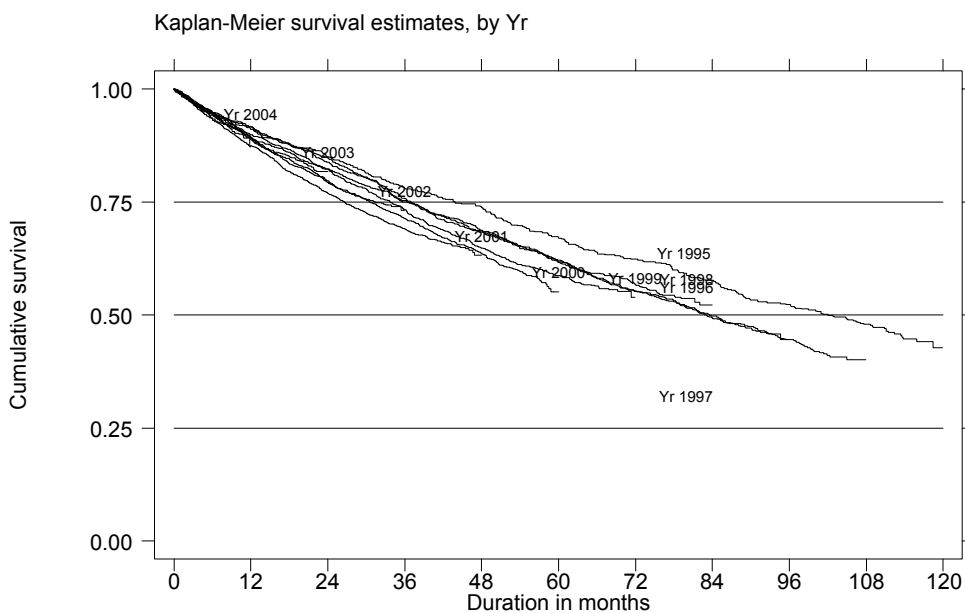
Year Interval (months)	1995		1996		1997		1998	
	% Survival	SE	% Survival	SE	% Survival	SE	% Survival	SE
6	95	1	94	1	94	1	95	1
12	92	1	91	1	89	1	92	1
24	85	2	85	1	82	1	84	1
36	78	2	75	2	75	1	76	1
48	74	2	69	2	69	1	68	1
60	67	2	62	2	62	2	62	1
72	62	2	55	2	55	2	57	1
84	58	2	50	2	49	2	-	-
96	52	2	45	2	-	-	-	-
108	48	2	-	-	-	-	-	-
120	43	3	-	-	-	-	-	-

Year Interval (months)	1999		2000		2001		2002	
	% Survival	SE	% Survival	SE	% Survival	SE	% Survival	SE
6	95	1	95	1	93	1	95	1
12	90	1	89	1	87	1	89	1
24	82	1	80	1	77	1	79	1
36	73	1	71	1	69	1	-	-
48	65	1	64	1	-	-	-	-
60	59	1	-	-	-	-	-	-

Year Interval (months)	2003		2004	
	% Survival	SE	% Survival	SE
6	94	1	94	1
12	89	1	-	-

SE=standard error

Figure 11.3.2: Unadjusted technique survival by year of entry, 1995-2004



As expected unadjusted HD technique survival showed better technique survival in the younger age groups than the older age groups. Ten year unadjusted HD technique survival in the age groups of 15-24, 25-34, 35-44, 45-54, and 55-64 was 73%, 68%, 53%, 36%, and 17% respectively. (Table 11.3.3 and fig 11.3.3)

Table 11.3.3: Unadjusted technique survival by age, 1995-2004

Age group (years) Interval (months)	<=14		15-24		25-34		35-44	
	% Survival	SE	% Survival	SE	% Survival	SE	% Survival	SE
6	94	0	97	1	96	1	96	0
12	90	0	94	1	94	1	94	1
24	79	1	88	1	90	1	89	1
36	79	1	86	2	86	1	85	1
48	74	1	84	2	83	1	81	1
60	74	1	82	2	81	1	77	1
72	74	1	80	2	79	1	73	1
84	74	1	78	2	76	2	68	2
96	74	1	76	3	74	2	63	2
108	-	-	73	4	68	3	61	2
120	-	-	73	4	68	3	53	4

Age group (years) Interval (months)	45-54		55-64		>=65	
	% Survival	SE	% Survival	SE	% Survival	SE
6	96	0	94	0	91	1
12	91	0	88	1	84	1
24	83	1	77	1	69	1
36	76	1	67	1	56	1
48	69	1	59	1	45	1
60	62	1	50	1	37	1
72	57	1	43	1	29	1
84	50	1	36	1	24	2
96	44	2	30	2	20	2
108	38	2	26	2	15	2
120	36	2	17	4	-	-

SE=standard error

Figure 11.3.3: Unadjusted technique survival by age, 1995-2004



Unadjusted HD technique survival in the non diabetic patients at 1 year, 5 years and 10 years was 92%, 71% and 47% respectively. In contrast unadjusted HD technique survival in diabetic patients was worse at 86%, 43% and 16% respectively. (Table 11.3.4 and fig 11.3.4)

Table 11.3.4: Unadjusted technique survival by Diabetes status, 1995-2004

Diabetes status Interval (months)	Non-Diabetic		Diabetic	
	% Survival	SE	% Survival	SE
6	95	0	93	0
12	92	0	86	0
24	87	0	73	1
36	81	0	62	1
48	76	1	52	1
60	71	1	43	1
72	66	1	36	1
84	62	1	29	1
96	57	1	23	1
108	52	1	19	2
120	47	2	16	2

SE=standard error

Figure 11.3.4: Unadjusted technique survival by Diabetes status, 1995-2004

