CHAPTER 14: PAEDIATRIC RENAL REPLACEMENT THERAPY

Summary

- This chapter reports on RRT for paediatric population in-depth and separately for the first time from the adult registry report.
- The incidence of paediatric RRT in Malaysia was 8 per million age-related population and the prevalence rate was 39 per million age-related population as of December 2002. The incident and prevalent cases showed a very slow uptake from mid 1980s when RRT was first initiated in the paediatric population till 1995 when there was a rapid increase till now.
- The distribution of RRT was very uneven among the 14 states in Malaysia
- Overall male predominate in all treatment modalities
- The number of patients aged 0-4 years on RRT remained very low.
- Treatment rates seem to be levelling off for those in the age-groups 5-9 years and 10-14 years in recent years; but the rates for those aged 15-19 years continued to rise.
- CAPD is the commonest mode of renal replacement therapy followed by haemodialysis and renal transplant.
- The government is the predominant provider of dialysis treatment for children.
- The commonest causes of ESRD in children age were glomerulonephritis (54%), and reflux nephropathy (7%) with a male preponderance in all age groups
- Renal transplant recipients had the best survival outcome at 91% at 10 years, HD next at 82% and CAPD the worst at 18% only. Graft survival was 88% at 1 year, 75% at 5 years, 59% at 10 years and 49% at 15 years.

Introduction

The Malaysian National Renal Registry has published annual reports since its inception ten years ago with the paediatric data incorporated within the main report. This will be the first time the paediatric data is being reported separately as a chapter of the main Renal Registry report. In this chapter, we will present results on:

A. Provision of RRT for Malaysian children, and in relation to patient demography
B. Treatment modality (HD, CAPD and Transplant) and sector of provision (Government, NGO, Private)
C. Causes of ESRD (Primary renal diseases)
D. Survival outcomes on RRT

While we track the trends in paediatric RRT provision from 1980, most results only focus on the years from 1990 onwards to 2002 as the numbers were too few prior to 1990 for meaningful analysis. The paediatric RRT population in this report is defined as children less than 20 years of age

A. RRT provision for Paediatric patients

Stock and Flow of Paediatric patients on RRT

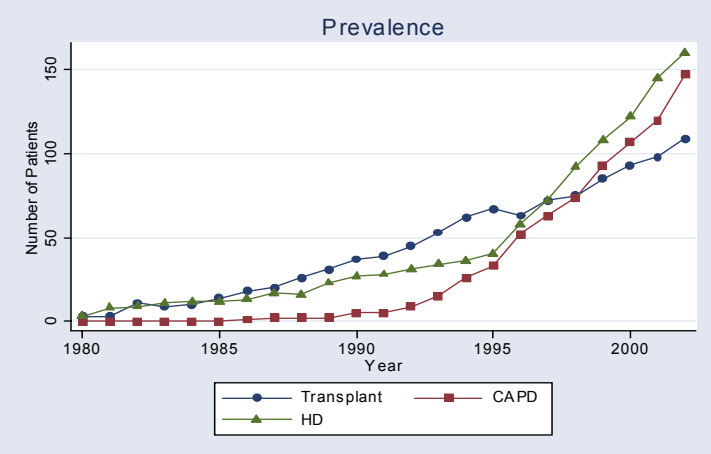
Table and figure 14.1 shows the stock and flow of patients from 1990. Prior to 1990, only a handful of patients less than 20 years of age were accepted for RRT and even then mainly onto haemodialysis or for renal transplants. The earliest treatment modality for children with ESRD in Malaysia was in 1980 with the acceptance of a patient less than 20 years of age into the haemodialysis programme, followed in 1984 by renal transplantation and CAPD in 1985. In 1990, only 11 patients less 20 year old were accepted into dialysis but this increased rapidly after 1995 to reach new dialysis intakes of 78 in 2002. The total patients dialysing at the end of each year increased from 32 in 1990 to 307 in 2002.

