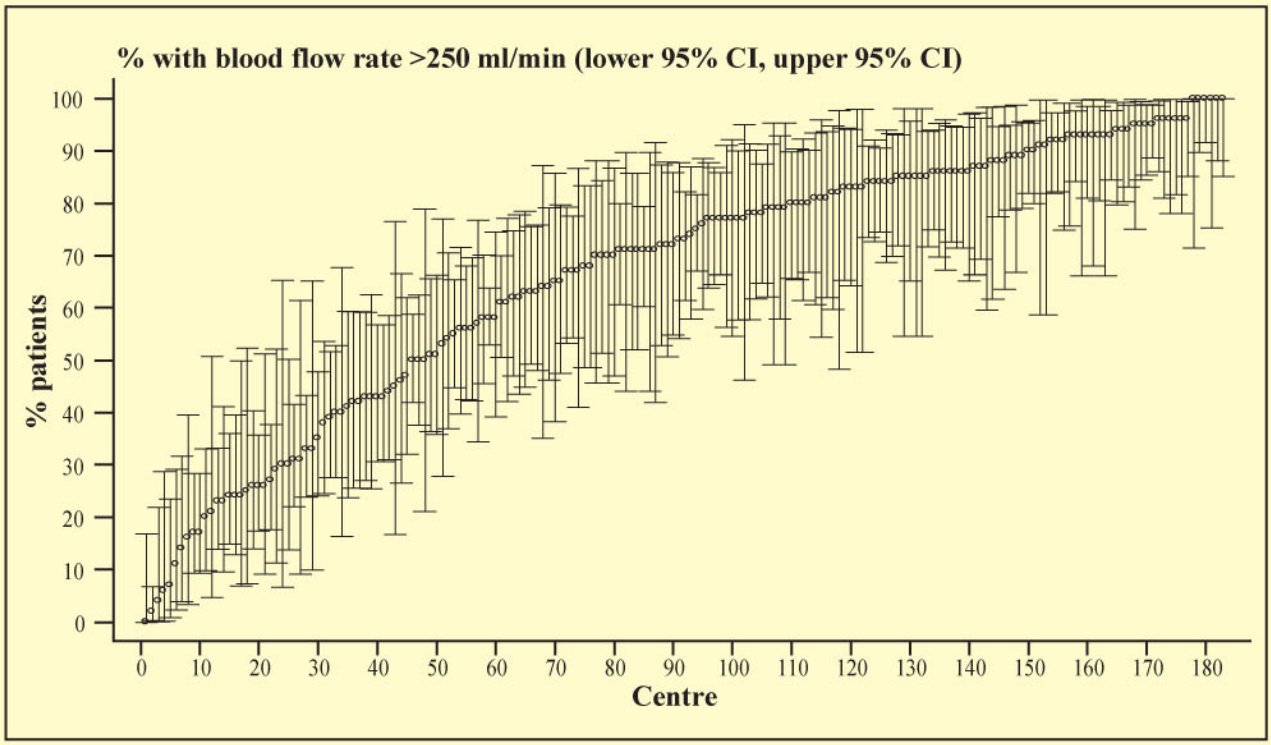
12th Report of the Malaysian Dialysis & Transplant Registry 2004



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&

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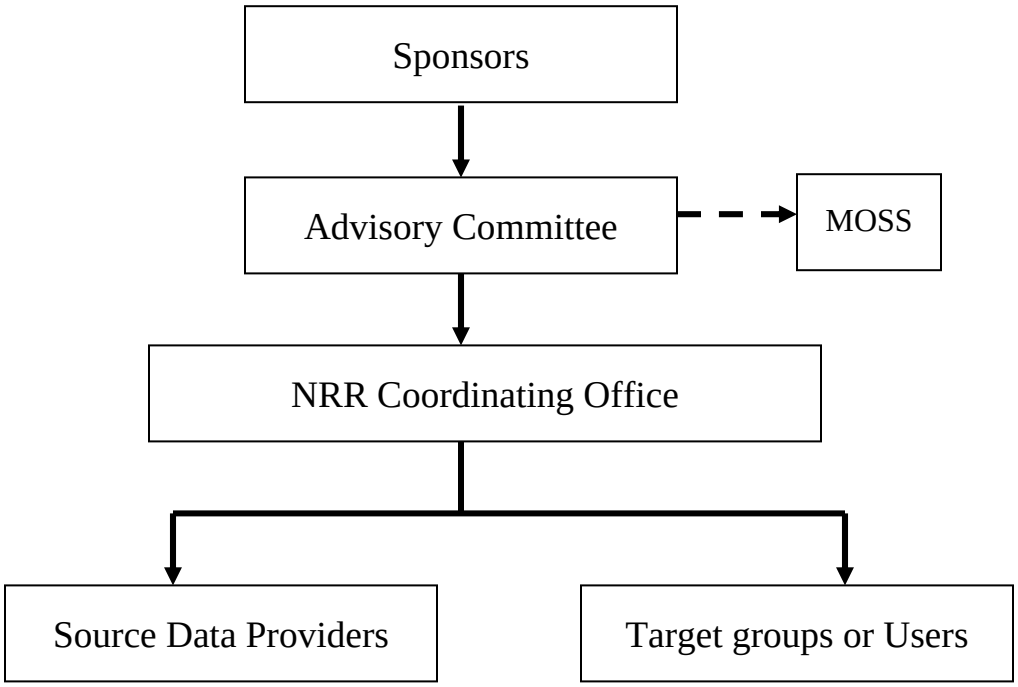
About the National Renal Registry……

The National Renal Registry (NRR) has its origin in the Dialysis and Transplant Registry established by the Department of Nephrology in 1992. The sponsors of NRR are the Malaysian Society of Nephrology (MSN) and Association of Dialysis Medical Assistants and Nurses (ADMAN).

The objectives of NRR are to:

1. Determine the disease burden attributable to End Stage Renal Disease (ESRD), and its geographic and temporal trends in Malaysia.
2. Determine the outcomes, and factors influencing outcomes of Renal Replacement Therapy.
3. Evaluate the RRT program.
4. Stimulate and facilitate research on RRT and ESRD.
5. Maintain the national renal transplant waiting list.

The NRR organization is as follows:



Sponsors.

The Malaysian Society of Nephrology is the main sponsor of the National Renal Registry (NRR) and Malaysian Organ Sharing System (MOSS) and the co-sponsor is the Association of Dialysis Medical Assistants and Nurses.

Advisory Committee.

This is the committee established by the sponsors to oversee the operations of the registry.

National Rena Registry Office

The NRR office is the coordinating center that collects and analyses the data. It publishes the annual report of Malaysian Dialysis & Transplant Registry and the Directory or Dialysis Centres in Malaysia. The Clinical Registry Manager (CRM) oversees the daily operation of the NRR. The Clinical Research Centre of Hospital Kuala Lumpur provides the epidemiology, statistic and information technology support to NRR.

Source Data Producers

These are the dialysis centres that collect the required data. It is the most critical and yet difficult element of the system. It has to be systematic and uniform, and producers of source data need to be trained and motivated to ensure high data quality.

Users or Target groups

These are the individuals or institutions to whom the regular registry reports are addressed. It is their needs for information to assist in the planning and implementing disease treatment, control and prevention activity that justify the investment in the registry. They include:

1. the Renal community
2. the RRT provider
3. the Public health practitioner
4. the Decision maker in various government and non-government agencies who have responsibilities for any aspects of ESRD treatment, prevention and control
5. the Researcher with an interest in ESRD and RRT.
6. the press and the public.

About MOSS……

Cadaver organ transplantation activity has noticeably increased in the last decade in Malaysia. A recurring issue of concern was how and to whom cadaver organs are allocated. In 1999, the Malaysian Society of Nephrology (MSN) had established a committee, which was tasked to initiate the development of a national organ-sharing network. The network was referred as the Malaysian Organ Sharing System or MOSS in short, and the committee was thus named MOSS committee

The functions of the MOSS committee thus established then under MSN were to:

1. Make policy decision concerning MOSS.
2. Secure funding from various sources to support MOSS operation.
3. Designate a place to be the coordinating centre for the operation of MOSS.
4. Canvass the views of nephrologist and other clinical staff involved concerning the policy and operation of MOSS.
5. Oversee the operation of the MOSS.
6. Employ a manager and other necessary support personnel to manage the day-to-day operation of the MOSS.
7. Appoint panel of nephrologist to examine eligibility of potential recipients

The objectives of MOSS in turn as established by MOSS Committee were:

1. To maintain a list of patients who have voluntarily enrolled as potential recipients in the cadaveric kidney transplantation program
2. To prioritise the waiting list according to an agreed criteria and scoring system
3. To update the waiting lists at periodic intervals according to specified criteria
4. To provide a list of suitably matched potential recipients based on agreed criteria when a cadaver organ is available
5. To prepare an annual report of the status of the cadaveric kidney transplantation program including the waiting list, donor status and outcomes

The National Renal Registry (NRR), which was then sponsored by MSN, was directed to assist in the setting up of MOSS and to make available its database to support MOSS operations. From this database, a transplant waiting list was generated and indeed was in use.

However, the subsequent operations of MOSS such as in entering new patients into the list, maintaining and updating the list, updating patient's information and so on, turned out to be logistically more difficult than had been expected. Over the years, various manual systems and procedures had been tried to coordinate and support the activities of the various parties involved in the transplantation process. In particular:

1. The nephrologist caring for dialysis patients who are potential recipients need to be able to efficiently put their patients on the list, update their patients' data, and take them off the list temporarily or otherwise when necessary.
2. The Transplant Centre performing the transplant surgery obviously need timely access to the recipient wait list that is ranked according to pre-determined criteria, as

well as to access their contact information in order to inform patients to come forward for transplant when an organ becomes available. At the same time, the transplant surgeon will want to review the selected patients' clinical information relevant to the transplant surgery.

3. The National Renal Registry is the channel through which nephrologists or dialysis centres notify patients in order to put patients on the wait list.
4. And finally, the MOSS Committee needs to be able to convey its policy and operational decisions to users, such as on assigning patients to nephrologist for purpose of managing their wait list status, adjudication on patient eligibility for transplant and their ranking on the list, final decision on entry into the SOS list.

In early 2004, the MOSS Committee proposed to MSN council to support the development of a web based system, named eMOSS, to support the operations of MOSS. The nature of MOSS operations, involving multiple parties spread throughout the country was ideally suited for web-based automation. The proposal was accepted and funds allocated for the development. The NRR and the Clinical Research Centre (CRC) were tasked with undertaking this project, and also to help fund it in part.

eMOSS website is allocated in http://msn.org.my . You may down load a copy of the user manual from the website. This website is reinforced with high security. There are pre-set rules to access right according to the approved guideline. Access to the patients information is however restricted to authorized and designated users only. To get your password please contact the MOSS coordinator at e-mail: moss@msn.org.my.

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FOREWORD

This report of the National Renal Registry continues to document the growth in the dialysis population. This growth has been contributed by providers from three sectors almost equally ie the public sector, the private sector and the non governmental organisations which are in the main charitable organisations. The government has remained the main funding agency for dialysis treatment. This unique arrangement is seen only in a few countries and in this country has served us well.

The most consistent growth has been with Hemodialysis (HD) treatment. Continuous Ambulatory Peritoneal Dialysis (CAPD) which has been available in this country for more than 20 years has yet to find its optimal position in the overall provision of renal replacement therapy (RRT). Many nephrologists feel that CAPD should have a greater share of the "RRT market". Presently CAPD is available only in public sector institutions. A cost effectiveness study reported in the last issue of the Registry's report showed that there is no difference in the cost per life year saved between HD and CAPD. In this report as was in the previous one, Quality of Life scores were higher in CAPD compared to hemodialysis patients. The perception that CAPD is more expensive than HD has led to many doctors not actively advocating this dialysis modality, despite its advantage as a home based self-care treatment. This report also showed that the death rate for CAPD has levelled off in the last few years reflecting perhaps the use of better systems, greater experience and expertise in the care of these patients.

Renal transplantation rate has remained low for many years. The easy accessibility to dialysis may have worked against renal transplantation. In the early years of RRT program in this country a patient did not get on to dialysis unless he has a potential living related donor. The easy access to cadaveric transplantation in China has also served as a disincentive for the living related renal transplantation program. The efforts to educate the public and healthcare givers will have to continue. The nephrologists managing newly diagnosed ESRD patients should actively promote kidney transplantation particularly among the younger patients.

While the growth has been laudable, a number of issues and challenges are seen as a result of the rapid expansion. Significant variation in practices was noted and is of some concern as they can lead to differing outcomes. Blood flow rates, frequency of dialysis and prescribed Kt/V are amongst parameters shown to vary and all of these have an impact on the adequacy of dialysis. The registry has undertaken to provide individual centre's report which captures key parameters in the provision of dialysis treatment. Centres can evaluate their performance and compare with the national average and take steps to correct any deficiencies. Such a step hopefully will lead to better outcomes in the future. Why does such a variation in practice occur? One possible explanation is the heterogeneous background of the providers. Apart from large institutions like the Ministry of Health, most of the other providers are stand-alone units. They may have different approaches to treatment. A more likely reason is the many constraints faced by the NGO centres. They include finance, expertise and other resources

Both doctors and nursing staff should take cognisance of these "gaps" in practice and in outcomes. More detailed studies may need to be done to determine the factors that lead to these "gaps" and the remedial actions that have to be taken. The registry is the repository of a lot of information that can be utilised for these types of studies and the committee welcomes interested individuals to undertake them.

I would like to thank all contributors for their continued support. I would also like to extend the committee's thanks to the editors Drs Lim Yam Ngo and Lim Teck Onn as well as the Manager Ms Lee Day Guat for their untiring efforts in ensuring the report is produced. We have endeavoured to make the report a readable and informative one which will be of use to all parties.

Zaki Morad Mohd Zaher
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Malaysian Society of Nephrology

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REPORT SUMMARY

- Intake of new dialysis patients showed a linear increase over the years -from 684 in 1995 to 2538 in 2004 with corresponding treatment rates of 33 and 101 per million population.
- Prevalent dialysis patients increased from 2232 (108 per million) in 1995 to 11554 (452 per million) at year end 2004.
- The number of new transplant patients increased from just above 100 in 1995 to 174 in 2004 but transplant rates remain about 6 per million. Patients with functioning renal transplants increased from 931(45 per million) to 1587 (61 per million) over the same period.
- Dialysis treatment rates varied from about 63 per million state population in the economically underdeveloped states to > 110 per million in the more economically advantaged states.
- From the centre survey carried out at the end of 2004, there were a total of 11554 dialysis patients, one third in the Ministry of Health (MOH) hospitals, another third in non-governmental organization (NGO) centres and about 28% in the private sector.
- The treatment gap between men and women has remained consistent over the years.
- Dialysis treatment rates for those < 55 years of age had plateaued while those >65 years continue to register rapid increase. 51% of new dialysis patients were at least 55 years old
- At least 85% of new patients were accepted into centre haemodialysis
- The government continued to fund about 50% of dialysis treatment, NGO funding increased to 18% in 2004, and self funding had decreased to 24%.
- In 2003, intake of new dialysis patients was distributed equally between the 3 sectors.
- Diabetes mellitus continues to be the commonest cause of ESRD accounting for 54% in 2004, followed by hypertension at 8%.
- The annual death rate for those on CAPD remained relatively unchanged over the last 10 years while there was an upward trend in the annual death rate for those on haemodialysis.
- Cardiovascular disease and death at home remained the commonest causes of death in 2004; accounting for 26% each, sepsis 13%.
- The unadjusted 5 and 10 year patient survival on dialysis were 59% and 35% respectively. HD patient survival was superior to that on CAPD.
- Older and diabetic patients had poorer survival on dialysis.
- Median QoL index scores were satisfactory. HD patients achieved a lower score than CAPD patients.
- Diabetes mellitus and older age group were factors associated with lower median QoL index scores.
- Employment amongst HD patients appeared to be positively influenced by increasing years on HD.
- 73% of HD patients compared to 62% on CAPD were on erythropoietin (EPO). Blood transfusion rate in dialysis patients remained at 10 -15%.
- There was decreasing use of oral iron supplements, use of IV Iron has increased.
- There was variation in the use of EPO and blood transfusion among HD and CAPD centres.
- Serum ferritin and transferrin saturation had increased over the years.
- Most dialysis centres had majority of patients with serum ferritin and transferrin saturation above the acceptable limit.
- In 2004, the percentage of patients with the haemoglobin > 10 gm/dl varied between 45 to 58 %.
- For the year 2004, mean serum albumin level was 40 g/L for HD patients and 33 g/L for CAPD patients.
- There were wide variations in the proportion of patients with serum albumin >40g/L in both HD and CAPD centres.
- For the year 2004, mean BMI value was 23.4 for HD and 23.2 for PD patients.

- There was some variation in proportion of patients with BMI $\geq$ 18.5 in both HD and PD centres.
- In 2004, the mean and median predialysis systolic BP in HD patients was 150 mm Hg respectively. The mean and median predialysis systolic BP in CAPD patients was 141 mmHg.
- The mean and median predialysis diastolic BP for HD patients were 80.3 mm Hg and 80.4 mm Hg respectively, while that for CAPD patients were 82.2 mm Hg and 83 mm Hg respectively.
- There was some variation noted in BP control between the various HD and PD centres.
- 71% of HD patients had total cholesterol level < 5.3 mmol/l versus 53% of CAPD patients. 30% of HD patients compared to 27% of CAPD patients had elevated serum triglycerides.
- Use of calcium based phosphate binders among dialysis patients increased with a marked reduction in the use of aluminium based binders.
- Serum calcium levels remained within normal levels among both HD and CAPD populations
- CAPD centres had higher calcium levels compared to HD centres for the year 2004
- The median serum phosphate levels were lower among patients on CAPD.
- The mean serum calcium phosphate product was higher among HD patients compared to CAPD patients. A higher number of centers on CAPD have a median serum calcium phosphate product less than 4.5 as compared to HD centers (71-78% versus 51.5 –65%).
- Prevalence of dialysis patients with HBsAg remained at about 4-5%.
- The prevalence of HCV infection was much higher in HD compared to CAPD patients(5%) but had decreased after 2001 from 23% to 17% in 2004.
- There was wide variation in the prevalence of patients with anti HCV antibody among HD centres.
- Haemodialysis practices have changed since 1997 to 2004. There was increased use of brachiocephalic fistulae as vascular access, higher blood flow rates, increased usage of synthetic membranes , increased number of reuse and universal use of bicarbonate buffer. Median prescribed KT/V had increased over the years but has plateaued over the last few years at 1.6.
- There was wide variation in the proportion of patients with KT/V of $\geq$1.3 among centres ranging from below 30% to 100%.
- Unadjusted HD technique survival was significantly better than unadjusted CAPD technique survival at 1 year, 5 years and 10 years.
- Unadjusted HD technique survival was better in the younger age groups and the non diabetics but was not related to year of starting HD.
- In 2004, CAPD remained the commonest mode of PD. The Baxter disconnect system was the commonest connectology used. Ninety-five percent of patients perform 4 exchanges a day, and most (92%) use a fill volume of 2 L.
- The median delivered weekly Kt/V was 2.1, with 61% achieving target of 2.0 with a 2-fold variation between the highest- and the lowest-performing centres (85% vs 43%).
- 81% of prevalent patients had low-average or high-average PET status.
- One- and 2-year technique survival for CAPD was 82% and 63%
- Technique survival was better for younger patients, females and non-diabetics but was not related to the year of starting dialysis.
- In 2004, peritonitis rates varied between 21.8 and 48.2 patient-months/episode among centres. Gram positive and Gram negative organisms each accounted for 29% of peritonitis episodes. The culture-negative rate remained stable at 33%. There was a trend to increasing peritonitis rate with increasing patient age and diabetics but not with gender.

Chapter 13 Renal Transplantation

- There were a total of 2650 renal transplantations reported to the Registry between 1975 and 2004; 1587 grafts were functioning at the end of 2004.
- There were 42 new renal transplantations done in Malaysia in 2004 and 132 done overseas.
- There were 57 centres of follow-up for renal transplant recipients in 2004.
- Mean age of new transplant patients in 2004 was 41 $\pm$ 13 years; 61% were male, 19% diabetic, 6% HbsAg positive and 8% anti-HCV positive at the time of transplantation.
- In 2004, 98% of prevalent renal transplant recipients were on prednisolone, 80% cyclosporine, 12% tacrolimus, 43% azathioprine and 36% mycophenolate mofetil.
- In 2004, 32 (2%) of prevalent transplant recipients died and 43 (3%) lost their grafts. Infection and cancer were the commonest causes of death accounting for 29% and 17% respectively. Cardiovascular disease was the third commonest cause at 11%. Renal allograft rejection accounted for 70% of graft loss.
- Overall transplant patient survival rate from 1993 to 2004 was 95%, 92%, 89% and 80% at 1 year, 3 years, 5 years and 10 years respectively, while the overall graft survival rate was 97%, 93%, 88% and 77% respectively.

Chapter 5: Paediatric Renal replacement therapy

- Intake of new paediatric dialysis patients increased from 12 in 1990 to 74 in 2004 giving a dialysis acceptance rate of 1 per million age related population to 7 per million age related population (pmarp) respectively.
- New renal transplant rate remained at only 1 pmarp over the last 15 years.
- At the end of 2004 there were a total of 390 children under 20 on dialysis giving a dialysis prevalence rate 36 pmarp.
- The number of patients with functioning transplants in 2004 was 111 giving a prevalence rate of 10 pmarp.
- Except for Perak, dialysis treatment rates were higher in the economically advantaged states of Malaysia.
- The number of 0-4 year olds provided RRT remained very low**.**
- CAPD was the preferred mode of initial dialysis modality.
- The government provided almost 90% of dialysis funding.
- Other glomerulonephritidis accounted for 29% of ESRD, focal segmental glomerulosclerosis 11%, and SLE 9%. 30% of patients had unknown primary renal disease.
- Patient survival on HD was 95% for 1 year, 85% for 5 years and 82% for 10 years. CAPD patient survival was 95% at 1 year, 81% at 5 years
- CAPD had worse technique survival compared to HD 2 years after the start of dialysis.
- Patient survival for renal transplantation was 97% for 1 year, 95% at 5 years and 95% at 10 years post transplant. Graft survival was 91% at 1 year, 80% at 5 years, and 69% at 10 years.

CHAPTER 1

ALL RENAL REPLACEMENT THERAPY

Lim Teck Onn
Lim Yam Ngo

1.1. Stock And Flow

Intake of new dialysis patients showed a linear increase over the years from 684 in 1995 to 2538 in 2004. Prevalent dialysis patients increased from 2232 in 1995 to 11554 at year end 2004. The number of new transplant patients increased from just above 100 in 1995 to 174 in 2004 and patients with functioning renal transplants increased from 931 to 1587 over the same period. (table and figure 1.01)

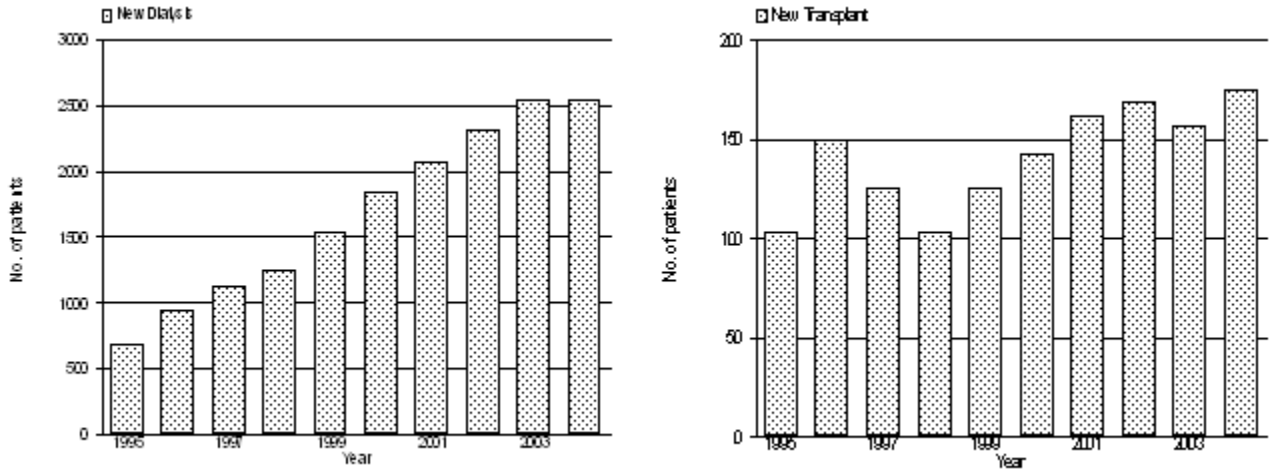
Table 1.01: Stock and Flow of RRT, Malaysia 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004*
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
New Transplants	103	150	126	103	126	143	162	169	157	174
Dialysis deaths	178	222	315	373	486	583	801	908	1128	1115
Transplant deaths	16	31	29	23	25	27	35	31	36	32
Dialysing at 31st Dec	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554
Functioning transplant at 31st Dec	931	1021	1080	1111	1172	1249	1333	1428	1501	1587

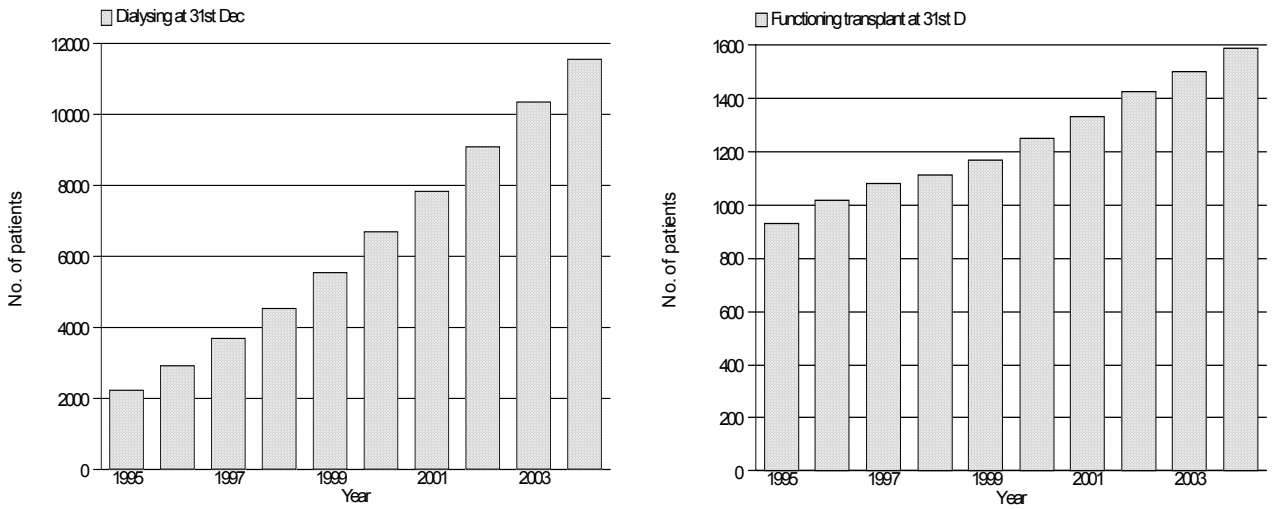
*preliminary results

Figure 1.01: Stock and Flow of RRT, Malaysia 1995 – 2004

(a) New Dialysis and Transplant patients



(b) Patients Dialysing and with Functioning Transplant at 31st December 1995 – 2004



1.2 Treatment Provision Rate

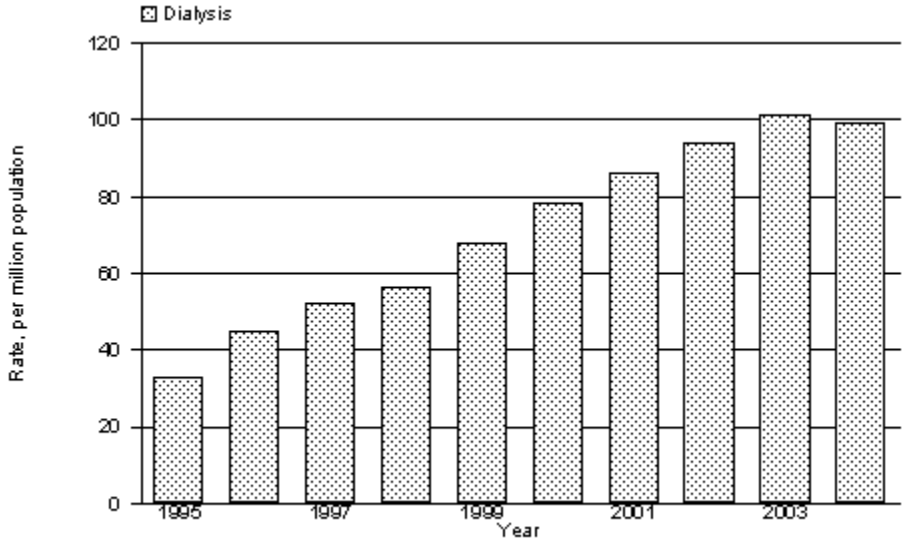
Dialysis acceptance rates showed a three-fold increase over the last 10 years - from 33 per million population in 1995 to 101 per million population in 2003. (Data for 2004 are preliminary since at the time preparation of this report there were still many new cases yet to be notified to registry.)
New transplant rates remained low over the years fluctuating between 5-7 per million population per year. (table and figure 1.02)

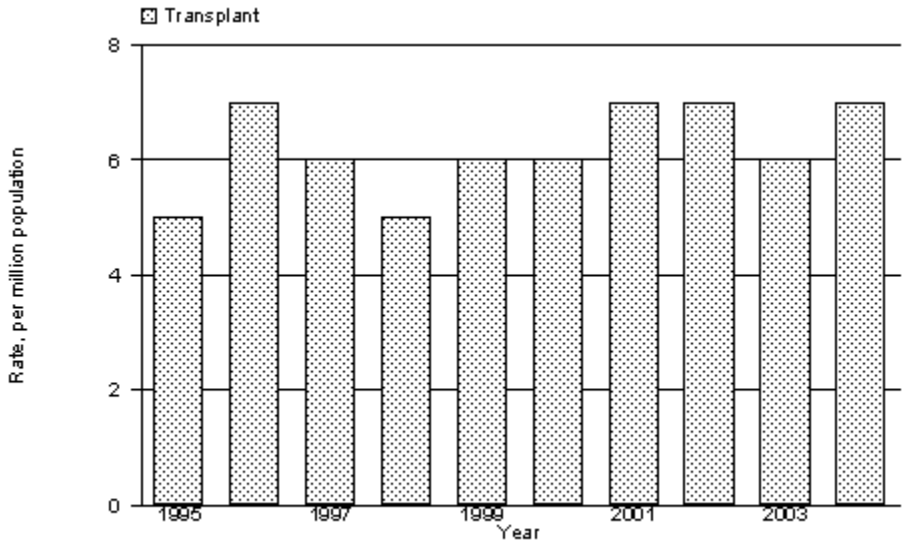
Table 1.02: New Dialysis Acceptance Rate and New Transplant Rate per million population 1995 – 2004

Acceptance rate	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004*
New Dialysis	33	45	52	56	68	78	86	94	101	99
New Transplant	5	7	6	5	6	6	7	7	6	7

*preliminary results

Figure 1.02: New Dialysis Acceptance and New Transplant Rate 1995 - 2004



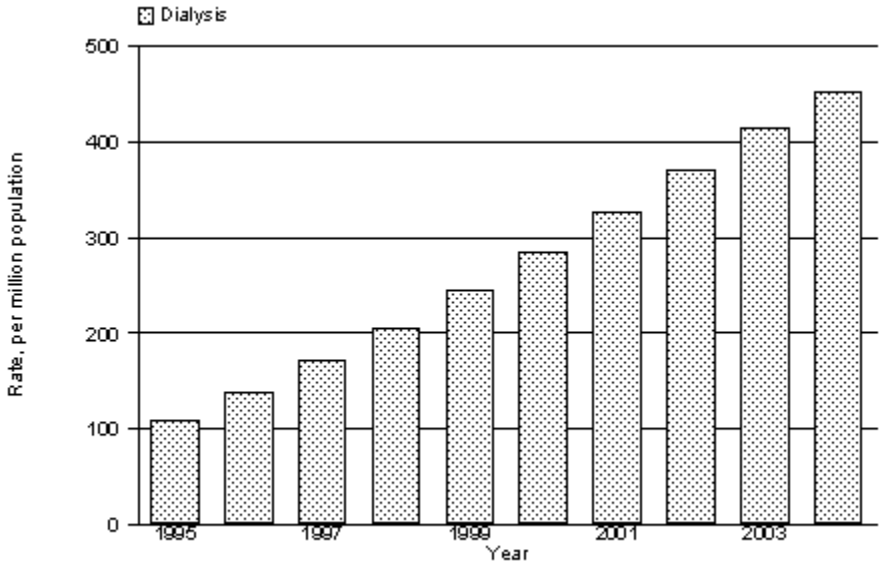


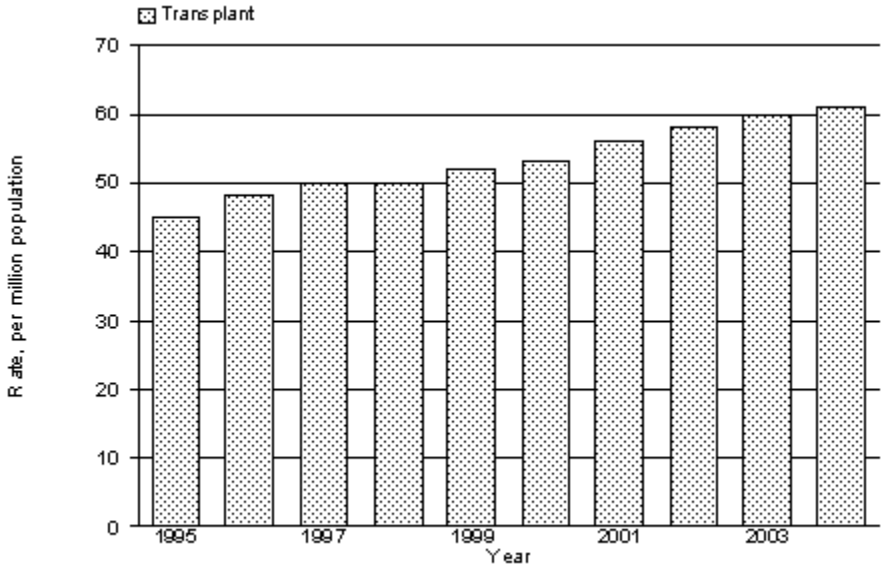
Dialysis prevalence rate quadrupled over the last 10 years, increasing from 108 per million population in 1995 to 452 in 2004. The transplant prevalence rates however only increased by one and half times from 45 to 61 per million population over the same period. (table and figure 1.03)

Table 1.03: RRT Prevalence Rate per million population 1995 – 2004

Prevalence rate	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Dialysis	108	138	171	204	244	285	326	370	413	452
Transplant	45	48	50	50	52	53	56	58	60	61

Figure 1.03: Dialysis and Transplant Prevalence Rate per million population 1995 - 2004





CHAPTER 2

DIALYSIS IN MALAYSIA

Lim Teck Onn
Lim Yam Ngo

2.1: PROVISION OF DIALYSIS IN MALAYSIA (registry report)

2.1 .1 Dialysis treatment provision

In 2003, 2540 new patients commenced dialysis, giving a treatment rate of 101 per million population, an increase of 7.5% from the year before and slightly more than 3-fold increase over the 9 years shown in table 2.1.2. At year end 2003, a total of 10342 patients were on dialysis treatment giving a prevalence rate of 413 per million per year.

Table 2.1.1: Stock and flow – Dialysis Patients 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004*
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
Died	178	222	315	373	486	583	801	908	1128	1115
Transplanted	36	56	59	61	69	106	133	143	121	140
Lost to Follow-up	5	5	5	8	7	10	15	23	43	80
Dialysing at 31st Dec	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554

*preliminary results

Table 2.1.2: Dialysis Treatment Rate per million population 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004*
Acceptance rate	33	45	52	56	68	78	86	94	101	99
Prevalence rate	108	138	171	204	244	285	326	370	413	452

*preliminary results

2.1.3.Geographic distribution (registry report)

The economically advantaged states of Malaysia – Melaka, Pulau Pinang, Negri Sembilan, Johor, Selangor and W. Persekutuan of Kuala Lumpur, and Perak - have dialysis treatment rates exceeding 100 per million state population since year 2000. Dialysis provision rate for Kedah was nearly 100 per million in 2003. The East Coast states of West Malaysia and Sabah and Sarawak averaged treatment rates of about 63 per million. Melaka continued to have the highest treatment rate at 180 in 2003 and Sabah the lowest at 45 per million.

Table 2.1.3: Dialysis Treatment Rate by State, per million state population 1995-2004

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004*
Negeri Melaka	74	82	95	109	91	150	156	169	180	201
Pulau Pinang	73	72	85	113	124	106	122	147	138	169
Negeri Sembilan	48	74	74	92	94	118	112	131	148	154
Johor Darul Takzim	43	58	79	71	104	131	137	146	145	141
Selangor & W. Persekutuan	62	81	76	91	102	121	118	126	133	128
Perak Darul Redzuan	28	58	61	64	75	106	104	115	125	114
Kedah & Perlis	19	26	54	47	59	69	66	86	99	85
Terengganu Darul Iman	18	27	36	34	36	37	77	88	69	78
Pahang Darul Makmur	21	16	44	36	46	49	52	52	66	66
Sarawak	20	36	46	33	44	51	67	58	62	66
Kelantan Darul Naim	9	6	12	15	26	31	59	61	72	63
Sabah	12	18	16	24	32	25	36	36	45	48

*preliminary results

2.2: DIALYSIS PROVISION IN MALAYSIA (Centre survey report)

2.2.1 Dialysis provision

Data submission of individual dialysis and transplant patients to the National Renal Registry is entirely voluntary and completeness cannot be ascertained. Dialysis centre surveys have been conducted in December of each year since 1999. This annual cross-sectional survey was carried out to describe the most current level and distribution of dialysis provision at the end of each year. This section reports the results of the centre survey carried out in December 2004. Dialysis provision is expressed in terms of number of centres, machines, treatment capacity (one HD machine to 5 patients) and patients.

At the end of 2004, there were a total of 11554 dialysis patients, one third receiving dialysis treatment provided by the Ministry of Health (MOH) hospitals, another third by non-governmental organization (NGO) centres and about 28% by the private sector. Almost all private dialysis patients received centre haemodialysis treatment compared to the MOH sector where chronic PD patients and home haemodialysis comprised 30% of all dialysis patients. (Table 2.2.1)

Table 2.2.1: Number of dialysis centres, HD machines and treatment capacity by sector, December 2004

Sector	Centre (No.)	Centre HD machines (No.)	Centre HD capacity (No.)	Centre HD patients (No.)	Centre HD capacity: patient ratio	All dialysis patients (No.)
MOH	112	920	4600	2791	1.65	3979
NGO	93	1316	6580	3628	1.81	3977
Private (PRV))	124	1105	5525	3681	1.5	3273
University (UNI)	8	30	150	42	3.57	229
Armed Forces (AF)	10	42	210	94	2.23	96

Of the 3 main sectors, the private sector had the largest number of dialysis centres but the NGO centres had the largest HD capacity. (Figure 2.2.1 a & b)

Figure 2.2.1(a): Distribution of dialysis centres by Sector, December 2004

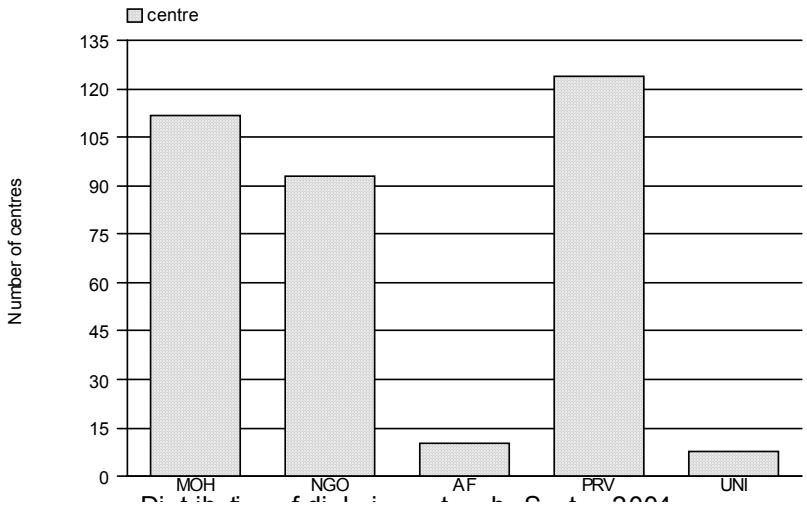


Figure 2.2.1(b): Distribution of HD capacity by Sector, December 2004

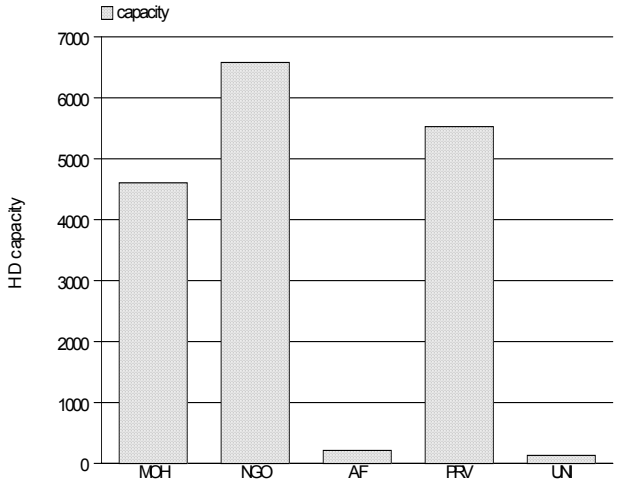
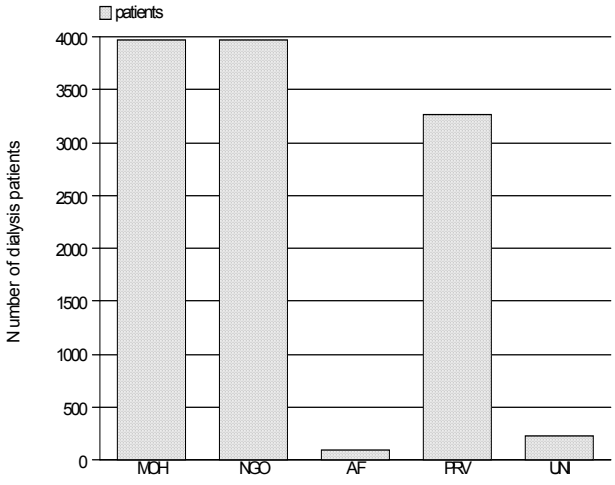
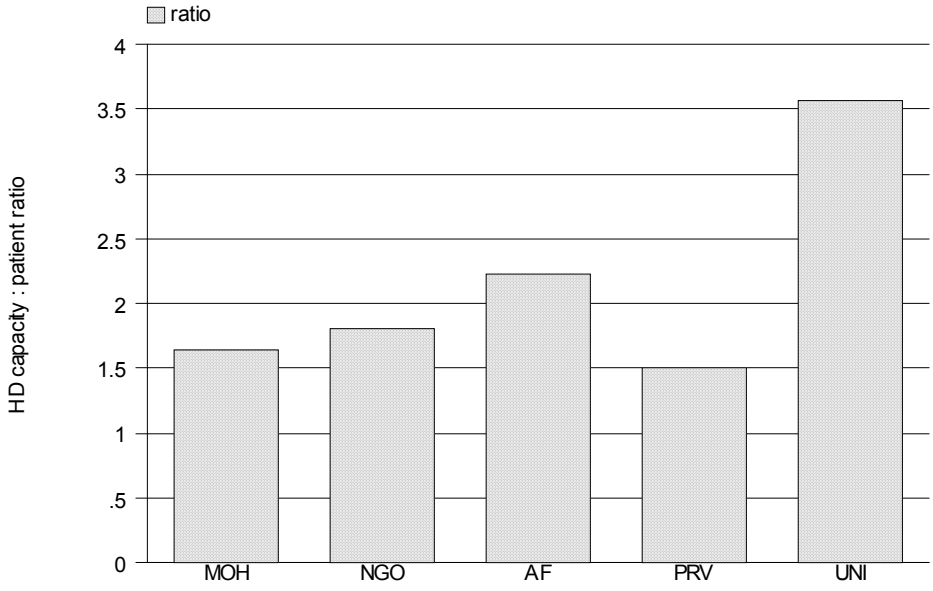


Figure 2.2.1(c): Distribution of dialysis patients by Sector, December 2004



The private sector had the lowest HD treatment capacity to patient ratio at 1.5 and the NGO sector the highest at 1.81. (Figure 2.2.1d)

Figure 2.2.1(d): HD capacity: patient ratio by Sector, December 2004



2.2.2.Geographic distribution (centre survey)

The economically advantaged states have the highest number of dialysis centres, treatment capacity, patients and treatment rate. However, other than Perak which had the highest HD capacity to patient ratio at 2.01, the less economically developed states of Terengganu, Sabah and Pahang had capacity to patient ratios > 1.8, higher than many of the economically developed states. (Table and Figure 2.2.2.).