Renal transplantation in this age group comprised mainly of living related renal transplants unlike in adults where the majority were from live unrelated or paid cadaveric donation done overseas. In the initial years of renal replacement therapy when chronic dialysis was scarce, parents made the sacrifice to donate one of their kidneys. Once chronic dialysis became more freely available, children could then be commenced on chronic dialysis. Hence it is not surprising that the number of renal transplantations done each year had not changed much in the years 1990 to 2002, ranging from 5 to 15 per year. At the end of 2002, there were 109 patients aged less than 20 years with functioning renal transplants. (Table 14.1)

Table 14.1 Stock and Flow, Paediatric Renal Replacement Therapy 1990 – 2002 (Age < 20 years)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
New HD Patients	9	5	9	10	4	7	21	21	21	23	14	24	27
New CAPD Patients	2	2	5	6	13	13	23	20	28	30	34	37	51
New Transplants	8	6	7	9	11	8	5	14	6	11	15	9	12
HD Deaths	0	2	1	2	0	2	0	3	3	2	4	1	10
CAPD Deaths	0	2	0	0	0	2	2	3	7	2	3	8	8
Transplant Deaths	1	0	0	0	1	0	2	0	0	0	1	0	1
On HD at 31st December	27	28	31	34	36	40	58	72	92	108	122	145	162
On CAPD at 31st December	5	5	9	15	26	33	52	63	74	93	107	120	145
Functioning Transplant at 31st Dec	38	40	46	54	63	68	64	73	76	86	94	99	109

Figure 14.1 Prevalent cases of RRT by modality in children under 20 years old



RRT treatment rates

Dialysis acceptance increased from one per million age related population in 1990 to 8 per million in 2002. (Table 14.2, Figure 14.2) The RRT prevalence rates had increased from 8 per million age related population to 39 over the same period. (Table 14.2, Figure 14.2). This reflected the increasing availability and acceptability of RRT for the paediatric population with increasing affluence of the country, and an increasing number of centres with expertise in paediatric ESRF care.

The incidence and prevalence of treated ESRF is lower than that reported by ERA-EDTA [2] and the USRDS but higher than that reported in the Japanese Registry [5] for similar years as shown in Table 14.3. The Malaysian registry captured data on those children who received long-term dialysis or transplantation. Until recently, the situation in Malaysia still preclude children younger than 5 years and particularly those <2 years of age from being routinely accepted for chronic dialysis or transplant. Hence the incidence on RRT is an underestimation of the true incidence of end stage renal failure (ESRF) in children unlike in Europe and North America where incident cases of RRT remained relatively stable while prevalent cases continue to rise [2].

The incidence rate of renal transplantation had been static for the last 10 years at one per million age related population compared to a total RRT incidence of 8 per million. This situation is quite different when compared to Europe and North America with more established paediatric RRT programmes where renal transplantation is the commonest modality of treatment for paediatric RRT (73.6% in UK 2001(1), 78.9% NAPRTCS 2002 [4]).

Table 14.2 Paediatric Dialysis and Transplant Treatment Rates per million age-group population, 1990 – 2002

Year Incidence rate	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
New HD	1	1	1	1	0	1	2	2	2	2	1	2	3
New CAPD	0	0	1	1	1	1	2	2	3	3	3	4	5
New Transplant	1	1	1	1	1	1	1	1	1	1	1	1	1
Prevalence Rate at 31st December													
On HD	3	3	3	4	4	4	6	7	9	11	12	14	15
On CAPD	1	1	1	2	3	4	5	7	8	9	10	11	14
Functioning Graft	4	5	5	6	7	7	7	8	8	9	9	9	10

Figure 14.2 Incidence and prevalence rate per million age related population years old on RRT

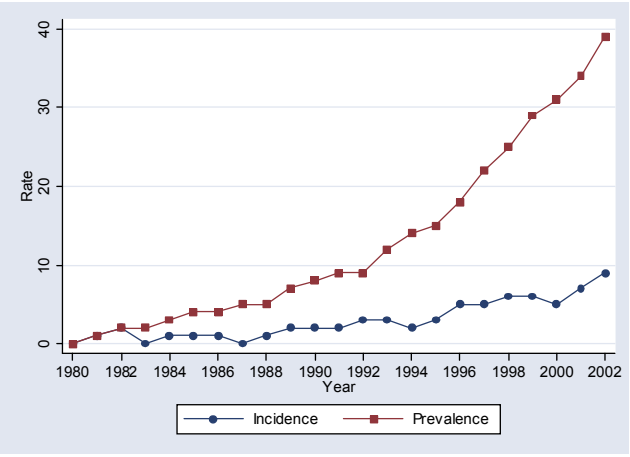


Table 14.3 Age definition, incidence and prevalence of paediatric RRT compared to other registries per million age related population (pmarp)