Table 2.2.2: Number of dialysis centres, number of HD machines and treatment capacity, HD capacity to patients ratio and number of dialysis patients by state in December 2004

State	Centre (No.)	Centre HD machines	Centre HD machines pmp	Centre HD capacity (No.)	Centre HD capacity pmp	Centre HD patients (No.)	Centre HD patients pmp	HD capacity: patient ratio	All dialysis patients (No.)	Dialysis treatment rate pmp
Melaka (Me)	13	184	263	920	1314	549	784	1.68	521	744
Penang (Pe)	37	347	241	1735	1203	1056	732	1.64	1010	700
Johor (Jo)	50	535	177	2675	883	1671	552	1.6	1862	615
Selangor & Federal Territory (SF)	96	1004	163	5020	817	2983	486	1.68	3467	564
Negeri Sembilan (Ne)	13	128	138	640	688	386	415	1.66	500	538
Perak (Pe)	40	386	173	1930	867	961	432	2.01	1184	532
Kedah & Perlis (KP)	27	235	116	1175	578	854	420	1.38	786	386
Sarawak (Sw)	17	187	83	935	413	647	286	1.45	732	324
Trengganu (Tr)	9	76	77	380	384	197	199	1.93	277	280
Pahang (Pa)	13	97	69	485	347	268	191	1.81	385	275
Kelantan (Ke)	15	104	70	520	351	311	210	1.67	355	240
Sabah (Sb)	17	130	45	650	227	353	123	1.84	475	166
Malaysia	347	3413	133	17065	667	10236	400	1.67	11554	452

Figure 2.2.2(a): Distribution of dialysis centres by State, December 2004

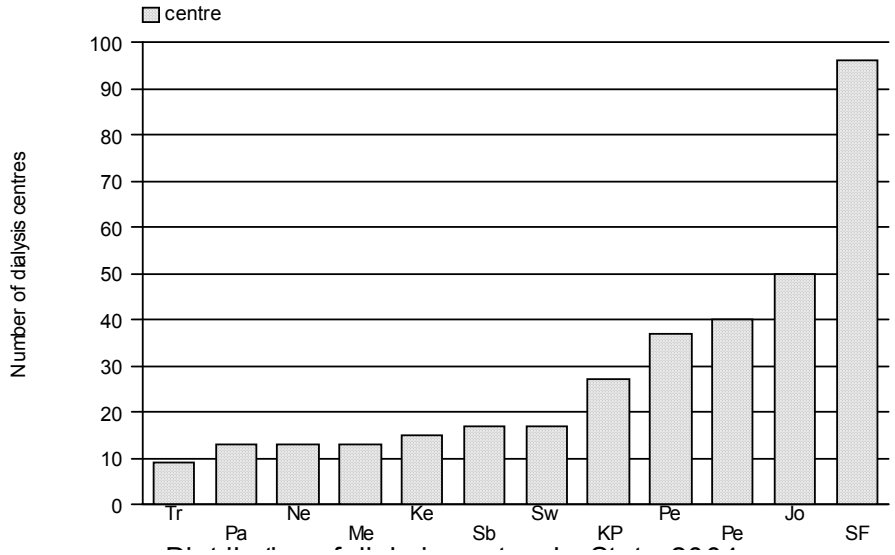


Figure 2.2.2(b): Distribution of dialysis patients by State, December 2004

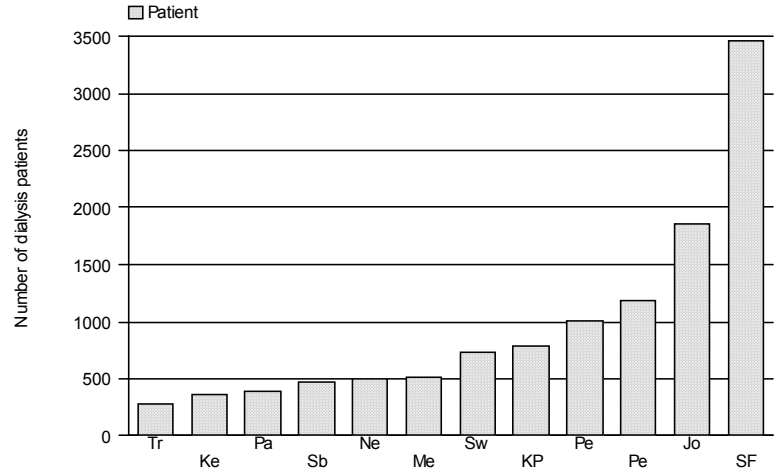


Figure 2.2.2(c): Distribution of dialysis treatment by State, December 2004

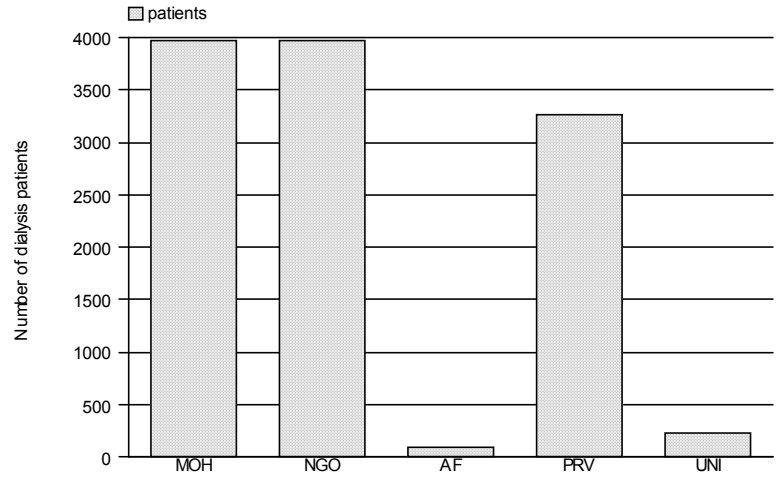
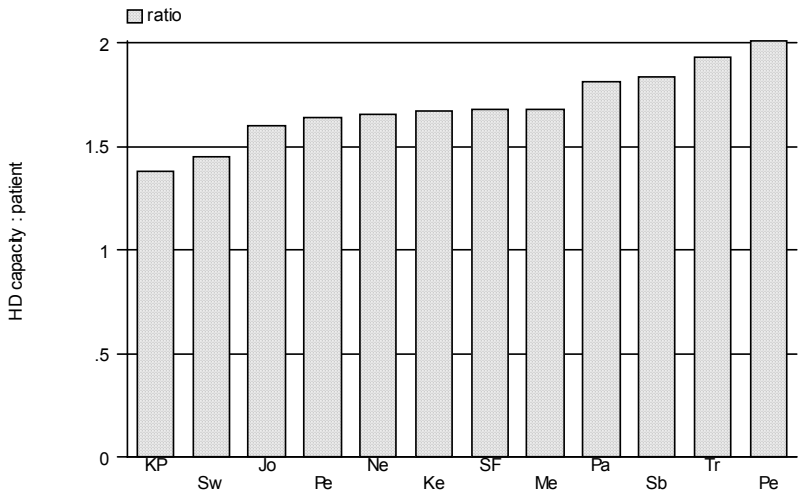


Figure 2.2.2(d): HD capacity to patient ratio by State, December 2004



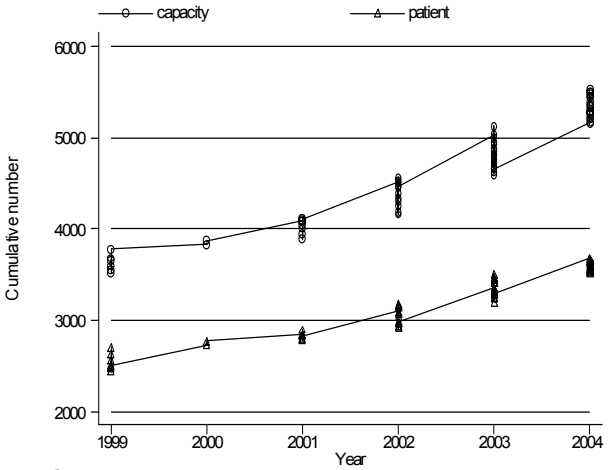
2.2.3 Growth in dialysis provision by sector (centre survey)

In the private sector, the number of patients paralleled the increase in HD capacity. HD capacity has increased rapidly in the MOH sector in line with official policy that every MOH hospital will have a HD centre by 2005. There was also a larger increase in HD capacity compared to patient numbers in the NGO sector.

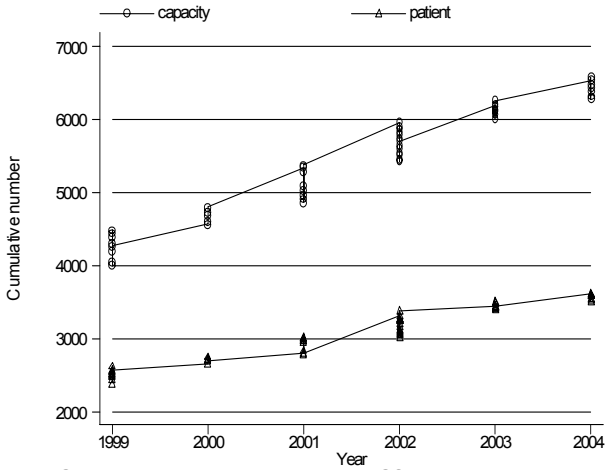
Table 2.2.3: Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1999-2004

Sector	Private		NGO		MOH	
	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients
1999	3780	2702	4485	2630	3070	2078
2000	3875	2772	4800	2756	3285	2221
2001	4125	2900	5370	3020	4020	2451
2002	4560	3184	5960	3385	4290	2656
2003	5130	3497	6260	3507	4470	2743
2004	5525	3681	6580	3628	4960	2927

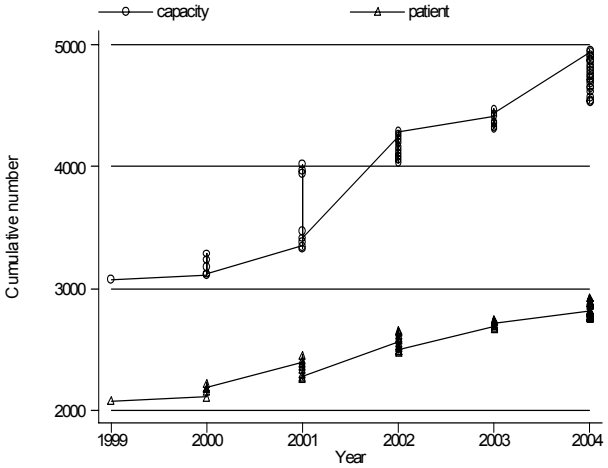
Figure 2.2.3: Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1999-2004



Growth in HD capacity and patient, private sector 1999-2004



Growth in HD capacity and patient, NGO sector 1999-2004



Growth in HD capacity and patient, MOH sector 1999-2004

2.3: DISTRIBUTION OF DIALYSIS TREATMENT

2.3.1 Gender distribution

The treatment gap between men and women has remained consistent over the years, suggesting this is a true reflection of the difference in ESRD incidence between the 2 sexes rather than any conscious or unconscious bias in treatment allocation.

Table 2.3.1 (a): Dialysis Treatment Rate by Gender, per million male or female population 1995– 2004

Gender	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Male	39	51	63	63	81	92	97	109	120	114
Female	32	45	49	57	61	73	88	93	93	98

Figure 2.3.1 (a): Dialysis Treatment by Gender 1995 – 2004

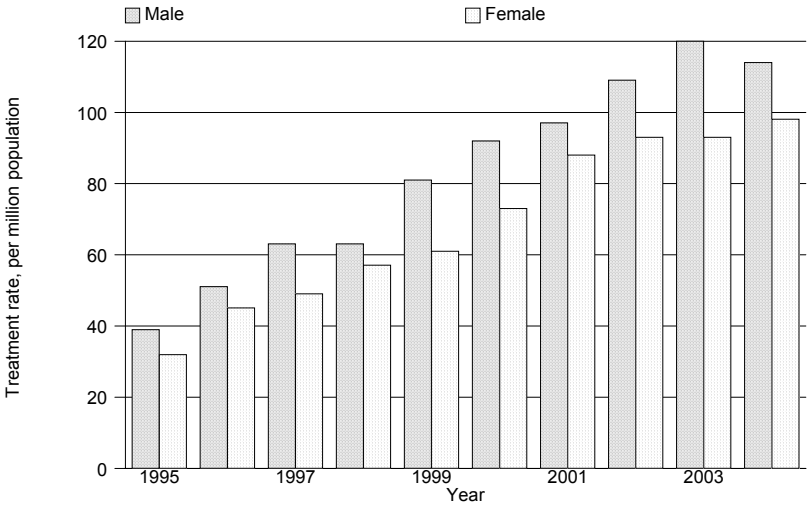
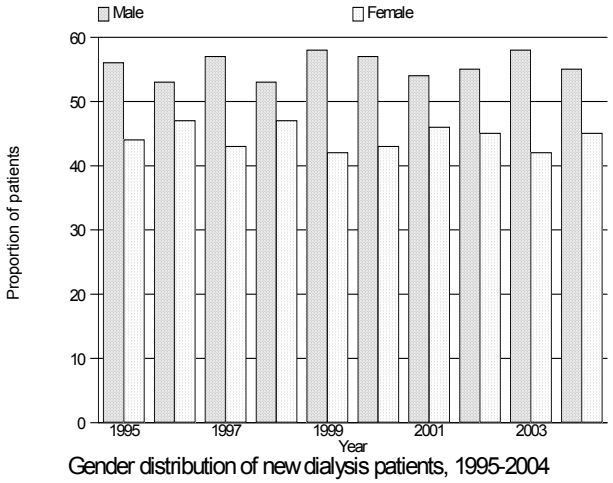


Table 2.3.2: Gender distribution of Dialysis Patients 1995-2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
% Male	56	53	57	53	58	57	54	55	58	55
% Female	44	47	43	47	42	43	46	45	42	45
Dialysing at 31st December	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554
% Male	59	57	57	56	56	56	55	55	55	55
% Female	41	43	43	44	44	44	45	45	45	45

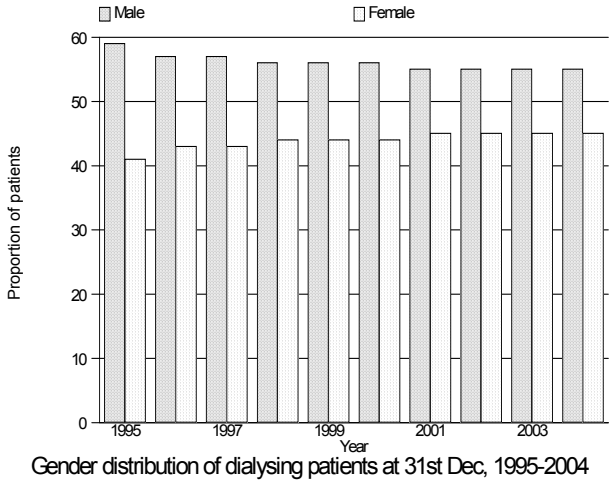
Figure 2.3.1 (b): Gender Distribution of Dialysis patients 1995 – 2004

(i) New Dialysis patients



Gender distribution of new dialysis patients, 1995-2004

(ii) Dialysing patients at 31st December



Gender distribution of dialysing patients at 31st Dec, 1995-2004

2.3.2 Age distribution

Dialysis treatment rates for those < 55 years of age have plateaued in the last few years, suggesting that almost all patients with ESRD in those age groups who were in need of dialysis were able to access treatment. However, the age groups 55-64 and >65 years continue to register increase in treatment rates, with the most rapid increase seen in those > 65 years. The treatment rate for patients 55 years and older has exceeded 550 per million since 2003. 51% of new dialysis patients were at least 55 years old

Table 2.3.2(a): Dialysis Treatment Rate by Age Group, per million age group population 1995 – 2004

Age groups (years)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1-14	1	3	3	3	3	4	4	5	4	4
15-24	10	13	15	15	16	18	22	28	25	25
25-34	31	39	39	41	42	46	47	53	50	47
35-44	59	67	80	81	86	98	102	100	99	104
45-54	120	153	166	173	224	247	249	268	273	270
55-64	158	230	289	310	369	430	508	530	576	522
>=65	110	169	214	228	300	348	434	493	567	573

Figure 2.3.2(a): Dialysis Treatment Rate by Age Group 1995 - 2004

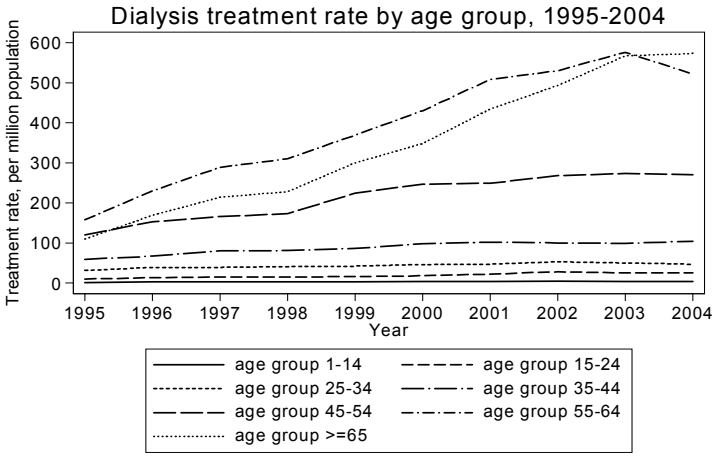
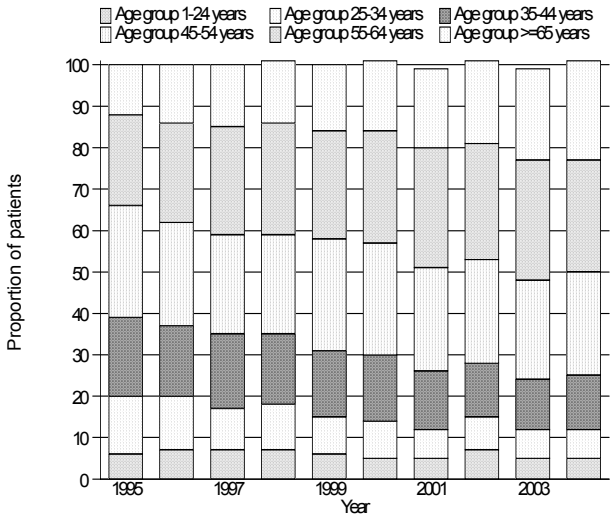


Table 2.3.2.(b): Percentage Age Distribution of Dialysis Patients 1995 – 2004

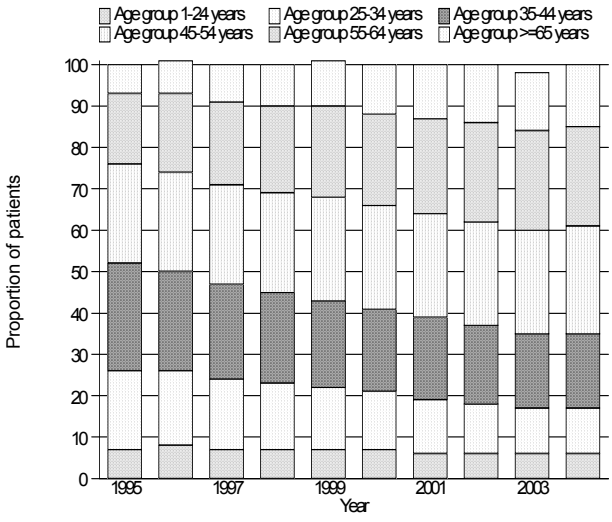
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
% 1-14 years	1	2	2	2	2	1	1	2	1	1
% 15-24 years	5	5	5	5	4	4	4	5	4	4
% 25-34 years	14	13	10	11	9	9	7	8	7	7
% 35-44 years	19	17	18	17	16	16	14	13	12	13
% 45-54 years	27	25	24	24	27	27	25	25	24	25
% 55-64 years	22	24	26	27	26	27	29	28	29	27
% >=65 years	12	14	15	15	16	17	19	20	22	24
Dialysing at 31st December	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554
% 1-14 years	1	2	2	2	2	2	1	1	1	1
% 15-24 years	6	6	5	5	5	5	5	5	5	5
% 25-34 years	19	18	17	16	15	14	13	12	11	11
% 35-44 years	26	24	23	22	21	20	20	19	18	18
% 45-54 years	24	24	24	24	25	25	25	25	25	26
% 55-64 years	17	19	20	21	22	22	23	24	24	24
% >=65 years	7	8	9	10	11	12	13	14	14	15

Figure 2.3.2(b): Age Distribution of New Dialysis patients 1995 – 2004

(i) New Dialysis patients



(ii) Dialysing patients at 31st December



2.3.3 Method and Location of dialysis

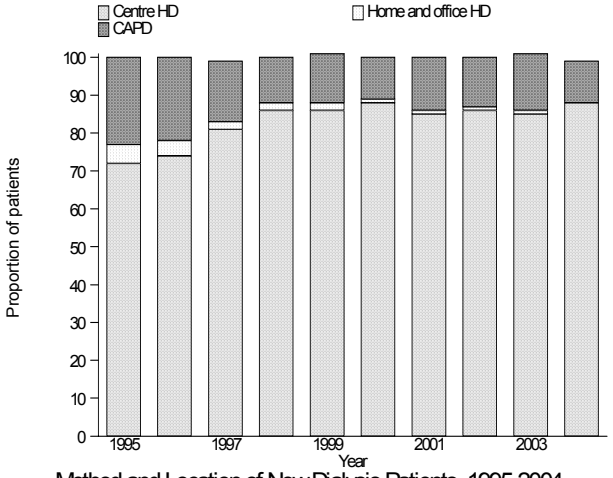
At least 85% of new patients were accepted into centre haemodialysis. The year 2004 finally saw the demise of home/office HD - a programme introduced at a time when dialysis treatment was not easily available. Chronic PD continued to account for about 10% of new and current dialysis patients. (Table & Figure 2.3.3)

Table 2.3.3: Method and Location of Dialysis 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
% Centre HD	72	74	81	86	86	88	85	86	85	88
% Home and office HD	5	4	2	2	2	1	1	1	1	0
% CAPD	23	22	16	12	13	11	14	13	15	11
Dialysing at 31st December	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554
% Centre HD	72	75	79	83	85	87	87	88	88	89
% Home and office HD	13	9	7	6	4	3	3	2	2	2
% CAPD	15	15	14	12	11	10	10	10	10	10

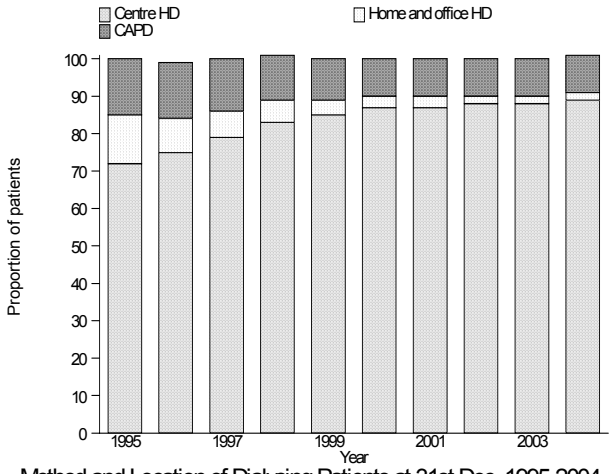
Figure 2.3.3: Method and Location of Dialysis Patients 1995 – 2004

(a) New Dialysis patients



Method and Location of New Dialysis Patients, 1995-2004

(b) Dialysing patients at 31st December



Method and Location of Dialysing Patients at 31st Dec, 1995-2004

2.3.4 Funding for Dialysis Treatment

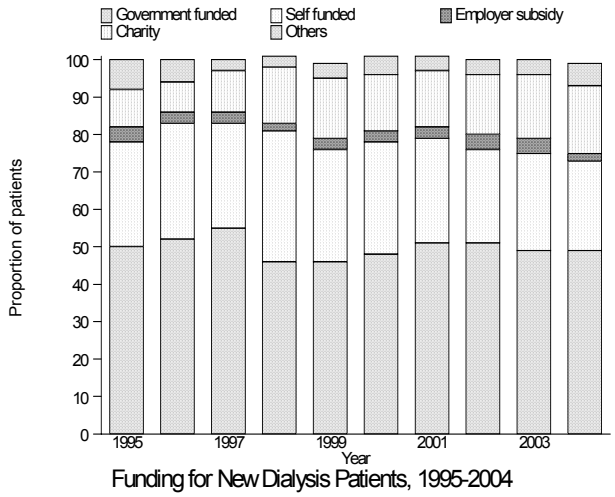
The government continued to provide almost fully subsidised dialysis treatment to about 50% of dialysis patients. The proportion of new patients who paid for their dialysis treatment shows a gradual decline over the years from about 30% in the late 1990's to about 24-26% in the last 3 years. There appear to be a corresponding increase in funding provided by NGO centres. (Table and Figure 2.3.6)

Table 2.3.4: Funding for Dialysis Treatment 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
% by Government	50	52	55	46	46	48	51	51	49	49
% self funded	28	31	28	35	30	30	28	25	26	24
% subsidized by Employer	4	3	3	2	3	3	3	4	4	2
% by Charity	10	8	11	15	16	15	15	16	17	18
% Others	8	6	3	3	4	5	4	4	4	6
Dialysing at 31st December	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554
% by Government	60	57	57	53	51	51	51	51	51	51
% self funded	24	26	26	28	28	27	27	25	24	24
% subsidized by Employer	5	5	4	4	4	4	4	4	4	4
% by Charity	8	8	10	12	13	14	15	16	17	17
% Others	3	4	3	3	4	4	4	4	4	5

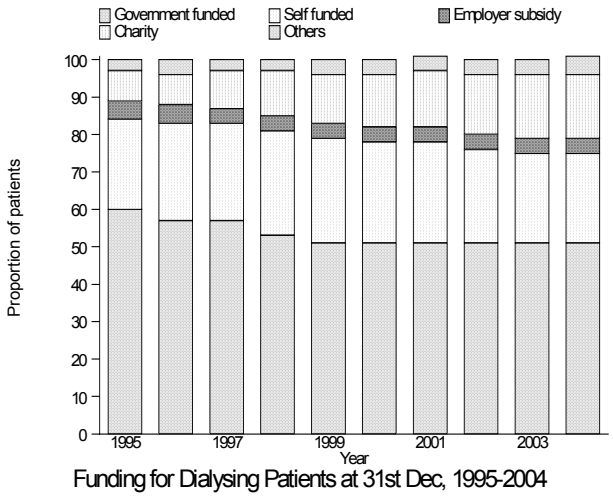
Figure 2.3.4: Funding for Dialysis Treatment 1995 – 2004

(a) New Dialysis Patients



Funding for New Dialysis Patients, 1995-2004

(b) Dialysing patients at 31st December



Funding for Dialysing Patients at 31st Dec, 1995-2004

2.3.5 Distribution of dialysis patients by sector

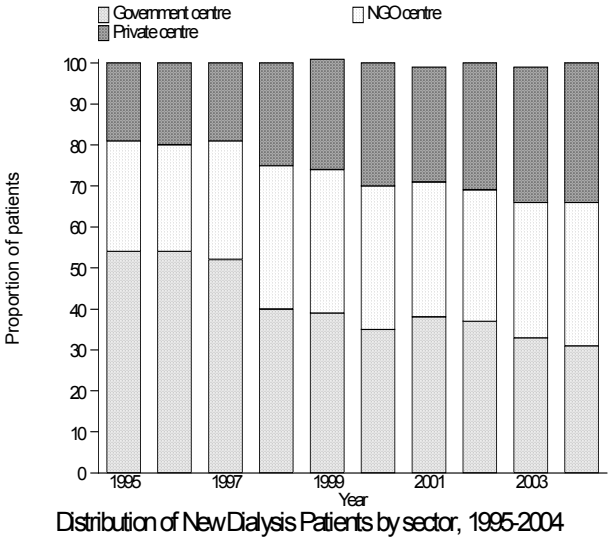
The proportion of new patients dialysed in private and NGO centres continued to increase while the proportion dialyzing in government centres has progressively declined. In 2003, intake of new dialysis patients was distributed equally between the 3 sectors. The year 2004 may perhaps be the first year that the proportion of new patients accepted for dialysis into government centres was lower than the other 2 sectors.

Table 2.3.5: Distribution of Dialysis Patients by Sector 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
% Government centre	54	54	52	40	39	35	38	37	33	31
% NGO centre	27	26	29	35	35	35	33	32	33	35
% Private centre	19	20	19	25	27	30	28	31	33	34
Dialysing at 31st December	2232	2919	3694	4534	5536	6690	7830	9079	10342	11554
% Government centre	65	60	56	51	46	43	42	41	39	37
% NGO centre	19	23	26	29	31	33	34	34	34	34
% Private centre	16	18	18	20	23	24	25	26	27	28

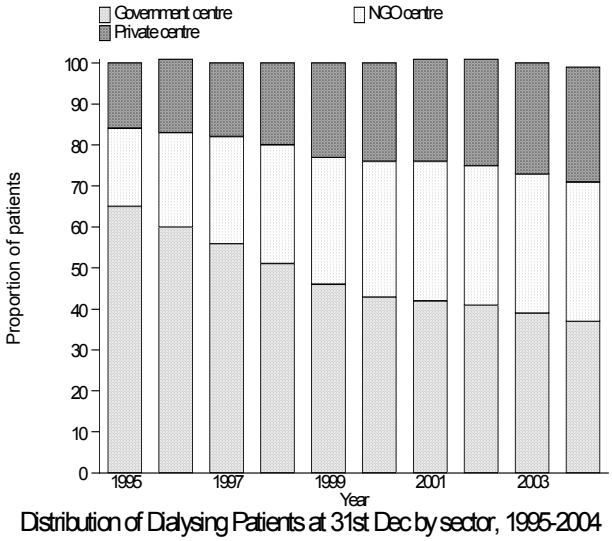
Figure 2.3.5: Distribution of Dialysis Patients by Sector 1995 – 2004

(a) New Dialysis Patients



Distribution of New Dialysis Patients by sector, 1995-2004

(b) Dialysing Patients at 31st December



Distribution of Dialysing Patients at 31st Dec by sector, 1995-2004

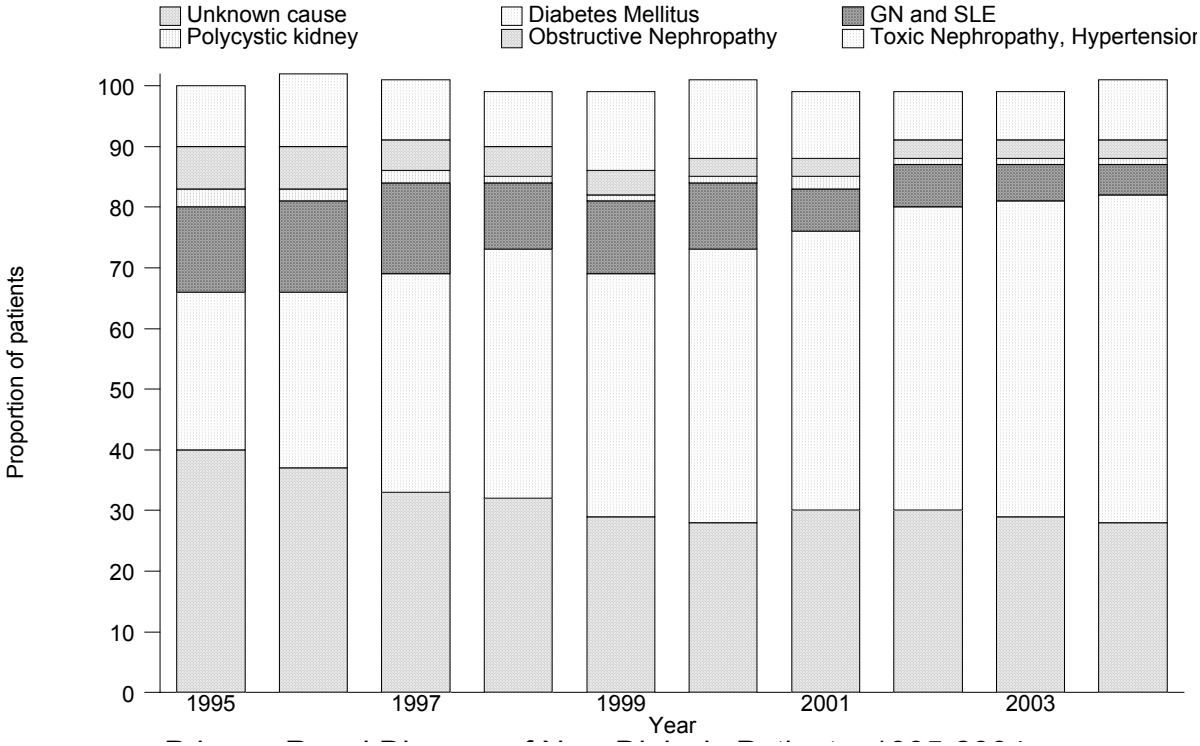
2.4: PRIMARY RENAL DISEASE

Diabetes mellitus continues to be the commonest cause of ESRD. Alarmingly the percentage continued to increase and accounted for 54% of all new ESRD patients in 2004. Hypertension as a cause of primary renal disease has been included in this report and was the second commonest cause of ESRD at about 7-12%. The proportion of patients with unknown primary renal disease was still very high at 28% in 2004. Only 4% ESRD was attributable to chronic glomerulonephritis excluding SLE nephritis.

Table 2.4.1: Primary Renal Disease 1995– 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New Dialysis patients	684	952	1133	1249	1542	1833	2071	2310	2540	2538
% Unknown cause	40	37	33	32	29	28	30	30	29	28
% Diabetes Mellitus	26	29	36	41	40	45	46	50	52	54
% GN	13	13	13	10	10	9	6	6	5	4
% SLE	1	2	2	1	2	2	1	1	1	1
% Polycystic kidney	3	2	2	1	1	1	2	1	1	1
% Obstructive Nephropathy	7	7	5	5	4	3	3	3	3	3
% Toxic Nephropathy	0	1	0	0	1	0	1	0	0	1
% Hypertension	8	9	9	8	11	12	9	7	7	8
% Others	2	2	1	1	1	1	1	1	1	1

Figure 2.4.1: Primary Renal Disease for New Dialysis Patients 1995– 2004



CHAPTER 3

DEATH AND SURVIVAL ON DIALYSIS

Wong Hin Seng
Ong Loke Meng
Wan Shaariah Md Yusuf

3.1: Death On Dialysis

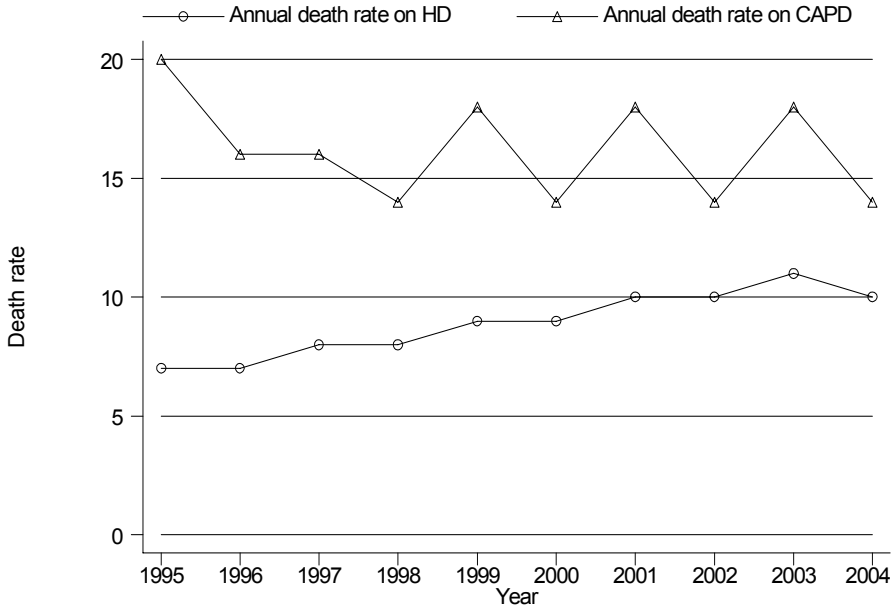
The number of death in dialysis patients for 2004 was 1115 (annual death rate of 10%). Nine hundred and sixty four died on haemodialysis (annual rate of 10%) while 151 died on continuous ambulatory peritoneal dialysis (annual death rate of 14%).

Table 3.1.1: Deaths on Dialysis 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
No. of dialysis patients at risk	1989	2576	3307	4114	5035	6113	7260	8455	9711	10948
Dialysis deaths	178	222	315	373	486	583	801	908	1128	1115
Dialysis death rate %	9	9	10	9	10	10	11	11	12	10
No. of HD patients at risk	1703	2193	2836	3594	4469	5487	6548	7614	8727	9870
HD deaths	120	160	241	299	386	493	671	793	950	964
HD death rate %	7	7	8	8	9	9	10	10	11	10
No. of CAPD patients at risk	286	383	471	520	567	626	712	841	984	1078
CAPD deaths	58	62	74	74	100	90	130	115	178	151
CAPD death rate %	20	16	16	14	18	14	18	14	18	14

Figure 3.1.1 shows the annual death rate on dialysis from 1995 till 2004. The annual death rate for those on CAPD in 2004 remained relatively unchanged over the last 10 years while there was an upward trend in the annual death rate for those on haemodialysis. The annual death rate for those on haemodialysis has increased by 43% over the last 10 years (from 7% in 1995 to 10% in 2004). This has narrowed the difference in the annual death rate between the two modalities of dialysis (from 13% in 1995 to 4% in 2004). The reasons for the marked change in the annual death rate for those treated with haemodialysis remained unclear. This may be partly contributed by changes in demographics of patients starting dialysis in recent years with a higher proportion of diabetics (26% in 1995 to 51% in 2003) and elderly patients (in 1995, 34% were aged more than 55 years compared with 50% in 2003).

Figure 3.1.1: Death Rates on Dialysis 1995 – 2004



The causes of death on dialysis are showed in Table 3.1.2. Cardiovascular disease remained the main cause of death in 2003; accounting for 26%. This has remained unchanged over the last 10 years. Death at home accounted for another 26% and a majority of these deaths were probably secondary to cardiovascular events. Death due to sepsis has gradually decreased over the last 10 years but still remained an important cause of death (13%).

Table 3.1.2: Causes of Death on Dialysis 1995 - 2004

Year	1995		1996		1997		1998		1999	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	45	25	50	23	85	27	110	29	129	27
Died at home	23	13	40	18	52	17	72	19	107	22
Sepsis	35	20	45	20	53	17	66	18	84	17
CAPD peritonitis	0	0	1	0	5	2	2	1	11	2
GIT bleed	2	1	3	1	4	1	7	2	18	4
Cancer	5	3	2	1	9	3	8	2	6	1
Liver disease	1	1	2	1	3	1	5	1	7	1
Others	29	16	30	14	31	10	52	14	73	15
Unknown	38	21	49	22	73	23	51	14	51	10
TOTAL	178	100	222	100	315	100	373	100	486	100

Year	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	177	30	209	26	304	33	320	28	290	26
Died at home	133	23	227	28	208	23	282	25	288	26
Sepsis	85	15	128	16	138	15	180	16	145	13
CAPD peritonitis	21	4	29	4	16	2	11	1	13	1
GIT bleed	18	3	18	2	23	3	28	2	23	2
Cancer	8	1	18	2	18	2	26	2	19	2
Liver disease	13	2	11	1	16	2	23	2	20	2
Others	84	14	102	13	121	13	182	16	279	25
Unknown	44	8	59	7	64	7	76	7	38	3
TOTAL	583	100	801	100	908	100	1128	100	1115	100

3.2: Patient Survival On Dialysis

3.2.1 Patient survival by type of dialysis modality

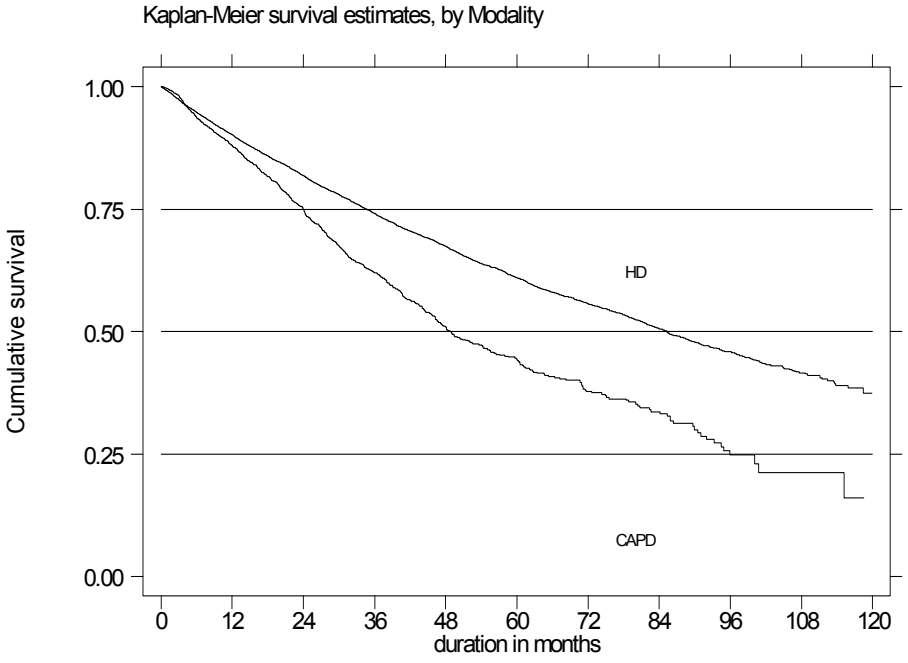
Patient survival by dialysis modalities is showed in Table 3.2.1 and Figure 3.2.1. The overall unadjusted 5 years and 10 years patient survival on dialysis were 59% and 35% respectively. Patient survival was superior in those on haemodialysis compared to those on CAPD and this survival difference widen as the duration on dialysis increases. At 5 years the patient survival on haemodialysis was 61% compared 44% in those on CAPD.

Table 3.2.1: Unadjusted patient survival by Dialysis modality, 1995-2004

Dialysis modality	CAPD			HD			All Dialysis		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	2227	94	0	13206	95	0	15433	95	0
12	1853	88	1	11250	90	0	13103	90	0
24	1144	75	1	8199	82	0	9340	81	0
36	673	62	1	5846	74	0	6519	72	0
48	380	51	1	4112	67	0	4492	65	0
60	236	44	2	2803	61	1	3039	59	1
72	140	38	2	1834	56	1	1973	54	1
84	79	34	2	1103	51	1	1181	49	1
96	30	25	3	577	46	1	605	44	1
108	11	21	3	241	42	1	251	39	1
120	-	-	-	20	37	2	20	35	2

* No. = Number at risk SE=standard error

Figure 3.2.1: Unadjusted patient survival by Dialysis modality, 1995-2004



3.2.2 Patient survival by year of starting dialysis

Table 3.2.2 shows the unadjusted patient survival by year of entry. The unadjusted 6 months survival of those starting dialysis in 2004 was 95%. Despite a progressive increase in the number of older people starting dialysis in recent years, the unadjusted patient survival remained constant over the last 10 years with a 1-year survival of 90%.

Table 3.2.2: Unadjusted patient survival by year of entry, 1995-2004

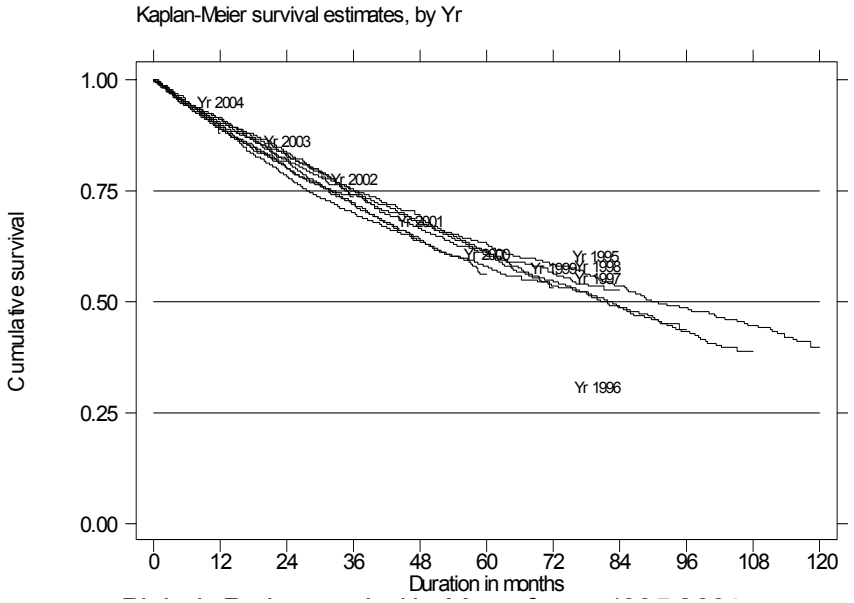
Year Interval (months)	1995			1996			1997			1998		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	685	94	1	934	95	1	1130	94	1	1240	95	1
12	643	91	1	869	91	1	1059	90	1	1173	91	1
24	548	83	1	768	84	1	950	82	1	1035	83	1
36	481	75	2	657	74	1	836	74	1	911	75	1
48	431	69	2	568	67	2	736	67	1	800	68	1
60	381	63	2	498	60	2	646	61	1	709	61	1
72	347	58	2	430	54	2	560	55	2	638	56	1
84	315	54	2	379	49	2	488	49	2	-	-	-
96	278	48	2	328	43	2	-	-	-	-	-	-
108	251	45	2	-	-	-	-	-	-	-	-	-
120	20	40	2	-	-	-	-	-	-	-	-	-

Year Interval (months)	1999			2000			2001			2002		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	1507	95	1	1801	95	1	2052	94	1	2320	95	0
12	1411	90	1	1661	90	1	1867	89	1	2147	90	1
24	1216	82	1	1412	80	1	1585	78	1	1824	80	1
36	1041	72	1	1222	72	1	1371	70	1	-	-	-
48	900	64	1	1061	64	1	-	-	-	-	-	-
60	805	58	1	-	-	-	-	-	-	-	-	-

Year Interval (months)	2003			2004		
	No.	% Survival	SE	No.	% Survival	SE
6	2463	94	0	1309	95	1
12	2273	89	1	-	-	-

* No. = Number at risk SE=standard error

Figure 3.2.2: Unadjusted patient survival by year of entry, 1995-2004



3.2.3 Patient survival by age at starting dialysis

The unadjusted survival for age groups ≤14 years, 15-24 years and 25-34 years at the start of dialysis were similar, with a 5-year survival of more than 80% as shown in Table 3.2.3. Beyond the age of 34 years old the unadjusted survival progressively worsened as the age on starting dialysis increases. The 9-year unadjusted survival for those who started dialysis at the age of less than 15 years was 76 % compared with 13% in those more than 64 years of age at the time of initiation of dialysis.