Registry	Age definition	Year of report	Incidence (pmarp)	Prevalence (pmarp)
Malaysia	< 20 years	2002	8.0	39.0
ERA-EDTA[2]	< 20 years	2000	10.0	62.1
UK Renal Registry[1]	< 15 years	2001	7.4	47.5
USRDS [6]	< 20 years	1995	13.0	58.0
Japanese Registry [5]	< 20 years	1998	4.0	22.0

RRT in relation to geography, gender and age

It is no mere coincidence that the highest number of children on dialysis was found in Selangor and Federal Territory (Table 14.4) as these were the states that had the first adult as well as paediatric nephrologists. Johor was the next state to have the services of a paediatric nephrologist. The economically developed states of Malaysia reflected higher intake of patients into dialysis. The east coast states of Peninsular Malaysia and Sabah which are also the most economically disadvantaged states as well as relatively large regions without easily available paediatric nephrology services to date recorded the least number of patients on dialysis. Perlis and Melaka are both states with very small population that could explain the small number of children on dialysis. This distribution of patients which probably reflected maldistribution of dialysis provision rather than actual lower incidence of ESRF needs to be rectified.

Figure 14.5 shows an overall male preponderance in all modalities of treatment which is similar to other registries [1, 2] The ratio of male to female dialysis or transplant children had not shown a dramatic change over the years to reflect a gender bias.

In relation to age, as shown in Table 14.6 and Figure 14.6(a), the number of new patients accepted into dialysis increased from the late 1980's to the late 1990's. Since then, the rising treatment rates have begun to level off for the age-groups 5-9 years and 10-14 years. The number of 0-4 year-olds provided chronic dialysis treatment remained very low. The dialysis acceptance rate for the age group 15-19 years has continued to rise however. The reason for this is unclear and needs further study.

The number of transplants done each year for the various child age-groups had either leveled off or shown a decrease for reasons alluded to earlier (Table 14.6 and Figure 14.6(b))

Table 14.4 Geographical Distribution of paediatric (<20 years) RRT 2002

State	Prevalent Cases (n)	Percentage (%)
Selangor	76	18
Johor	50	12
Federal Territory	48	12
Sarawak	42	10
Kedah	35	8
Perak	27	7
Penang	25	6
Negeri Sembilan	24	6
Pahang	20	5
Sabah	19	5
Terengganu	18	4
Kelantan	11	3
Melaka	11	3
Perlis	8	2
Total	414	101

Table 14.5 Gender distribution of New Dialysis and Transplant Patients 1980-2002

	New Dialysis		New Transplant	
	N=296	N=206	N=104	N=59
Year	% Male	% Female	% Male	% Female
1980 – 1984	65	35	69	31
1985 – 1989	65	35	66	34
1990 – 1994	54	46	63	37
1995 - 1999	60	40	61	39
2000 - 2002	58	42	64	36

Figure 14.5 Number of New dialysis and Transplant patients by gender 1980 - 2002

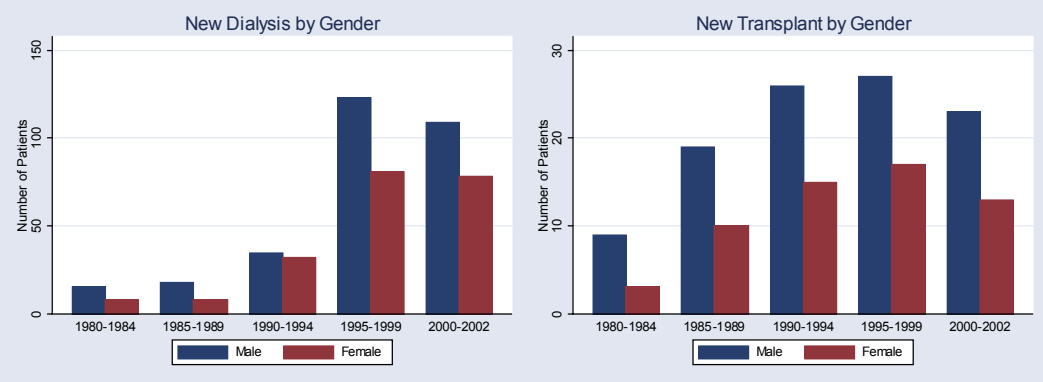


Table 14.6 Dialysis acceptance and New Transplant rate per million age group population 1990-2002

	New Dialysis				New Transplant			
	Age groups (years)				Age groups (years)			
Year	0 – 4	5 – 9	10-14	15-19	0 – 4	5 – 9	10-14	15-19
1990	0	0	1	4	0	0	1	2
1991	0	0	0	3	0	0	2	1
1992	0	1	2	4	0	0	1	2
1993	0	1	2	5	0	0	1	3
1994	1	1	3	2	0	0	1	3
1995	0	1	4	4	0	0	0	3
1996	0	3	9	9	0	0	1	1
1997	1	1	5	12	1	0	2	3
1998	0	3	8	10	0	0	1	1
1999	0	3	9	11	1	0	2	2
2000	0	4	5	11	0	0	4	3
2001	1	2	9	15	0	1	1	2
2002	3	2	10	17	0	0	3	2

Figure 14.6(a) Dialysis Treatment Rate by Age Group 1990-2002

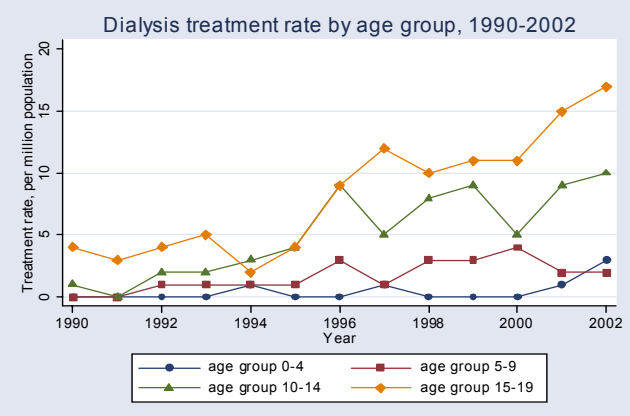
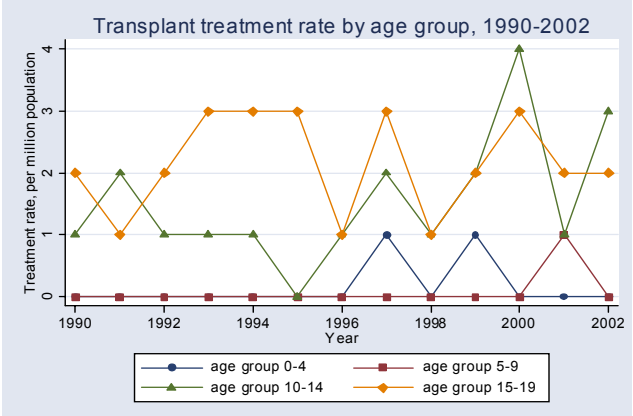


Figure 14.6(b) Transplant Treatment Rate by Age Group 1990-2002



B. Treatment modality and Sector of provision

HD was surprisingly the commonest dialysis modality in Malaysian children in the early 1990's even though CAPD treatment has been available in the country since 1981. Since 1994 however, CAPD has rapidly overtaken HD as the preferred treatment modality for children; by 2002 65% of new patients were taken on CAPD. At year end 2002, 56% of all children on dialysis were on CAPD, while HD constituted 16.5% of all children on RRT.