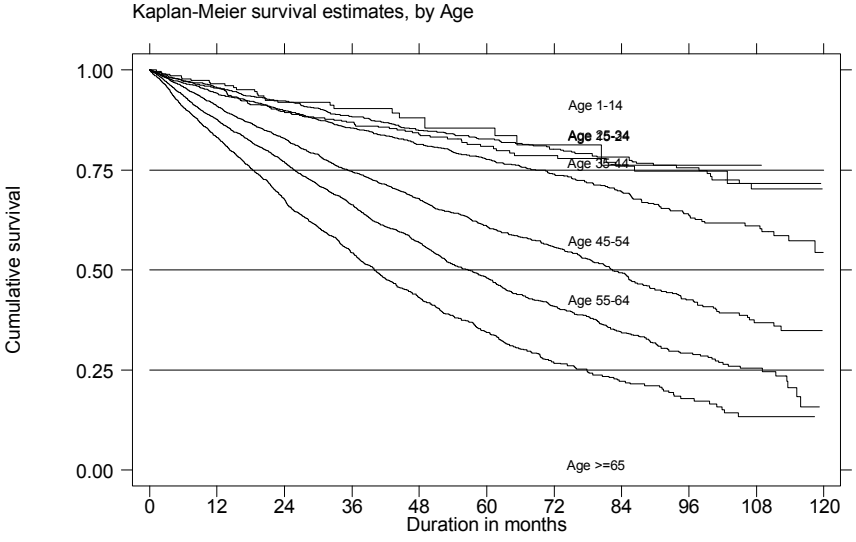
Table 3.2.3: Unadjusted patient survival by age, 1995-2004

Age group (years)	<=14			15-24			25-34			35-44		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	244	98	1	730	97	1	1432	97	0	2397	97	0
12	218	96	1	614	95	1	1274	95	1	2080	94	0
24	160	92	2	424	89	1	978	92	1	1616	90	1
36	105	90	2	307	87	1	748	88	1	1248	86	1
48	72	88	3	223	84	2	575	85	1	942	81	1
60	45	86	3	158	81	2	436	83	1	685	78	1
72	24	81	4	109	79	2	314	80	1	478	74	1
84	12	76	6	73	76	3	211	78	2	306	70	1
96	4	76	6	37	75	3	122	76	2	175	64	2
108	2	76	6	14	72	4	53	70	3	85	61	2
120	-	-	-	2	72	4	3	70	3	12	54	4

Age group (years)	45-54			55-64			>=65		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	3923	96	0	4063	94	0	2646	91	1
12	3351	91	0	3413	88	1	2156	83	1
24	2442	83	1	2377	77	1	1346	68	1
36	1724	75	1	1579	66	1	811	54	1
48	1207	68	1	1021	57	1	461	43	1
60	809	61	1	646	48	1	264	34	1
72	521	56	1	387	41	1	147	27	1
84	301	49	1	214	34	1	70	22	2
96	149	42	2	95	29	1	30	18	2
108	54	37	2	39	25	2	10	13	2
120	4	35	2	3	16	4	-	-	-

* No. = Number at risk SE=standard error

Figure 3.2.3: Unadjusted patient survival by age, 1995-2004



3.2.4 Patient survival by Diabetic status

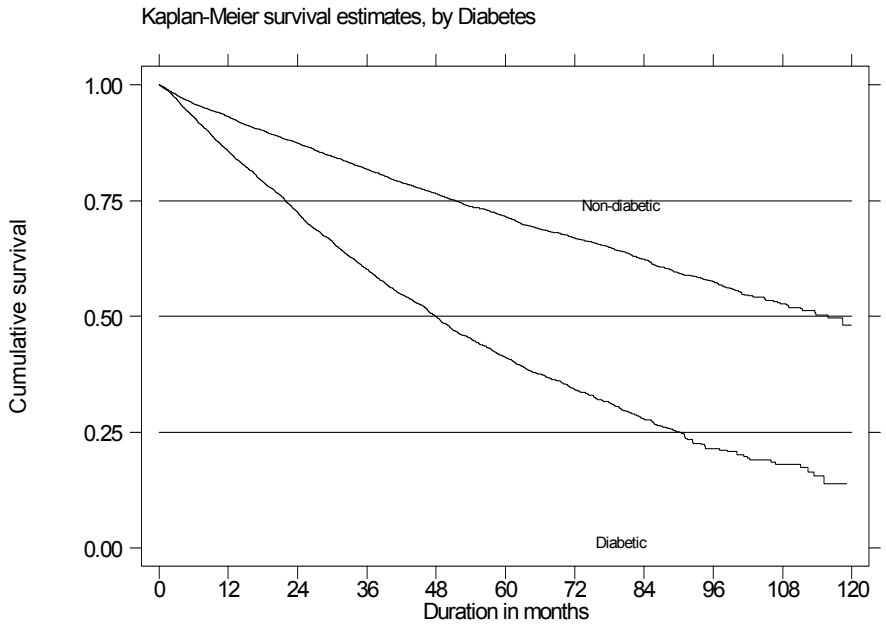
The unadjusted patient survival among diabetic and non diabetic patients are showed in Table 3.2.4 and Figure 3.2.4. The presence of diabetes mellitus has major impact on patient survival. The difference in the unadjusted patient survival appeared as early as 6 months after initiation of dialysis and increased with the time on dialysis. The 10 years unadjusted patient survival among diabetics and non diabetics were 48% and 14% respectively.

Table 3.2.4: Unadjusted patient survival by Diabetes status, 1995-2004

Diabetes status Interval (months)	Non-Diabetic			Diabetic		
	No.	% Survival	SE	No.	% Survival	SE
6	8715	96	0	6718	93	0
12	7629	93	0	5474	86	0
24	5789	87	0	3551	73	1
36	4325	82	0	2194	60	1
48	3150	76	1	1344	50	1
60	2250	71	1	789	41	1
72	1520	67	1	453	34	1
84	972	62	1	209	28	1
96	524	58	1	82	21	1
108	219	53	1	33	18	1
120	18	48	2	3	14	2

* No. = Number at risk SE=standard error

Figure 3.2.4: Unadjusted patient survival by Diabetes status, 1995-2004



CHAPTER 4

QUALITY OF LIFE AND REHABILITATION OUTCOMES OF DIALYSIS PATIENTS

Liu Wen Jiun
Alinda Chiu Sze Fung
Chew Thian Fook
Zaki Morad B Mohd Zaher

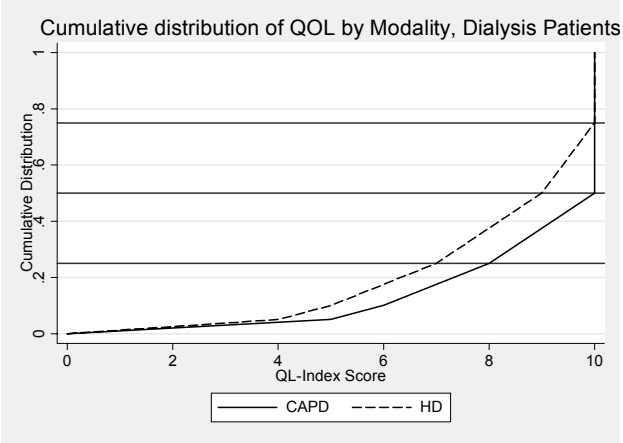
A: Quality of Life on Dialysis

11080 patients who entered dialysis between 1997-2004 were analysed. 9224 HD patients and 1856 CAPD patients reported median quality of life (QoL) index score of 9 and 10 respectively (Table 4.1 Figure 4.1)

Table 4.1: Cumulative distribution of QoL-Index score in relation to Dialysis modality, All Dialysis patients 1997-2004

Dialysis modality	CAPD	HD
Number of patients	1856	9224
Centile		
0	0	0
0.05	5	4
0.10	6	5
0.25 (LQ)	8	7
0.5 (median)	10	9
0.75 (UQ)	10	10
0.90	10	10
0.95	10	10
1	10	10

Figure 4.1: Cumulative distribution of QoL-Index score in relation to Dialysis modality, All Dialysis patients



Diabetics have a lower median QOL index score (8 versus 10) than nondiabetics (Table4.2 and Figure 4.2) whilst there was no difference seen between gender (Table 4.3 and Figure 4.3).

Table 4.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, All Dialysis patients 1997-2004

Diabetes mellitus	No	Yes
Number of patients	6280	4800
Centile		
0	0	0
0.05	6	4
0.10	7	5
0.25 (LQ)	9	6
0.5 (median)	10	8
0.75 (UQ)	10	10
0.90	10	10
0.95	10	10
1	10	10

Figure 4.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, All Dialysis patients 1997-2004

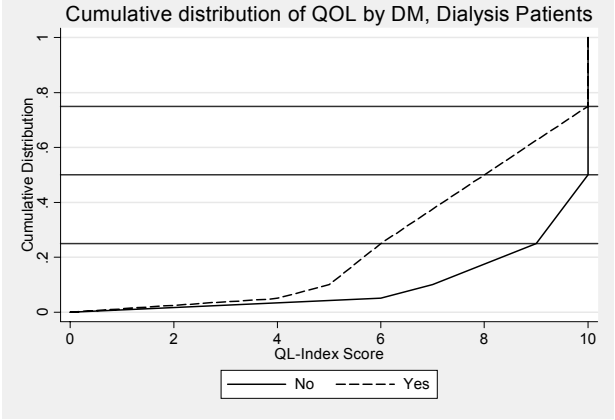
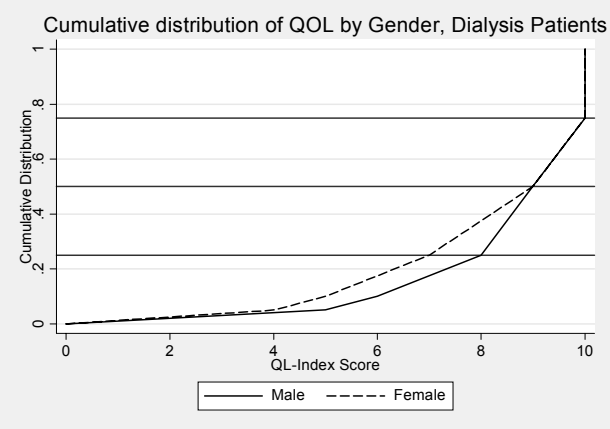


Table 4.3: Cumulative distribution of QoL-Index score in relation to Gender, All Dialysis patients 1997-2004

Gender	Male	Female
Number of patients	6143	4937
Centile		
0	0	0
0.05	5	4
0.10	6	5
0.25 (LQ)	8	7
0.5 (median)	9	9
0.75 (UQ)	10	10
0.90	10	10
0.95	10	10
1	10	10

Figure 4.3: Cumulative distribution of QoL-Index score in relation to Gender, All Dialysis patients 1997-2004

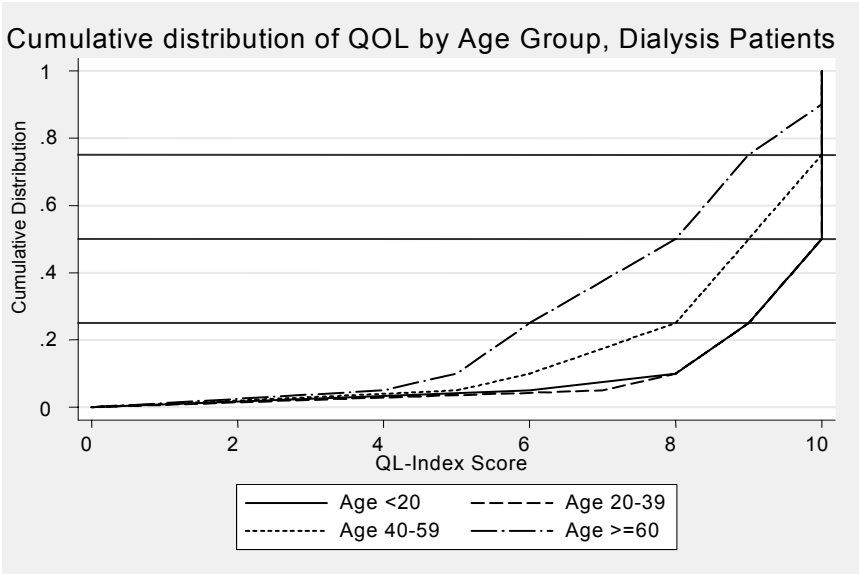


There was a trend of lower median QoL index score being associated with older dialysis patients (Table 4.4 and Figure 4.4).

Table 4.4: Cumulative distribution of QoL-Index score in relation to Age, All Dialysis patients 1997-2004

Age group (years)	<20	20-39	40-59	>=60
Number of patients	473	2079	5415	3113
Centile				
0	0	0	0	0
0.05	6	7	5	4
0.10	8	8	6	5
0.25 (LQ)	9	9	8	6
0.5 (median)	10	10	9	8
0.75 (UQ)	10	10	10	9
0.90	10	10	10	10
0.95	10	10	10	10
1	10	10	10	10

Figure 4.4: Cumulative distribution of QoL-Index score in relation to Age, All Dialysis patients 1997-2004



There were no obvious trends in QoL index seen either in the HD or CAPD cohort over the last 8 years. (Table 4.5, Table 4.6, Figure 4.5 and Figure 4.6)

Table 4.5: Cumulative distribution of QoL-Index score in relation to Year of entry, HD patients 1997-2004

Year of Entry	1997	1998	1999	2000	2001	2002	2003	2004
Number of patients	721	803	1001	1212	1349	1504	1426	1208
Centile								
0	0	0	0	0	0	0	0	0
0.05	5	5	5	5	5	4	5	4
0.10	6	6	6	6	5	5	5	5
0.25 (LQ)	8	8	7	7	7	7	7	7
0.5 (median)	9	9	9	9	9	9	9	9
0.75 (UQ)	10	10	10	10	10	10	10	10
0.90	10	10	10	10	10	10	10	10
0.95	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10

Figure 4.5: Cumulative distribution of QoL-Index score in relation to Year of entry, HD patients 1997-2004

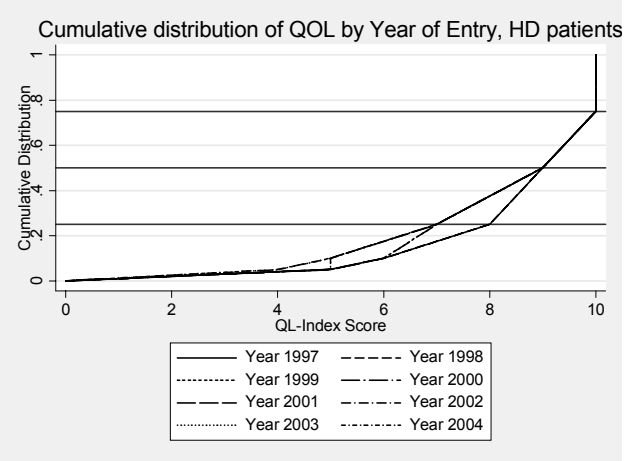


Figure 4.6: Cumulative distribution of QoL-Index score in relation to Year of entry, CAPD patients 1997-2004

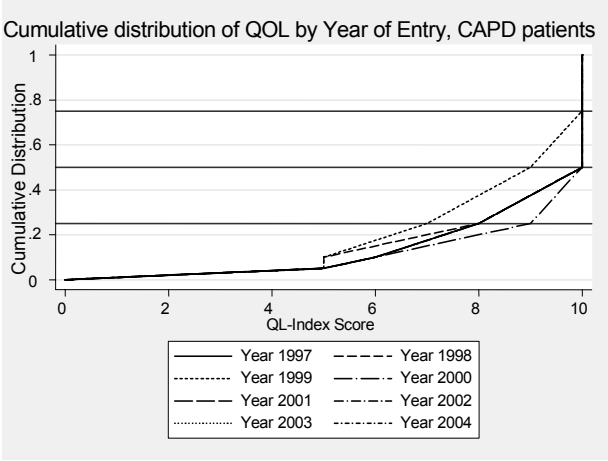


Table 4.6: Cumulative distribution of QoL-Index score in relation to Year of entry, CAPD patients 1997-2004

Year of Entry	1997	1998	1999	2000	2001	2002	2003	2004
Number of patients	164	117	166	187	269	319	365	269
Centile								
0	0	0	0	0	0	0	0	0
0.05	5	5	5	5	5	5	5	5
0.10	6	5	5	6	6	6	6	6
0.25 (LQ)	8	8	7	9	8	8	8	8
0.5 (median)	10	10	9	10	10	10	10	10
0.75 (UQ)	10	10	10	10	10	10	10	10
0.90	10	10	10	10	10	10	10	10
0.95	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10

B : Work Related Rehabilitation

Analysis was done on HD patients (n=3831) and CAPD patients (n=601) who entered dialysis between 1997 –2004 (Table 4.7). Only patients who were working for pay and those who were unable to work for pay due to health reasons were included. The proportion of patients on employment were comparable between the two modalities (HD 72% vs CAPD 74%)

Table 4.7: Work related rehabilitation in relation to Modality, Dialysis patients 1997-2004

Modality	CAPD		HD	
	N	%	N	%
Number of patients	601		3831	
Able to return for Full or Part time for pay	443	74	2751	72
Unable to work for pay*	158	26	1080	28

Amongst HD patients, the proportion on employment decreased with shorter HD duration; a reflection of increasing proportion of patients with poor health. (Table 4.8). There was no obvious trend in work related rehabilitation seen amongst the CAPD cohort (Table 4.9)

Table 4.8: Work related rehabilitation in relation to Year of Entry, HD patients 1997-2004

Year	1997		1998		1999		2000		2001		2002		2003		2004	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Number of patients	362		402		493		530		524		568		521		431	
Able to return for Full or Part time for pay	298	82	317	79	376	76	406	77	359	69	404	71	357	69	234	54
Unable to work for pay*	64	18	85	21	117	24	124	23	165	31	164	29	164	31	197	46

* Exclude patients unable to find employment for non-health related reasons

Table 4.9: Work related rehabilitation in relation to Year of Entry, CAPD patients 1997-2004

Year	1997		1998		1999		2000		2001		2002		2003		2004	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Number of patients	70		38		47		61		79		111		126		69	
Able to return for Full or Part time for pay	51	73	31	82	35	74	40	66	65	82	84	76	90	71	47	68
Unable to work for pay*	19	27	7	18	12	26	21	34	14	18	27	24	36	29	22	32

* Exclude patients unable to find employment for non-health related reasons

CHAPTER 5

PAEDIATRIC RENAL REPLACEMENT THERAPY

Lee Ming Lee
Susan Pee
Lynster Liaw
Wan Jazilah Wan Ismail
Lim Yam Ngo

A: RRT Provision for Paediatric Patients (younger than 20 years of age)

The paediatric RRT population in this report is defined as patients less than 20 years of age.

The number of new patients commencing on dialysis had increased from 12 in 1990 to 74 in 2004 giving a dialysis acceptance rate of 1per million age related population to 7 per million age related population (pmarp) respectively. The number of new transplant patients has not shown much increase over the years at about 6-8 in the early 1990s to about 10 in the last few years with an equivalent transplant rate at only 1 pmarp over the last 15 years.

Not surprisingly the number of prevalent dialysis patients continued to rise steeply and by the end of 2004 there were a total of 390 children under 20 on dialysis. The equivalent dialysis prevalence rate increased from 4 pmarp in 1990 to 36 in 2004. The number of patients with functioning transplants increased only slightly from 38 in 1990 to 111 in 2004 (prevalence rate of 4 and 10 pmarp respectively). ((tables & figures 5.01 & 5.02)

Table 5.01: Stock and Flow of Paediatric Renal Replacement Therapy 1990-2004

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New HD patients	10	6	8	10	5	7	21	21	22	23	12	24	28	33	34
New CAPD patients	2	2	6	7	13	12	23	20	28	29	37	38	53	39	40
New Transplants	8	6	6	9	11	8	5	14	6	11	14	9	11	11	9
HD deaths	0	2	1	2	0	2	0	3	3	2	4	1	10	5	9
CAPD deaths	0	2	0	0	0	2	2	3	7	2	3	8	8	9	4
Transplant deaths	1	0	0	0	1	0	2	0	0	0	1	0	1	1	0
On HD at 31st Dec	26	27	30	33	34	38	56	70	91	107	121	145	164	189	216
On CAPD at 31st Dec	5	5	8	14	26	32	51	62	73	91	109	122	150	161	174
Functioning transplant at 31st Dec	38	40	45	53	62	67	63	72	75	84	91	96	103	108	111

Figure 5.01a: Incident cases of RRT by modality in children under 20 years old, 1990-2004

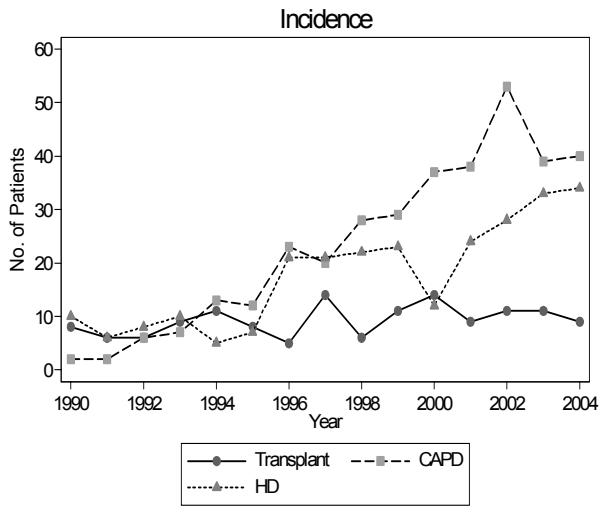


Figure 5.01b: Prevalent cases of RRT by modality in children under 20 years old, 1990-2004

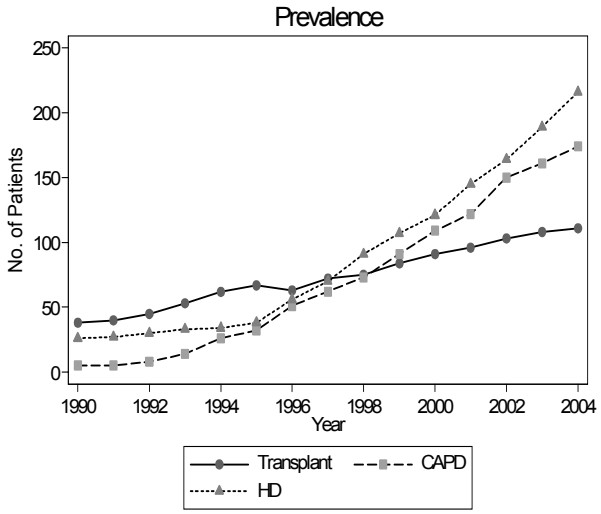
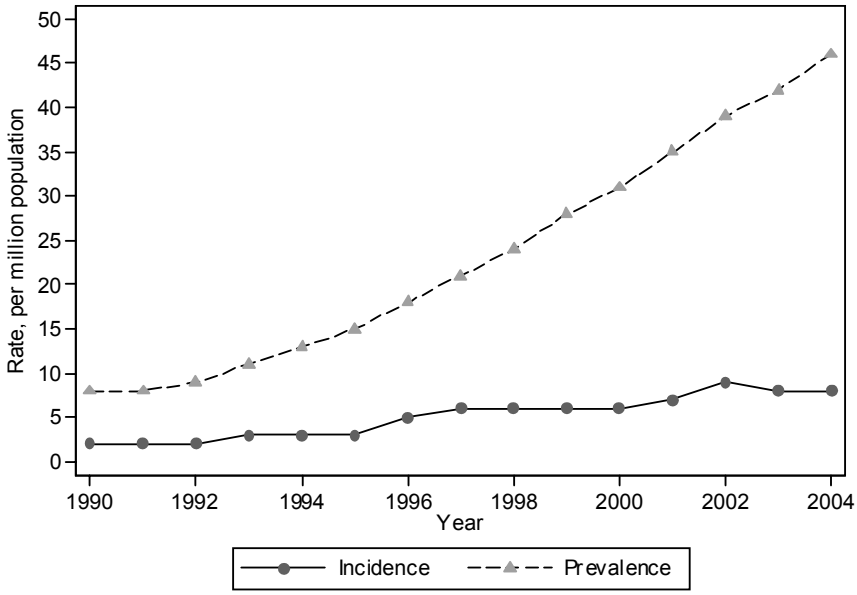


Table 5.02: Paediatric Dialysis and Transplant Treatment Rates per million age-group population 1990-2004

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Incidence rate															
New HD	1	1	1	1	1	1	2	2	2	2	1	2	3	3	3
New CAPD	0	0	1	1	1	1	2	2	3	3	4	4	5	4	4
New Transplant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
All RRT	2	2	3	3	3	3	5	5	6	6	6	7	8	8	8
Prevalence rate															
On HD	3	3	3	4	4	4	6	7	9	11	12	14	15	18	20
On CAPD	1	1	1	2	3	3	5	6	7	9	11	12	14	15	16
Functioning Graft	4	5	5	6	7	7	7	7	8	8	9	9	10	10	10
All RRT	8	9	9	12	14	14	18	20	24	28	32	33	39	43	46

Figure 5.02: Incidence and prevalence rate per million age related population years old on RRT, 1990-2004



B: Distribution of Paediatric Dialysis

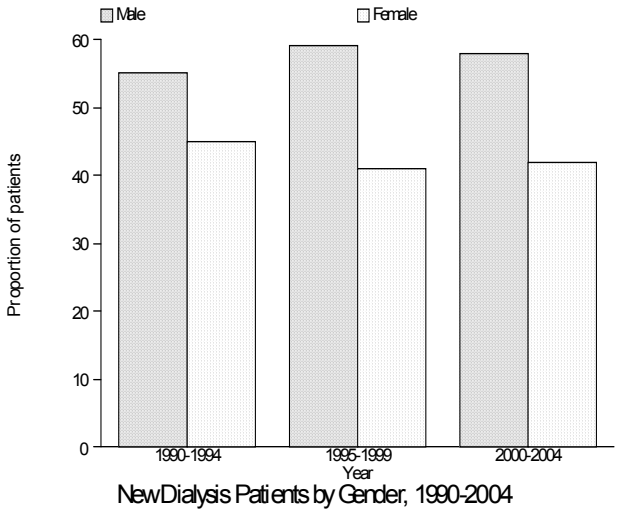
Table 5.03 shows that except for Perak, the treatment rate was still noticeably higher for states in the west coast of West Malaysia; probably a reflection of its more economically developed status.

Table 5.03: Dialysis Treatment Rate by State, per million state age group population, 1990-2004

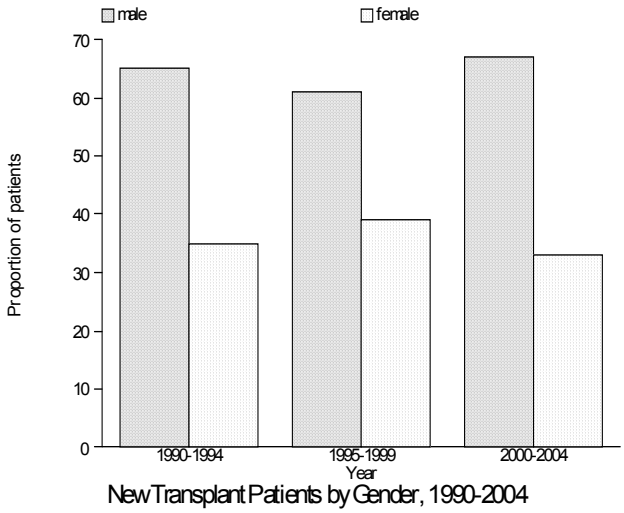
State	1990-1994	1995-1999	2000-2004
Negeri Melaka	2	5	11
Johor Darul Takzim	0	5	11
Negeri Sembilan	2	9	10
Kedah & Perlis	2	5	10
Pulau Pinang	4	4	10
Terengganu Darul Iman	0	3	9
Selangor & W. Persekutuan	3	8	8
Kelantan Darul Naim	0	1	7
Pahang Darul Makmur	1	5	6
Perak Darul Redzuan	1	3	6
Sarawak	2	5	5
Sabah	1	1	4

Figure 5.04 shows persistent trend of male predominance amongst the new dialysis and transplant patients consistent with higher incidence of ESRD among males. However this trend appears more marked among the transplant recipients which may indirectly reflect gender bias (spoken or unspoken) for preferential treatment in an Asian society such as ours.

Figure 5.04: Number of New Dialysis and Transplant Patients by gender 1990-2004



New Dialysis Patients by Gender, 1990-2004



New Transplant Patients by Gender, 1990-2004

Figure 5.05 shows that after the initial rise in the early 1990s; the 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 treatment rate for the age group 15-19 years had continued to increase until the last 2 years when it has also begun to level off. The overall incidence of paediatric RRT in Malaysia remained at 8 pmarp

Figure 5.05: Dialysis and Transplant Treatment Rate by Age group 1990-2004

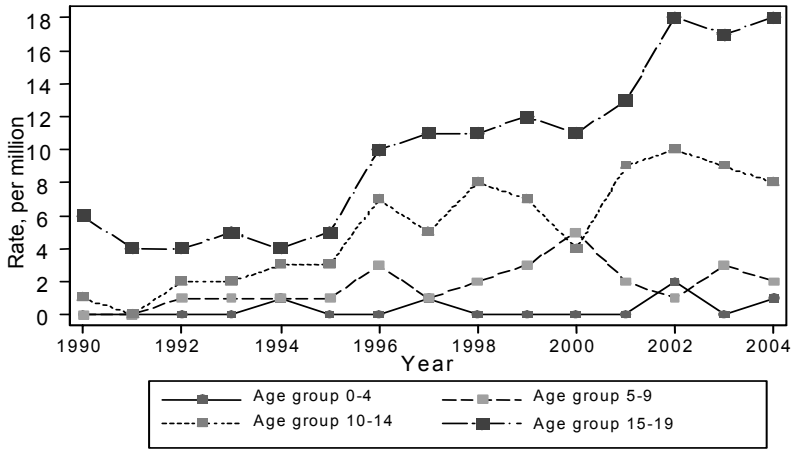


Figure 5.06 shows that CAPD was the preferred mode of dialysis as the initial treatment modality; the converse of that seen in the early 1990s when the CAPD experience was still new to nephrologist taking care of children.

Figure 5.06: New Dialysis by treatment modality 1990-2004

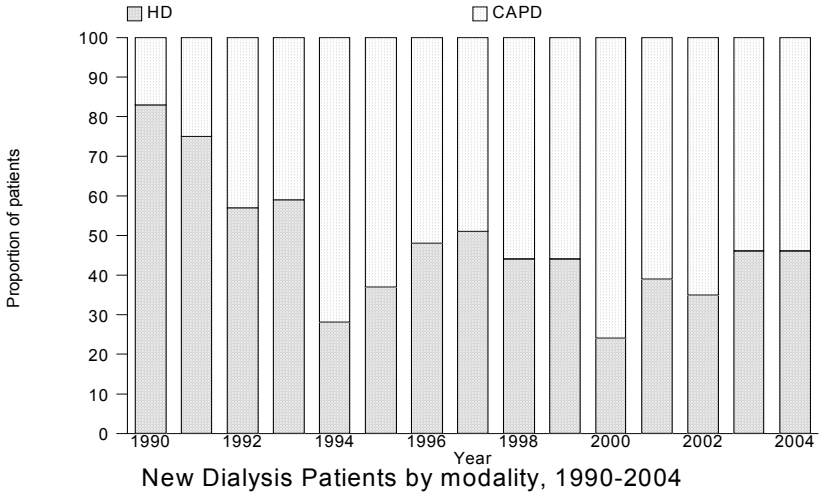
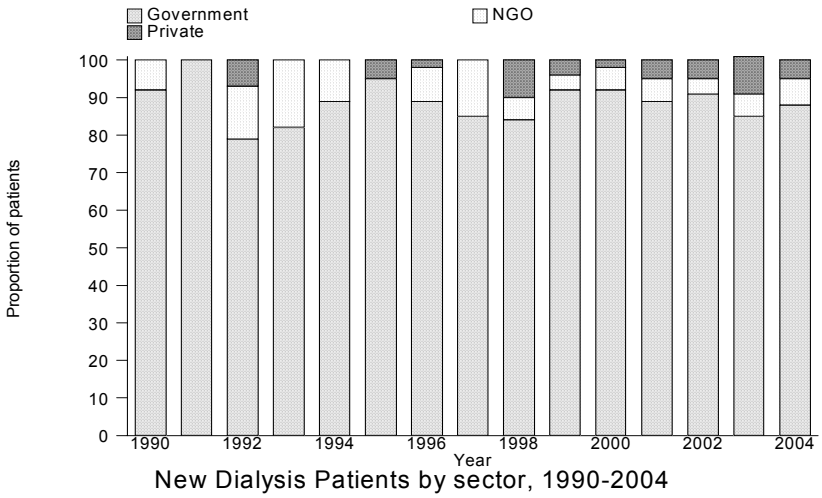


Figure 5.07 shows that almost 90% of children less than 20 years of age receive their dialysis treatment from government centres and hence government funded, unlike in adults where only one third of dialysis patients were treated in government centres.

Figure 5.07: New Dialysis by sector 1990-2004



C: Primary Renal Disease

Glomerulonephritis was the commonest cause of ESRD accounting for 29%. Focal segmental glomerulosclerosis (FSGS) on its own accounted for 11% of all ESRD. It is interesting but alarming to note that SLE was the 3rd commonest known cause of ESRD (9%) considering the age of the patient at start of RRT. Up to 30% of these children still presented with ESRD of unknown aetiology ie they present for the first time in end-stage renal failure. Hopefully this figure should decrease in future with improved access to specialized health care. (table 5.08)

Table 5.08: Primary Renal Disease 1990-2004

Primary Renal Disease	Male		Female		All	
	N	%	N	%	N	%
Glomerulonephritis	140	29	98	29	238	29
FSGS	66	14	26	8	92	11
Systemic Lupus Erythematosus	17	4	45	14	62	9
Refux nephropathy	45	9	18	5	63	8
Obstructive uropathy	35	7	6	2	41	5
Renal dysplasia	13	3	11	3	24	3
Hereditary nephritis	15	3	7	3	22	3
(Alports)	(10)	(2)	(3)	(1)	(13)	(2)
Cystic kidney disease	4	1	3	1	7	1
Others	5	1	6	2	11	1
Unknown	139	29	103	31	242	30
Total	479		323		802	100

D: Types of Renal Transplant

Table 5.09 shows that living related renal transplantation was still the commonest type of transplantation done but the incidence of cadaveric transplantation has increased noticeably in the last 5 years. An increasing number of children (20% after 2000) had their renal transplantation done overseas – the commercial cadaver and living donor programs

Table 5.09: Types of Renal Transplant 1990-2004

Year	1990-1994		1995-1999		2000-2004	
	No.	%	No.	%	No.	%
Commercial cadaver	1	3	9	20	11	20
Commercial living donor	9	23	2	5	5	9
Living related donor	30	75	31	70	21	39
Cadaver	0	0	2	5	17	31
Living emotionally related	0	0	0	0	0	0
TOTAL	40	100	44	100	54	100

E: Survival Analysis

Table and Figure 5.10 show the obvious superiority of transplantation over CAPD and HD in terms of patient survival. Patient survival for renal transplantation was 97% for 1 year, 95% at 5 years and 95% at 10 years post transplant. Patient survival on HD was 95% for 1 year, 85% for 5 years and 82% for 10 years. CAPD patients showed the worst survival; 95% at 1 year, 81% at 5 years. There were too few CAPD patients at 10 years for meaningful analysis.

Figure 5.10 shows that patient survival for CAPD and HD were quite comparable up till 3 to 5 years into dialysis.

Table 5.10: Patient Survival by Modality of RRT, 1990-2004

Modality	Transplant			CAPD			HD		
Interval (years)	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
1	116	97	1	284	95	1	236	95	1
5	69	95	2	55	81	3	85	85	2
10	28	95	2	2	30	22	16	82	3
12	12	95	2	2	30	22	8	82	3
14	4	95	2	-	-	-	2	34	25

* No. = Number at risk SE = Standard Error

Figure 5.10: Patient Survival by Modality of RRT, 1990-2004

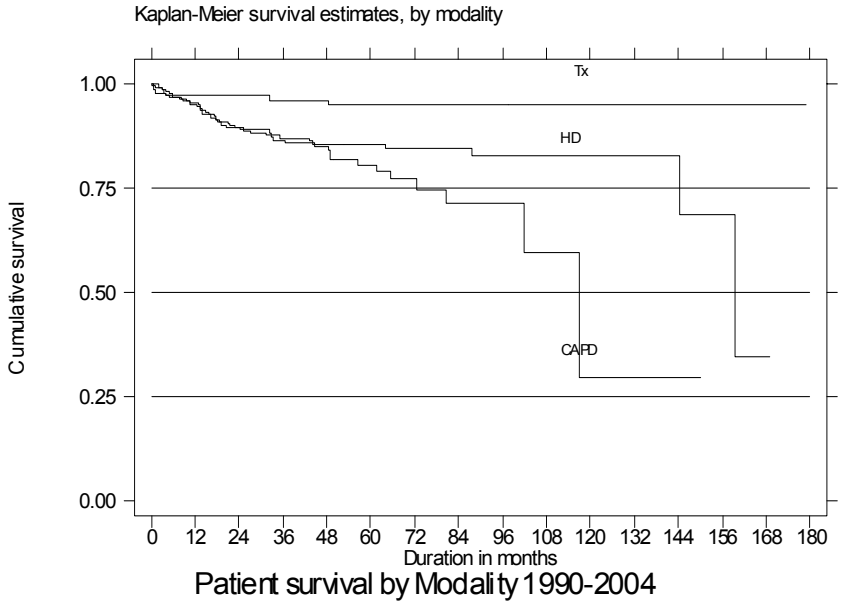


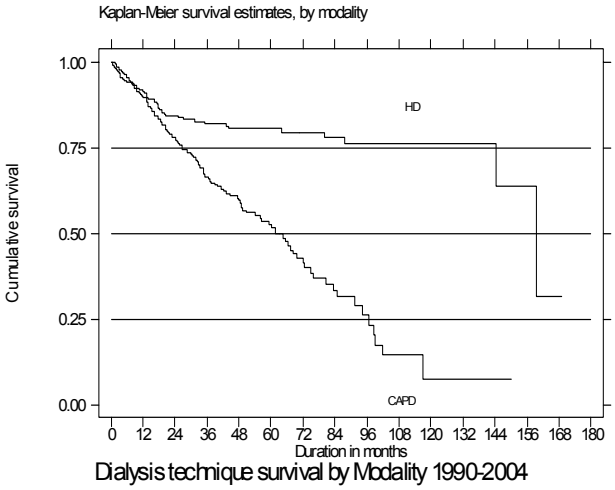
Table and Figure 5.11 below show comparable technique survival for both HD and CAPD in the first 2 years of dialysis. After that CAPD showed a progressive deterioration in technique survival compared to HD.

Table 5.11: Dialysis Technique Survival by Modality, 1990-2004

Modality	CAPD			HD		
Interval (years)	No.	% survival	SE	No.	% survival	SE
1	284	90	2	236	92	2
5	55	53	4	85	81	3
10	2	7	6	16	76	3
12	2	7	6	8	76	3
14	-	-	-	2	32	23

* No. = Number at risk SE = Standard Error

Figure 5.11: Dialysis Technique Survival by Modality, 1990-2004



Dialysis technique survival by Modality 1990-2004

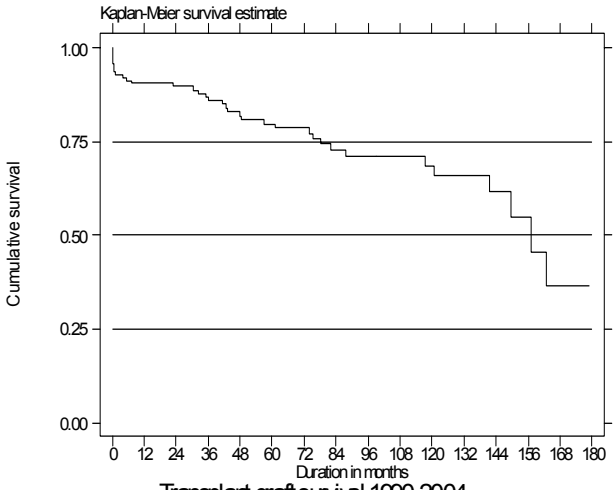
Table and Figure 5.12 show that the graft survival was 91% at 1 year, 80% at 5 years, and 69% at 10 years.

Table 5.12: Transplant Graft Survival 1990-2004

Interval (years)	No.	% survival	SE
1	116	91	3
5	69	80	4
10	28	69	5
12	12	62	7
14	4	37	12

* No. = Number at risk SE = Standard Error

Figure 5.12: Transplant Graft Survival 1990-2004



Transplant graft survival 1990-2004

CHAPTER 6

MANAGEMENT OF ANAEMIA IN DIAYSIS PATIENTS

Philip Jeremiah
Bee Boon Cheak

6.1: Treatment of Anemia in Dialysis patients

From 1997 to 2004 there was an increasing percentage of patients on erythropoietin (EPO) - as expected more haemodialysis patients were on EPO; 73% compared to 62%. Throughout this period, however, the blood transfusion rate has remained at 10 -15%

Surprisingly, there were a decreasing number of patients on oral iron supplements. The use of IV Iron has increased however, but this is still far from optimum (at best 10 %). Table 6.1.1 – 6.1.2

Table 6.1.1: Treatment for Anemia, HD patients 1997-2004

Year	No. of subjects	% on Erythropoietin	% received blood transfusion	% on oral Iron	% received parenteral Iron
1997	1695	46	8	92	4
1998	2141	46	13	92	4
1999	2996	51	15	90	5
2000	4392	56	15	88	5
2001	5194	62	13	88	5
2002	6108	67	10	85	7
2003	7043	71	12	83	8
2004	8123	73	11	79	10

Table 6.1.2: Treatment for Anemia, CAPD patients 1997-2004

Year	No. of subjects	% on Erythropoietin	% received blood transfusion	% on oral Iron	% received parenteral Iron
1997	476	37	12	96	3
1998	541	44	16	96	3
1999	610	44	14	94	0
2000	662	46	11	92	4
2001	781	45	11	91	2
2002	891	49	11	93	2
2003	1237	53	14	87	4
2004	1331	62	15	83	6

Comparing the years 2004 and 1997, 50% of centers (median) have 76% of their patients on EPO compared to 46% in 1997. At the 95th centile, 5% of centers have 96% of their patient on EPO compared to 71% in1997. At the 5th centile, 5% of centers have 40 % of patients on EPO compared to 20% in1997. A similar trend was seen in the CAPD centres. (Table / Figures 6.1.3 – 6.1.4)
What is surprising is that approximately 5% of the HD centers have all their patients on EPO. Centers with extremes in utilization of EPO, perhaps should have their EPO use reviewed.