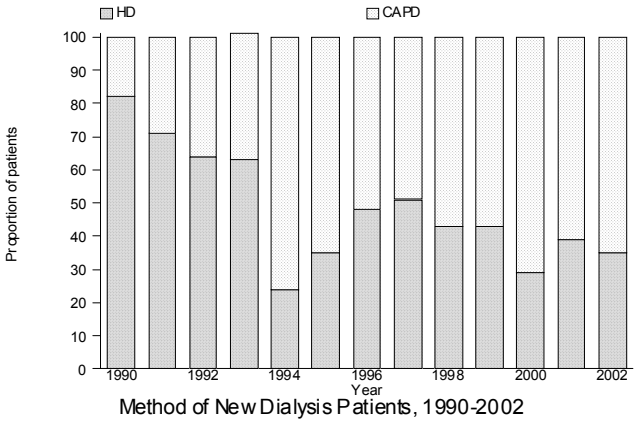
HD in children was usually initiated secondary to failure of CAPD treatment or where there was an absolute contraindication to CAPD. In the NAPRTCS[4] report, the predominant mode of dialysis is still peritoneal dialysis (2/3 of all dialysis) with automated peritoneal dialysis as the preferred mode at 75% and CAPD at only 25%. In Malaysia, the majority of patients on peritoneal dialysis were on CAPD and only a handful on automated peritoneal dialysis. This is purely because of economics – automated peritoneal dialysis cost considerably more than CAPD and the price differential between the two modalities of peritoneal dialysis would usually have to be paid by the child's own family.

Thus, provision of RRT services is still largely confined to the public sector, as shown in Table 14.8 and Figure 14.8. For example in 2002, 92% of patients aged less than years had their dialysis therapy provided by the public sector. This is as expected for a specialty (paediatric nephrology) not widely available in the private or NGO sector and where CAPD is the dominant mode of therapy, unlike the case for adult nephrology.

Table 14.7 New Dialysis by treatment modality 1990 - 2002

Year	N	% HD	% CAPD	Year	N	% HD	% CAPD
1990	11	82	18	1997	41	51	49
1991	7	71	29	1998	49	43	57
1992	14	64	36	1999	53	43	57
1993	16	63	38	2000	48	29	71
1994	17	24	76	2001	61	39	61
1995	20	35	65	2002	78	35	65
1996	44	48	52				

Figure 14.7 New Dialysis by treatment modality 1990 - 2002

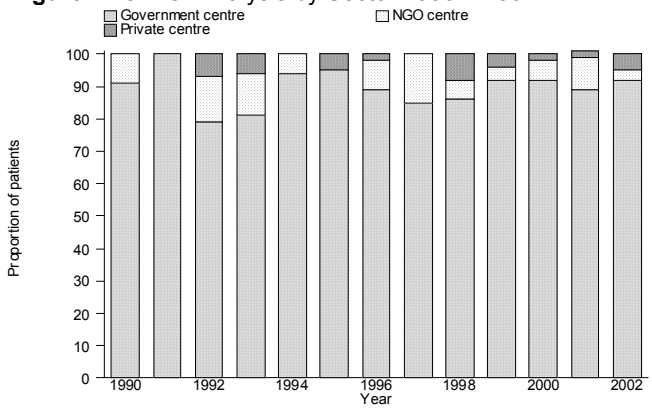


Method of New Dialysis Patients, 1990-2002

Table 14.8 New Dialysis by Sector 1990 - 2002

Year	N	% Govt	% NGO	% Private	Year	N	% Govt	% NGO	% Private
1990	11	91	9	0	1997	41	85	15	0
1991	7	100	0	0	1998	49	86	6	8
1992	14	79	14	7	1999	53	92	4	4
1993	16	81	13	6	2000	48	92	6	2
1994	17	94	6	0	2001	61	89	10	2
1995	20	95	0	5	2002	78	92	3	5
1996	44	89	9	2					

Figure 14.8 New Dialysis by Sector 1990 – 2002



Distribution of New Dialysis Patients by sector, 1990-2002

C. Primary Renal Disease

Table 14.9 shows that more than half (54%) of treated ESRD in those aged <20 years was caused by glomerulonephritis, and 20% of this 54% was due to focal segmental glomerulosclerosis. Reflux nephropathy accounted for 7%. The number of patients with reflux nephropathy has fallen from 26% (1990-1994) to 7% (2002). This may be due to earlier detection and better management of urinary tract infection although literature about the effectiveness of this intervention differs. Renal dysplasia and obstructive uropathy contributed to less than 10% of patients which is lower than other registry reports [1, 4]. In the ERA–EDTA database glomerulonephritis and pyelonephritis were the two commonest causes of ESRD[2]. In the 2003 ANZDATA Registry report glomerulonephritis and hypoplasia /dysplasia were the two leading causes of ESRD in both Australia and New Zealand.[3] In Kuwait chronic glomerulonephritis was the leading cause followed by obstructive uropathy and vesicoureteric reflux[7]. There was still an unacceptably high percentage of children with unknown cause of F.

There was a preponderance of boys particularly in the glomerulonephritis group (Table 14.9). Posterior urethral valve was the commonest cause of obstructive uropathy; hence it is no surprise that boys also predominated in this disease category. Glomerulonephritis and reflux nephropathy were commoner causes in the older age group while renal dysplasia presented at a younger age.

D. Patient Survival outcome by RRT modality

Table and Figure 14.10 show the patient survival rates by modality of treatment from 1980 to 2002. Among the three modalities of treatment; renal transplantation had the best whereas CAPD had the worst survival outcome.

Patient survival on CAPD was 97% at one year, 84% at 5 years with a rapid deterioration from 8 years onwards to only 27% at 10 years. The survival on CAPD was fairly comparable to survival on HD until 8 years into dialysis when a rapid deterioration is seen in CAPD but not in HD. The leading causes of mortality in CAPD were cardiovascular and sudden death at home (42%) and infection (21%); half of which was caused by peritonitis. On the other hand, patient survival on HD was 96% at one year, 87% at 5 years, 75% at 10 years. As a dialysis modality it had a more favourable long term outcome than CAPD. Although deaths were few in the HD population, the recorded causes of death in HD patients were infection related (57%) and cardiovascular causes and sudden death at home (28.5%).

Table 14.11 and Figure 14.11 show an average of 10% progressive deterioration in CAPD technique survival annually. Technique survival on CAPD was 94% at 1 year, 61% at 5 years and only 7% at 10 years. The causes of technique failure could not be analysed from the existing database and need further study.

Haemodialysis technique survival was 92% at one-year, 80% at 5-years, and 69% at 10 years.

Table 14.9 Primary Renal Disease 1990– 2002

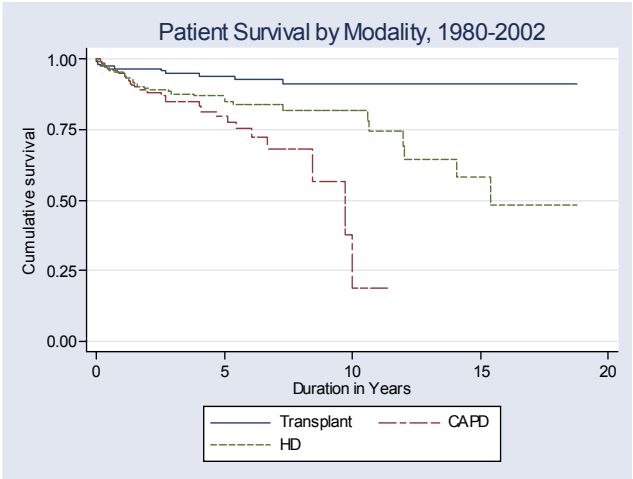
Primary Renal Disease	Male		Female		All	
	N	%	N	%	N	%
Glomerulonephritis	130	60%	111	40%	241	54%
• (FSGS)						(20%)
Reflux nephropathy	34	75%	12	25%	46	7%
Renal dysplasia	13	50%	9	50%	22	5%
Obstructive uropathy	14	75%	5	25%	19	5%
Unknown	63	46%	43	54%	106	26%

Table14.10 Patient Survival by Modality of RRT, 1980-2002

Modality Interval (years)	Transplant % survival	SE	CAPD % survival	SE	HD % survival	SE
1	97	1	95	1	95	1
5	94	2	80	4	87	2
10	91	3	19	16	82	3
15	91	3			58	10

* SE Standard Error

Figure 14.10 Patient Survival by Modality



(Table 14.11) Haemodialysis technique survival was comparable to that of CAPD in the first 2 years of therapy but showed progressive advantage subsequently. Six to 10% of patients of patients on CAPD were transferred to HD yearly compared to 2-3% from HD to CAPD (data not shown). This is lower than that reported by NAPRTCS where the change in modality of dialysis (PD to HD and vice-versa) was 20% at 2 years. Before 2 years of therapy the incidence of change of modality was less in CAPD than HD, equalized at 2 years but increased for CAPD till 30% at 3 years while it plateaued for HD at 3 years.[4]

The first paediatric renal transplantation in Malaysia was done in 1984. Since then a total of 69 paediatric transplantations were performed from 1984 to 2002. Of these, living related renal transplantation contributed 75.5%, cadaveric transplantation 16% and commercial transplantation 8.5%. (Table 14.12) There was an increase in the proportion of cadaveric transplantations from 2000 onwards.