Table 6.1.3: Variation in Erythropoietin utilization (% patients) among HD centers, 2004

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	7	20	36	46	63	71	92
1998	46	0	10	36	50.5	60	79	87
1999	69	9	18	43	54	66	82	93
2000	100	0	22.5	46.5	59.5	70	87.5	100
2001	118	8	32	50	61	75	92	100
2002	137	15	30	56	69	78	91	95
2003	160	16	37	58.5	75	84	96.5	100
2004	187	6	40	63	76	86	96	100

Figure 6.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2004

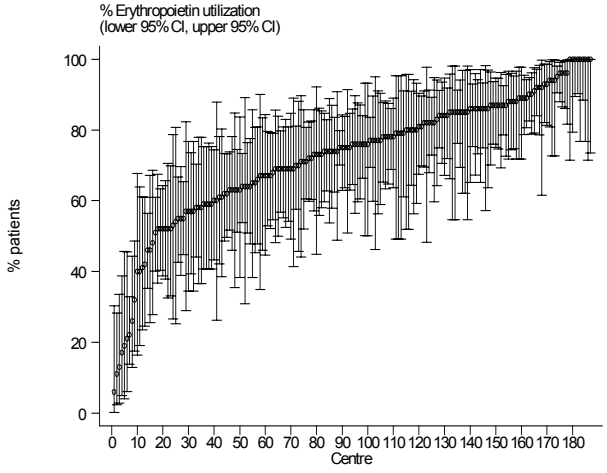


Figure 6.1.4: Variation in Erythropoietin utilization (% patients) among CAPD centres, 2004

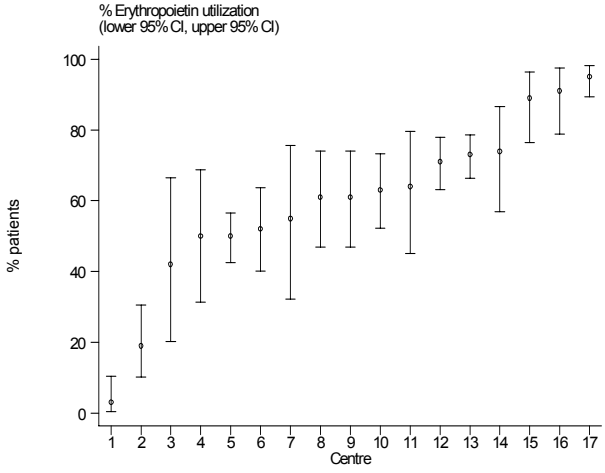


Table 6.1.4: Variation in Erythropoietin utilization (% patients) among CAPD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	19	19	21	41	49	53	53
1998	9	0	0	14	38	49	71	71
1999	9	17	17	33	40	43	79	79
2000	11	19	19	35	45	50	75	75
2001	12	28	28	31	44	53.5	86	86
2002	14	27	27	38	49	55	70	70
2003	17	22	22	35	50	58	92	92
2004	17	3	3	50	61	73	95	95

From 1997 to 2004, the median weekly EPO dose has remained at 4000 units in both HD and CAPD centres. In both HD and CAPD, at the 5th centile, 5% of centers have their weekly EPO dose at 2000 units. In HD patients, at the 95th centile, 5% of centers have their weekly EPO dose at 7000 units compared to 4000 units for CAPD patients. (Table / Figure 6.1.5 – 6.1.6)

Table 6.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	31	2000	2000	4000	4000	4000	6000	8000
1998	33	2000	2000	4000	4000	4000	4000	4000
1999	53	2000	2000	2000	4000	4000	4000	4000
2000	83	2000	2000	2000	4000	4000	4000	6000
2001	97	2000	2000	3000	4000	4000	6000	8000
2002	114	2000	2000	4000	4000	4000	5000	6000
2003	135	2000	2000	4000	4000	4000	6000	8000
2004	169	2000	2000	4000	4000	4000	7000	8000

Figure 6.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres 2004

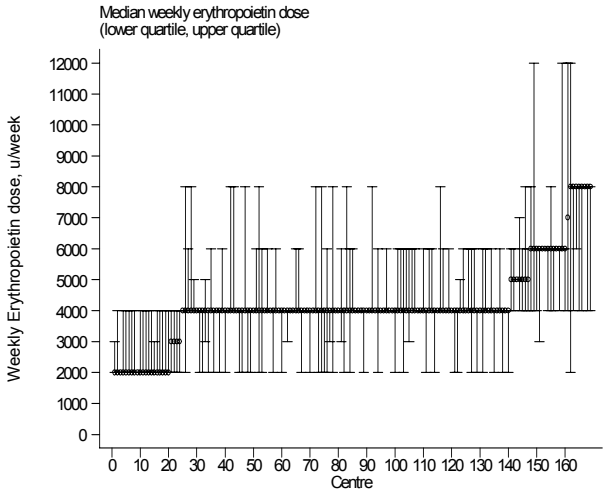


Figure 6.1.6: Variation in median weekly Erythropoietin dose (u/week) among CAPD centres 2004

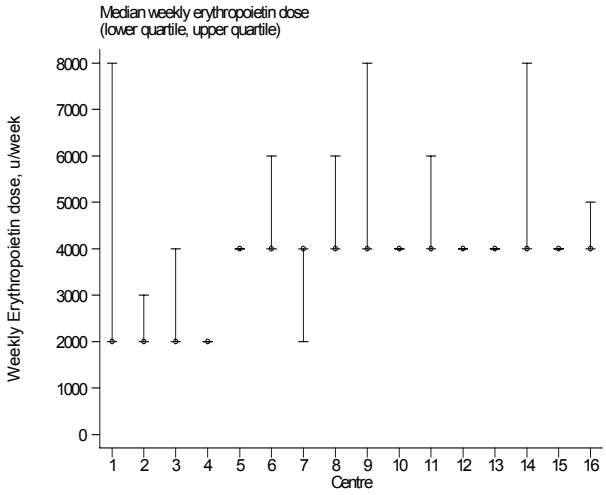


Table 6.1.6: Variation in median weekly Erythropoietin dose (u/week) among CAPD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	4000	4000	4000	4000	4000	4000	4000
1998	7	2000	2000	4000	4000	4000	4000	4000
1999	7	2000	2000	2000	4000	4000	4000	4000
2000	8	2000	2000	3000	4000	4000	4000	4000
2001	10	2000	2000	4000	4000	4000	4000	4000
2002	12	2000	2000	3000	4000	4000	6000	6000
2003	15	2000	2000	4000	4000	4000	5000	5000
2004	16	2000	2000	3000	4000	4000	4000	4000

In HD centres, the usage of blood transfusion has dropped from 12% to 7%. However there has been an increase in the transfusion rate in CAPD centres to 17% in 2004. In both HD and CAPD centres, at the 95th centile, 5% of centers have 36% of their patients who had received blood transfusion.(Table / Figure 6.1.7 – 6.1.8)

Table 6.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	0	0	0	7	14	37	71
1998	46	0	0	5	9	16	43	47
1999	69	0	0	5	11	25	44	73
2000	100	0	0	5	12	21	52	88
2001	118	0	0	4	12	18	40	62
2002	137	0	0	3	8	16	39	64
2003	160	0	0	3	9	19	33	64
2004	187	0	0	2	7	17	36	53

Figure 6.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2004

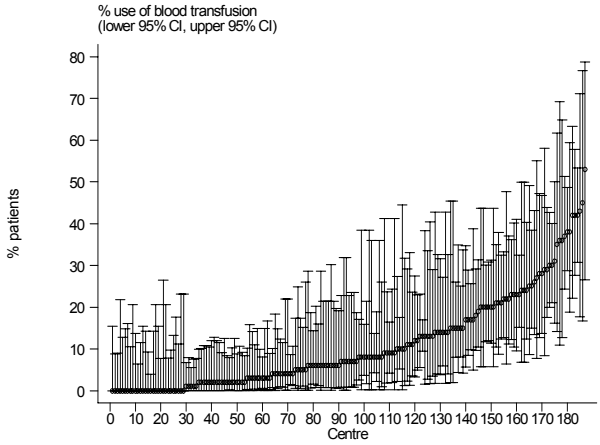


Figure 6.1.8: Variation in use of blood transfusion (% patients) among CAPD centres, 2004

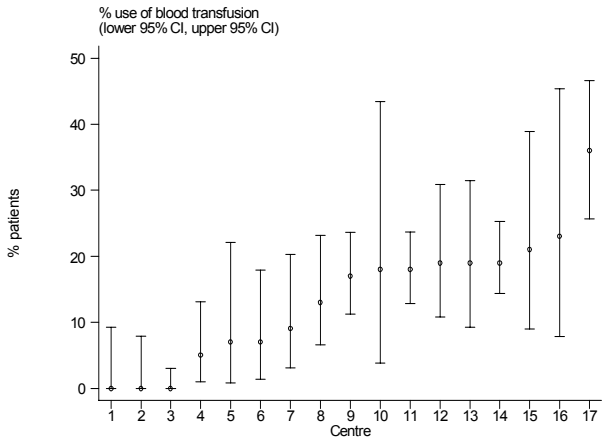


Table 6.1.8: Variation in use of blood transfusion (% patients) among CAPD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	1	1	4	6	29	47	47
1998	9	0	0	7	15	25	100	100
1999	9	0	0	3	7	22	48	48
2000	11	0	0	0	9	18	42	42
2001	12	0	0	0	4	15.5	37	37
2002	14	0	0	5	8	15	41	41
2003	17	0	0	4	13	25	57	57
2004	17	0	0	7	17	19	36	36

6.2: Iron Status on Dialysis

In both HD and CAPD, the mean and median serum ferritin and transferrin saturation in patients with or without EPO has slowly increased over the years. Likewise, more than 80% of patients have serum ferritin of at least 100 ng/ml and transferrin saturation greater than 20%. This is more so in CAPD compared to HD. (Tables / Figures 6.2.1 – 6.2.8)

Table 6.2.1: Distribution of Serum Ferritin without Erythropoietin, HD patients 1997 –2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
1997	280	493.1	349.3	435.5	162.5	850.5	86
1998	224	430.8	383.2	297.5	128.4	636.5	80
1999	337	517.9	424.3	402.8	162.8	809.5	86
2000	571	487.5	416.8	363.2	152.5	741	83
2001	758	537.6	453.9	383.5	172	828	87
2002	803	519.5	447.3	373	168.5	781	85
2003	917	551.5	434	457	190	826.5	87
2004	1044	588.9	462.9	471	218	905.6	89

Figure 6.2.1: Cumulative distribution of Serum Ferritin without Erythropoietin, HD patients 1997-2004

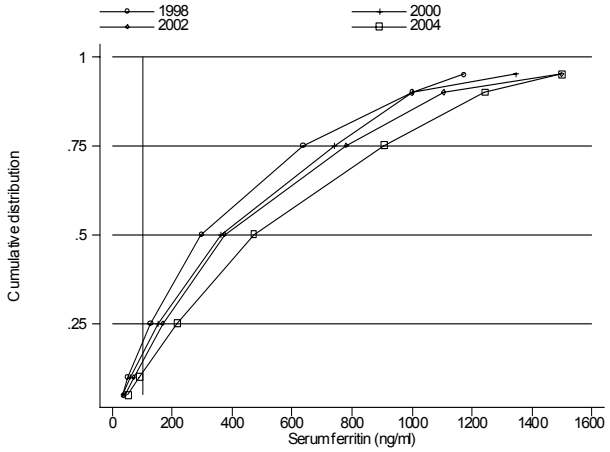


Figure 6.2.2: Cumulative distribution of Serum Ferritin without Erythropoietin, CAPD patients 1997-2004

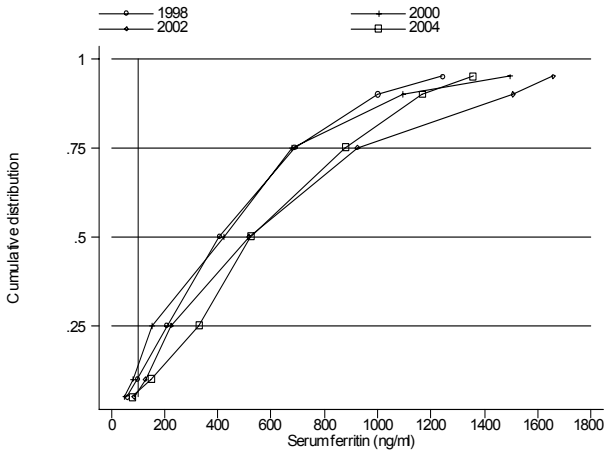


Table 6.2.2: Distribution of Serum Ferritin without Erythropoietin, CAPD patients 1997–2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
1997	133	469	333.5	392	198	718	88
1998	92	492.4	368.3	405	208.2	687.5	87
1999	124	553.7	400.1	499.3	255.3	686.8	94
2000	144	505.9	433.8	420	152.3	675.5	88
2001	223	543.8	417.5	440	216.9	754	91
2002	236	634.8	491.2	514.9	226	924.6	93
2003	330	602.8	428.5	503.9	269	834	93
2004	302	606.9	385.4	522.4	330	877.5	94

Table 6.2.3: Distribution of Serum Ferritin on Erythropoietin, HD patients 1997 – 2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
1997	471	543.3	347	495.5	219	973	90
1998	328	549.9	382.4	476.5	248	809.8	91
1999	586	560.4	418.6	453	225	829	93
2000	1175	587.9	456.6	475	218.8	860	91
2001	1637	597.5	444.2	491	236	894.2	91
2002	2224	593.1	459.3	464.8	231.3	878.2	91
2003	3137	640.9	428	563	298.5	932	94
2004	3841	670.3	460.8	572	306	979	94

Figure 6.2.3: Cumulative distribution of Serum Ferritin on Erythropoietin, HD patients 1997-2004

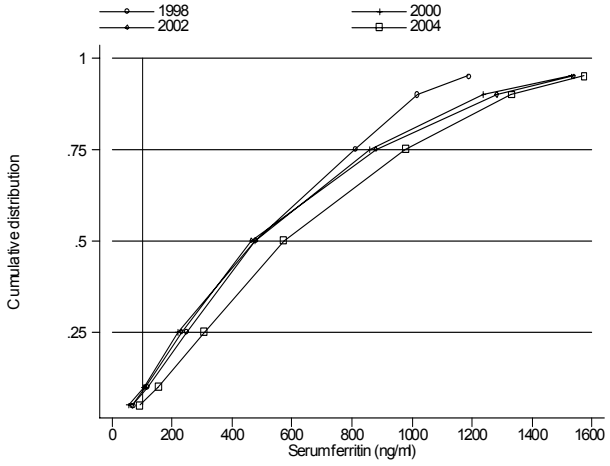


Figure 6.2.4: Cumulative distribution of Serum Ferritin on Erythropoietin, CAPD patients 1997-2004

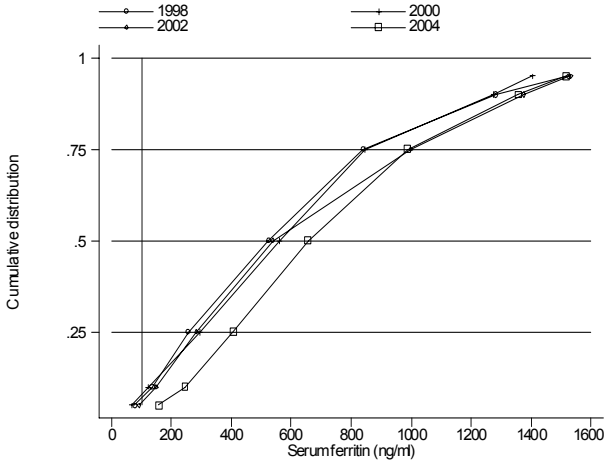


Table 6.2.4: Distribution of Serum Ferritin on Erythropoietin, CAPD patients 1997 – 2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
1997	129	550.8	323.7	496	256	862	93
1998	135	611.2	438.3	524.7	257	839.5	93
1999	136	604.8	436.3	540.6	264.6	870.1	93
2000	180	608.2	416.7	560	295.2	846.3	92
2001	261	645.9	449.2	557.5	275.7	885.4	93
2002	345	666.8	462.4	538.5	284	999.5	94
2003	518	689.6	459.5	588.4	304	993.2	96
2004	542	728.8	426.9	655.6	405.5	987.4	98

Table 6.2.5: Distribution of transferrin saturation without Erythropoietin, HD patients 1997 –2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
1997	723	34.1	16.6	29.8	22.7	40.4	84
1998	599	33.3	16.2	29.5	22.1	41.7	82
1999	654	32.9	16.3	29.9	20.9	42.4	78
2000	800	32.7	16.9	28.6	20.9	41.4	78
2001	836	36.9	18.5	32.5	23.9	45.8	84
2002	811	36.5	18.9	32	22.9	45.7	83
2003	922	40.3	18.6	36.1	27.2	51.2	91
2004	1031	41.2	18.1	37.5	28.5	50.1	92

Figure 6.2.5: Cumulative distribution of transferrin saturation without Erythropoietin, HD patients 1997-2004

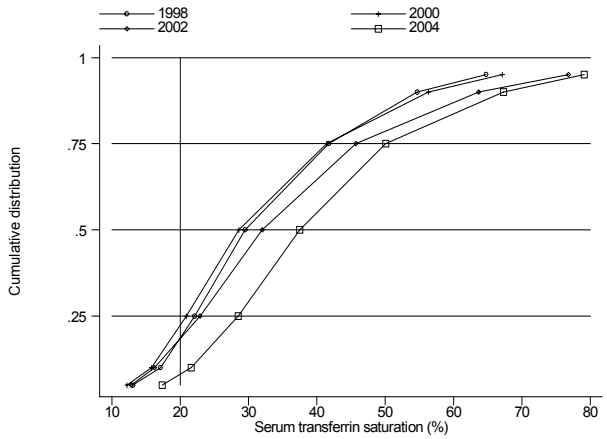


Figure 6.2.6: Cumulative distribution of transferrin saturation without Erythropoietin, CAPD patients 1997-2004

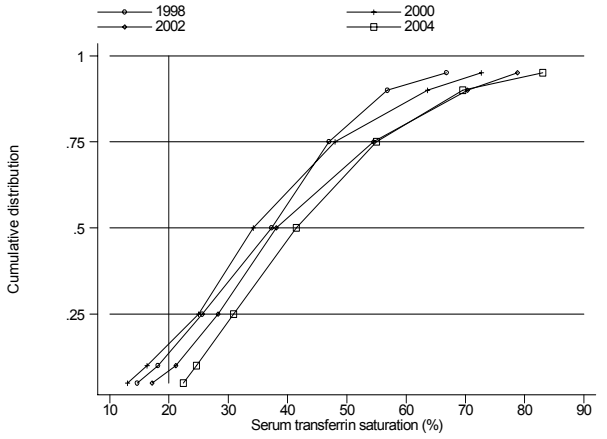


Table 6.2.6: Distribution of transferrin saturation without Erythropoietin, CAPD patients 1997–2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
1997	246	38.7	17.9	35.3	25.4	47.6	88
1998	184	37.7	15.7	37.3	25.6	47	85
1999	194	37.7	16.2	36.6	25.9	47	88
2000	237	37.9	18.5	34.2	25	48	86
2001	279	43.2	20.8	40	27.8	56.7	89
2002	332	42.7	19.1	38.1	28.3	54.5	92
2003	398	45.1	19.7	41.2	31.2	58.1	93
2004	378	44.5	18.1	41.5	30.9	55	98

Table 6.2.7: Distribution of transferrin saturation on Erythropoietin, HD patients 1997 – 2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
1997	636	35.9	17.3	31.4	24.2	43.3	87
1998	549	34.9	15.5	32	24.4	42.5	86
1999	703	34.5	16	31.6	23.2	42	85
2000	1249	34.9	16.7	30.4	23	43.9	84
2001	1634	36.2	17.9	32.3	23.6	45	84
2002	1995	34.6	17.6	30.6	22.2	43.6	81
2003	2645	39.6	18.4	36	26.6	48.9	90
2004	3264	39.6	17	36.1	27.7	48.1	93

Figure 6.2.7: Cumulative distribution of transferrin saturation on Erythropoietin, HD patients 1997-2004

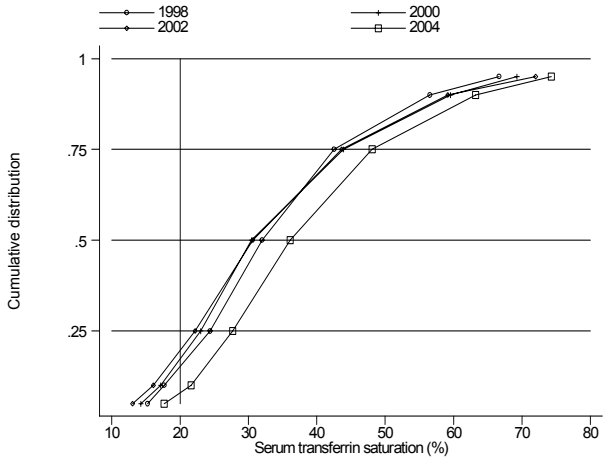


Figure 6.2.8: Cumulative distribution of transferrin saturation on Erythropoietin, CAPD patients 1997-2004

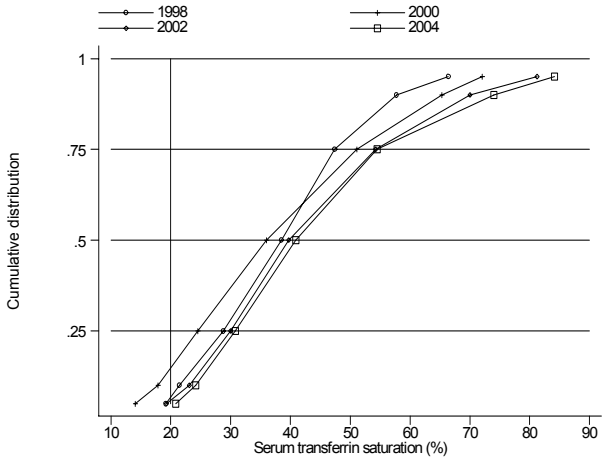


Table 6.2.8: Distribution of transferrin saturation on Erythropoietin, CAPD patients 1997 – 2004

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
1997	147	42.2	19.7	35.6	27	59	91
1998	111	39.4	13.8	38.5	28.8	47.4	94
1999	137	38.9	17	37	26.1	48.3	86
2000	238	38.9	18.7	36	24.5	51.1	86
2001	292	44.1	19.6	40.7	29.2	55.8	94
2002	363	43.6	18.6	39.7	30	54.3	94
2003	461	44.7	17.8	40.6	31.8	55.7	96
2004	694	44.7	18.7	40.9	30.8	54.5	96

In HD centers, from 1997 – 2004, 50% of centers (median) have an increasing serum ferritin and transferrin saturation in their patients on EPO. At the median, more than 90% of patients on EPO have a serum ferritin of greater than 100 ng/ml and more than 80% have a transferrin saturation of greater than 20%.
A similar trend was seen in the CAPD centers. (Table / Figure 6.2.9 – 6.2.10)

Table 6.2.9: Variation in iron status outcomes among HD centres 2004

(a) Median serum ferritin among patients on erythropoietin

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	21	220.5	250	390	495.5	614.5	792	809.3
1998	11	205	205	425	457	575.4	711.8	711.8
1999	22	189.5	242	336	408	552	823.9	873.5
2000	40	125	192.3	353.1	501.7	642.1	876	1087.5
2001	53	198	255.3	412.3	508.5	643.5	923.5	1188.5
2002	74	135.4	213.5	364	462	608.5	836.5	1031
2003	96	145.5	284	451	552.4	690	997	1787.5
2004	120	116.5	322.2	463.1	572.6	714.3	1036.3	2000

Figure 6.2.9(a): Variation in median serum ferritin among patients on erythropoietin, HD centres 2004

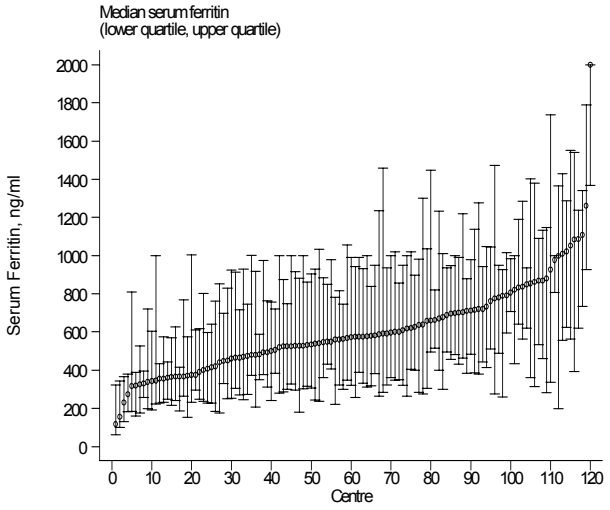
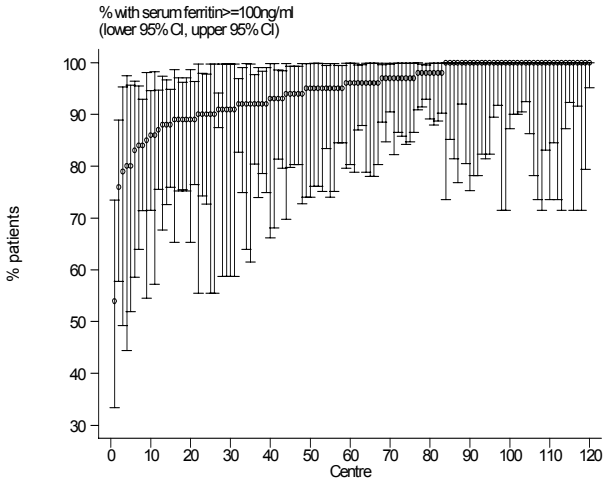


Figure 6.2.9(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml, HD centres 2004



(b) Proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	21	71	75	86	91	93	100	100
1998	11	79	79	89	90	95	96	96
1999	22	76	81	91	94	97	100	100
2000	40	67	73	87.5	93	96	100	100
2001	53	69	79	88	93	96	100	100
2002	74	67	75	86	93	96	100	100
2003	96	63	79	91	96	100	100	100
2004	120	54	83.5	91	96	100	100	100

Table 6.2.9(c) Median transferrin saturation among patients on erythropoietin

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	27	20.8	22.6	27.6	32	37.1	68.5	69.2
1998	21	21.4	23.5	26.4	29.5	33.7	39.8	51.2
1999	27	18.7	21.6	26.3	31	36.4	41.3	44.8
2000	46	16.7	22.7	27.9	31.2	35.9	44.1	55.5
2001	53	21	22.7	26.8	31.7	36.5	47.8	74.9
2002	62	15.5	20.7	25.1	31.4	36.5	50.4	58.9
2003	87	18.5	24.2	30.7	34.9	42.2	56.3	71.6
2004	111	20.4	26.4	32.4	37	40.6	54.3	66.8

Figure 6.2.9(c): Variation in median transferrin saturation among patients on erythropoietin, HD centres 2004

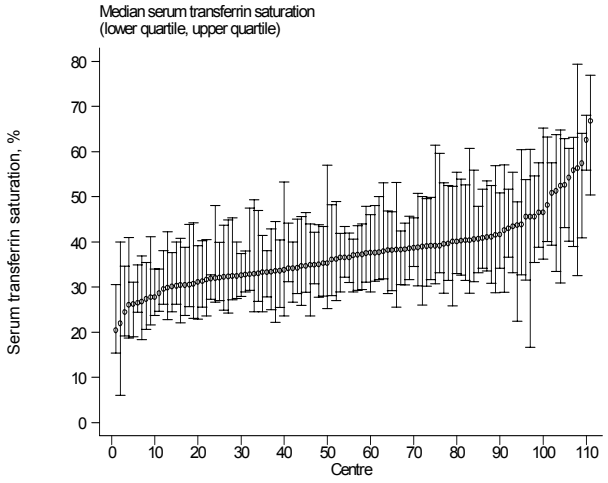
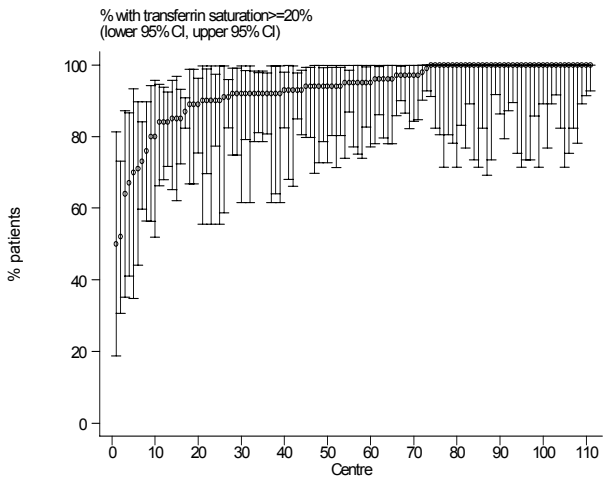


Figure 6.2.9(d): Variation in proportion of patients on erythropoietin with transferrin saturation ≥ 20%, HD centres 2004



(d) Proportion of patients on erythropoietin with transferrin saturation ≥ 20%

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	27	50	69	82	90	94	100	100
1998	21	62	68	82	89	95	100	100
1999	27	42	63	82	87	94	100	100
2000	46	29	60	76	85.5	93	100	100
2001	53	56	62	75	88	95	100	100
2002	62	30	55	70	80	90	100	100
2003	87	43	69	85	92	100	100	100
2004	111	50	71	92	95	100	100	100

Table 6.2.10: Variation in iron status outcomes among CAPD centres 2004

(a) Median serum ferritin among patients on erythropoietin

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	4	377.5	377.5	404.8	457.3	530	577.5	577.5
1998	4	409.4	409.4	458.7	528.8	606.3	663	663
1999	5	297.4	297.4	330	459.5	499.8	847	847
2000	6	335	335	439.6	681.3	775	775.8	775.8
2001	7	259.4	259.4	475.5	602.5	623	758	758
2002	10	360.4	360.4	450.8	477.4	571.3	826.5	826.5
2003	13	307.6	307.6	478.2	520.5	713.5	954.9	954.9
2004	13	312.4	312.4	527.8	613	788.5	1169.5	1169.5

Figure 6.2.10(a): Variation in median serum ferritin among patients on erythropoietin, CAPD centres 2004

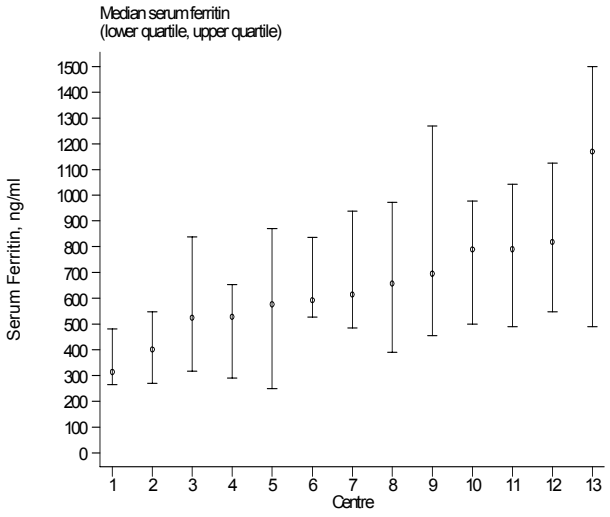
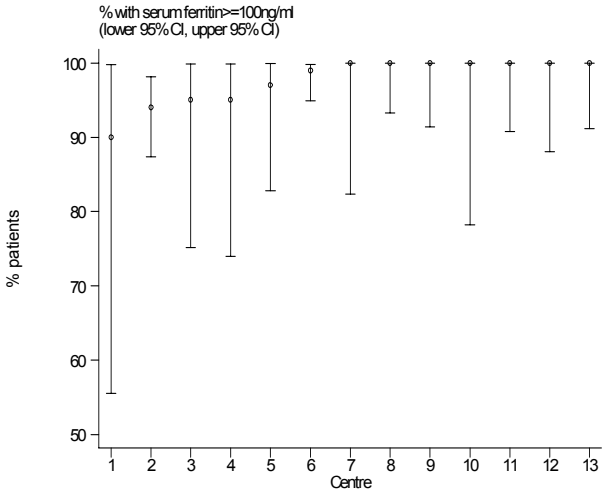


Figure 6.2.10(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml, CAPD centres 2004



(b) Proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	4	84	84	88.5	93.5	97	100	100
1998	4	82	82	88.5	97.5	100	100	100
1999	5	85	85	93	94	100	100	100
2000	6	88	88	89	94.5	100	100	100
2001	7	83	83	91	96	100	100	100
2002	10	89	89	92	93.5	100	100	100
2003	13	86	86	95	97	98	100	100
2004	13	90	90	95	100	100	100	100

Table 6.2.10(c) Median transferrin saturation among patients on erythropoietin

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	26.7	26.7	27.6	33.6	42.5	70.5	70.5
1998	4	34.2	34.2	34.6	35.9	41.7	46.5	46.5
1999	6	24	24	27.2	33.5	39.5	44.4	44.4
2000	7	21.9	21.9	24.4	34.9	37.6	52.6	52.6
2001	8	28.4	28.4	30.4	38.1	48.1	79.8	79.8
2002	9	28.9	28.9	36.1	38.3	41	60	60
2003	12	32.3	32.3	35.6	40.7	48.1	63.1	63.1
2004	16	29.1	29.1	36.7	40.9	50.7	82.5	82.5

Figure 6.2.10(c): Variation in median transferrin saturation among patients on erythropoietin, CAPD centres 2004

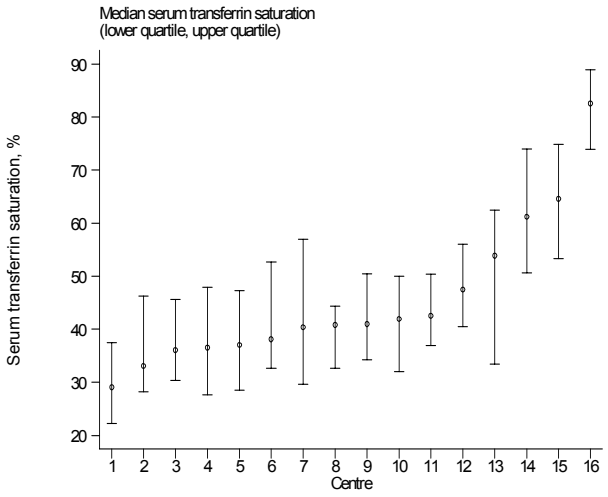


Figure 6.2.10(d): Variation in proportion of patients on erythropoietin with transferrin saturation ≥20%, CAPD centres 2004

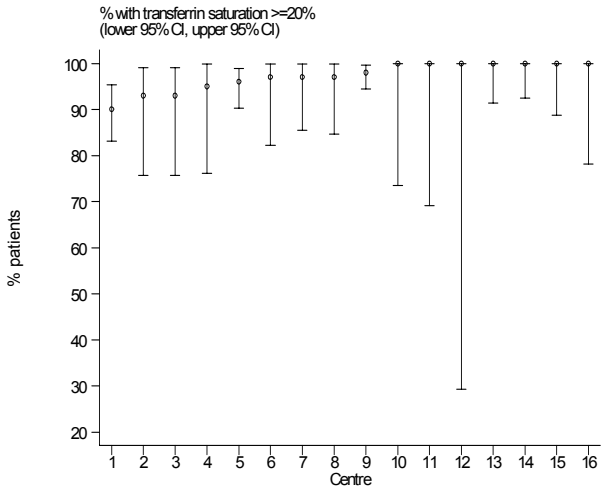


Table 6.2.10(d) Proportion of patients on erythropoietin with transferrin saturation ≥ 20%

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	70	70	88	90.5	100	100	100
1998	4	81	81	88	95.5	96.5	97	97
1999	6	53	53	83	85.5	94	100	100
2000	7	64	64	73	87	100	100	100
2001	8	84	84	91.5	95	96.5	100	100
2002	9	78	78	91	93	98	100	100
2003	12	91	91	94	96	99	100	100
2004	16	90	90	95.5	97.5	100	100	100

6.3: Haemoglobin Outcomes on Dialysis

The mean and median haemoglobin concentration in all dialysis patients with or without EPO was steadily increasing; in 2004 the mean and median haemoglobin ranged from 9.8 to 10.4 g/dl. The percentage of patients with the haemoglobin of > 10 or > 11 g/dl was also steadily increasing. In 2004, the percentage of patients with the haemoglobin > 10 gm/dl varied between 45 to 58 %. Similarly, the percentage of patient with the haemoglobin > 11 gm/dl varied between 23-33 %. (Table / Figure 6.3.1 – 6.3.4)

Table 6.3.1: Distribution of Haemoglobin Concentration without Erythropoietin, HD patients 1997 – 2004

Year	No. of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10 g/dL	% Patients >10 g/dL	% Patients ≤11 g/dL	% Patients >11 g/dL
1997	896	9.3	1.9	9	8	10.5	69	31	82	18
1998	1119	9.1	1.9	8.9	7.8	10.3	71	29	83	17
1999	1400	9.1	1.9	8.9	7.8	10.3	70	30	85	15
2000	1754	9.4	2.1	9.1	7.9	10.6	67	33	80	20
2001	1809	9.4	1.9	9.3	8	10.6	64	36	81	19
2002	1795	9.6	2.1	9.4	8.1	10.9	62	38	76	24
2003	1804	9.7	2.1	9.5	8.3	11	60	40	75	25
2004	1919	10.1	2.1	9.9	8.6	11.6	53	47	68	32

Figure 6.3.1: Cumulative distribution of haemoglobin Concentration without Erythropoietin, HD patients 1997-2004

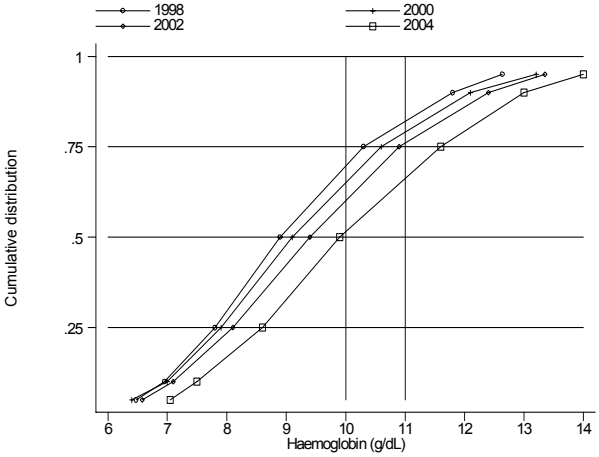


Figure 6.3.2: Cumulative distribution of haemoglobin concentration without Erythropoietin, CAPD patients 1997-2004

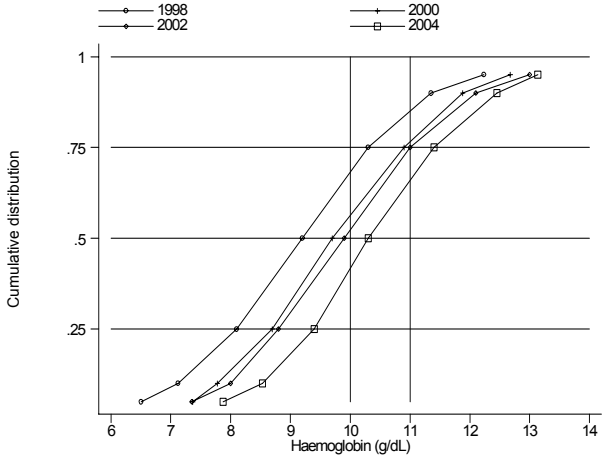


Table 6.3.2: Distribution of Haemoglobin Concentration without Erythropoietin, CAPD patients 1997– 2004

Year	No. of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10 g/dL	% Patients >10 g/dL	% Patients ≤11 g/dL	% Patients >11 g/dL
1997	297	9.2	1.6	9.1	8.1	10.3	72	28	86	14
1998	301	9.3	1.8	9.2	8.1	10.3	68	32	84	16
1999	336	9.5	1.6	9.5	8.4	10.5	66	34	84	16
2000	342	9.8	1.7	9.7	8.7	10.9	58	42	79	21
2001	405	9.8	1.8	9.7	8.6	10.7	59	41	78	22
2002	434	10	1.8	9.9	8.8	11	54	46	76	24
2003	543	10	1.7	9.9	8.9	11	52	48	76	24
2004	478	10.4	1.6	10.3	9.4	11.4	42	58	67	33

Table 6.3.3: Distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1997 – 2004

Year	No. of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10 g/dL	% Patients >10 g/dL	% Patients ≤11 g/dL	% Patients >11 g/dL
1997	773	8.9	1.6	8.9	7.8	9.9	76	24	90	10
1998	971	9.1	1.6	9.1	7.9	10.2	71	29	88	12
1999	1503	9.2	1.5	9.1	8.1	10.2	71	29	89	11
2000	2333	9.4	1.7	9.4	8.3	10.5	65	35	85	15
2001	3049	9.4	1.6	9.4	8.3	10.5	65	35	85	15
2002	3859	9.5	1.7	9.5	8.4	10.7	62	38	81	19
2003	4785	9.6	1.6	9.6	8.5	10.7	61	39	81	19
2004	5723	9.8	1.6	9.9	8.8	10.9	55	45	77	23

Figure 6.3.3: Cumulative distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1997-2004

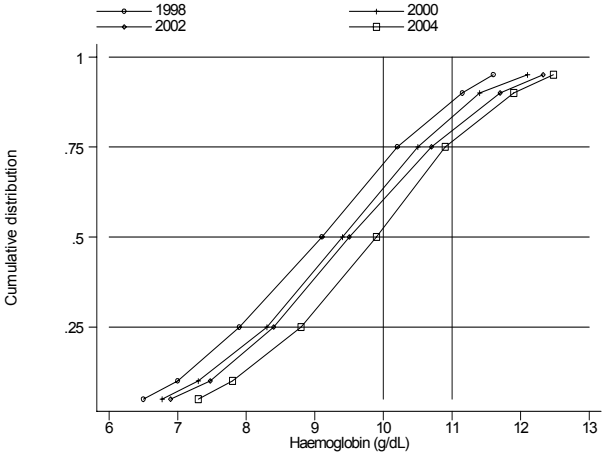


Figure 6.3.4: Cumulative distribution of Haemoglobin Concentration on Erythropoietin, CAPD patients 1997-2004

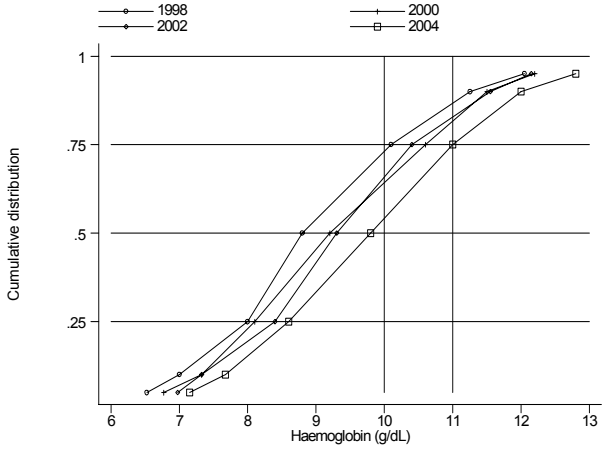


Table 6.3.4: Distribution of Haemoglobin Concentration on Erythropoietin, CAPD patients 1997 – 2004

Year	No. of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10 g/dL	% Patients >10 g/dL	% Patients ≤11 g/dL	% Patients >11 g/dL
1997	175	8.8	1.5	8.6	7.7	9.8	79	21	94	6
1998	238	9	1.6	8.8	8	10.1	74	26	88	12
1999	262	9	1.6	8.9	7.9	10.2	73	27	89	11
2000	299	9.4	1.7	9.2	8.1	10.6	65	35	82	18
2001	345	9.3	1.6	9.4	8.2	10.5	65	35	86	14
2002	432	9.4	1.6	9.3	8.4	10.4	69	31	83	17
2003	640	9.7	1.7	9.6	8.6	10.8	60	40	78	22
2004	797	9.8	1.7	9.8	8.6	11	54	46	76	24

(Table/Figure 6.3.5 – 6.3.6) In HD patients on EPO, 50% of the centers (median) have their haemoglobin level at 9.7 gm/dl. At the 95th centile, 5% of the centers have their patient's haemoglobin at 10.9g/dl. At the 5th centile, 5% of the centers have their patient's haemoglobin at 8.6 g/dl.
In 2004, 50% of centers (median) achieved haemoglobin of > 10 gm/dl or > 11 gm/dl in 41.5% or 19% of patients respectively. A similar trend was noted in CAPD patients

Table 6.3.5: Variation in Haemoglobin outcomes among HD centres 2004

(a) Median haemoglobin level among patients on erythropoietin

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	31	7.8	7.9	8.5	8.9	9.4	10.4	10.6
1998	35	7.4	7.7	8.5	9.1	9.5	10.4	10.4
1999	52	7.9	8.1	8.6	9.1	9.7	10.1	10.8
2000	83	8	8.3	8.7	9.3	9.8	10.5	14.9
2001	95	7.6	8.3	8.9	9.4	9.9	10.6	11.3
2002	110	8.3	8.5	9	9.5	10	10.7	11.6
2003	137	7.8	8.5	9	9.5	10	10.8	11.4
2004	168	7.8	8.6	9.2	9.7	10.2	10.9	11.2

Figure 6.3.5(a): Variation in median haemoglobin level among patients on Erythropoietin, HD centres 2004

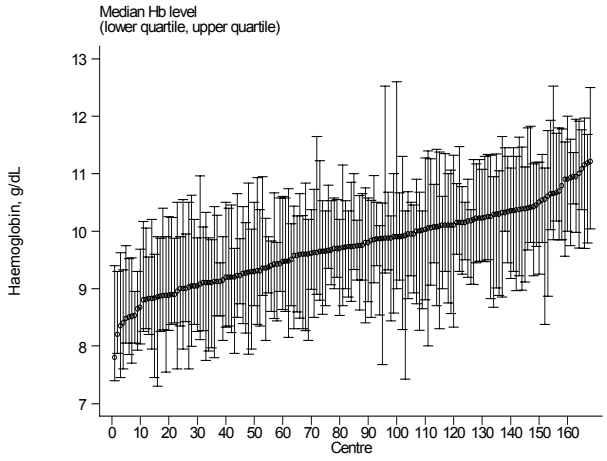
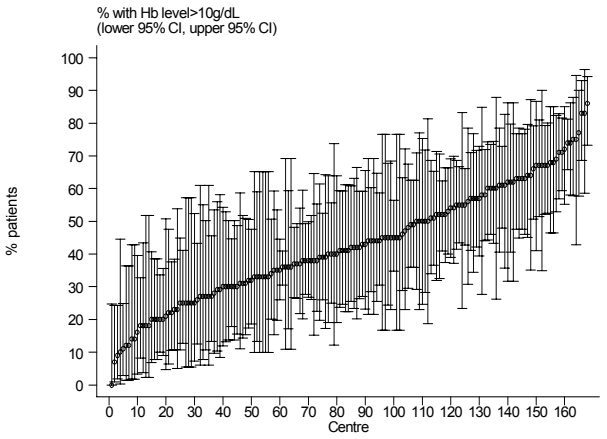


Figure 6.3.5(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10 g/dL, HD centres 2004



(b) Proportion of patients on erythropoietin with haemoglobin level > 10 g/dL

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	31	0	0	13	25	31	60	82
1998	35	0	0	14	29	39	62	63
1999	52	7	8	16.5	25	39.5	57	71
2000	83	0	7	18	31	43	65	100
2001	95	5	10	23	33	46	68	71
2002	110	0	13	27	38	50	67	100
2003	137	0	10	24	38	50	69	100
2004	168	0	14	30	41.5	56.5	72	86

Table 6.3.5(c) Proportion of patients on erythropoietin with haemoglobin level > 11 g/dL

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	31	0	0	0	7	17	30	33
1998	35	0	0	5	9	17	27	31
1999	52	0	0	1.5	9	16	33	38
2000	83	0	0	4	13	18	33	95
2001	95	0	0	7	13	23	37	54
2002	110	0	3	12	19	28	40	82
2003	137	0	0	8	15	27	44	61
2004	168	0	0	10.5	19	30	44	58

Figure 6.3.5(c): Variation in proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, HD centres 2004

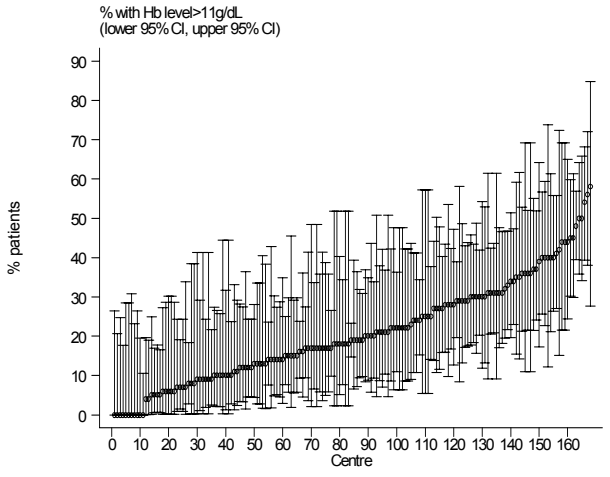


Figure 6.3.6(a): Variation in median haemoglobin level among patients on Erythropoietin, CAPD centres 2004

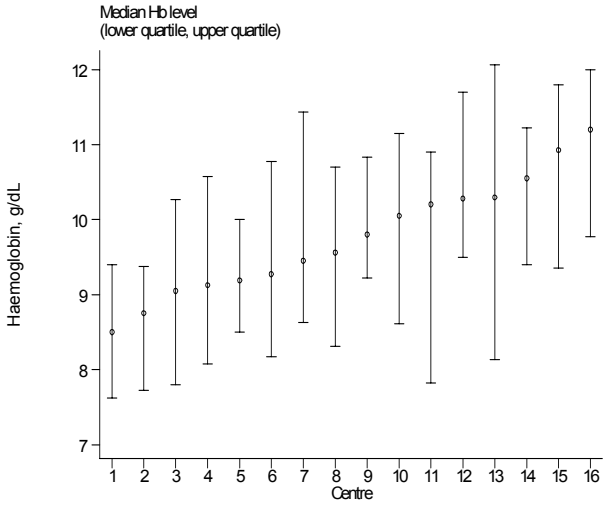


Table 6.3.6: Variation in Haemoglobin outcomes among CAPD centres 2004

(a) Median haemoglobin level among patients on erythropoietin

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	7.8	7.8	7.8	8.7	9	9.5	9.5
1998	7	7.7	7.7	8.2	9	9.4	9.5	9.5
1999	7	8.1	8.1	8.4	8.7	9.5	9.5	9.5
2000	9	8.2	8.2	8.9	9	9.8	10.1	10.1
2001	11	9	9	9.2	9.4	9.6	9.9	9.9
2002	12	8.8	8.8	9	9.3	9.6	10.1	10.1
2003	15	8.5	8.5	9.3	9.6	10.1	11.3	11.3
2004	16	8.5	8.5	9.2	9.7	10.3	11.2	11.2

Table 6.3.6(b) Proportion of patients on erythropoietin with haemoglobin level > 10 g/dL

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	0	0	10	19	31	38	38
1998	7	11	11	15	23	30	40	40
1999	7	19	19	20	23	40	44	44
2000	9	24	24	30	34	43	50	50
2001	11	15	15	30	35	43	47	47
2002	12	15	15	23	31.5	40	50	50
2003	15	0	0	27	35	52	76	76
2004	16	13	13	31	45	60.5	72	72

Figure 6.3.6(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10 g/dL, CAPD centres 2004

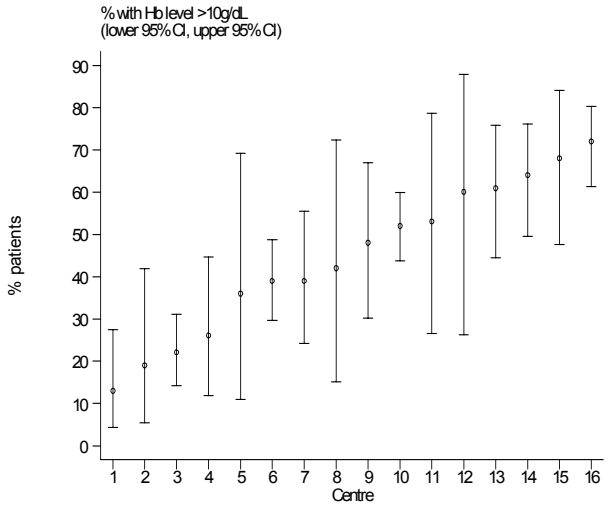


Figure 6.3.6(c): Variation in proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, CAPD centres 2004

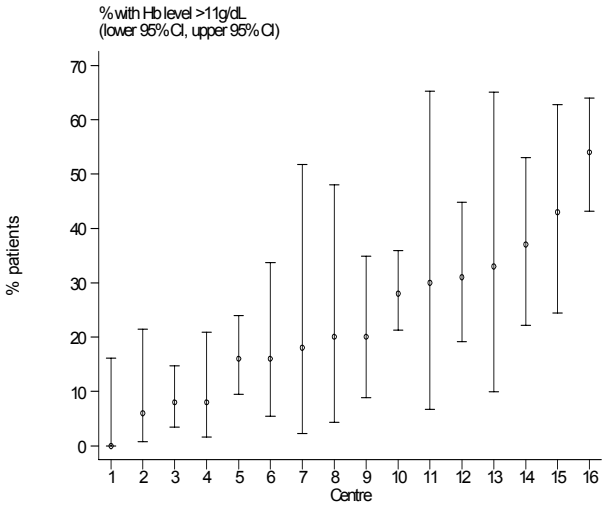


Table 6.3.6(c) Proportion of patients on erythropoietin with haemoglobin level > 11 g/dL

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	0	0	0	5.5	8	10	10
1998	7	0	0	8	12	13	20	20
1999	7	5	5	8	9	13	14	14
2000	9	10	10	15	17	20	36	36
2001	11	7	7	9	15	20	25	25
2002	12	6	6	12	19	23	25	25
2003	15	0	0	12	16	24	52	52
2004	16	0	0	12	20	32	54	54

CHAPTER 7

NUTRITIONAL STATUS ON DIALYSIS

Ahmad Fauzi Abdul Rahman
Tilakavati Karupaiah

7.1: Serum Albumin Levels on Dialysis

Table 7.1.1 indicates that mean serum albumin levels for HD patients for the years 1997 to 2004 were acceptable as they were above the criteria of increased mortality risk (<35g/L). The trend appears to be stabilizing at this level. Percentage of patients with serum albumin levels < 35g/L was between 11 to 18%. For the year 2004, mean serum albumin was 40 g/L which was just at the borderline of mortality risk (≥40g/L). Only 13% had values < 35 g/L compared to 54% at ≥ 40g/L.

Table 7.1.1: Distribution of serum Albumin (g/L), HD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
1997	1644	40.9	6.2	41	37.7	44.3	3	8	30	59
1998	2075	41.2	6.5	41	37.5	44.7	3	9	28	59
1999	2755	39.7	6.1	39.7	36.3	43	4	13	35	49
2000	3734	38.6	7	39	36	42	5	11	41	43
2001	4666	39	5.6	38.5	36	41.8	3	15	44	38
2002	5568	39.2	5.6	39	36.5	42	3	12	42	43
2003	6529	39.9	5.4	40	37.3	42.5	3	9	35	52
2004	7511	40	5.2	40	37.3	42.8	3	10	34	54

Fig. 7.1.1 shows that there was some improvement in serum albumin levels from the years 1998 to 2004

Figure 7.1.1: Cumulative distribution of Albumin (g/L), HD patients 1997-2004

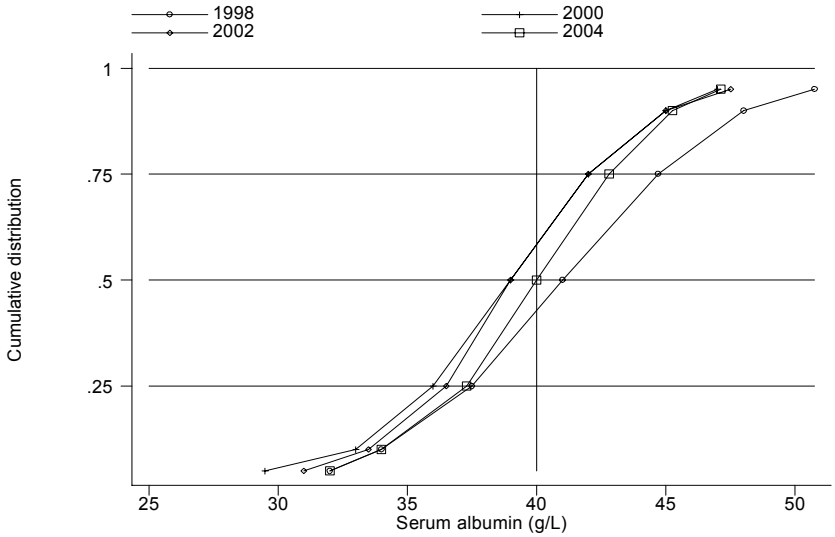


Table and figure 7.1.2 indicate that for CAPD patients, mean values for serum albumin levels each year from1997 to 2004 showed a downward trend from 35.7 to 33 g/L indicating increasing mortality risk (<35g/L). Percentage of patients with serum albumin levels < 35g/L increased from 44% to 59%. One possible explanation for the above trend could be that as CAPD became widely available more elderly diabetic patients were included in the program. In 2004, the mean value was at 33g/L well below the level for increased mortality risk (35 g/L). Overall 59% of this population had values <35 g/L compared to only 11% with ≥ 40g/L.

Table 7.1.2: Distribution of serum Albumin (g/L), CAPD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
1997	471	35.7	6.8	35.7	31.5	39.5	16	28	34	22
1998	536	35.8	6.7	36	32	39.7	16	25	35	24
1999	597	34.1	6.6	34	30.8	38	21	33	32	14
2000	640	34.3	6.1	35	31	38.3	20	28	37	14
2001	750	33.3	6.2	33.6	29.3	37	27	33	28	12
2002	862	33.9	5.9	34.3	30.8	37.5	21	35	33	12
2003	1182	33.3	5.8	33.8	29.7	37.3	26	33	30	11
2004	1285	33	6	33.8	29.5	37.3	27	32	30	11

Figure 7.1.2: Cumulative distribution of Albumin (g/L), CAPD patients 1997-2004

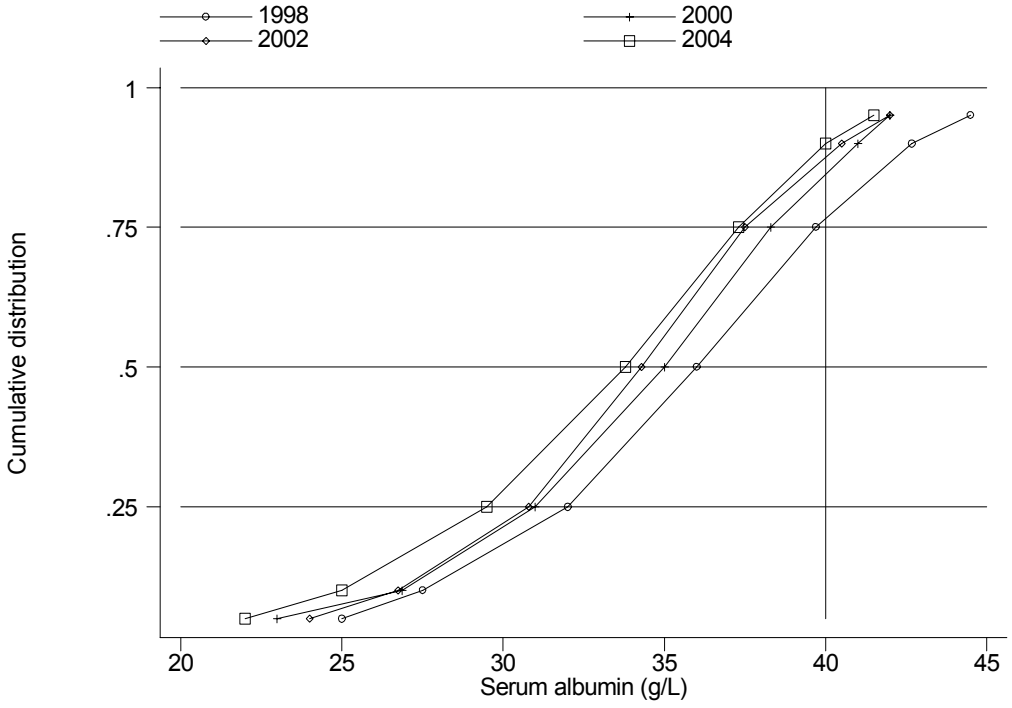


Table 7.1.3 indicates a J curve in the proportion of patients in HD centres with serum albumin ≥ 40g/L from 1997 to 2004. This may be due to the increasing number of centers participating in collection of data for NRR since 2000. However there was a wide variation in serum albumin levels among dialysis centers with some centers reporting no patients with serum albumin above 40g/L. Half the centers had 60% of patients with serum albumin >40g/L in 2004. The disparity among centers was still wide as the range was between 4 and 100%.

Table 7.1.3: Variation in Proportion of patients with serum albumin ≥ 40g/L among HD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	3	10	32	59.5	77	95	96
1998	45	9	14	31	59	80	95	97
1999	64	4	8	20	50.5	71	90	95
2000	92	0	3	21	39	62.5	84	98
2001	111	0	2	13	40	57	89	100
2002	132	0	7	21	43.5	62.5	83	100
2003	150	0	15	39	56.5	70	91	100
2004	182	4	10	36	60	74	88	100

Fig. 7.1.3 indicates the wide variation in the proportion of patients with serum albumin ≥40g/L in the 182 HD centres for the year 2004.

Figure 7.1.3: Variation in Proportion of patients with serum albumin ≥ 40g/L, HD centres 2004

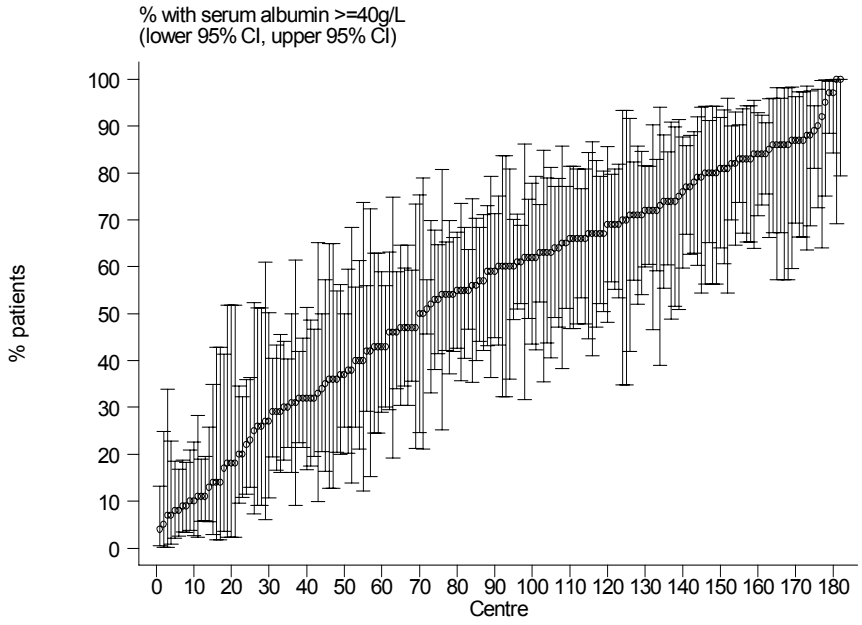


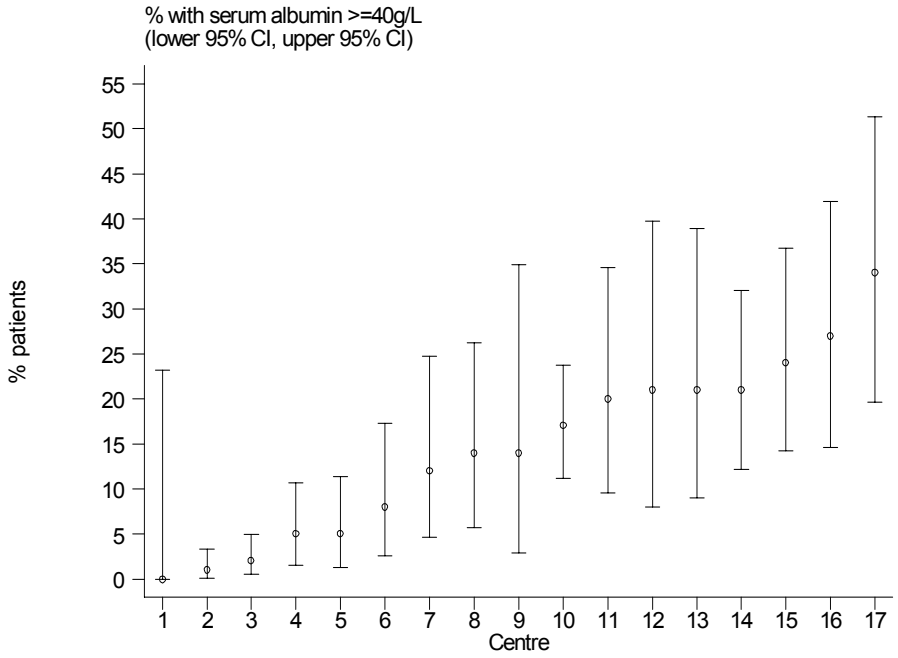
Table 7.1.4 indicates a decreasing trend in the proportion of patients with serum albumin ≥ 40g/L from 1997 to 2004 among CAPD centres. A number of centers had no patients with serum albumin above 40g>L. The center with the highest proportion of patients with serum albumin > 40 g/L only recorded a percentage of 34.

Table 7.1.4: Variation in Proportion of patients with serum albumin ≥ 40g/L among CAPD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	5	5	10	28	29	59	59
1998	9	0	0	7	19	35	36	36
1999	9	2	2	10	13	22	29	29
2000	11	0	0	5	17	28	42	42
2001	12	1	1	4	16.5	27.5	38	38
2002	14	4	4	6	10.5	16	35	35
2003	17	0	0	5	12	14	48	48
2004	17	0	0	5	14	21	34	34

Fig. 7.1.4 indicates the wide variation in proportion of patients with serum albumin ≥40g/L among CAPD centres for the year 2004.

Figure 7.1.4: Variation in Proportion of patients with serum albumin ≥ 40g/L, CAPD centres 2004



7.2: Body Mass Index (BMI) on Dialysis

Table 7.2.1 indicates a stable trend in mean BMI values in HD patients ranging from 23.2 to 24.3. Percentage of patients with BMI < 18.5 decreased from 19% in 1997 to 14% in 2004. Percentage of patients with BMI ≥25 increased from 20% in 1997 to 28% in 2004. For the year 2004, mean BMI value was 23.4. However 14% of this group had values <18.5 compared to 28% at ≥ 25.

Table 7.2.1: Distribution of BMI, HD patients 1997-2004

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients >=25
1997	1542	23.8	17.2	21.5	19.1	24.3	19	61	20
1998	1978	24.3	19.4	21.6	19.1	24.3	19	60	21
1999	2704	23.7	17.1	21.4	19.2	24.4	18	61	21
2000	3839	23.1	12.8	21.6	19.3	24.5	18	60	22
2001	4520	23.1	12	21.9	19.3	24.7	18	59	23
2002	5032	23.3	11.7	22	19.5	24.9	16	59	24
2003	5902	23.2	10.8	22.1	19.5	25.1	16	58	26
2004	6639	23.4	9.9	22.4	19.8	25.4	14	58	28

Fig. 7.2.1 showing cumulative distribution indicates that there was an decreasing number of patients with BMI <25

Figure 7.2.1: Cumulative distribution of BMI, HD patients 1997-2004

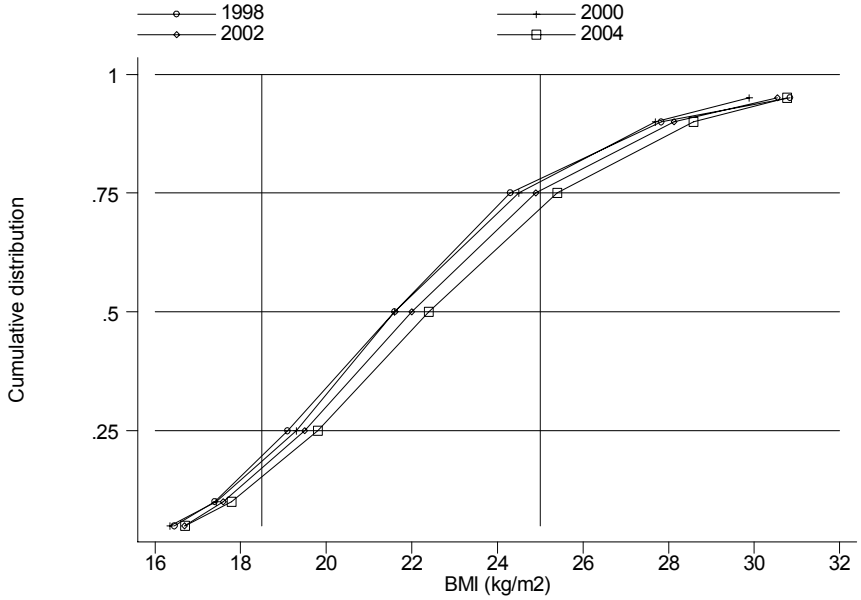


Table 7.2.2 indicates a stable trend in mean BMI values for PD patients ranging from 22.6 to 23.2. However the percentage of patients with BMI < 18.5 decreased from 21% in 1997 to 17% in 2004. Percentage of patients with BMI ≥25 increased from 23% in 1997 to 31% in 2004. For the year 2004 mean BMI value was 23.2. However 17% of this group had values <18.5 compared to 31% at ≥ 25.

Table 7.2.2: Distribution of BMI, CAPD patients 1997-2004

Year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients >=25
1997	420	22.6	12.5	21.9	18.9	24.7	21	56	23
1998	491	22.1	11.1	21.3	18.7	24	22	57	20
1999	552	21.8	4.4	21.5	18.9	24.5	22	56	22
2000	602	21.7	4.4	21.5	18.6	24.6	25	53	22
2001	663	22.2	4.8	21.8	18.7	25.2	23	50	26
2002	750	22.4	4.8	22.1	18.8	25.5	23	48	30
2003	1064	23	6.8	22.6	19.2	25.8	19	51	30
2004	1167	23.2	7.1	22.6	19.5	26.1	17	51	31

Fig. 7.2.2 shows that overall the cumulative distribution data indicates a BMI <25 for an decreasing number of patients.

Figure 7.2.2: Cumulative distribution of BMI, CAPD patients 1997-2004

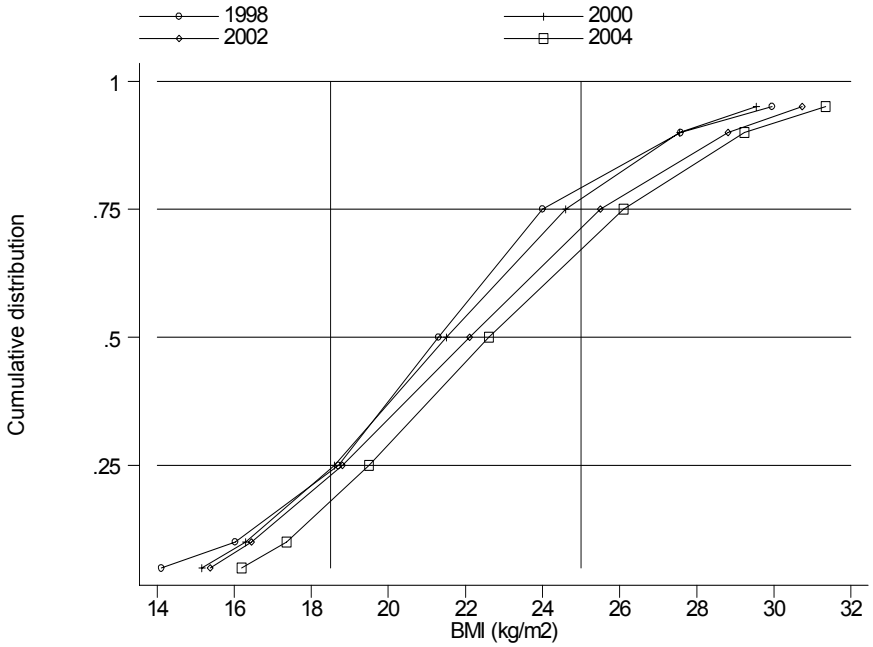


Table 7.2.3 indicates an increasing trend in the proportion of HD patients among centres with BMI ≥ 25 from 1997 to 2004.

Table 7.2.3: Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	60	64	75	80.5	88	100	100
1998	45	63	68	76	80	85	96	96
1999	64	58	68	77	83	88.5	94	100
2000	94	59	69	78	83	88	95	100
2001	108	56	68	77	82	88	93	100
2002	123	60	69	77	84	89	100	100
2003	147	57	71	79	85	90	100	100
2004	171	61	70	81	86	90	100	100

Fig. 7.2.3 indicates the variation in proportion of patients with BMI ≥18.5 in 171 HD centers for the year 2004.

Figure 7.2.3: Variation in Proportion of patients with BMI ≥ 18.5, HD centres 2004

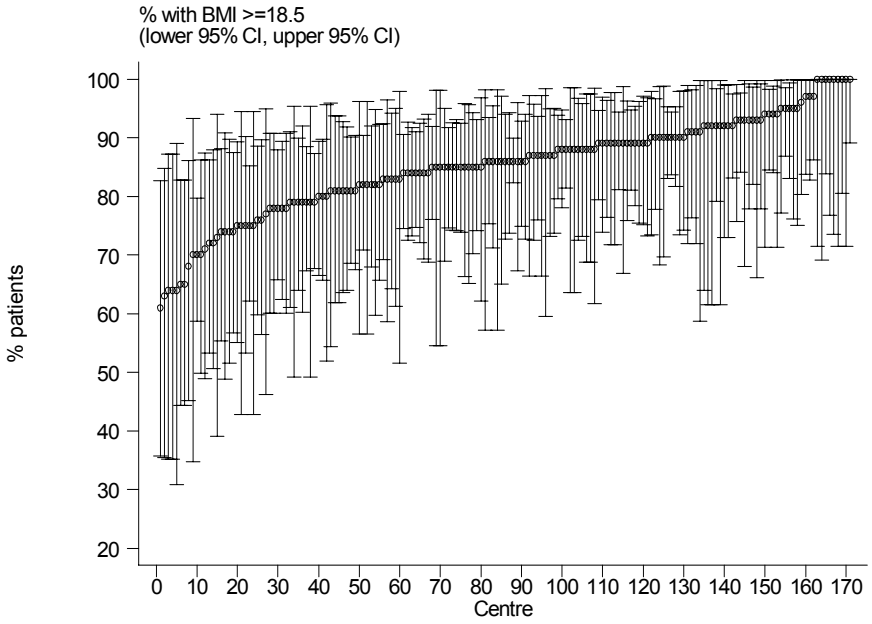


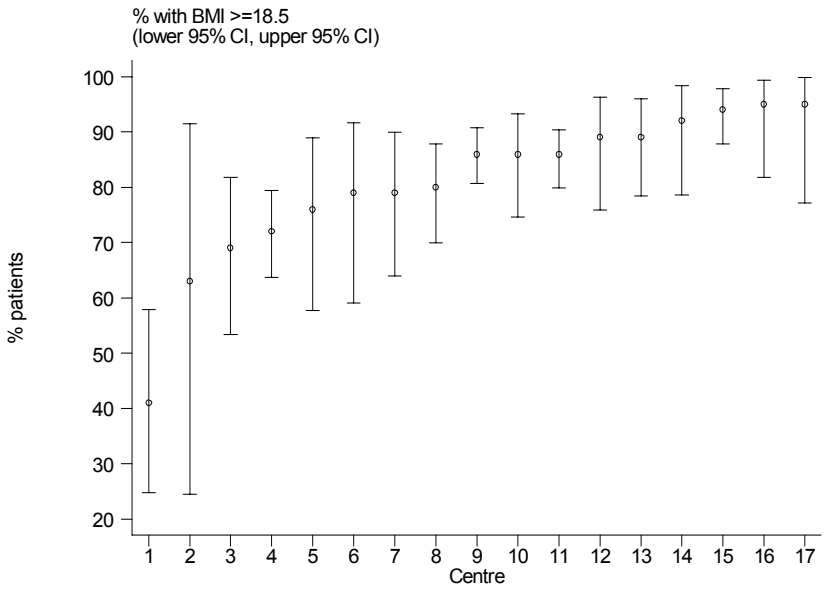
Table 7.2.4 indicates a stable trend in the proportion of CAPD patients with BMI ≥ 25 from 1997 to 2004.

Table 7.2.4: Variation in Proportion of patients with BMI ≥ 18.5 among CAPD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	50	50	74	81	88	93	93
1998	9	15	15	78	89	91	100	100
1999	9	0	0	67	76	83	95	95
2000	11	13	13	71	76	88	89	89
2001	12	17	17	73	79	86.5	90	90
2002	14	32	32	74	81.5	84	92	92
2003	17	26	26	80	85	88	100	100
2004	17	41	41	76	86	89	95	95

Fig. 7.2.4 indicates the variation in the proportion of patients with BMI of > 18.5 in the 17 CAPD centres varying from about 40% to 95%.

Figure 7.2.4: Variation in Proportion of patients with BMI ≥ 18.5, CAPD centres 2004



CHAPTER 8

BLOOD PRESSURE CONTROL AND DYSLIPIDAEMIA

S Prasad Menon
Lee Wan Tin

8.1: Blood Pressure Control on Dialysis

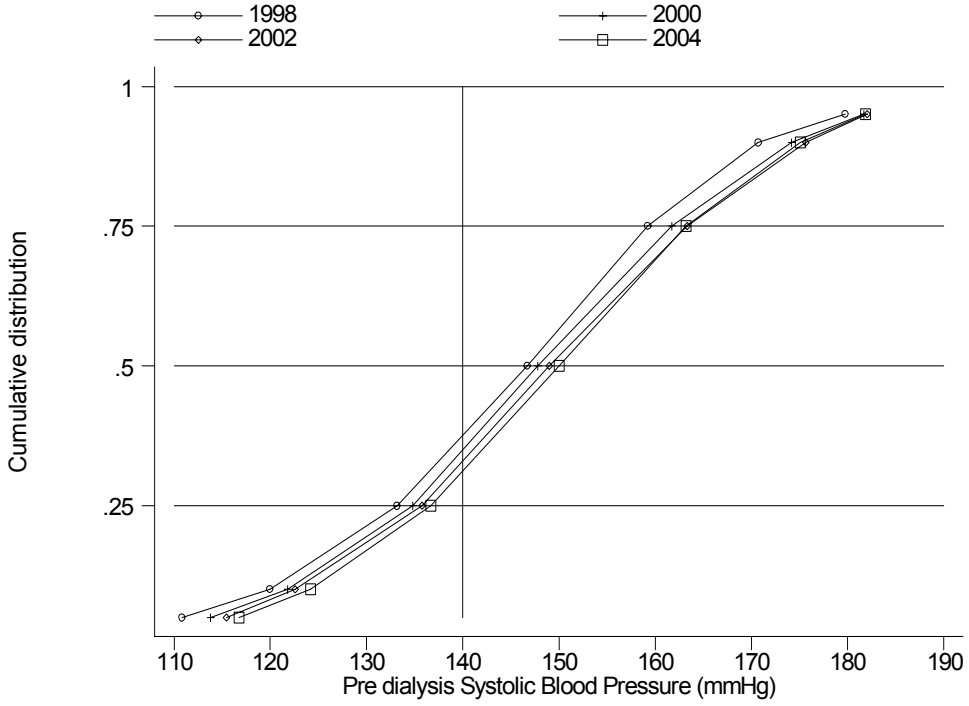
Between 1997 and 2001, there was a trend where the mean and median predialysis systolic BP tended to increase. This trend has plateaued in the last few years. This higher pre systolic BP probably reflects the trend in accepting older patients onto the dialysis programme.

In 2004, the mean and median predialysis systolic BP in HD patients were 149.8 mm Hg and 150 mm Hg respectively (Table 8.1.1), which was similar to the 2003 figures.

Table 8.1.1: Distribution of Pre dialysis Systolic Blood Pressure (mmHg), HD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <120 mmHg	% patients 120-<140 mmHg	% patients 140-<160 mmHg	% patients 160-<180 mmHg	% patients ≥180 mmHg
1997	1659	144.5	20.8	144.2	130.8	158.1	11	30	35	19	4
1998	2108	146	20.5	146.7	133.2	159.2	10	27	39	19	5
1999	2965	148.7	20.8	148.5	135.3	162.2	8	25	38	23	6
2000	4310	148	20.6	147.8	134.8	161.7	9	25	38	23	6
2001	5147	148.8	20.9	148.8	134.9	162.6	8	25	37	23	7
2002	5911	149.2	20.6	149	135.8	163.3	8	24	38	24	6
2003	6839	149.7	20.2	149.8	136.4	162.9	7	24	39	23	7
2004	7856	149.8	20	150	136.7	163.2	7	23	39	25	6

Figure 8.1.1: Cumulative distribution of Pre dialysis Systolic Blood Pressure (mmHg), HD patients 1997-2004



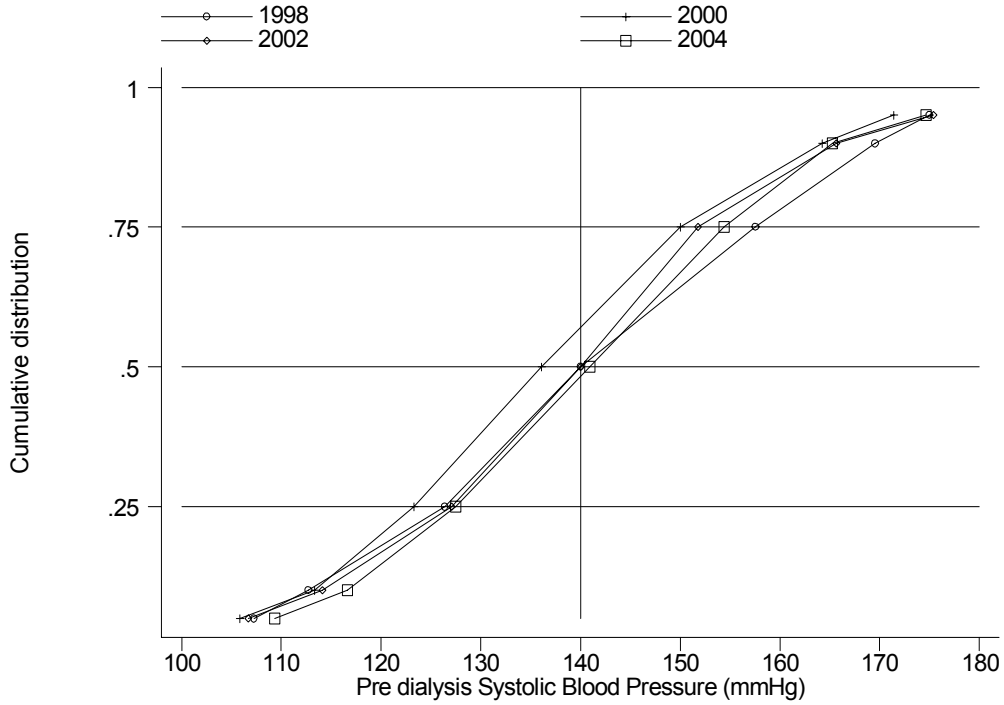
As in the previous years, the mean and median predialysis systolic BP in CAPD patients continued to be lower than that of HD patients, i.e. 141 mm Hg and 140.9 mm Hg respectively (Table 8.1.2).

The percentage of patients with predialysis systolic BP < 140 mm Hg was lower in HD patients as compared with CAPD patients, 30% vs. 47% (Tables 8.1.1 and 8.1.2)

Table 8.1.2: Distribution of Pre dialysis Systolic Blood Pressure (mmHg), CAPD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <120 mmHg	% patients 120-<140 mmHg	% patients 140-<160 mmHg	% patients 160-<180 mmHg	% patients ≥180 mmHg
1997	468	142.7	20.3	142.9	128.3	156.3	13	31	37	17	3
1998	519	141	21.2	140	126.4	157.5	16	34	29	18	3
1999	576	141	19.8	140	127.2	156	14	35	34	15	2
2000	638	137.2	20.4	136.1	123.3	150	18	39	29	13	2
2001	739	139	20.2	137.5	125.8	151.7	16	38	30	13	3
2002	843	139.8	20.5	140	127.1	151.8	14	36	34	12	4
2003	1156	140.5	20.1	140	126.7	154.1	15	35	32	15	3
2004	1260	141	19.8	140.9	127.5	154.4	13	34	35	13	3

Figure 8.1.2: Cumulative distribution of Pre dialysis Systolic Blood Pressure (mmHg), CAPD patients 1997-2004



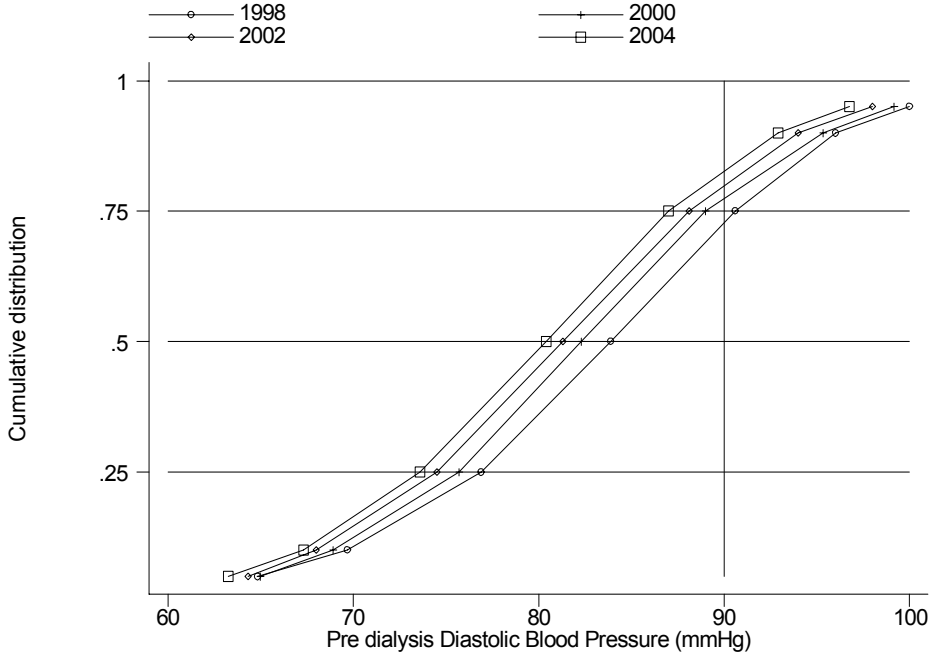
In comparison with the predialysis systolic BP, the predialysis diastolic BP appeared to be better controlled in the HD patients in 2004.

The mean and median predialysis diastolic BP were 80.3 mm Hg and 80.4 mm Hg respectively (Fig 8.1.3). The percentage of HD patients with the predialysis diastolic BP < 90 mm Hg was 84%.

Table 8.1.3: Distribution of Pre dialysis Diastolic Blood Pressure (mmHg), HD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <70 mmHg	% patients 70-<80 mmHg	% patients 80-<90 mmHg	% patients 90-<100 mmHg	% patients ≥100 mmHg
1997	1660	83.7	10.9	84.2	77	90.7	10	23	38	22	6
1998	2108	83.5	10.7	83.9	76.9	90.6	10	24	38	23	5
1999	2965	83.5	10.5	83.5	77.1	90	10	24	40	21	6
2000	4309	82.2	10.4	82.3	75.7	89	11	28	39	18	4
2001	5146	81.6	10.4	81.7	75	88.3	12	30	37	17	4
2002	5907	81.2	10.4	81.3	74.5	88.1	13	30	37	16	3
2003	6837	80.6	10.2	80.8	73.9	87.2	14	32	37	14	3
2004	7854	80.3	10.2	80.4	73.6	87	15	32	36	14	3

Figure 8.1.3: Cumulative distribution of Pre dialysis Diastolic Blood Pressure (mmHg), HD patients 1997-2004

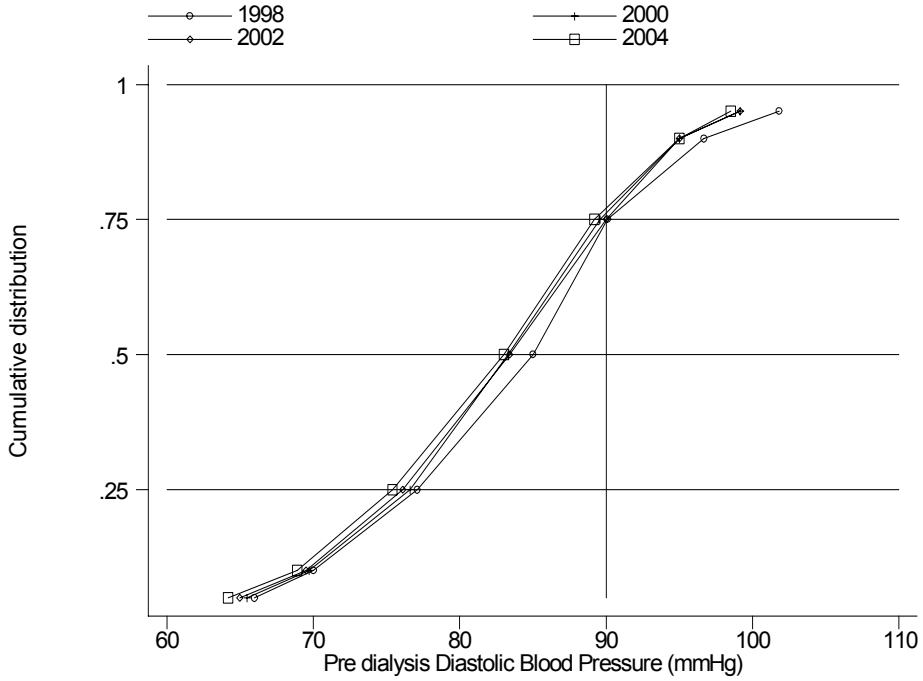


In CAPD patients, the mean and median predialysis diastolic BP in 2004 was 82.2 mm Hg and 83 mm Hg respectively. 78% of CAPD patients had satisfactory control with predialysis diastolic BP < 90 mm Hg.

Table 8.1.4: Distribution of Pre dialysis Diastolic Blood Pressure (mmHg), CAPD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <70 mmHg	% patients 70-<80 mmHg	% patients 80-<90 mmHg	% patients 90-<100 mmHg	% patients ≥100 mmHg
1997	467	85.3	10.6	85.8	79.8	91.4	6	19	41	26	8
1998	519	84.3	11.3	85	77.1	90.1	8	24	36	24	8
1999	576	84	10.9	84.2	77.9	90	9	20	44	20	7
2000	638	82.9	11	83.3	76.6	89.6	10	24	41	20	5
2001	739	83.1	10.9	82.7	76.4	89.6	9	29	38	18	6
2002	843	82.8	10.8	83.4	76.1	90	11	24	41	21	5
2003	1158	82.2	10.9	82.3	75.5	89.4	12	26	38	19	4
2004	1259	82.2	10.5	83	75.4	89.2	11	28	39	18	4

Figure 8.1.4: Cumulative distribution of Pre dialysis Diastolic Blood Pressure (mmHg), CAPD patients 1997-2004



When comparing centers, there was a variation among HD centers with 25% of HD centers having a median predialysis systolic BP below 144.7 mm Hg while another 25% have median predialysis systolic BP above 154.7 mm Hg (Table 8.1.5).

Table 8.1.5: Variation in BP control among HD centres 2004

(a) Median Systolic blood pressure (mmHg) among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	120.5	130.4	140	144.9	151.9	158	159.8
1998	46	128.7	134.8	141.3	146.8	150	157.7	158.1
1999	69	132.1	135.5	143	149	155.3	164.5	170.2
2000	99	130.6	135	141.2	147.5	154.3	163	173.8
2001	116	126.7	136.3	143.1	148.8	155.7	162.9	185.8
2002	133	122.9	137.6	144.3	149	153.8	163.2	171.4
2003	156	124.6	136.3	144.5	150.8	155.6	163.2	171.4
2004	184	122.1	136.9	144.7	150.1	154.7	162.9	171

Figure 8.1.5(a): Variation in median systolic blood pressure (mmHg) among HD patients, HD centres 2004

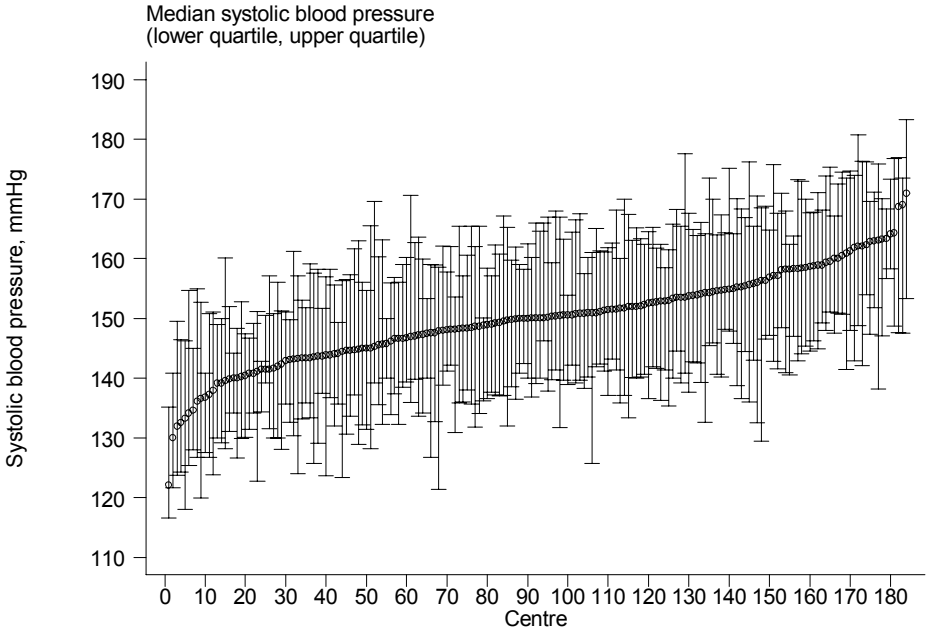


Table 8.1.5(b) Median Diastolic blood pressure (mmHg) among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	70	78	82.1	83.6	85.6	87.7	92.5
1998	46	76.9	78.6	82.6	84.1	85.8	89.8	90.7
1999	69	76.8	79.8	81.4	83.4	86.3	90	94.5
2000	99	74.4	76.8	80	82.5	84.7	88.5	95.7
2001	116	73.6	75.8	79.9	82	84.2	88.1	91.3
2002	133	72	75.2	79.1	81	84	88.3	101.4
2003	156	73.3	75.1	78.6	80.8	83.8	86.8	97.5
2004	184	70.6	74	78.6	80.7	83.1	86.8	93.3

Figure 8.1.5(b): Variation in median diastolic blood pressure (mmHg) among HD patients, HD centres 2004

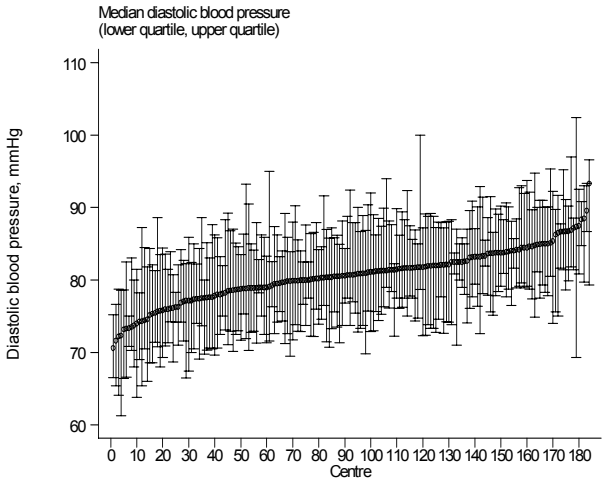


Figure 8.1.5(c): Variation in proportion of HD patients with pre dialysis blood pressure ≤ 140/90 mmHg, HD centres 2004

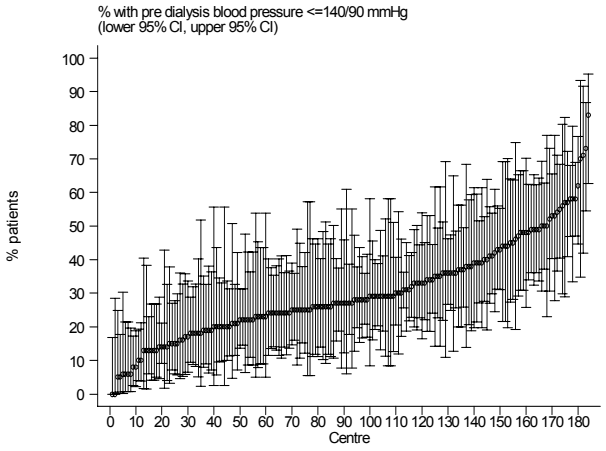


Table 8.1.5(c) Proportion of HD patients with Pre dialysis Blood Pressure ≤ 140/90 mmHg

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	15	17	30	38	45	76	88
1998	46	6	18	26	32	43	60	67
1999	69	0	11	23	32	43	60	67
2000	99	0	12	23	33	45	63	71
2001	116	0	8	21	32	42	57	75
2002	133	0	9	22	31	40	53	80
2003	156	0	8	20	27	40	60	80
2004	184	0	8	20.5	27	38	57	83

Similarly 25% of CAPD centers had median predialysis systolic BP below 137.7 mm Hg while another 25% of CAPD centers had a median predialysis systolic BP above 143.3 mm Hg (Table 8.1.6).

There was also some variation in the median predialysis diastolic BP in HD patients across the various centers (Table 8.1.5). The figures for CAPD patients are as given in the Table 8.1.6 (b).