The overall patient survival for paediatric renal transplants was 97% at 1 year, and 92% at five, ten and 15 years (Table & Figure 14.10).

Table 14.13 and Figure 14.13 show that the graft survival for our paediatric renal transplants was 86% at 1 year, 73% at 5 years, 63% at 10 years and 53% at 15 years. We could not analyse the difference in survival between living related and cadaveric transplantation, nor the causes of graft loss in this report. In the NAPRTCS data the graft survival are 93% at 1 year, 86% at 3 years and 80% at 5 years for living related transplantation and 84% at 1 year, 74% at 3 years and 66% at 5 years for cadaveric transplantation.[4]

Table 14.11 Dialysis Technique Survival by Modality 1980-2002

Modality	CAPD		HD	
Interval (years)	% survival	SE*	% survival	SE*
1	89	2	93	2
5	54	4	83	3
10	5	4	76	4
15			54	10

* SE Standard Error

Figure 14.11 Dialysis Technique survival by modality

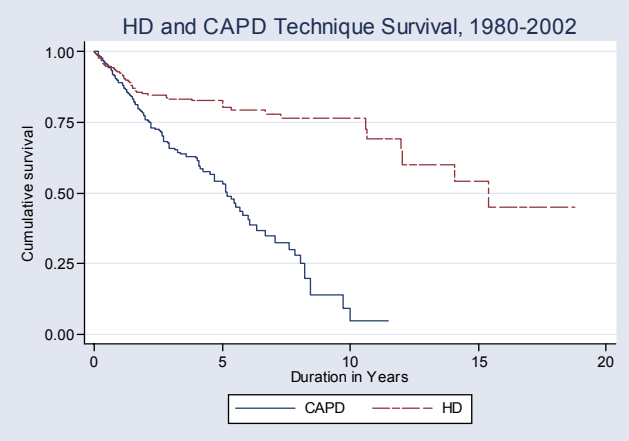


Table 14.12 Types of Transplant 1985-2002

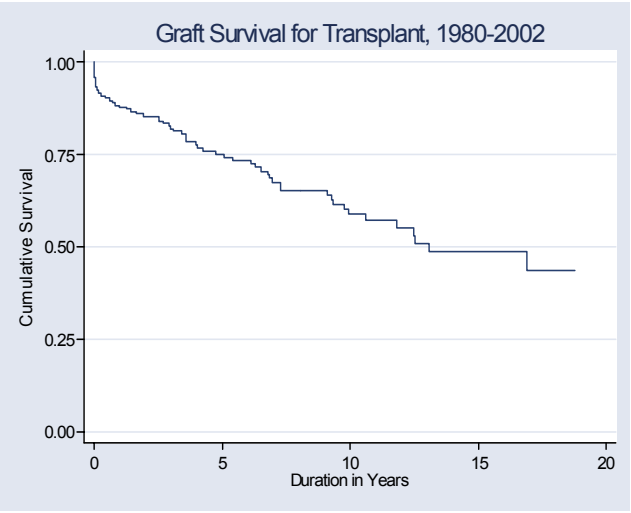
Year	1985-1989		1990-1994		1995-1999		2000-2002	
	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	0	0	1	2	9	20	4	11
Commercial living donor	5	17	9	22	2	5	5	14
Living related donor	23	79	31	76	31	70	14	39
Living emotionally related	0	0	0	0	0	0	0	0
Cadaver	1	3	0	0	2	5	13	36
Total	29	100	41	100	44	100	36	100

Table 14.13 Transplant Allograft survival, 1980-2002

Interval (years)	% survival	SE*
1	88	3
5	75	4
10	59	5
15	49	6

* SE Standard Error

Figure 14.13 Transplant allograft survival 1980-2002



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