Table 8.1.6: Variation in BP control among CAPD centres 2004

(a) Median Systolic blood pressure (mmHg) among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	124	124	139.4	142.5	150	151.6	151.6
1998	9	109	109	134.5	143.2	145.8	156.5	156.5
1999	9	90	90	133.7	140	144.9	152.8	152.8
2000	11	112.7	112.7	131.3	135	139.3	150.8	150.8
2001	12	119.6	119.6	133.7	137	138.2	149	149
2002	14	124.4	124.4	135.2	140.6	144.2	148.2	148.2
2003	17	122.2	122.2	131	142.2	146.9	151.5	151.5
2004	17	127.7	127.7	137.7	139.5	143.3	149.3	149.3

Figure 8.1.6(a): Variation in median systolic blood pressure (mmHg) among CAPD patients, CAPD centres 2004

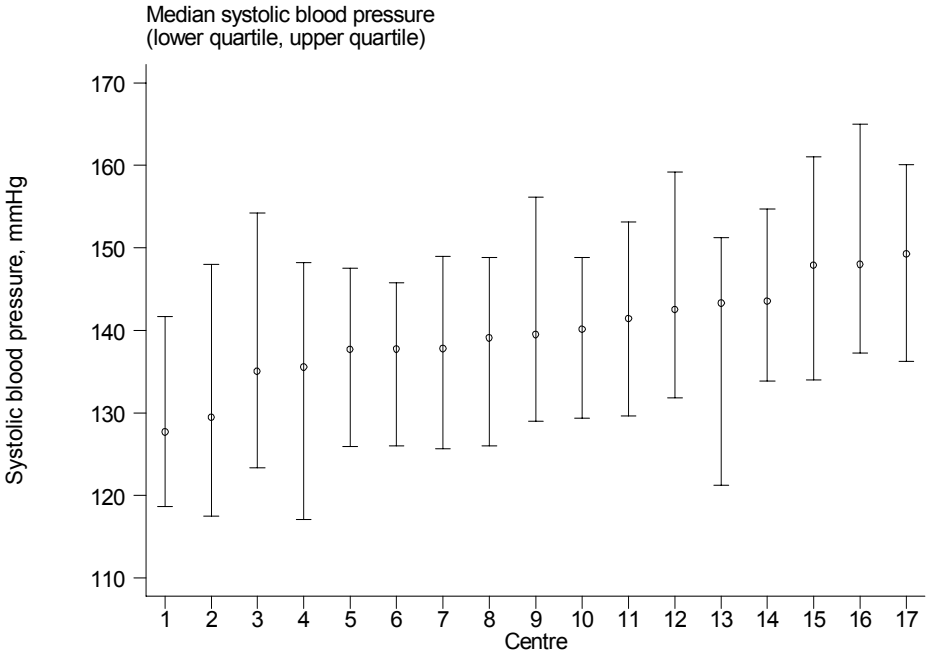


Table 8.1.6(b) Median Diastolic blood pressure (mmHg) among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	82.5	82.5	85.3	86	86	88.7	88.7
1998	9	70.7	70.7	84	85.8	86.3	87.3	87.3
1999	9	70	70	81.7	84.3	85.8	87	87
2000	11	69.8	69.8	80	83	84.4	88	88
2001	12	77.6	77.6	81.3	82.7	84.8	88	88
2002	14	79.2	79.2	82.3	84.2	85.3	90.2	90.2
2003	17	63.8	63.8	80.8	82.9	84.4	89.5	89.5
2004	17	77.5	77.5	82.9	83.8	84.5	87	87

Figure 8.1.6(b): Variation in median diastolic blood pressure (mmHg) among CAPD patients, CAPD centres 2004

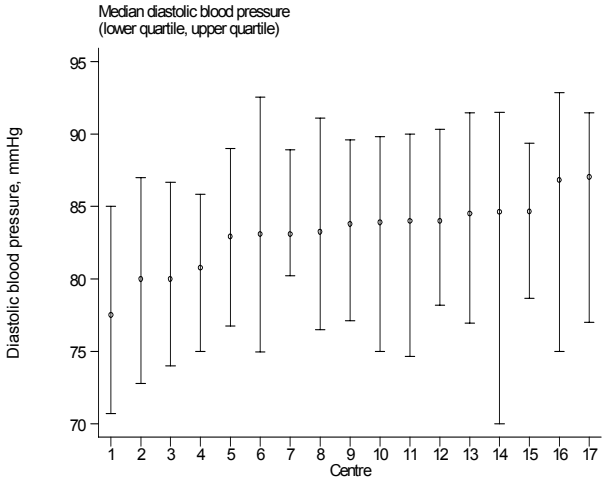


Figure 8.1.6(c): Variation in proportion of CAPD patients with pre dialysis blood pressure ≤ 140/90 mmHg, CAPD centres 2004

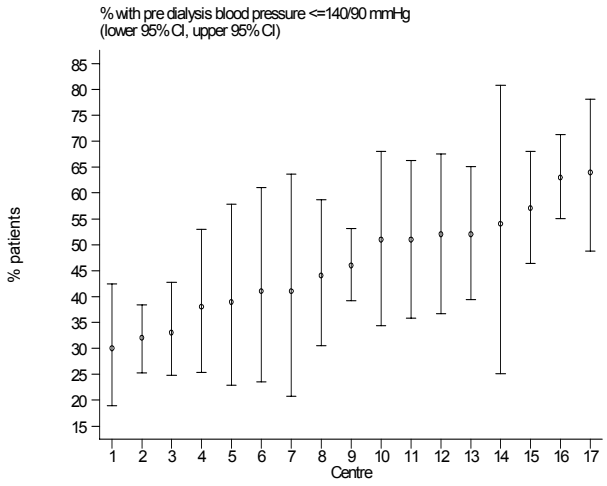


Table 8.1.6(c) Proportion of CAPD patients with Pre dialysis Blood Pressure ≤ 140/90 mmHg

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	26	26	35	41	46	59	59
1998	9	35	35	41	44	49	100	100
1999	9	30	30	40	47	56	100	100
2000	11	23	23	53	56	60	96	96
2001	12	36	36	47	53	60	89	89
2002	14	21	21	35	45	51	68	68
2003	17	28	28	37	44	66	100	100
2004	17	30	30	39	46	52	64	64

8.2: Dyslipidaemia in Dialysis Patients

The previous trend of better total cholesterol control in HD patients in comparison with CAPD patients continued in 2004, with 71% of HD patients having total cholesterol level < 5.3 mmol/l versus 53% of CAPD patients having total cholesterol level < 5.3 mmol/l (Table 8.2.1 and 8.2.2).

Table 8.2.1: Distribution of serum Cholesterol (mmol/L), HD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <3.5 mmol/L	% patients 3.5-<5.3 mmol/L	% patients 5.3-<6.2 mmol/L	% patients ≥6.2 mmol/L
1997	1158	5.1	1.4	5.1	4.2	5.9	8	49	24	19
1998	1166	5.1	1.3	5	4.2	5.8	7	53	22	17
1999	1872	5	1.3	4.9	4.1	5.7	10	54	20	15
2000	2956	5	1.2	4.9	4.2	5.8	8	53	23	16
2001	3898	5.1	1.3	4.9	4.2	5.8	8	52	24	16
2002	4751	5	1.2	4.9	4.2	5.7	9	55	24	13
2003	5811	4.8	1.1	4.8	4.1	5.5	9	59	21	11
2004	6644	4.7	1.1	4.7	4	5.4	11	60	21	8

Figure 8.2.1: Cumulative distribution of Cholesterol (mmol/L), HD patients 1997-2004

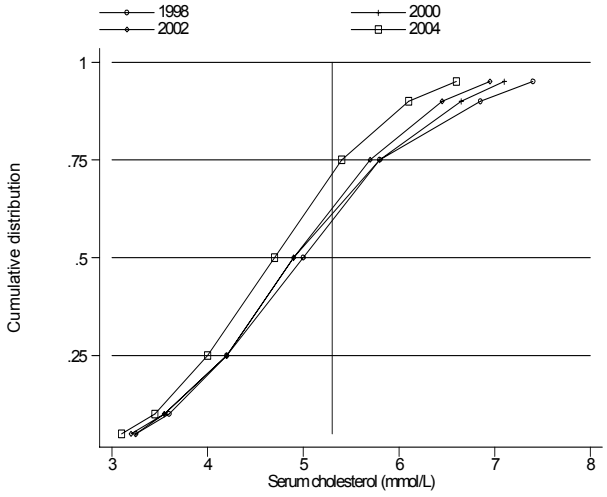


Figure 8.2.2: Cumulative distribution of Cholesterol (mmol/L), CAPD patients 1997-2004

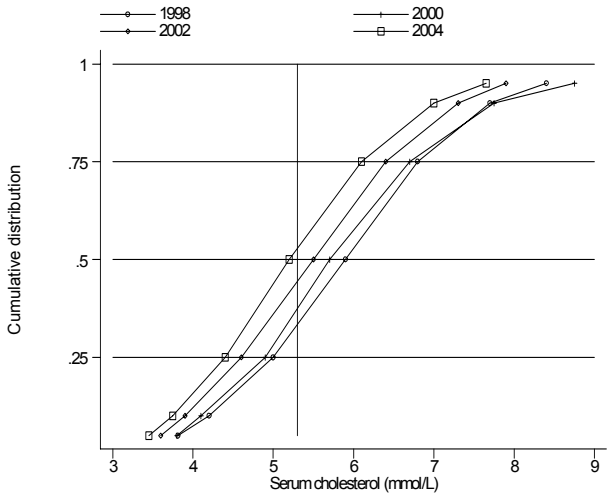


Table 8.2.2: Distribution of serum Cholesterol (mmol/L), CAPD patients 1997-2004

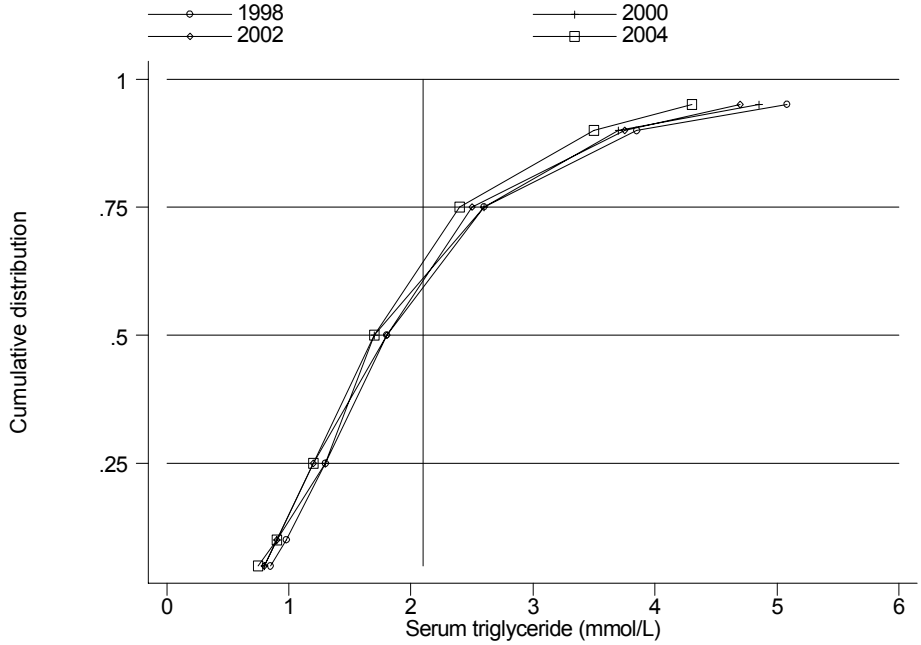
Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <3.5 mmol/L	% patients 3.5-<5.3 mmol/L	% patients 5.3-<6.2 mmol/L	% patients ≥6.2 mmol/L
1997	420	6.1	1.4	6	5.1	6.9	2	27	28	43
1998	348	6	1.4	5.9	5	6.8	3	29	28	41
1999	434	5.7	1.4	5.6	4.9	6.4	3	37	30	31
2000	526	5.9	1.6	5.7	4.9	6.7	3	31	30	36
2001	581	5.8	1.4	5.7	4.8	6.6	2	36	27	35
2002	766	5.6	1.4	5.5	4.6	6.4	4	38	28	29
2003	1106	5.4	1.4	5.3	4.4	6.1	5	45	27	23
2004	1231	5.3	1.4	5.2	4.4	6.1	5	48	26	21

This improvement has brought the proportion of CAPD patients with elevated triglyceride levels (>2.3 mmol/l) closer to HD patients' data (27%) in 2004 (Table 8.2.3).

Table 8.2.3: Distribution of serum Triglyceride (mmol/L), HD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <1.7 mmol/L	% patients 1.7-<2.3 mmol/L	% patients 2.3-<3.5 mmol/L	% patients ≥3.5 mmol/L
1997	1074	2.1	1.4	1.8	1.3	2.5	45	24	18	12
1998	1089	2.2	1.5	1.8	1.3	2.6	42	26	20	12
1999	1634	2.1	1.3	1.7	1.2	2.5	49	22	18	11
2000	2393	2.1	1.4	1.7	1.3	2.6	48	22	19	12
2001	3162	2.1	1.4	1.7	1.2	2.5	48	22	17	13
2002	3861	2.1	1.4	1.8	1.2	2.5	47	22	18	12
2003	4715	2	1.3	1.7	1.2	2.5	48	23	18	11
2004	5543	2	1.2	1.7	1.2	2.4	51	22	17	10

Figure 8.2.3: Cumulative distribution of serum Triglyceride (mmol/L), HD patients 1997-2004

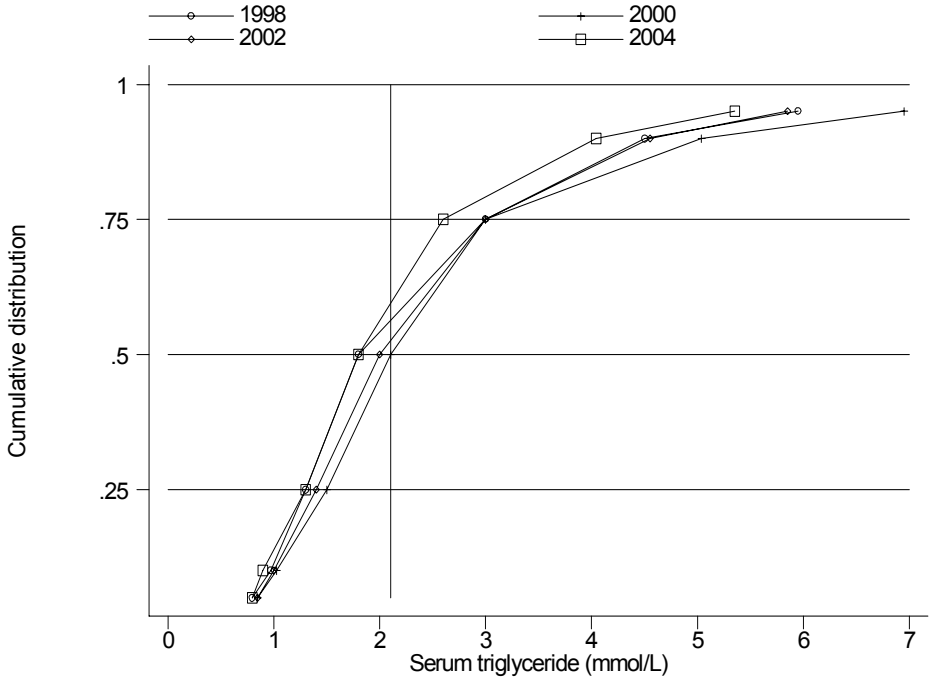


The proportion of patients with elevated triglyceride levels (> 2.3 mmol/l) in CAPD patients in 2004 was less than in previous years (30% in 2004 compared with 35% in 2003 and 44% in 2001) (Table 8.2.4).

Table 8.2.4: Distribution of serum Triglyceride (mmol/L), CAPD patients 1997-2004

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <1.7 mmol/L	% patients 1.7-<2.3 mmol/L	% patients 2.3-<3.5 mmol/L	% patients ≥3.5 mmol/L
1997	413	2.6	1.9	2.2	1.4	3	36	22	25	18
1998	344	2.4	1.8	1.8	1.3	3	42	22	17	19
1999	421	2.4	1.6	2	1.4	3	38	25	18	19
2000	520	2.7	2.2	2.1	1.5	3	33	24	23	21
2001	576	2.6	1.8	2	1.4	3	36	22	22	20
2002	767	2.5	1.7	2	1.4	3	39	21	22	18
2003	1102	2.3	1.6	1.8	1.3	2.8	45	20	21	14
2004	1224	2.2	1.6	1.8	1.3	2.6	47	22	17	13

Figure 8.2.4: Cumulative distribution of serum Triglyceride (mmol/L), CAPD patients 1997-2004



The variation in medium serum cholesterol levels and triglyceride levels among dialysis centers is illustrated in Figure 8.2.5(a) and Figure 8.2.5(c) [HD centers], Figure 8.2.6(a) and Figure 8.2.6(c) [CAPD centers]. This will allow individual dialysis centers to gauge their center's lipid "performance" in comparison to other dialysis centers reporting to the Malaysian Renal Registry.

Table 8.2.5: Variation in dyslipidaemia among HD centres 2004

(a) Median serum cholesterol level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	34	4.1	4.3	4.6	5	5.3	5.8	5.9
1998	28	4	4.4	4.8	5	5.2	5.3	5.4
1999	47	3.5	4.3	4.6	4.8	5.1	5.5	5.8
2000	75	4	4.3	4.8	4.9	5.2	5.5	5.8
2001	95	4.2	4.5	4.7	4.9	5.2	5.8	6.3
2002	112	4.4	4.5	4.7	4.9	5.1	5.4	6
2003	142	4	4.3	4.6	4.8	5	5.3	5.6
2004	164	3.8	4.1	4.5	4.7	4.9	5.3	5.7

Figure 8.2.5(a): Variation in median serum cholesterol level among HD patients, HD centres 2004

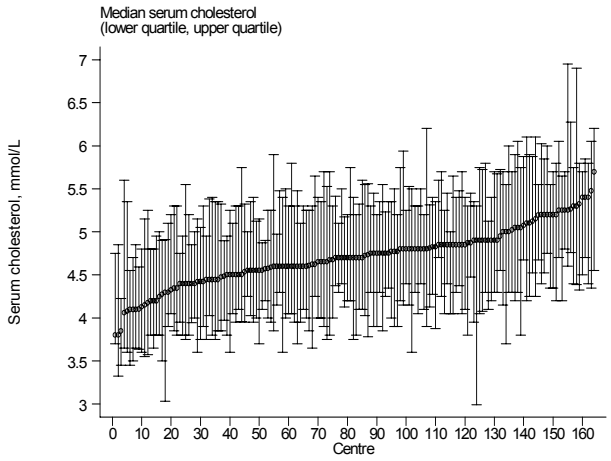


Figure 8.2.5(b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, HD centres 2004

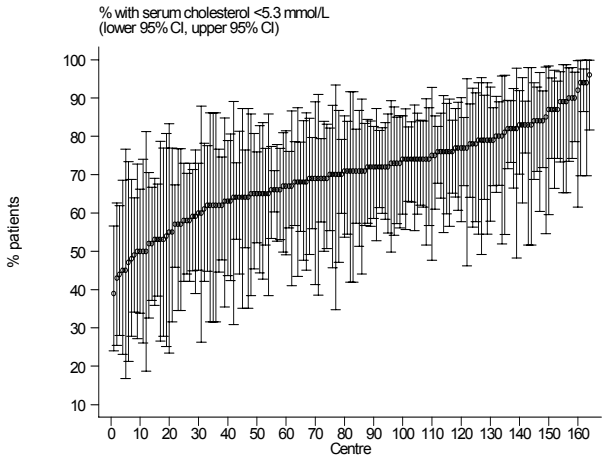


Table 8.2.5(b) Proportion of patients with serum cholesterol < 5.3 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	34	33	35	48	57	64	84	92
1998	28	38	42	52	59.5	69	84	89
1999	47	34	38	57	68	76	84	93
2000	75	32	38	51	60	68	83	100
2001	95	13	37	54	60	68	80	90
2002	112	31	42	57	64	70	79	92
2003	142	40	48	61	68	76	84	100
2004	164	39	50	63.5	71	78	89	96

Table 8.2.5(c) Median serum triglyceride level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	33	1.3	1.3	1.6	1.8	1.9	2.5	2.9
1998	27	1.4	1.5	1.7	1.8	1.9	2	2.2
1999	39	1.3	1.3	1.5	1.6	1.9	2.3	2.5
2000	59	1.3	1.4	1.5	1.8	2	2.4	2.6
2001	79	.9	1.3	1.5	1.7	1.9	2.5	3.3
2002	95	1.2	1.3	1.6	1.8	1.9	2.3	2.9
2003	122	1.2	1.3	1.6	1.7	1.9	2.2	2.5
2004	150	1	1.3	1.5	1.6	1.9	2.2	2.8

Figure 8.2.5(c): Variation in median serum triglyceride level among HD patients, HD centres 2004

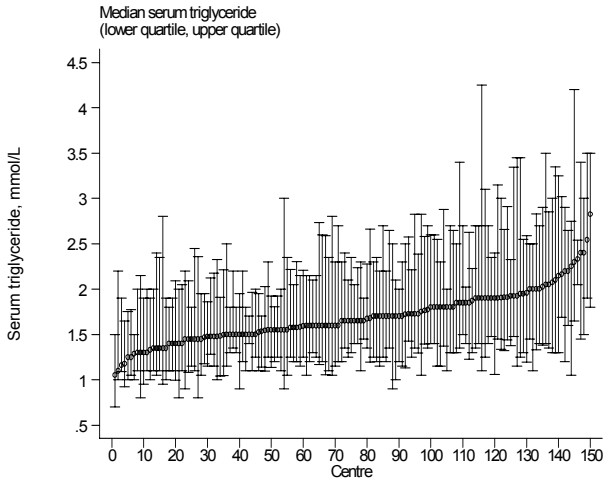


Figure 8.2.5(d): Variation in proportion of patients with serum triglyceride < 2.1 mmol/L, HD centres 2004

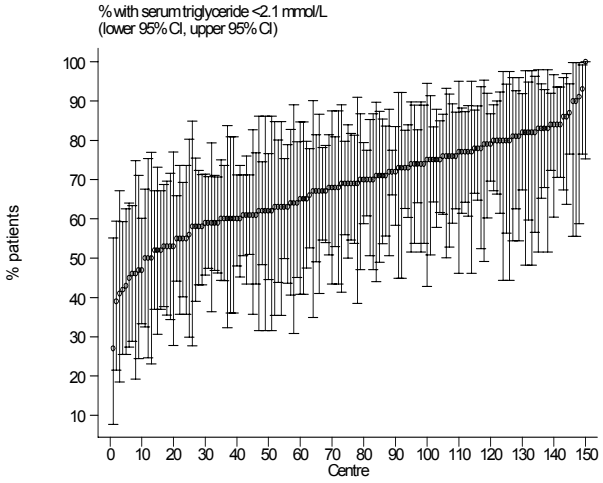


Table 8.2.5(d) Proportion of patients with serum triglyceride < 2.1 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	33	29	36	60	65	77	83	85
1998	27	47	53	58	64	69	79	82
1999	39	43	48	61	67	75	90	92
2000	59	17	36	57	65	72	84	100
2001	79	33	41	57	66	74	86	100
2002	95	9	45	58	65	72	83	90
2003	122	30	48	59	67	74	86	100
2004	150	27	46	60	69	77	86	100

Table 8.2.6: Variation in dyslipidaemia among CAPD centres 2004

(a) Median serum cholesterol level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	5.8	5.8	5.9	5.9	6.1	6.1	6.1
1998	6	5.1	5.1	5.6	5.8	6.1	6.2	6.2
1999	8	5.3	5.3	5.6	5.7	5.9	6	6
2000	10	4.9	4.9	5.3	5.7	6	6.4	6.4
2001	10	5	5	5.5	5.9	6	6.2	6.2
2002	14	4.9	4.9	5.4	5.6	5.7	6.3	6.3
2003	17	4.6	4.6	5.2	5.3	5.7	6.1	6.1
2004	17	4.6	4.6	5	5.3	5.5	5.9	5.9

Figure 8.2.6(a): Variation in median serum cholesterol level among CAPD patients, CAPD centres 2004

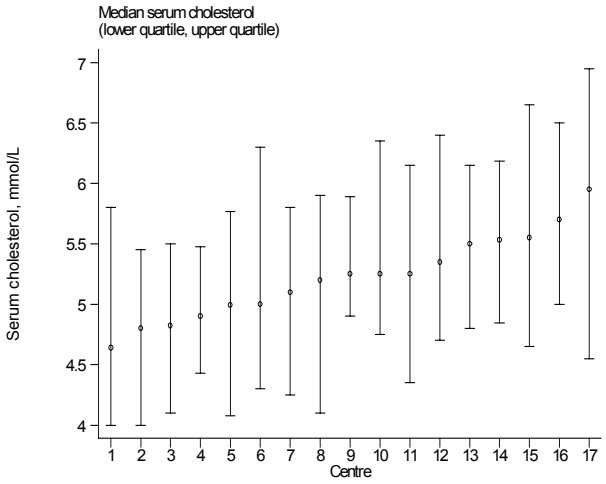


Figure 8.2.6(b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, CAPD centres 2004

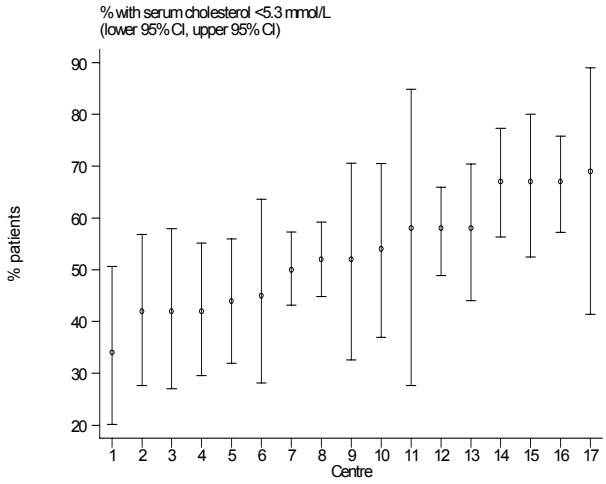


Table 8.2.6(b) Proportion of patients with serum cholesterol < 5.3 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	27	27	27	29	31	33	33
1998	6	24	24	27	32	38	50	50
1999	8	6	6	29.5	39.5	43.5	50	50
2000	10	11	11	18	31	47	50	50
2001	10	23	23	30	34	44	61	61
2002	14	25	25	36	41	43	80	80
2003	17	0	0	38	48	54	81	81
2004	17	34	34	44	52	58	69	69

Table 8.2.6(c) Median serum triglyceride level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	1.7	1.7	1.9	2.1	2.2	2.4	2.4
1998	6	1.2	1.2	1.5	1.7	1.9	2.1	2.1
1999	8	1.6	1.6	1.9	2	2.1	2.6	2.6
2000	10	1.8	1.8	2	2.1	2.5	2.8	2.8
2001	10	1.5	1.5	1.8	2	2.1	3	3
2002	14	1.6	1.6	1.8	2	2.1	2.4	2.4
2003	17	1.1	1.1	1.7	1.8	2	2.2	2.2
2004	17	1.4	1.4	1.6	1.8	1.9	2.1	2.1

Figure 8.2.6(c): Variation in median serum triglyceride level among CAPD patients, CAPD centres 2004

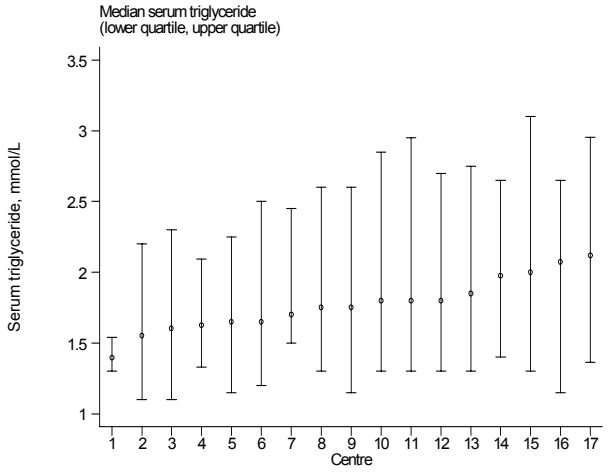


Figure 8.2.6(d): Variation in proportion of patients with serum triglyceride < 2.1 mmol/L, CAPD centres 2004

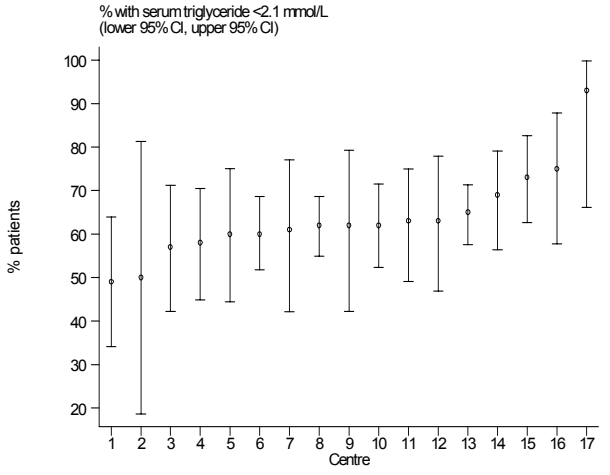


Table 8.2.6(d) Proportion of patients with serum triglyceride < 2.1 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	6	40	40	46	52	56	61	61
1998	6	51	51	58	60.5	70	73	73
1999	8	37	37	53	56.5	62.5	71	71
2000	10	18	18	38	51.5	54	67	67
2001	10	28	28	51	52.5	58	68	68
2002	14	37	37	51	54	57	75	75
2003	17	48	48	56	59	62	100	100
2004	17	49	49	60	62	65	93	93

CHAPTER 9

MANAGEMENT OF RENAL BONE DISEASE IN DIALYSIS PATIENTS

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9.1: Treatment of Renal Bone Disease

Since 1997 the majority of dialysis patients on both HD (>90%) and CAPD (75-84%) received calcium carbonate as a phosphate binder. The usage of aluminium phosphate binders fell sharply since 1997 to 1% in 2004. Vitamin D was used in increasing numbers in both HD and CAPD patients. (table 9.1.1 & 9.1.2)

Table 9.1.1: Treatment for Renal Bone Disease, HD patients 1997-2004

Year	No. of subjects	No. of subjects on $CaCO_3$	% on $CaCO_3$	No. of subjects on $Al(OH)_3$	% on $Al(OH)_3$	No. of subjects on Vitamin D	% on Vitamin D
1997	1695	1543	91	417	25	694	41
1998	2141	1956	91	343	16	652	30
1999	2996	2693	90	244	8	770	26
2000	4392	3977	91	239	5	1084	25
2001	5194	4810	93	145	3	1145	22
2002	6108	5536	91	171	3	1375	23
2003	7043	6430	91	118	2	1692	24
2004	8151	7332	90	106	1	2009	25

Table 9.1.2: Treatment for Renal Bone Disease, CAPD patients 1997-2004

Year	No. of subjects	No. of subjects on $CaCO_3$	% on $CaCO_3$	No. of subjects on $Al(OH)_3$	% on $Al(OH)_3$	No. of subjects on Vitamin D	% on Vitamin D
1997	476	393	83	57	12	114	24
1998	541	425	79	46	9	110	20
1999	610	450	74	36	6	75	12
2000	662	522	79	15	2	96	15
2001	781	588	75	5	1	84	11
2002	891	713	80	6	1	130	15
2003	1237	1040	84	10	1	238	19
2004	1341	1125	84	18	1	304	23

9.2: Serum Calcium and Phosphate Control

The median corrected serum calcium level was 2.4 to 2.5 mmol/l in CAPD patients and 2.3 mmol/l amongst HD patients.

Table 9.2.1: Distribution of corrected Serum Calcium, HD patients 1997-2004

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥2.2 & ≤2.6 mmol/L
1997	1633	2.3	.3	2.3	2.2	2.5	57
1998	2060	2.3	.3	2.3	2.2	2.5	60
1999	2732	2.3	.3	2.3	2.2	2.5	59
2000	3704	2.4	.3	2.3	2.2	2.5	61
2001	4618	2.4	.2	2.4	2.2	2.5	64
2002	5485	2.3	.3	2.3	2.2	2.5	60
2003	6471	2.3	.2	2.3	2.2	2.4	62
2004	7466	2.3	.2	2.3	2.2	2.4	62

Figure 9.2.1: Cumulative distribution of corrected Serum Calcium, HD patients 1997-2004

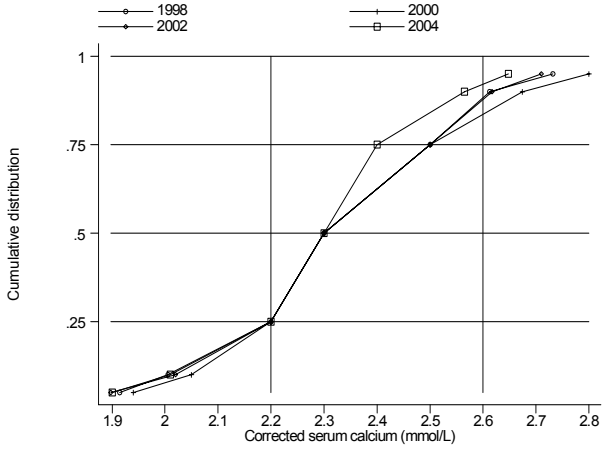


Figure 9.2.2: Cumulative distribution of corrected Serum Calcium, CAPD patients 1997-2004

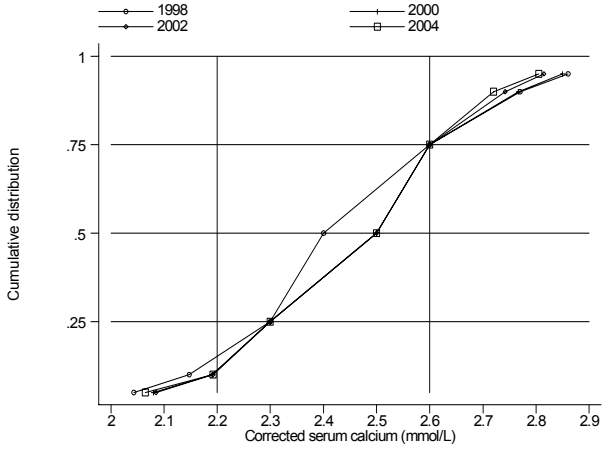


Table 9.2.2: Distribution of corrected Serum Calcium, CAPD patients 1997-2004

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥2.2 & ≤2.6 mmol/L
1997	469	2.5	.3	2.5	2.3	2.6	57
1998	535	2.4	.3	2.4	2.3	2.6	59
1999	593	2.5	.2	2.5	2.3	2.6	63
2000	635	2.5	.2	2.5	2.3	2.6	60
2001	744	2.5	.3	2.5	2.4	2.7	56
2002	859	2.5	.2	2.5	2.3	2.6	63
2003	1169	2.4	.2	2.5	2.3	2.6	62
2004	1277	2.5	.2	2.5	2.3	2.6	66

The median serum phosphate levels were lower among patients on CAPD (1.5 to 1.6 mmol/l) compared to HD patients(1.8-1.9 mmol/l). (table and fig 9.2.3 & 9.2.4)

Table 9.2.3: Distribution of Serum Phosphate, HD patients 1997-2004

Year	No of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥1.6 & <1.8 mmol/L	% patients ≥1.8 & <2.2 mmol/L	% patients ≥2.2 & ≤2.6 mmol/L
1997	1649	1.9	.5	1.9	1.6	2.3	16	27	19
1998	2051	1.9	.5	1.9	1.6	2.2	16	33	17
1999	2861	1.9	.5	1.9	1.5	2.2	15	28	18
2000	4080	1.9	.6	1.8	1.5	2.2	16	29	15
2001	4765	1.9	.5	1.8	1.5	2.2	17	27	16
2002	5679	1.9	.5	1.8	1.5	2.2	17	27	17
2003	6593	1.8	.5	1.8	1.5	2.2	17	26	15
2004	7545	1.8	.5	1.8	1.5	2.2	17	25	15

Figure 9.2.3: Cumulative distribution of Serum Phosphate, HD patients 1997-2004

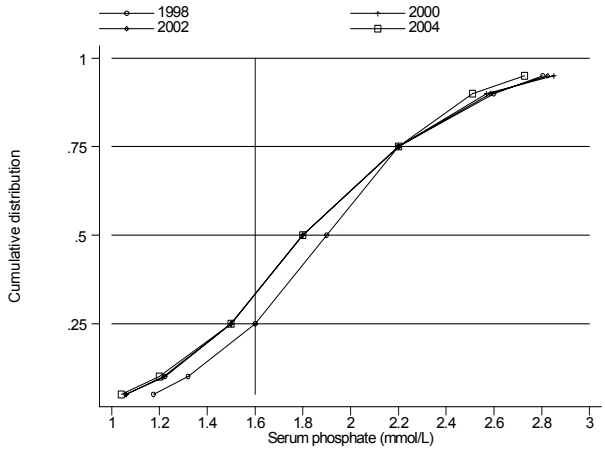


Figure 9.2.4: Cumulative distribution of Serum Phosphate, CAPD patients 1997-2004

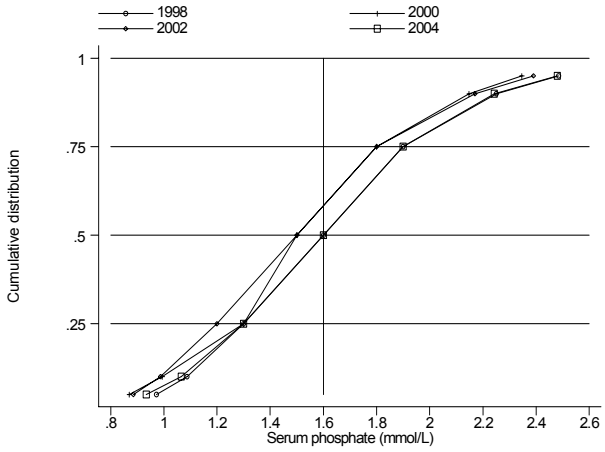


Table 9.2.4: Distribution of Serum Phosphate, CAPD patients 1997-2004

Year	No of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥1.6 & <1.8 mmol/L	% patients ≥1.8 & <2.2 mmol/L	% patients ≥2.2 & ≤2.6 mmol/L
1997	470	1.6	.4	1.5	1.3	1.8	17	20	6
1998	537	1.6	.5	1.6	1.3	1.9	17	20	8
1999	583	1.6	.5	1.6	1.3	1.9	16	22	7
2000	633	1.5	.5	1.5	1.3	1.8	14	19	6
2001	732	1.5	.5	1.5	1.2	1.8	14	17	5
2002	862	1.5	.5	1.5	1.2	1.8	15	16	7
2003	1175	1.6	.5	1.5	1.2	1.9	14	19	8
2004	1279	1.6	.5	1.6	1.3	1.9	16	20	8

The mean serum calcium phosphate product was higher among HD patients compared to CAPD patients (4.1 to 4.5 compared to 3.8 to 4.0).

Table 9.2.5: Distribution of corrected calcium x phosphate product, HD patients 1997-2004

Year	No of Subjects	Mean	SD	Median	LQ	UQ	% patients <3.5 $mmol^2/L^2$	% patients ≥3.5 & <4 $mmol^2/L^2$	% patients ≥4 & <4.5 $mmol^2/L^2$	% patients ≥4.5 & <5 $mmol^2/L^2$	% patients ≥5 & <5.5 $mmol^2/L^2$	% patients ≥5.5 $mmol^2/L^2$
1997	1615	4.5	1.3	4.5	3.6	5.3	23	14	15	17	12	20
1998	2020	4.5	1.2	4.4	3.7	5.2	21	15	18	15	13	19
1999	2698	4.4	1.3	4.3	3.4	5.2	27	14	15	14	11	18
2000	3651	4.4	1.3	4.3	3.5	5.2	25	15	16	15	10	19
2001	4555	4.3	1.3	4.2	3.4	5.2	27	16	16	13	11	18
2002	5403	4.4	1.3	4.3	3.4	5.2	27	16	15	13	10	19
2003	6388	4.2	1.3	4.1	3.3	5.1	30	16	15	13	10	16
2004	7345	4.2	1.3	4.1	3.3	5	32	16	15	12	10	15

Figure 9.2.5: Cumulative distribution of corrected Calcium x Phosphate product, HD patients 1997-2004

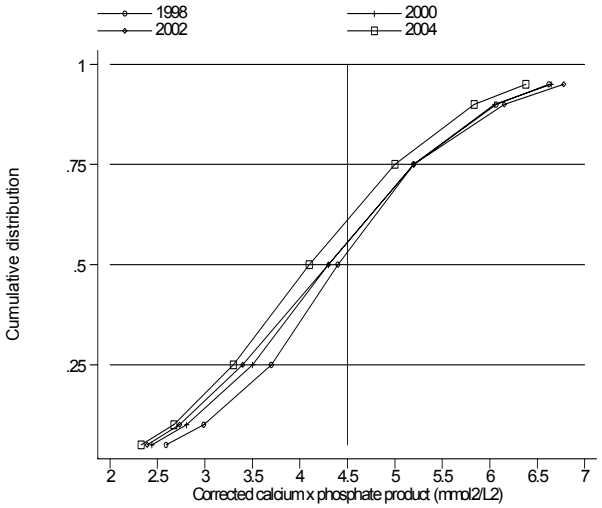


Figure 9.2.6: Cumulative distribution of corrected Calcium x Phosphate product, CAPD patients 1997-2004

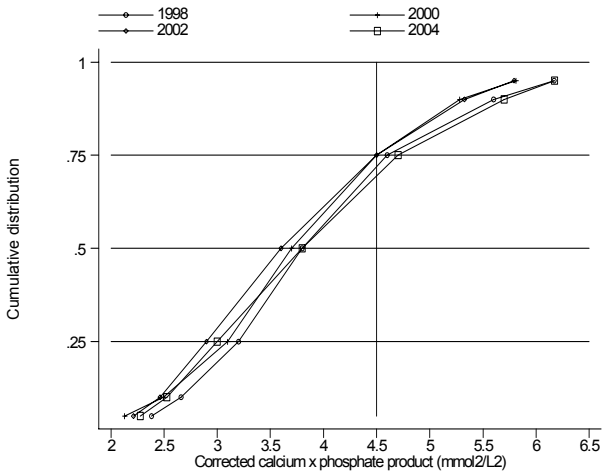


Table 9.2.6: Distribution of corrected calcium x phosphate product, CAPD patients 1997-2004

Year	No of Subjects	Mean	SD	Median	LQ	UQ	% patients <3.5 $mmol^2/L^2$	% patients ≥3.5 & <4 $mmol^2/L^2$	% patients ≥4 & <4.5 $mmol^2/L^2$	% patients ≥4.5 & <5 $mmol^2/L^2$	% patients ≥5 & <5.5 $mmol^2/L^2$	% patients ≥5.5 $mmol^2/L^2$
1997	468	3.9	1.1	3.7	3.1	4.5	40	20	15	10	6	7
1998	533	4	1.1	3.8	3.2	4.6	38	18	16	10	6	11
1999	580	4	1.2	3.8	3.2	4.8	36	20	13	12	9	10
2000	621	3.8	1.1	3.7	3.1	4.5	44	19	12	10	7	8
2001	723	3.8	1.1	3.6	2.9	4.5	46	18	12	10	8	7
2002	856	3.8	1.2	3.6	2.9	4.5	45	17	12	11	7	8
2003	1164	3.9	1.2	3.7	3	4.6	43	17	13	10	8	10
2004	1275	4	1.2	3.8	3	4.7	41	15	14	10	8	12

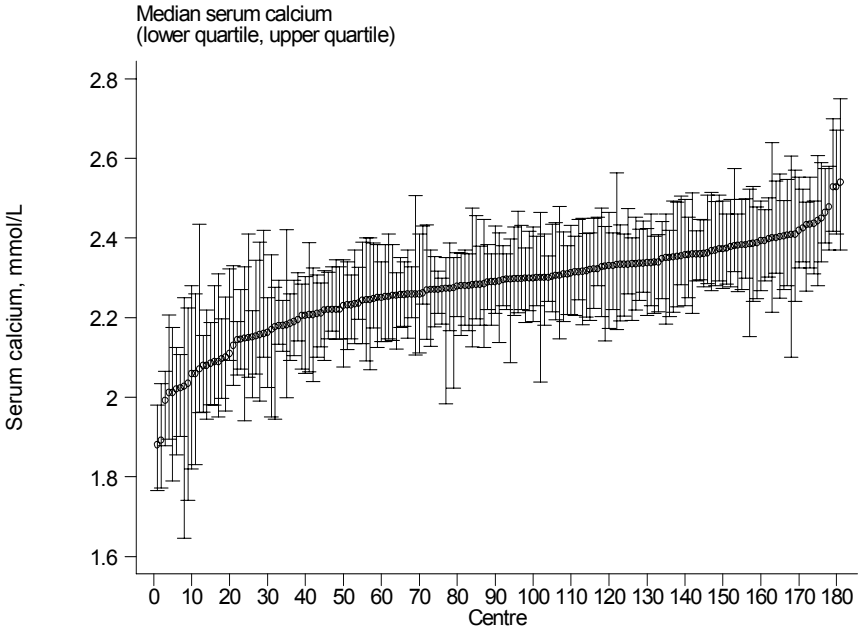
In 2004 the median calcium value among HD centres was 2.3 mmol/l compared to 2.4 mmol/l in CAPD centre (table 9.2.7a and 9.2.8a)

Table 9.2.7: Variation in corrected serum calcium levels among HD centres, 2004

(a) Median serum calcium level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	2.1	2.2	2.3	2.3	2.4	2.5	2.5
1998	45	1.9	2.1	2.2	2.3	2.4	2.4	2.5
1999	64	1.7	2	2.2	2.3	2.4	2.5	2.5
2000	91	2	2.2	2.3	2.3	2.4	2.6	3.2
2001	110	1.9	2.1	2.3	2.3	2.4	2.5	2.6
2002	131	1.9	2.1	2.2	2.3	2.4	2.5	2.6
2003	149	2	2.1	2.2	2.3	2.4	2.5	2.5
2004	181	1.9	2.1	2.2	2.3	2.4	2.4	2.5

Figure 9.2.7(a): Variation in median serum calcium level among HD patients, HD centres 2004



We reviewed among centers (both HD and CAPD) the proportion of patients with serum calcium range between 2.2 to 2.6 mmol/l from 1997 to 2004. The median was higher for CAPD centres(71%) compared to HD centres(63%) for the year 2004.

Table 9.2.7(b) Proportion of patients with serum calcium 2.2 to 2.6 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	23	36	50	58	63	73	75
1998	45	21	25	53	65	72	80	81
1999	64	8	24	49	61	68	80	100
2000	91	0	25	53	61	70	79	100
2001	110	0	31	56	66	72	86	100
2002	131	5	25	48	60	70	80	91
2003	149	11	30	51	63	70	81	92
2004	181	0	24	48	63	72	82	90

Figure 9.2.7(b): Variation in proportion of patients with serum calcium 2.2 to 2.6 mmol/L, HD centres 2004

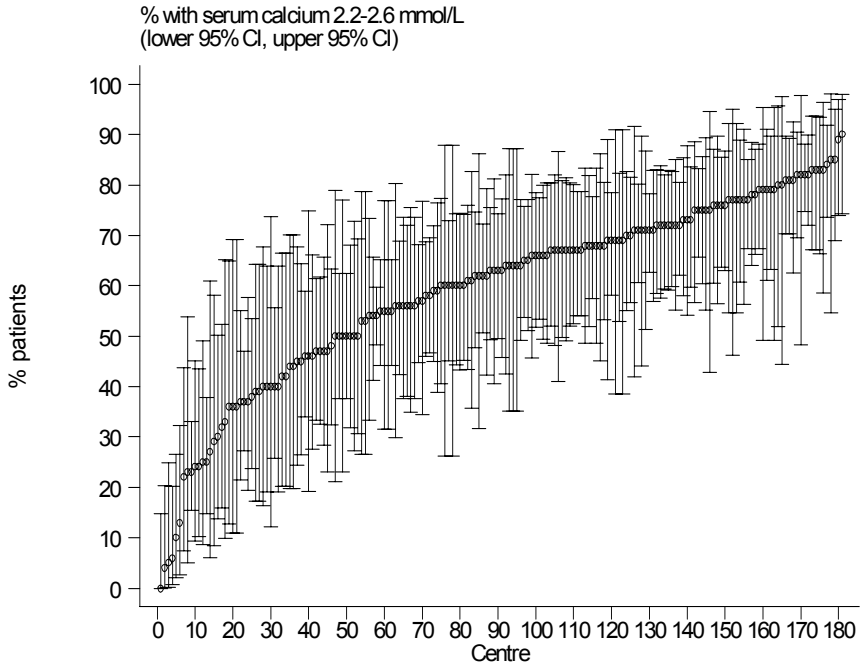


Table 9.2.8: Variation in corrected serum calcium levels among CAPD centres, 2004

(a) Median serum calcium level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	2.1	2.1	2.4	2.4	2.5	2.6	2.6
1998	9	2.3	2.3	2.4	2.4	2.5	2.6	2.6
1999	9	2.4	2.4	2.4	2.5	2.5	2.6	2.6
2000	11	2.4	2.4	2.4	2.5	2.5	2.6	2.6
2001	12	2.3	2.3	2.4	2.5	2.5	2.6	2.6
2002	14	2.4	2.4	2.4	2.5	2.5	2.6	2.6
2003	17	2.3	2.3	2.4	2.4	2.5	2.6	2.6
2004	17	2.3	2.3	2.4	2.4	2.5	2.5	2.5

Figure 9.2.8(a): Variation in median serum calcium level among CAPD patients, CAPD centres 2004

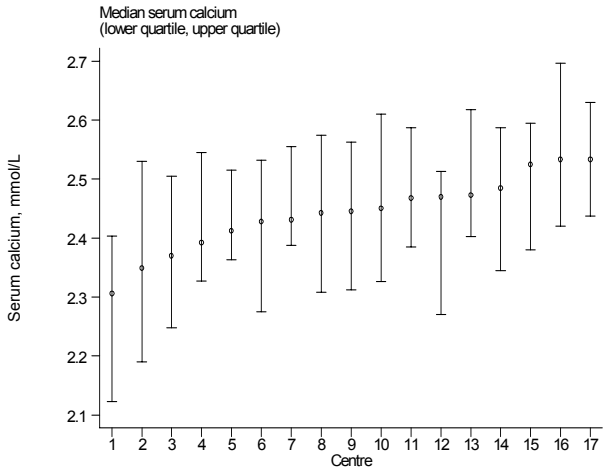


Figure 9.2.8(b): Variation in proportion of patients with serum calcium 2.2 to 2.6 mmol/L, CAPD centres 2004

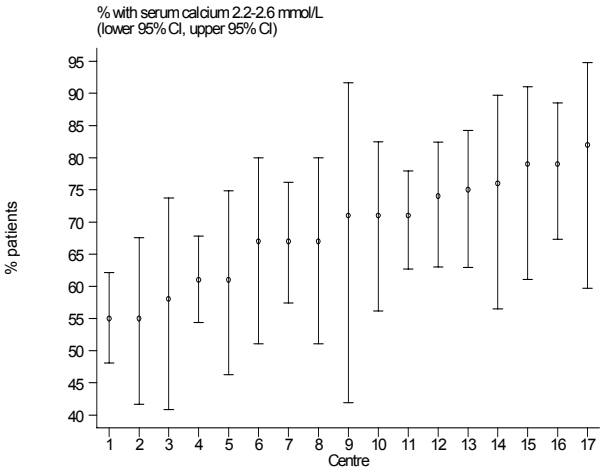


Table 9.2.8(b) Proportion of patients with serum calcium 2.2 to 2.6 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	34	34	35	59	67	71	71
1998	9	0	0	43	56	58	79	79
1999	9	43	43	54	58	63	82	82
2000	11	44	44	46	55	69	83	83
2001	12	46	46	53	57	60.5	69	69
2002	14	48	48	55	69.5	73	80	80
2003	17	40	40	61	65	67	76	76
2004	17	55	55	61	71	75	82	82

In reviewing the proportion of patients with a serum phosphate level below 1.6 mmol/l, the CAPD centers have a higher median proportion of patients with serum phosphate level below 1.6 mmol/L compared to HD centres.

Table 9.2.9: Variation in serum phosphate levels among HD centres, 2004

(a) Median serum phosphate level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	1.3	1.5	1.8	1.9	2.1	2.3	2.8
1998	45	1.5	1.5	1.8	1.9	2	2.2	2.6
1999	66	1.1	1.6	1.7	1.9	2	2.1	2.3
2000	97	1.4	1.6	1.7	1.9	2	2.2	3.7
2001	109	1.4	1.5	1.7	1.8	2	2.1	2.5
2002	133	1.3	1.6	1.8	1.8	2	2.2	2.4
2003	155	.9	1.5	1.7	1.8	2	2.2	2.5
2004	183	1.3	1.6	1.7	1.8	1.9	2.2	2.5

Figure 9.2.9(a): Variation in median serum phosphate level among HD patients, HD centres 2004

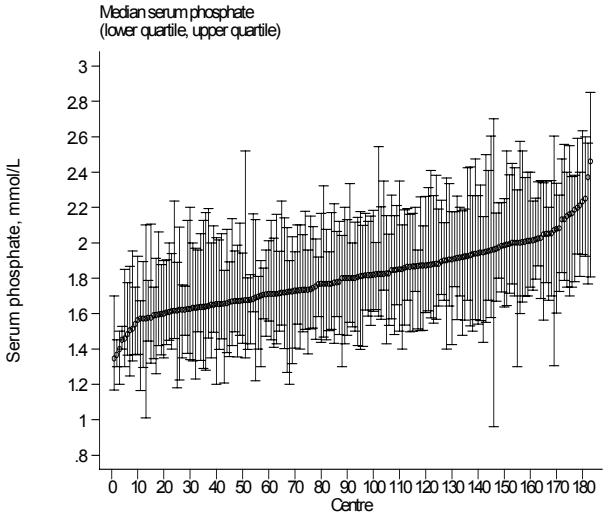


Figure 9.2.9(b): Variation in proportion of patients with serum phosphate ≤ 1.6 mmol/L, HD centres 2004

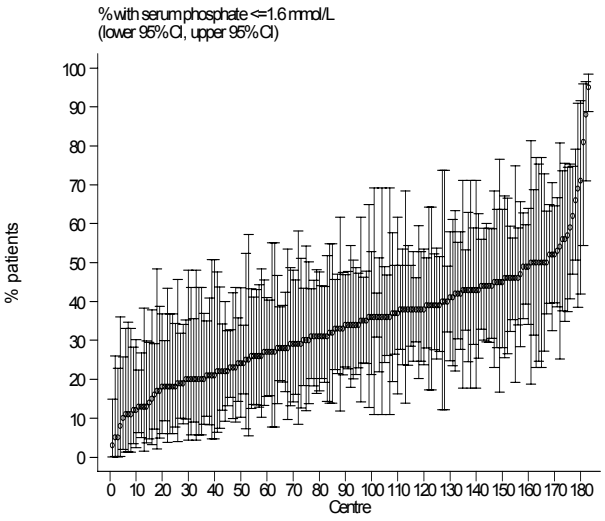


Table 9.2.9(b) Proportion of patients with serum phosphate ≤ 1.6 mmol/L among HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	0	10	17	25.5	36	55	71
1998	45	0	5	17	22	29	54	56
1999	66	0	11	20	29	39	51	87
2000	97	4	10	22	29	38	50	68
2001	109	0	11	22	28	38	58	83
2002	133	0	8	21	29	35	53	74
2003	155	5	12	22	32	39	55	95
2004	183	3	12	23	34	43	56	95

Table 9.2.10: Variation in serum phosphate levels among CAPD centres, 2004

(a) Median serum phosphate level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	1.4	1.4	1.5	1.5	1.6	1.7	1.7
1998	9	1.1	1.1	1.5	1.6	1.6	1.8	1.8
1999	9	1.5	1.5	1.6	1.6	1.7	2.2	2.2
2000	11	1.3	1.3	1.4	1.5	1.6	1.9	1.9
2001	12	1.3	1.3	1.4	1.5	1.6	2	2
2002	14	1.4	1.4	1.5	1.6	1.6	2	2
2003	17	1.2	1.2	1.4	1.5	1.6	1.7	1.7
2004	17	1.3	1.3	1.5	1.5	1.7	1.8	1.8

Figure 9.2.10(a): Variation in median serum phosphate level among CAPD patients, CAPD centres 2004

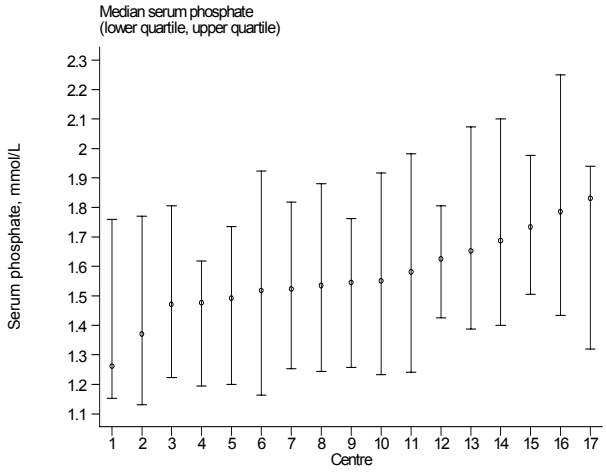


Figure 9.2.10(b): Variation in proportion of patients with serum phosphate ≤ 1.6 mmol/L, CAPD centres

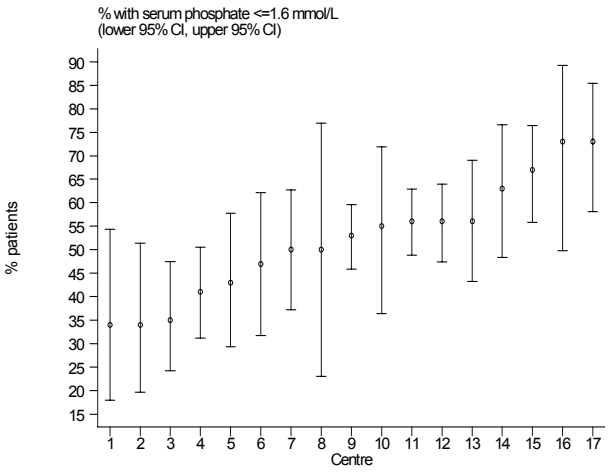


Table 9.2.10(b) Proportion of patients with serum phosphate ≤ 1.6 mmol/L, CAPD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	24	24	53	54	63	75	75
1998	9	37	37	45	52	56	100	100
1999	9	0	0	43	51	56	57	57
2000	11	22	22	48	56	66	72	72
2001	12	27	27	50	57.5	66	71	71
2002	14	31	31	49	55.5	61	73	73
2003	17	33	33	48	56	63	75	75
2004	17	34	34	43	53	56	73	73

A higher number of CAPD centers have median serum calcium phosphate product less than 4.5 as compared to HD centers (71-78% versus 51.5 –65%). There is an increasing trend among HD centers achieving a corrected calcium phosphate product less than 4.5 $mmol^2/L^2$ (table and fig 9.2.11 & 9.2.12)

Table 9.2.11: Variation in corrected calcium x phosphate product among HD centres, 2004

(a) Median corrected calcium x phosphate product among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	2.9	3.7	4.1	4.4	4.8	5.3	6.2
1998	45	3.2	3.4	4.1	4.5	4.7	5.1	5.3
1999	64	2.4	3.2	4	4.3	4.7	5.2	5.4
2000	89	2.9	3.5	4	4.3	4.7	5.2	6.1
2001	106	3	3.5	4	4.3	4.6	5	6.3
2002	130	2.9	3.6	4	4.3	4.5	5.1	5.9
2003	149	2.2	3.3	3.9	4.2	4.5	4.9	5.7
2004	181	2.9	3.3	3.8	4.1	4.4	5	5.5

Figure 9.2.11(a): Variation in median corrected calcium x phosphate product among HD patients, HD centres 2004

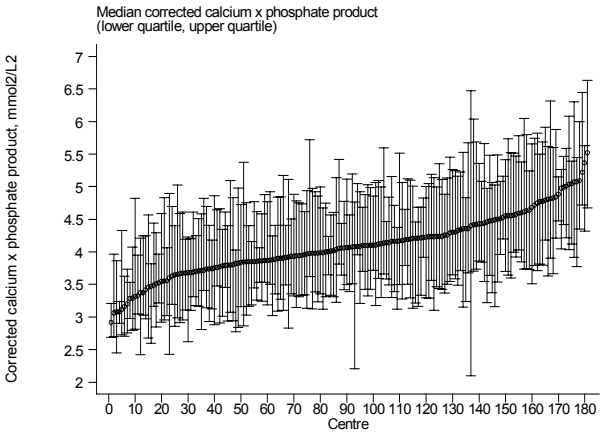


Figure 9.2.11(b): Variation in proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, HD centres 2004

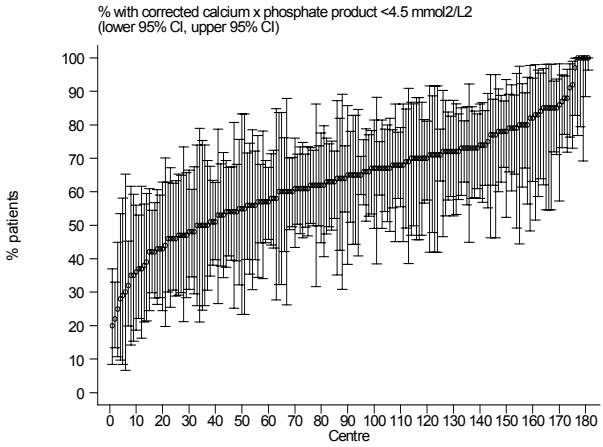


Table 9.2.11(b) Proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	15	26	39	51.5	65	77	100
1998	45	29	33	43	53	66	80	91
1999	64	18	31	43.5	55.5	66	90	97
2000	89	14	25	46	56	66	80	91
2001	106	9	38	47	57	70	82	87
2002	130	17	31	48	57	68	83	99
2003	149	27	35	50	62	70	85	100
2004	181	20	36	54	65	73	88	100

Table 9.2.12: Variation in corrected calcium x phosphate product among CAPD centres, 2004

(a) Median corrected calcium x phosphate product among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	3.5	3.5	3.6	3.7	3.8	3.9	3.9
1998	9	2.8	2.8	3.7	3.8	3.9	4	4
1999	9	3.1	3.1	3.8	4	4.1	4.2	4.2
2000	11	3.3	3.3	3.5	3.7	4	4.4	4.4
2001	12	3.1	3.1	3.4	3.7	4	4.7	4.7
2002	14	3.3	3.3	3.5	3.7	4.1	4.6	4.6
2003	17	3.1	3.1	3.5	3.7	4	4.1	4.1
2004	17	3.2	3.2	3.6	3.8	4	4.4	4.4

Figure 9.2.12(a): Variation in median corrected calcium x phosphate product among CAPD patients, CAPD centres 2004

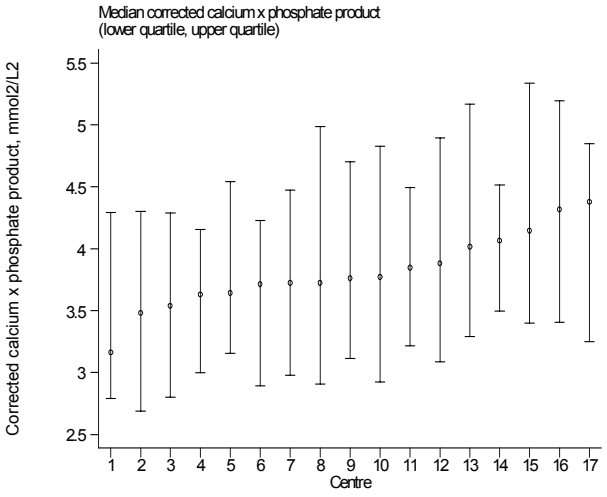


Figure 9.2.12(b): Variation in proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, CAPD centres 2004

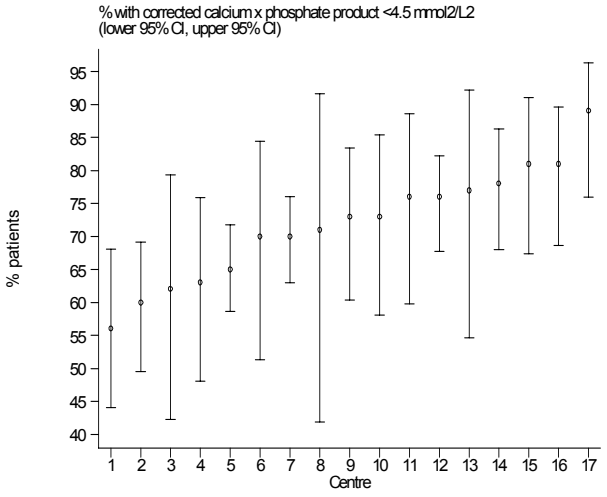


Table 9.2.12(b) Proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	70	70	74	78	82	94	94
1998	9	64	64	72	72	80	100	100
1999	9	61	61	65	71	75	100	100
2000	11	56	56	71	73	83	91	91
2001	12	45	45	73.5	75	79	83	83
2002	14	44	44	64	71	82	90	90
2003	17	60	60	67	74	79	87	87
2004	17	56	56	65	73	77	89	89

Conclusion

Following realization of the toxicity associated with prolonged use of aluminium based phosphate binders, there was increased use of calcium based binders amongst the dialysis population in Malaysia. This however was not associated with significant hypercalcemia. The control of phosphate retention was better amongst CAPD patients. A higher phosphate level and a higher calcium phosphate product in HD patients predispose towards the development of cardiovascular disease. It would be interesting to study the incidence of cardiovascular disease in relation to these factors. Two important goals for the future in bone disease management are attainment of optimal phosphate control and calcium phosphate product in all centers.

CHAPTER 10

HEPATITIS ON DIALYSIS

Teo Sue Mei
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Between 1997 and 2004, the prevalence of HD and CAPD patients with hepatitis B surface antigen (HBsAg) wass quite similar and unchanged over the years, with a slightly lower prevalence in CAPD patients.

The prevalence of HCV infection was much higher in HD compared to CAPD patients although this decreased after 2001 from 23% to 17% in 2004. This is probably due to better and more stringent implementation of infection control measures.

Table 10.1: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, HD patients 1997-2004

Year	No. of subjects	Prevalence of HBsAg+ (%)	Prevalence of Anti-HCV+ (%)
1997	1695	6	23
1998	2141	6	22
1999	2996	6	23
2000	4392	6	25
2001	5194	6	23
2002	6108	5	20
2003	7003	5	19
2004	7556	5	17

Table 10.2: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, CAPD patients 1997-2004

Year	No. of subjects	Prevalence of HBsAg+ (%)	Prevalence of Anti-HCV+ (%)
1997	476	3	5
1998	541	3	6
1999	610	2	5
2000	662	2	5
2001	781	2	3
2002	891	3	4
2003	1232	3	4
2004	1262	4	5

A comparison between HD centers in 2004 showed that overall proportion of positive HBsAg patients did not vary widely. About 43% (N=78) of centers have no patients with HBsAg positive. This is probably because some centers practice the policy of not accepting HBsAg positive patients.

There is however one center where all patients are HBsAg positive. This particular center is part of a large haemodialysis facility where all HBsAg positive patients are segregated.

Table 10.3: Variation in Proportion of patients with positive HBsAg at annual survey among HD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	0	0	1	5	9	17	19
1998	46	0	0	1	5	8	15	16
1999	69	0	0	0	4	9	14	31
2000	100	0	0	0	4	9	15	91
2001	118	0	0	0	4	8	14	83
2002	137	0	0	0	3	7	13	15
2003	160	0	0	0	4	8	13	60
2004	183	0	0	0	3	8	13	100

Figure 10.3: Variation in Proportion of patients with positive HBsAg among HD centres, 2004

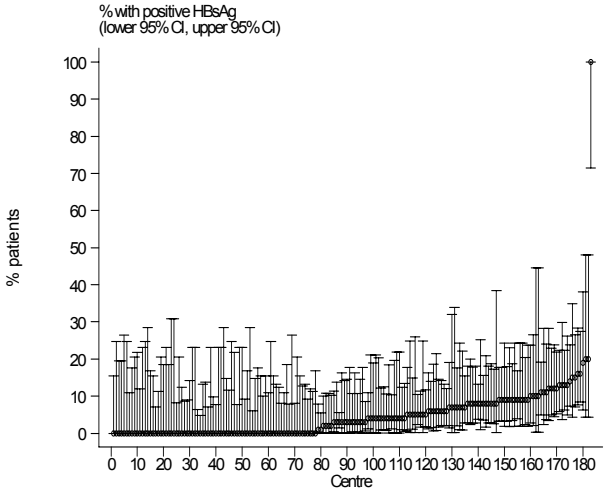


Figure 10.4: Variation in Proportion of patients with positive HBsAg among CAPD centres, 2004

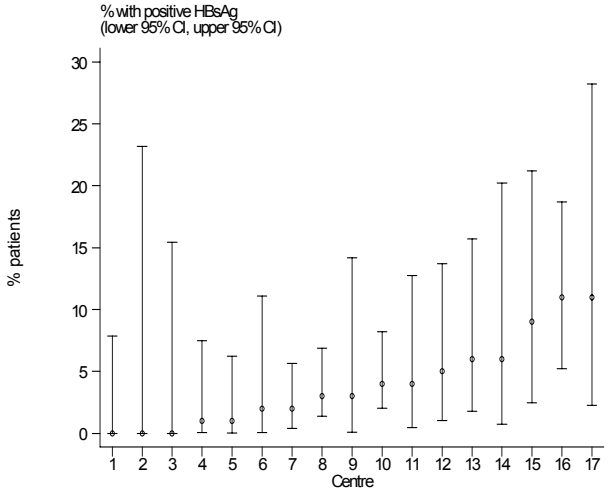


Table 10.4: Variation in Proportion of patients with positive HBsAg at annual survey among CAPD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	0	0	0	2	3	8	8
1998	9	0	0	0	1	3	6	6
1999	9	0	0	0	2	2	4	4
2000	11	0	0	0	0	5	9	9
2001	12	0	0	0	2	3	8	8
2002	14	0	0	1	3	9	20	20
2003	17	0	0	2	4	6	8	8
2004	17	0	0	1	3	6	11	11

In 2004, the proportion of HBsAg positive patients did not vary widely among CAPD centers. The highest prevalence recorded was 10% in 2 centers, and this maybe due to pre existing HBsAg positivity in some patients who were previously on HD and have switched modality of dialysis to CAPD.

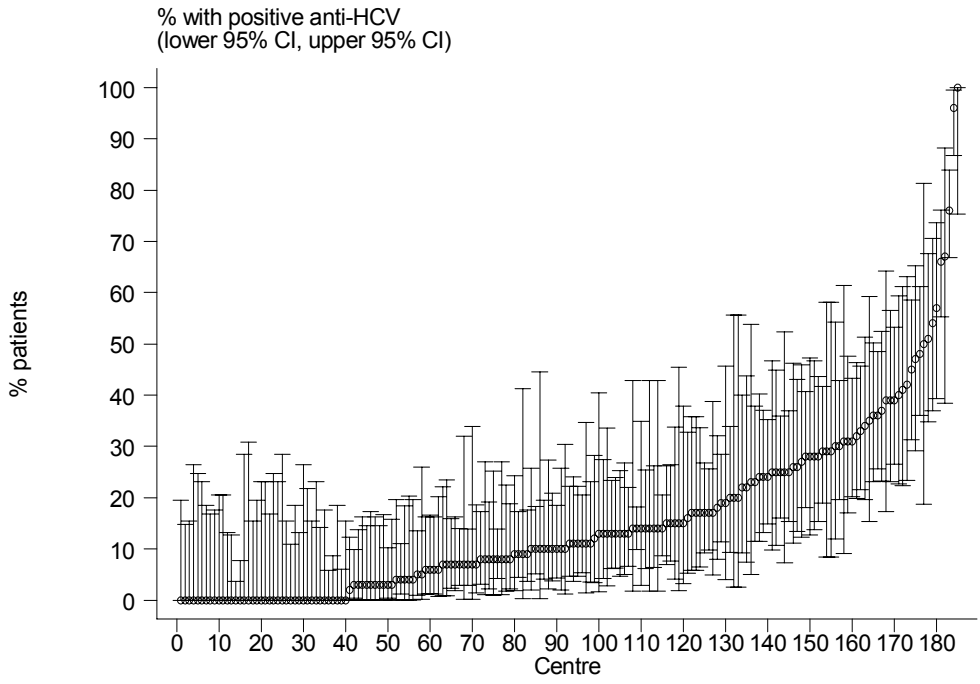
The situation with HCV infection is different. The proportion of anti-HCV positive patients varied widely between HD centers. (fig 10.5) This variability may be due to the following reasons:

1) Difference in infection control protocol practiced.
2) The cumulative risk of HCV infection increases with each year on HD; therefore older centers may have a much higher prevalence than newer centers.
3) High local prevalence of HCV infection (>30%) is an independent risk factor for seroconversion. Out of 185 centers, there are 28 centers (15%) with local prevalence of >30%.

Table 10.5: Variation in Proportion of patients with positive anti-HCV at annual survey among HD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	46	0	0	15	21	29	56	64
1998	46	0	0	11	19.5	31	59	100
1999	69	0	0	7	18	31	57	100
2000	100	0	0	7	17	31	74.5	94
2001	118	0	0	6	15	27	67	93
2002	137	0	0	5	13	25	55	100
2003	160	0	0	5	11	23.5	51.5	96
2004	185	0	0	3	11	24	48	100

Figure 10.5: Variation in Proportion of patients with positive anti-HCV among HD centres, 2004

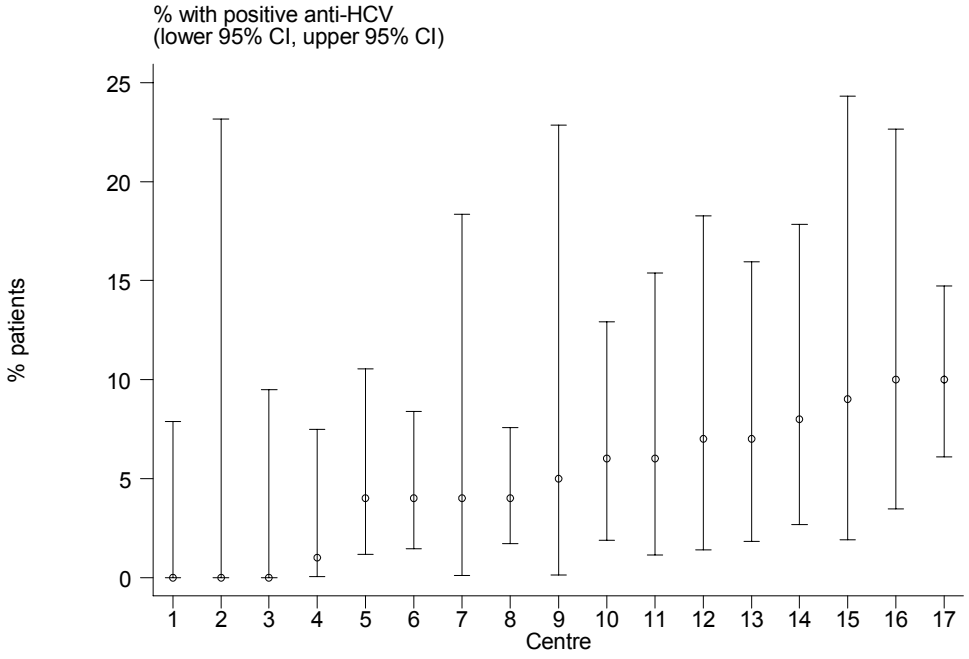


In 2004, the median proportion of HCV infected patients were however quite similar to that of HBsAg positive patients among the CAPD centers, and did not vary widely.

Table 10.6: Variation in Proportion of patients with positive anti-HCV at annual survey among CAPD centres, 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1997	7	0	0	0	6	7	9	9
1998	9	0	0	0	2	4	12	12
1999	9	0	0	2	4	7	14	14
2000	11	0	0	0	3	8	10	10
2001	12	0	0	0	3	4	9	9
2002	14	0	0	2	3	8	20	20
2003	17	0	0	1	3	6	9	9
2004	17	0	0	4	5	7	10	10

Figure 10.6: Variation in Proportion of patients with positive anti-HCV among CAPD centres, 2004



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

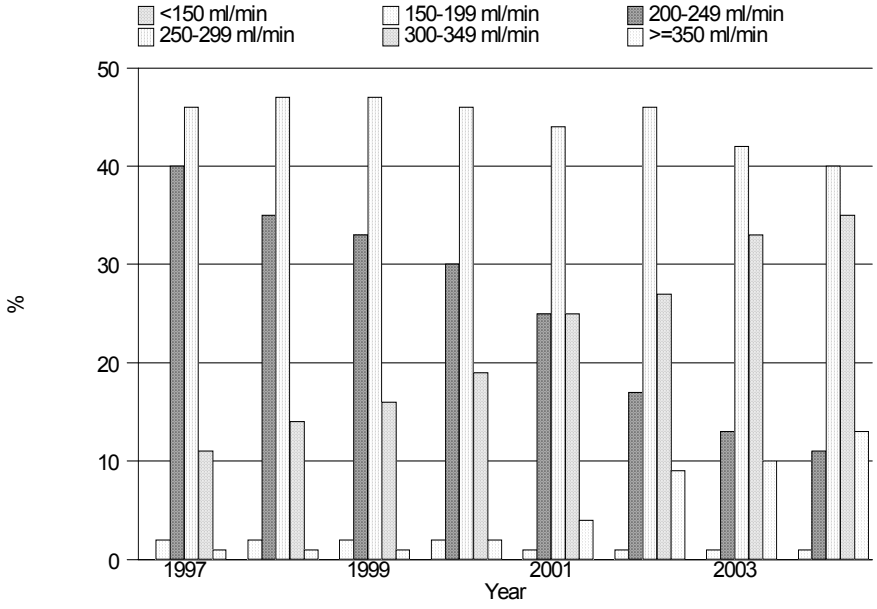
There was increasing use of higher blood flow rates from 1997 to 2004. The proportion of patients with blood flow of 300-349 mls/min had increased from 11% to 35% and those with blood flow ≥ 350 mls/ min from 1% to 13%. In 2004, 48% had blood flow rates of ≥ 300 mls/min compared to only 12% in 1997.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

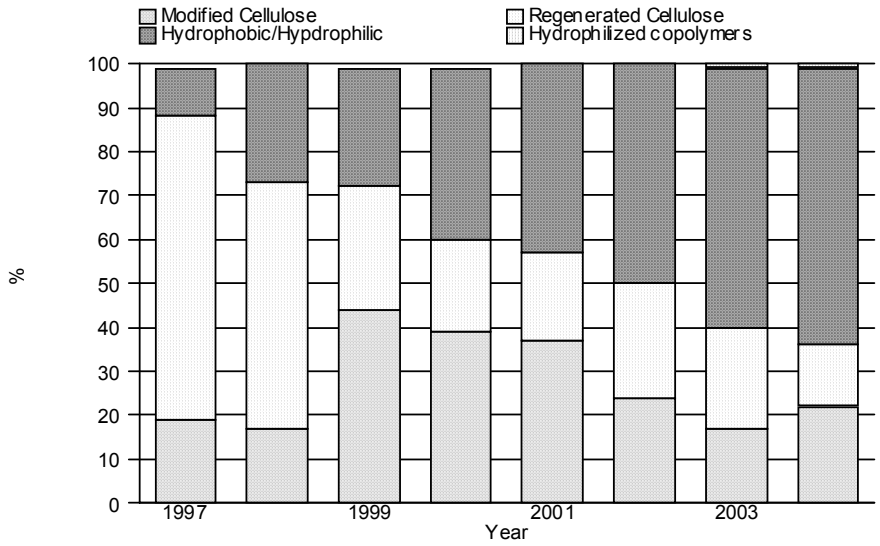
Use of synthetic membranes (hydrophobic/hydrophilic and hydrophilised copolymers) had increased markedly from 11% in 1997 to 64% in 2004. The usage of regenerated cellulose membrane had decreased from 69% in 1997 to 14% in 2004. Modified cellulose membrane usage rose from 19% in 1997 to a peak of 39% 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/Hypdrophilic	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/Hypdrophilic	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

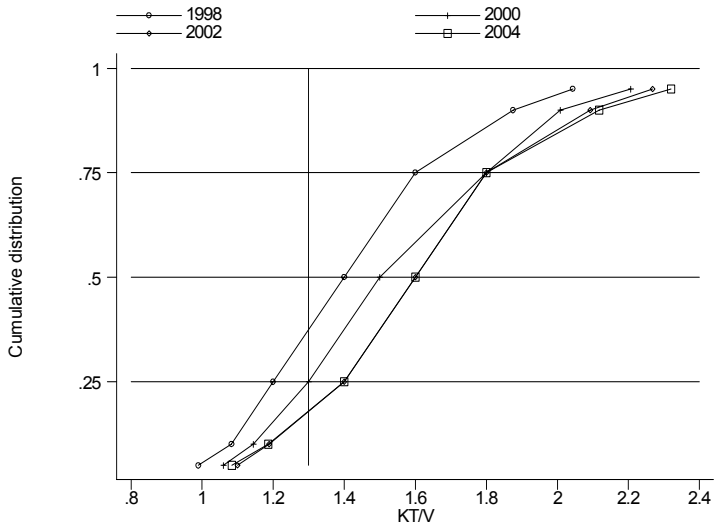
Dialysate buffer	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Acetate	551	33	627	30	552	19	393	9
Bicarbonate	1123	67	1492	70	2429	81	3969	91
TOTAL	1674	100	2119	100	2981	100	4362	100
Dialysate buffer	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Acetate	240	5	138	2	77	1	33	0
Bicarbonate	4920	95	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 ³1.3
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 $\geq$ 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



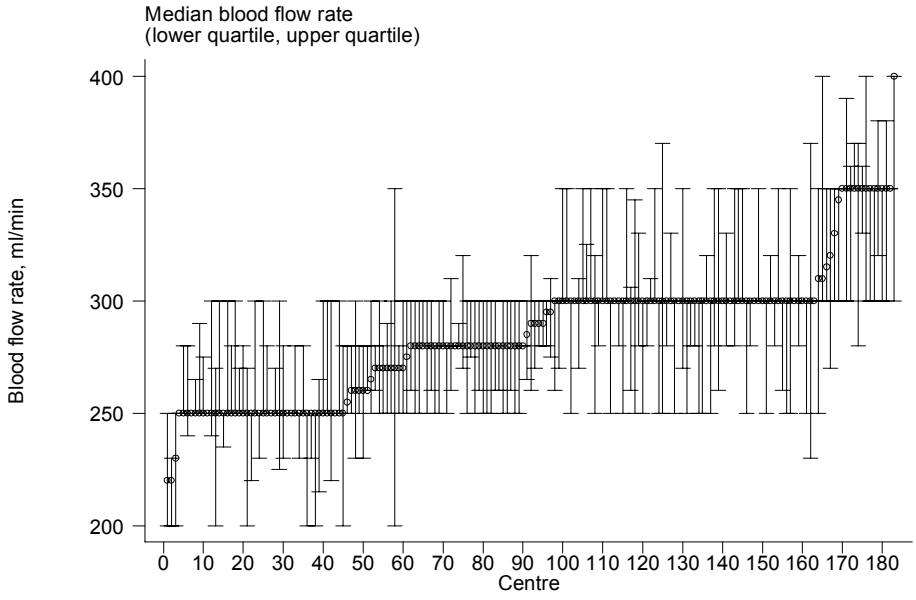
Median blood flow rates among centres had increased from 250mls/min in 1997 to 290 mls/min in 2004. There was a wide variation in practice among centers. The centre median blood flow rates ranged from a minimum of 200 mls/min to a maximum of 400 mls/min. (table 11.2.8a)

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	5th Centile	LQ	Median	UQ	95th 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	5th Centile	LQ	Median	UQ	95th 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

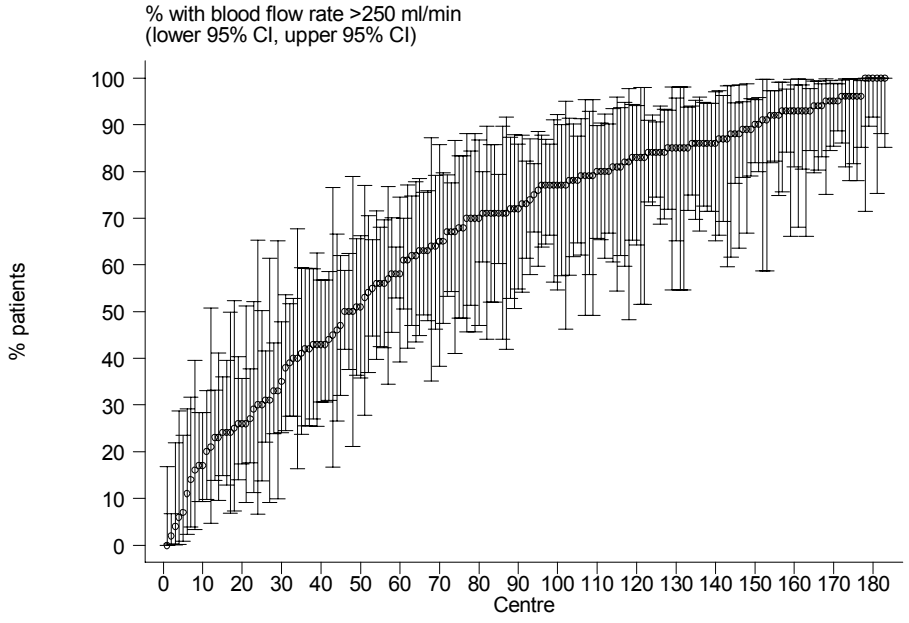
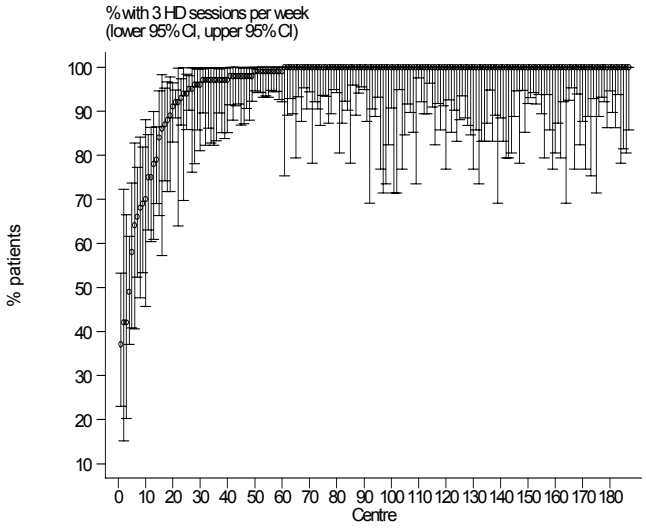


Figure 11.2.8(c): Variation in proportion of patients with 3 HD sessions per week among HD centres 2004

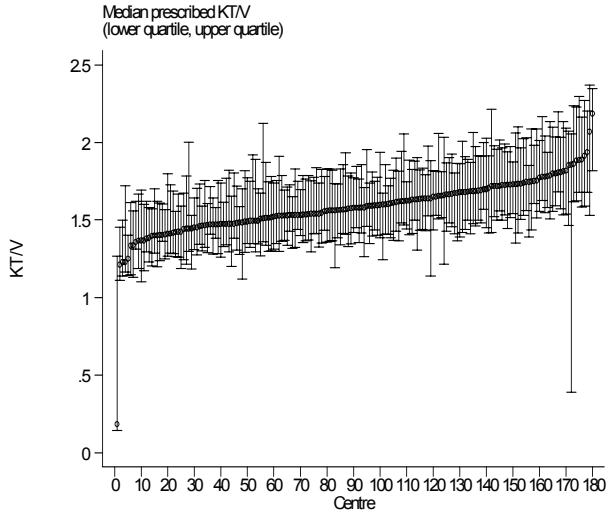


In a small number of centres, a significant proportion of their patients were on less than 3 HD sessions per week in 2004. week.

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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th 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



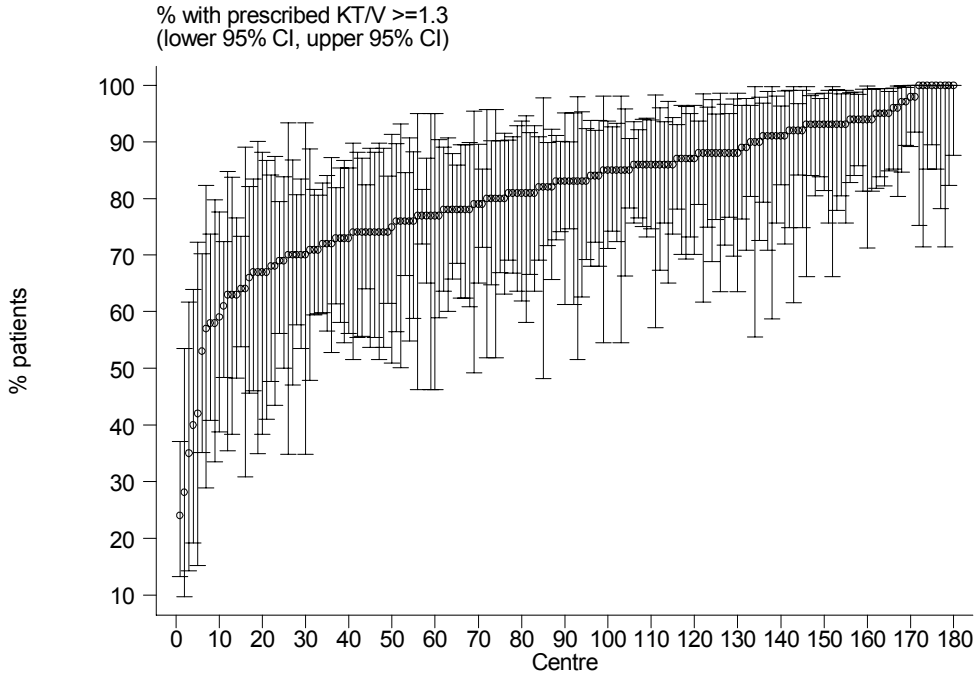
Median prescribed KT/V in HD patients among centers was 1.6 in 2004. With the exception of 1 centre with median prescribed KT/V of <1, the majority of centers had median prescribed KT/V of >1.3. (table and fig 11.2.8d)

In 1997, half of the centers had 58% of patients with prescribed KT/V ≥1.3. This proportion had increased to 83% in 2004. There is wide variation in the proportion of patients with KT/V ≥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 ≥ 1.3 among HD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th 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 ≥ 1.3 among HD centres 2004



11.3: Technique Survival on Dialysis

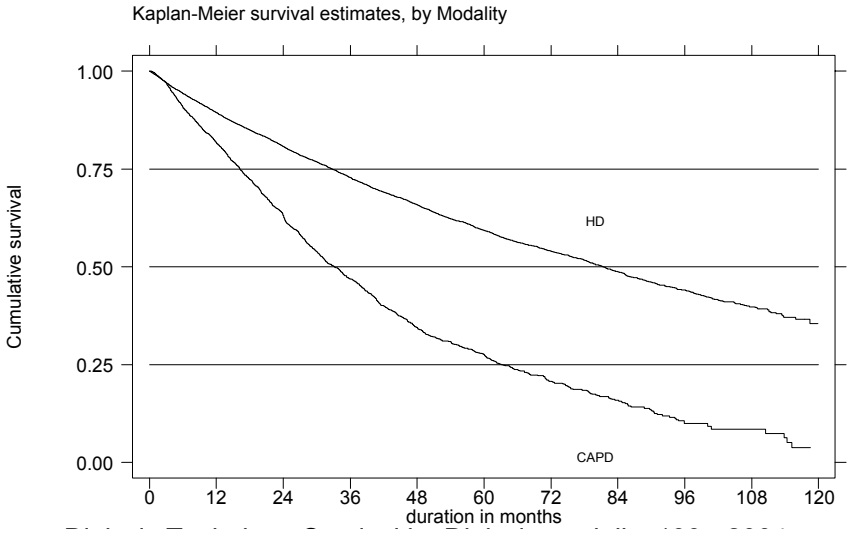
Unadjusted HD technique survival at 1 year, 5 years and 10 years was 89%, 59% and 36% respectively. In comparison, unadjusted CAPD technique survival was 82% at 1 year, 28% at 5 years and negligible at 10 years. (Table 11.3.1 and fig 11.3.1)

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

Dialysis modality	CAPD		HD		All Dialysis	
Interval (months)	% 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

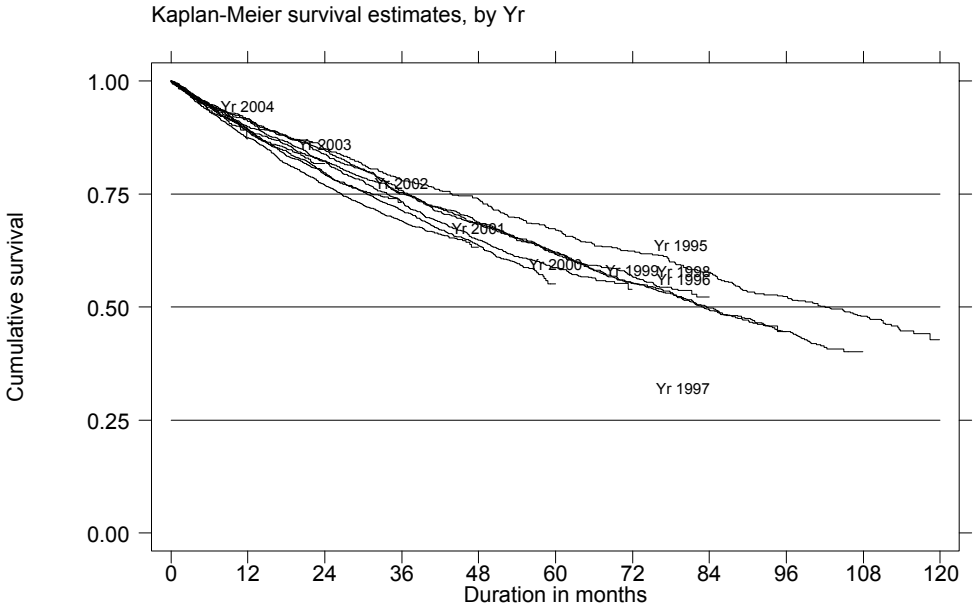
Year	1995		1996		1997		1998	
Interval (months)	% Survival	SE	% Survival	SE	% Survival	SE	% Survival	SE
6	95	1	94	1	94	1	95	1
12	92	1	91	1	89	1	92	1
24	85	2	85	1	82	1	84	1
36	78	2	75	2	75	1	76	1
48	74	2	69	2	69	1	68	1
60	67	2	62	2	62	2	62	1
72	62	2	55	2	55	2	57	1
84	58	2	50	2	49	2	-	-
96	52	2	45	2	-	-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

Year	1999		2000		2001		2002	
Interval (months)	% 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	2003		2004	
Interval (months)	% 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)

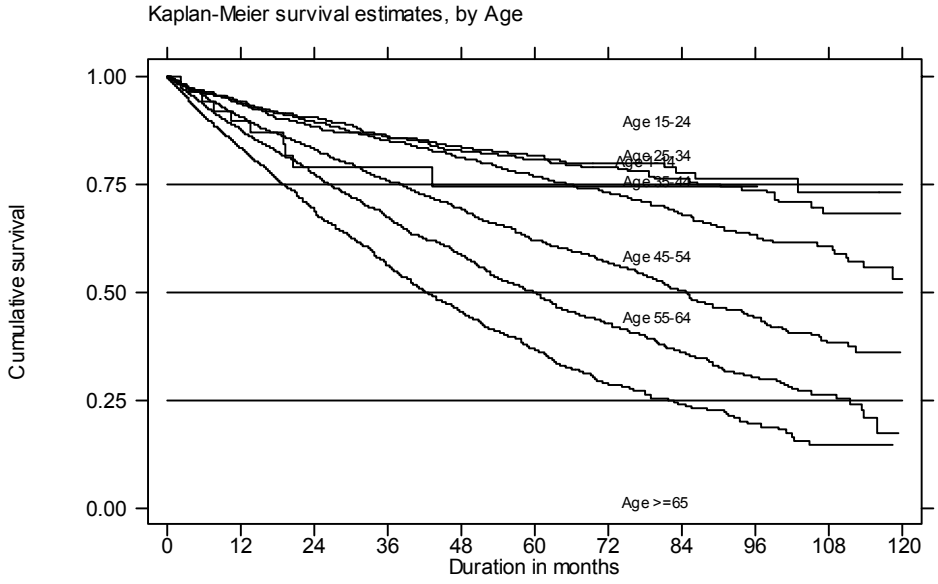
Table 11.3.3: Unadjusted technique survival by age, 1995-2004

Age group (years)	<=14		15-24		25-34		35-44	
Interval (months)	% 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)	45-54		55-64		>=65	
Interval (months)	% 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



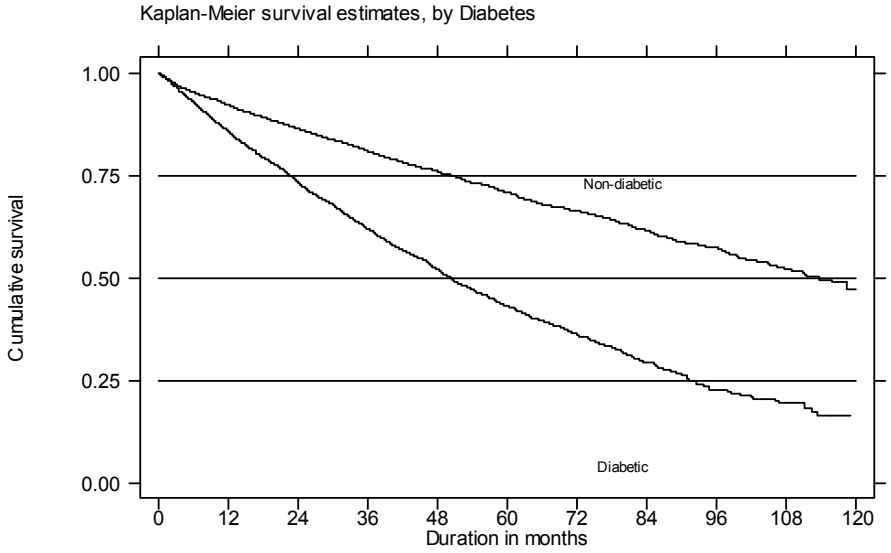
Unadjusted HD technique survival in the non diabetic patients at 1 year, 5 years and 10 years was 92%, 71% and 47% respectively. In contrast unadjusted HD technique survival in diabetic patients was worse at 86%, 43% and 16% respectively. (Table 11.3.4 and fig 11.3.4)

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

Diabetes status	Non-Diabetic		Diabetic	
Interval (months)	% 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



CHAPTER 12

CHRONIC PERITONEAL DIALYSIS PRACTICES

Chang Sean Haw

12.1: Mode of PD (Tables 12.1.1 to 12.1.4)

In 2004, CAPD remained the commonest mode of PD (96%), with cycler-assisted PD accounting for only 1% of PD modalities. The Baxter disconnect system was the commonest connectology used (87%). Ninety-five percent of patients perform 4 exchanges a day, and most (92%) use a fill volume of 2 L.

Table 12.1.1: Chronic Peritoneal Dialysis Regimes, 1997-2004

PD regime	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
Standard CAPD	440	94	492	93	577	96	633	97
DAPD	26	6	32	6	16	3	16	2
CCPD	4	1	6	1	6	1	5	1
TOTAL	470	100	530	100	599	100	654	100

PD regime	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
Standard CAPD	755	98	837	97	1155	97	1212	96
DAPD	17	2	24	3	33	3	39	3
CCPD	2	0	3	0	5	0	13	1
TOTAL	774	100	864	100	1193	100	1264	100

Table 12.1.2: CAPD Connectology, 1997-2004

CAPD Connectology	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
UVXD	28	6	10	2	4	1	1	0
Baxter disconnect	433	92	501	95	343	58	234	39
B Braun disconnect	10	2	18	3	248	42	370	61
Fresenius disconnect	0	0	0	0	0	0	0	0
TOTAL	471	100	529	100	595	100	605	100

CAPD Connectology	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
UVXD	0	0	5	1	2	0	1	0
Baxter disconnect	436	57	714	87	1040	87	1133	89
B Braun disconnect	324	43	93	11	7	1	34	3
Fresenius disconnect	0	0	11	1	151	13	109	9
TOTAL	760	100	823	100	1200	100	1277	100

Table 12.1.3: CAPD Number of Exchanges per day, 1997-2004

No. of Exchanges/ day	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
2	0	0	2	0	0	0	2	0
3	3	1	4	1	4	1	1	0
4	454	97	508	96	579	97	624	96
5	12	3	16	3	13	2	23	4
TOTAL	469	100	530	100	596	100	650	100

No. of Exchanges/ day	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
2	1	0	0	0	4	0	6	0
3	5	1	11	1	14	1	12	1
4	735	95	834	96	1138	96	1225	95
5	31	4	28	3	32	3	53	4
TOTAL	772	100	873	100	1188	100	1296	100

Table 12.1.4: CAPD Volume per Exchange, 1997– 2004

Volume per Exchange (L)	1997		1998		1999		2000	
	No.	%	No.	%	No.	%	No.	%
1	24	5	25	5	19	3	25	4
2	444	95	496	95	557	96	595	95
3	0	0	0	0	2	0	7	1
TOTAL	468	100	521	100	578	100	627	100

Volume per Exchange (L)	2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%
1	32	4	37	4	40	3	42	3
2	711	95	793	94	1090	94	1154	92
3	9	1	14	2	31	3	63	5
TOTAL	752	100	844	100	1161	100	1259	100

12.2: Achievement of Solute Clearance and Peritoneal Transport

Data for Kt/V has been collected only since 2003. The median delivered weekly Kt/V was 2.1, with 61% achieving the K/DOQI recommended target of 2.0. When the data was analysed according to the percentage of patients in each center achieving a Kt/V of >2.0, there was a 2-fold variation between the highest- and the lowest-performing centres (85% vs 43%). Half of the centres were able to have up to 56% of their patients achieving the K/DOQI target. As a result of ADEMEX and other studies, a lower Kt/V target of 1.8 has been proposed. Seventy-five percent of patients were able to achieve this lower target. (Tables and figures 12.2.1 and 12.2.2)

Table 12.2.1: Distribution of delivered KT/V, CAPD patients 2003-2004

Year	No of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥2.0 per week
2003	790	3.7	19.9	2.1	1.8	2.5	59
2004	1064	2.8	9.9	2.1	1.8	2.5	61

Figure 12.2.1: Cumulative distribution of delivered KT/V, CAPD patients 2003-2004

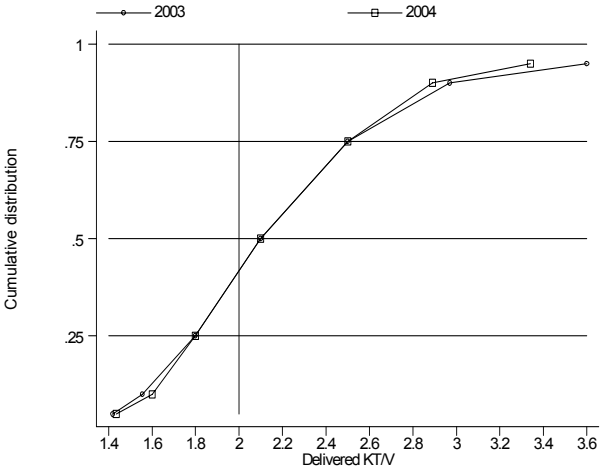


Figure 12.2.2: Variation in proportion of patients with KT/V ≥ 2.0 per week among CAPD centres 2004

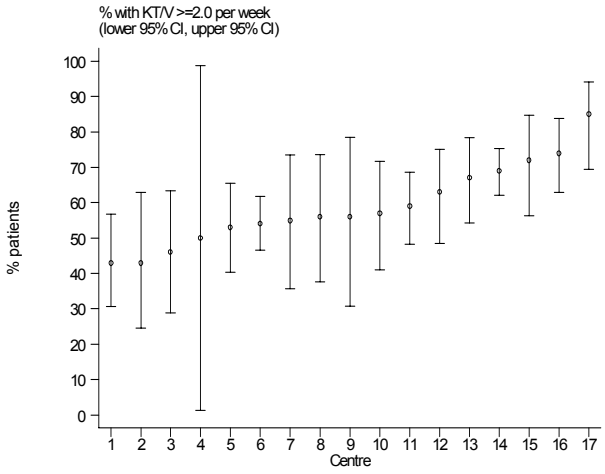


Table 12.2.2: Variation in proportion of patients with KT/V ≥ 2.0 per week among CAPD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2003	14	0	0	51	59	62	73	73
2004	17	43	43	53	56	67	85	85

Data for PET has been collected only since 2003. Seventy-nine percent of new patients, and 81% of prevalent patients, have low- or high-average PET status. However, high PET status was more common among prevalent than new patients (10% vs 6%). These figures were similar to those from 2003. (Tables 12.2.3 and 12.2.4)

Table 12.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2004

PET	2003		2004	
	No.	%	No.	%
Low	10	6	67	15
Low average	85	51	187	41
High average	62	37	176	38
High	11	7	29	6
TOTAL	168	100	459	100

* New PD patients=patients commencing dialysis since 2003

Table 12.2.4: Peritoneal transport status by PET D/P creatinine at 4 hours, prevalent PD patients 2003-2004

	2003		2004	
PET	No.	%	No.	%
Low	10	3	40	9
Low average	175	44	180	42
High average	172	43	168	39
High	39	10	41	10
TOTAL	396	100	429	100

*Prevalent PD patients = patients commencing dialysis before 2003

12.3: Technique Survival on PD (Tables and Figures 12.3.1 to 12.3.5)

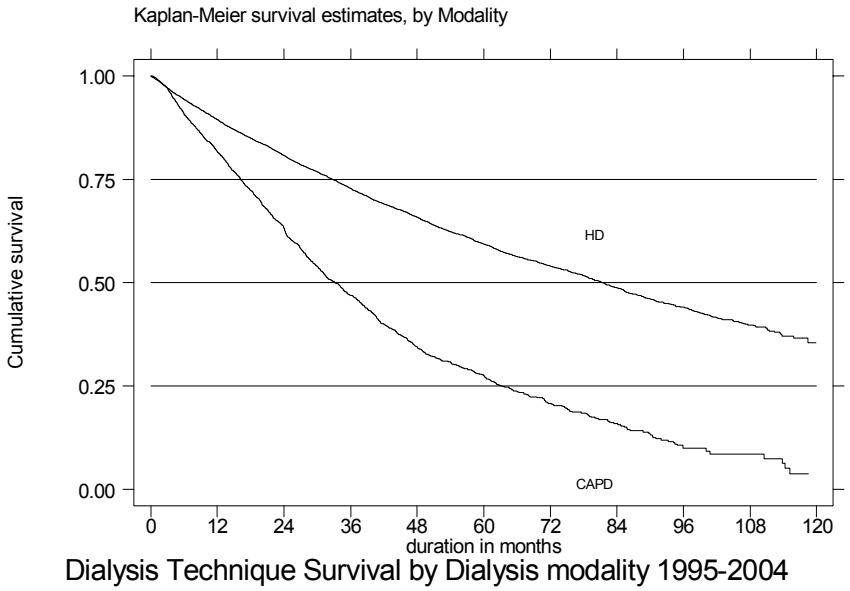
One- and 2-year technique survival for CAPD was 82% and 63% respectively, which were inferior to haemodialysis (89% and 81% respectively). The figures for CAPD have remained unchanged for patients starting 1995 or later. Technique survival is age-dependent, with a more marked drop-off for patients aged 65 years or above. Diabetics have poorer technique survival than non-diabetics. Females have better technique survival than males, with the 2 curves separating from about 24 months after starting CAPD.

Table 12.3.1: Unadjusted technique survival by Dialysis modality, 1995-2004

Dialysis modality	CAPD			HD		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE
6	2227	91	1	13206	94	0
12	1853	82	1	11250	89	0
24	1144	63	1	8199	81	0
36	673	47	1	5846	73	0
48	380	34	1	4112	66	0
60	236	28	1	2803	59	1
72	140	21	1	1834	54	1
84	79	16	1	1103	49	1
96	30	10	1	577	44	1
108	11	9	1	241	40	1
120	-	-	-	20	36	2

* No. = Number at risk SE=standard error

Figure 12.3.1: Unadjusted technique survival by Dialysis modality, 1995-2004



Dialysis Technique Survival by Dialysis modality 1995-2004

Table 12.3.2: Unadjusted technique survival by year of entry, 1995-2004

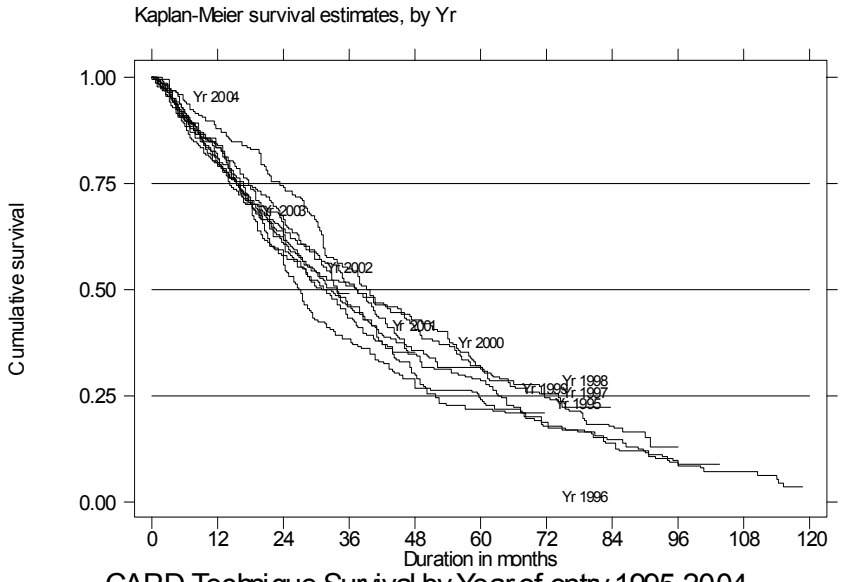
Year	1995			1996			1997			1998		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	153	91	2	200	91	2	187	94	2	144	92	2
12	140	83	3	178	81	3	170	88	2	127	83	3
24	97	59	4	139	67	3	141	74	3	96	65	4
36	70	43	4	105	51	3	101	55	4	75	51	4
48	49	30	4	68	35	3	76	42	4	59	41	4
60	36	22	3	53	28	3	57	32	3	45	32	4
72	29	18	3	35	18	3	44	25	3	35	25	4
84	22	14	3	27	15	3	32	18	3	-	-	-
96	14	8	2	16	9	2	-	-	-	-	-	-
108	11	7	2	-	-	-	-	-	-	-	-	-
120	2	3	2	-	-	-	-	-	-	-	-	-

Year	1999			2000			2001			2002		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	188	89	2	206	91	2	303	90	2	341	92	1
12	174	84	3	185	81	3	264	80	2	291	80	2
24	116	57	3	138	63	3	196	61	3	226	64	3
36	77	38	3	101	46	3	149	46	3	-	-	-
48	56	28	3	77	35	3	-	-	-	-	-	-
60	49	25	3	-	-	-	-	-	-	-	-	-

Year	2003			2004		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE
6	369	89	2	145	91	2
12	331	80	2	-	-	-

* No. = Number at risk SE=standard error

Figure 12.3.2: Unadjusted technique survival by year of entry, 1995-2004



CAPD Technique Survival by Year of entry 1995-2004

Table 12.3.3: Unadjusted technique survival by age, 1995-2004

Age group (years) Interval (months)	<=14			15-24			25-34			35-44		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	199	98	1	194	93	2	229	93	2	323	94	1
12	181	96	1	157	84	3	201	89	2	280	87	2
24	133	86	3	91	69	4	141	78	3	186	70	3
36	85	73	4	50	56	4	108	69	3	113	56	3
48	58	66	4	27	41	5	67	53	4	70	46	3
60	34	59	5	14	31	6	52	47	4	44	36	4
72	18	44	6	8	29	6	37	37	4	23	25	4
84	9	34	7	4	18	7	24	32	4	16	22	4
96	3	20	9	2	18	7	11	25	5	8	15	4
108	2	20	9	2	18	7	4	20	6	4	15	4
120	-	-	-	-	-	-	-	-	-	2	10	5

Age group (years) Interval (months)	45-54			55-64			>=65		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	540	92	1	484	89	1	263	81	2
12	447	82	2	392	77	2	201	68	3
24	273	62	2	233	56	2	92	39	3
36	153	43	2	127	38	2	42	21	3
48	90	32	2	54	22	2	20	11	2
60	57	26	2	32	16	2	9	5	2
72	37	21	2	18	11	2	5	4	2
84	21	14	2	8	7	2	3	2	1
96	6	7	2	4	3	2	-	-	-
108	-	-	-	3	3	2	-	-	-
120	-	-	-	-	-	-	-	-	-

* No. = Number at risk SE=standard error

Figure 12.3.3: Unadjusted technique survival by age, 1995-2004

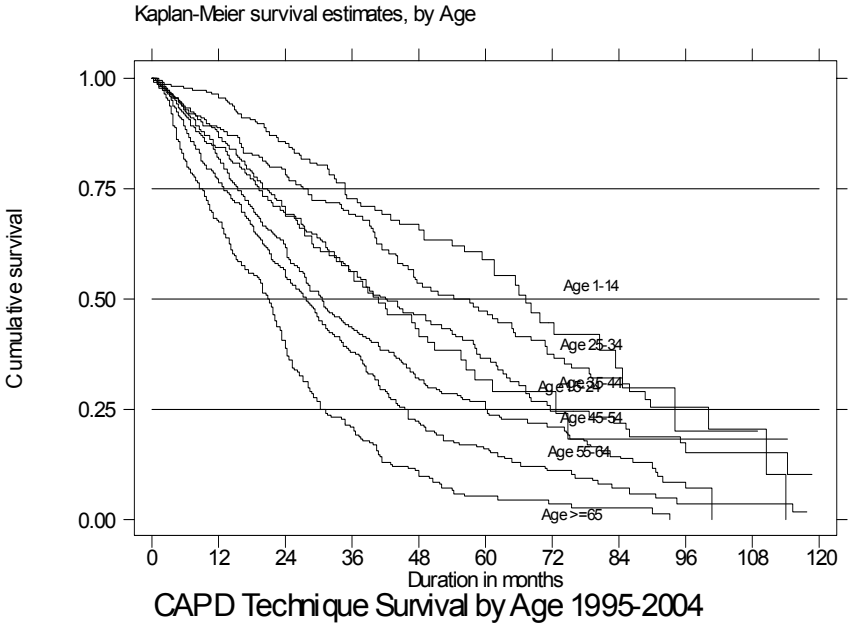
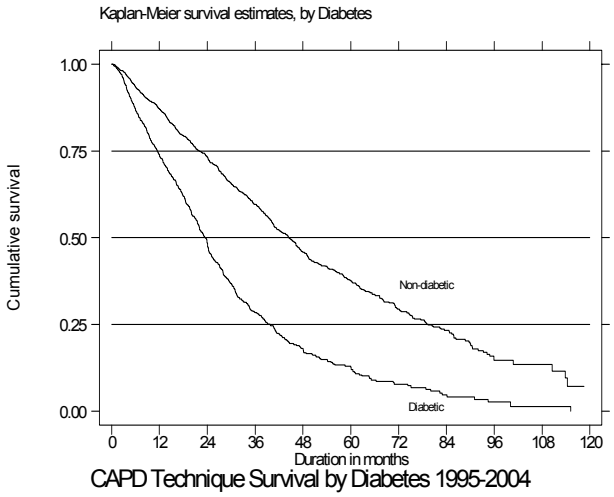


Table 12.3.4: Unadjusted technique survival by Diabetes status, 1995-2004

Diabetes status Interval (months)	Non-Diabetic			Diabetic		
	No.	% Survival	SE	No.	% Survival	SE
6	1366	93	1	862	87	1
12	1169	87	1	684	74	1
24	789	73	1	355	49	2
36	510	60	1	163	28	2
48	301	46	2	80	18	2
60	194	38	2	43	13	1
72	121	29	2	20	8	1
84	71	23	2	9	5	1
96	26	15	2	5	3	1
108	10	13	2	2	1	1
120	2	7	3	-	-	-

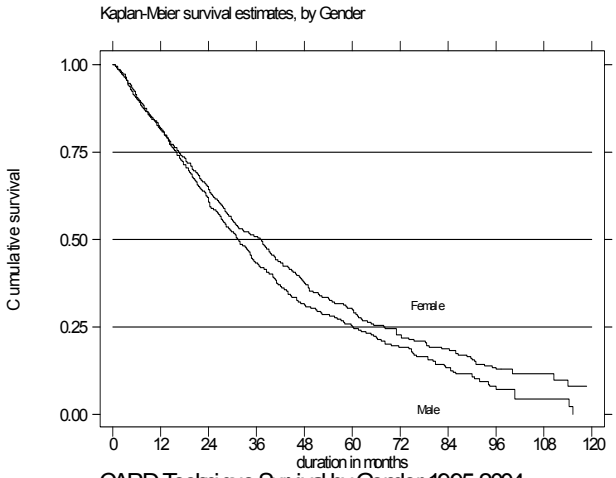
* No. = Number at risk SE=standard error

Figure 12.3.4: Unadjusted technique survival by Diabetes status, 1995-2004



CAPD Technique Survival by Diabetes 1995-2004

Figure 12.3.5: Unadjusted technique survival by Gender, 1995-2004



CAPD Technique Survival by Gender 1995-2004

Table 12.3.5: Unadjusted technique survival by Gender, 1995-2004

Gender Interval (months)	Male			Female		
	No.	% Survival	SE	No.	% Survival	SE
6	1133	91	1	1095	90	1
12	940	81	1	914	82	1
24	560	62	1	584	65	1
36	304	43	2	369	51	2
48	167	31	2	214	38	2
60	105	25	2	132	30	2
72	62	19	2	80	22	2
84	31	13	2	49	18	2
96	9	7	2	21	13	2
108	3	5	2	9	11	2
120	-	-	-	2	8	3

* No. = Number at risk SE=standard error

12.4: PD Peritonitis (Tables 12.4.1 to 12.4.3, figure 12.4.1)

There was a greater than 2-fold variation between the centres with the highest and lowest peritonitis rates (21.8 vs 48.2 patient-months/episode). In 2004, Gram positive and Gram negative organisms each accounted for 29% of peritonitis episodes. The culture-negative rate remained stable at 33%. There is a trend to increasing peritonitis rate with patient age. This is especially marked for patients aged 65 years and above. Diabetics had a higher peritonitis rate than non-diabetics, but there was no difference between the genders.

Table 12.4.1: Variation in peritonitis rate (pt-month/epi) among CAPD centres 2004

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	12	10.9	10.9	18.4	22.8	34.7	1019.7	1019.7
2001	13	14.1	14.1	21.3	24.1	30	240.9	240.9
2002	14	12	12	17.3	23.9	35.7	86.1	86.1
2003	14	19.8	19.8	23	35.7	83.2	421.8	421.8
2004	14	21.8	21.8	24	33	35.7	48.2	48.2

* Criteria for combination of centres with less than 10 subjects not applied

Figure 12.4.1: Variation in peritonitis rate (pt-month/ epi) among CAPD centres 2004

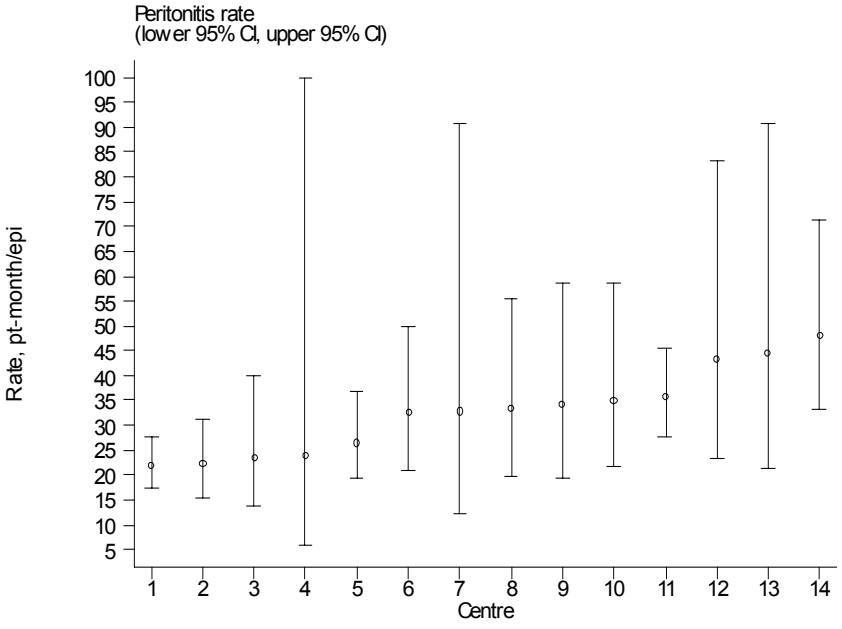


Table 12.4.2: Causative organism in PD peritonitis, 2000-2004

Microorganism	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives										
• Staph. Aureus	35	11	41	13	62	17	41	12	48	13
• Staph Coagulase Neg.	39	13	34	11	41	11	52	15	43	12
• Strep	12	4	13	4	9	3	11	3	11	3
• Others	4	1	6	2	7	2	15	4	4	1
(B) Gram Negatives										
• Pseudomonas	19	6	14	5	22	6	18	5	27	7
• Others	45	15	56	18	67	19	73	21	79	22
(C) Polymicrobial	9	3	10	3	8	2	3	1	2	1
(D) Others										
• Fungal	19	6	21	7	11	3	10	3	15	4
• Mycobacterium	6	2	4	1	1	0	3	1	4	1
• Others	2	1	14	5	14	4	13	4	8	2
(E) No growth	117	38	96	31	117	33	106	31	120	33
TOTAL	307	100	309	100	359	100	345	100	361	100

Table 12.4.3: Factors influencing peritonitis rate, 2000-2004

Factors	N (No. at risk)	Annualised rate: Epi/ pt-year	(95% CI)	
Age (years):				
<=14	69	0.424	(0.342,	0.527)
15-24	38	0.48	(0.360,	0.641)
25-34	82	0.465	(0.390,	0.553)
35-44	93	0.500	(0.420,	0.596)
45-54	142	0.550	(0.477,	0.636)
55-64	121	0.592	(0.506,	0.693)
>=65	50	0.735	(0.575,	0.939)
Gender:				
Male	281	0.522	(0.470,	0.580)
Female	314	0.525	(0.478,	0.577)
Diabetes:				
No	412	0.494	(0.455,	0.537)
Yes	183	0.619	(0.542,	0.706)

CHAPTER 13

RENAL TRANSPLANTATION

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13.0. Introduction

This chapter presents results of the Renal Transplant Section of the National Transplant Registry (NTR). The Renal Transplant section was formerly part of the National Renal Registry, which has been established since 1993 until its transplant component was transferred to the NTR in 2004. The renal transplant database currently comprises 2650 records of renal transplant recipients who have been transplanted since 1975. Case ascertainment in the early years was virtually 100% complete as transplant activity was low and almost all were performed locally. Ascertainment however is less complete since 1987 when significant numbers of patients began to go overseas for renal transplant treatment, initially to India and later to China.

The kidney transplant program was initiated in Malaysia after the first successful living related donor renal transplantation was carried out in Hospital Kuala Lumpur (HKL) on 15th December 1975 utilising an immunosuppressive protocol combining azathioprine and corticosteroids. The last 3 decades have seen many changes in renal transplantation activity in Malaysia (Fig 13.1.1). HKL has remained the major renal transplant centre of Malaysia for the last 3 decades. University Malaya Medical Centre started its transplant program in 1991 followed by Selayang Hospital in 2000. A few private hospitals do renal transplantation occasionally. Although cadaveric transplantation started early in 1976, the transplant program in Malaysia was almost an exclusively living related donor program until 1987 when many patients sought commercial living unrelated donor transplantation in India. It was only in 1996 when the Indian government passed legislation banning all commercial transplant activity that the number of commercial living unrelated transplants dropped. However, this was taken over by commercial cadaveric transplantation in China. In the early years, local transplants were carried out using an immunosuppressive protocol combining azathioprine and corticosteroids. In 1992 cyclosporine (CsA) based triple therapy was introduced. Since then CsA has remained the backbone of primary immunosuppression until recently when tacrolimus and mycophenolate mofetil (MMF) were increasingly used. The use of CsA was reported since 1987 among commercial transplant recipients.

13.1. Stock And Flow

New renal transplant patients showed a modest increase from 66 transplants per year in 1987 to 174 per year in 2004. This increase in the number of transplants was mainly due to overseas commercial transplantation. By 2004, the number of functioning renal transplants has increased from 227 in 1987 to 1587 (Table 13.1.1).

Table 13.1.1: Stock and Flow of Renal Transplantation, 1975-2004

Year	87	88	89	90	91	92	93	94	95	96
New transplant patients	66	90	95	125	117	118	140	204	103	150
Died	8	9	10	19	13	16	20	28	16	31
Graft failure	8	12	8	12	18	19	23	21	28	28
Lost to follow up	0	0	0	5	1	3	1	3	3	1
Functioning graft at 31st December	227	296	373	462	547	627	723	875	931	1021

Year	97	98	99	00	01	02	03	04
New transplant patients	126	103	126	143	162	169	157	174
Died	29	23	25	27	35	31	36	32
Graft failure	38	47	36	32	40	38	42	43
Lost to follow up	0	2	4	7	3	5	6	13
Functioning graft at 31st December	1080	1111	1172	1249	1333	1428	1501	1587

*Incidence of acute rejection among all new patients and all functioning graft in 2004 is 10% and 1% respectively

Figure 13.1.1: Stock and Flow of Renal Transplantation, 1975-2004

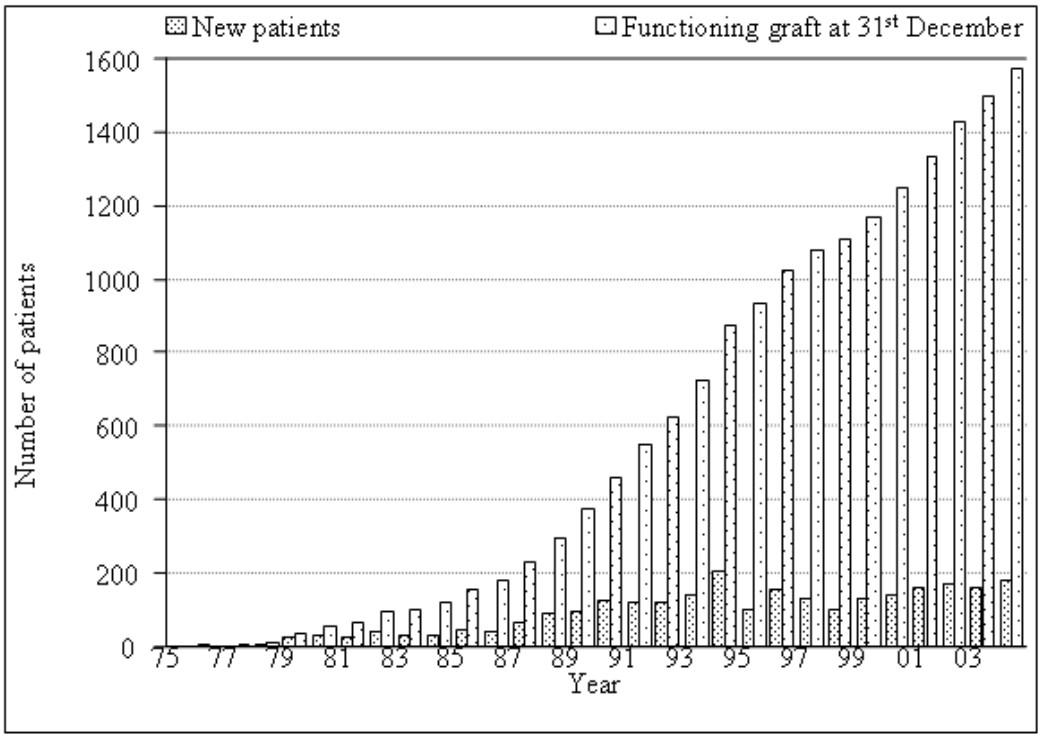
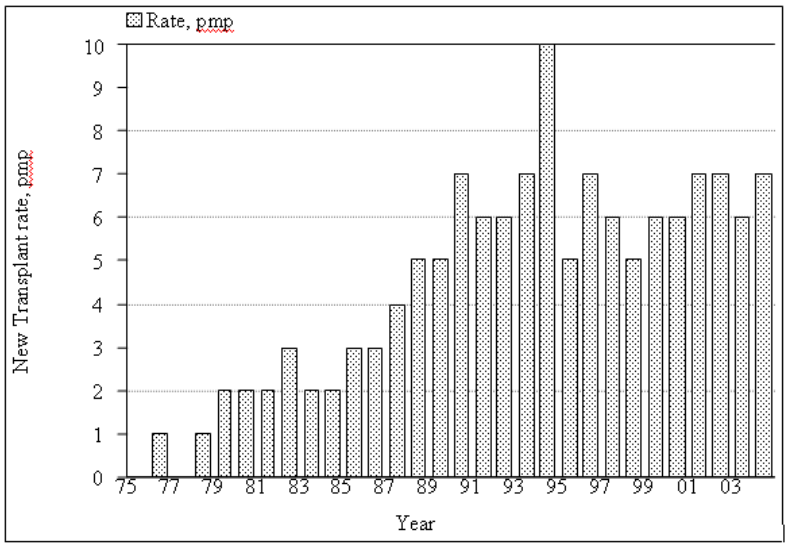


Table 13.1.2: New transplant rate per million population (pmp), 1975-2004

Year	75	76	77	78	79	80	81	82	83	84	85
New transplant patients	1	6	5	8	23	30	25	40	29	27	46
Transplant prevalence rate pmp	0	1	0	1	2	2	2	3	2	2	3

Year	96	97	98	99	00	01	02	03	04
New transplant patients	150	126	103	126	143	162	169	157	174
New transplant rate pmp	7	6	5	6	6	7	7	6	7

Figure 13.1.2: New transplant rate, 1975-2004



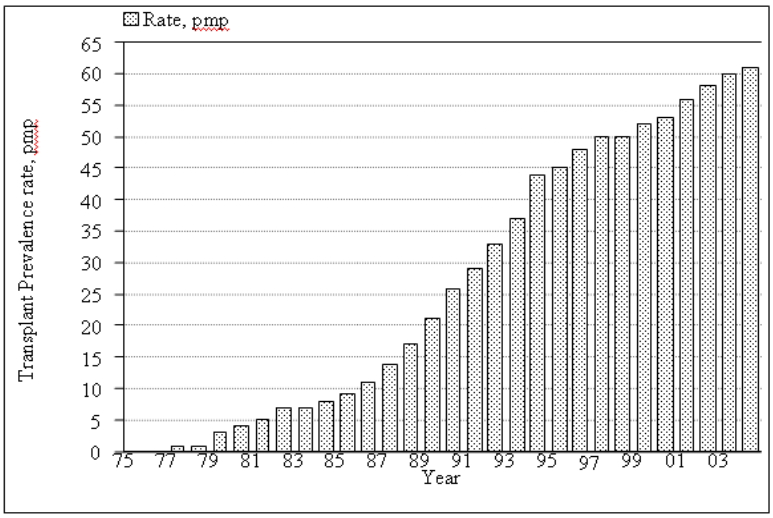
Incident rates for renal transplantation showed modest increase from 2-3 per million population in the early 80's to between 5-7 per million since 1990 (Table 13.1.2). The transplant prevalence rate has increased steadily from 4 per million population in 1980 to 62 per million in 2004 (Table 13.1.3).

Table 13.1.3: Transplant prevalence rate per million population (pmp), 1975-2004

Year	75	76	77	78	79	80	81	82	83	84	85
Functioning graft at 31st December	1	5	7	13	32	54	65	96	103	119	150
Transplant prevalence rate pmp	0	0	1	1	3	4	5	7	7	8	9

Year	97	98	99	00	01	02	03	04
Functioning graft at 31st December	1080	1111	1172	1249	1333	1428	1501	1587
Transplant prevalence rate pmp	50	50	52	53	56	58	60	62

Figure 13.1.3: Transplant prevalence rate, 1975-2004



13.2. Recipients' Characteristics

The mean age for new transplant recipients has increased from 31±6 years in 1980 to 41±13 years in 2004 (Table 13.2.1). Since renal transplantation was established in Malaysia in 1975, men are in the majority among renal transplant recipients. However, the percentage has reduced gradually from around 70-80% in the early 1980's to 55-65% over the last 10 years. Over the years, the proportion of diabetic transplant recipients has increased, from hardly any in the early 1980's to 10-20% for the last decade.

In 2004, 6% were HbsAg positive and 8% had anti-HCV antibodies at the time of transplantation. The proportion of HbsAg positivity had reduced from 10-20% in the period 1985-1994 to 5-10% for the last 10 years while the number of recipients with anti-HCV antibodies at the time of transplantation had also reduced from 20-30% in the early 1990's to 8-15% for the last 8 years since the screening test was introduced in 1989. For those transplanted prior to the screening test, anti-HCV antibodies were found in 40-60%.

Table 13.2.1: Renal Transplant Recipients' Characteristics, 1975-2004

Year	75	76	77	78	79	80	81	82	83	84
New transplant patients	1	6	5	8	23	30	25	40	29	27
Age at transplant (years)										
Mean	31	37	26	35	30	31	31	29	29	31
SD		6	4	4	8	6	8	9	7	9
% Male	100	83	80	88	78	83	68	70	66	70
% Diabetic (co-morbid / primary renal disease)	0	0	0	0	4	0	4	0	3	7
% HbsAg positive	0	0	0	14	11	21	7	23	25	0
% Anti-HCV positive	0		0	67	0	60	67	50	82	50

Year	85	86	87	88	89	90	91	92	93	94
New transplant patients	46	42	66	90	95	125	117	118	140	204
Age at transplant (years)										
Mean	30	28	32	33	39	35	34	38	38	39
SD	7	8	11	12	15	13	11	13	13	12
% Diabetic (co-morbid / primary renal disease)	0	2	2	4	8	6	7	13	10	11
% HbsAg positive	20	16	24	15	31	16	11	13	9	10
% Anti-HCV positive	55	64	61	60	40	41	18	22	23	13

Year	95	96	97	98	99	00	01	02	03	04	TOTAL
New transplant patients	103	150	126	103	126	143	162	169	157	174	2650
Age at transplant (years)											
Mean	36	39	36	38	37	40	41	40	42	41	37
SD	12	11	12	11	13	13	13	13	13	13	13
% Male	57	57	63	59	61	64	63	56	66	61	63
% Diabetic (co-morbid / primary renal disease)	13	9	11	9	10	14	18	15	22	19	11
% HbsAg positive	7	13	6	6	5	5	4	7	9	6	10
% Anti-HCV positive	16	20	7	18	10	8	15	9	10	8	18

Chronic glomerulonephritis was the primary cause of ESRF in only 10-20% of renal transplant recipients in the early 1980's, and this had increased to 25-35% for the last 5 years (Table 13.2.2). While the majority of renal transplant recipients still presented late with unknown primary renal disease, the proportion had decreased from 50-80% in the 1980's to 30-45% for the last 5 years. As expected, patients with diabetes mellitus had become increasingly frequent renal transplant recipients, from <5% in the 1980's to 7-16% over the last 5 years.

Table 13.2.2: Primary causes of end stage renal failure, 1975-2004

Year	1975		1976		1977		1978		1979		1980		1981		1982		1983		1984	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	1	100	6	100	5	100	8	100	23	100	30	100	25	100	40	100	29	100	27	100
Glomerulonephritis	0	0	1	17	2	40	2	25	3	13	3	10	4	16	7	18	5	17	4	15
Diabetes Mellitus	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	1	4
Hypertension	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1	3	1	3	1	4
Obstructive uropathy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0
ADPKD	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0
Drugs / toxic nephropathy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hereditary nephritis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	4	67	3	60	6	75	16	70	25	83	16	64	28	70	21	72	14	52
Others	1	100	1	17	0	0	0	0	3	13	3	10	3	12	7	18	2	7	7	26

Year	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	103	100	150	100	126	100	103	100	126	100	143	100	162	100	169	100	157	100	174	100	2650	100
Glomerulonephritis	29	28	45	30	29	23	28	27	41	33	47	33	41	25	53	31	51	32	59	34	724	27
Diabetes Mellitus	11	11	10	7	9	7	5	5	9	7	16	11	23	14	16	9	25	16	27	16	207	8
Hypertension	4	4	7	5	4	3	5	5	6	5	18	13	17	10	23	14	24	15	45	26	186	7
Obstructive uropathy	2	2	2	1	3	2	4	4	4	3	3	2	3	2	2	1	2	1	2	1	57	2
ADPKD	1	1	4	3	2	2	1	1	1	1	3	2	1	1	3	2	5	3	4	2	36	1
Drugs / toxic nephropathy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	3	0
Hereditary nephritis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
Unknown	50	49	77	51	64	51	54	52	62	49	55	38	62	38	69	41	60	38	78	45	1360	51
Others	13	13	11	7	18	14	10	10	6	5	12	8	22	14	15	9	12	8	26	15	265	10

13.3. Transplant Practices

In the early years, from 1975 up till 1986 renal transplantation was predominantly live related donor transplantation, which made up 90-100% of all renal transplants in the country. After 1986 the transplant rate increased significantly, contributed mainly by commercial live unrelated donor transplants done in India which made up 60-70% of all transplants while only 20-30% of all transplants were from live related donors. It was only in 1996 when such activities were proscribed that the proportion of commercial live unrelated transplants dropped. However, this was later taken over by commercial cadaveric transplant activity in China. In 2004, commercial transplants from China constituted 74% of all new renal transplantation, while live donor transplantation made up 12% and local cadaveric transplants contributed another 11% of all new renal transplantation (Table 13.3.1).

Table 13.3.1: Type of Renal Transplantation, 1975-2004

Year	1985		1986		1987		1988		1989		1990		1991		1992		1993		1994	
	No	%	N.	%	No	%	No	%	No	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial Cadaver	0	0	2	5	2	3	0	0	3	3	0	0	3	3	3	3	15	11	21	11
Commercial Live Donor	1	2	1	3	15	25	43	49	61	65	72	59	64	59	73	66	83	61	143	72
Live Donor (genetically related)	42	98	36	92	44	72	45	51	30	32	50	41	42	39	31	28	36	26	33	17
Live Donor (emotionally related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadaver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	2	1	2	1
TOTAL	43	100	39	100	61	100	88	100	94	100	122	100	109	100	111	100	136	100	199	100

Year	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial Cadaver	36	39	105	72	80	68	50	52	60	51	79	56	82	51	102	60	109	69	126	74	879	34
Commercial Live Donor	18	19	4	3	7	6	4	4	4	3	10	7	7	4	11	7	3	2	4	2	628	25
Live Donor (genetically related)	35	38	34	23	23	19	26	27	38	32	20	14	32	20	31	18	25	16	19	11	842	33
Live Donor (emotionally related)	0	0	0	0	0	0	2	2	5	4	6	4	4	2	3	2	5	3	2	1	27	1
Cadaver	4	4	2	1	8	7	15	15	10	9	27	19	37	23	22	13	15	10	19	11	173	7
Total	93	100	145	100	118	100	97	100	117	100	142	100	162	100	169	100	157	100	170	100	2549	100

*Commercial cadaver (China, India, other overseas) *Commercial live donor (living unrelated) *Cadaver (local)
*For 101 patients there is no complete information on type; it is known that 84 are living related

Table 13.3.2: Biochemical data, 2004

Biochemical parameters	
Creatinine, μmol/L	N=1492
• Mean	131.6
• SD	63.6
• Median	119
• Minimum	38
• Maximum	817
Hb, g/dL	N=1492
• Mean	12.9
• SD	1.9
• Median	12.9
• Minimum	4.9
• Maximum	19.7
Albumin, g/L	N=1492
• Mean	39.6
• SD	4.9
• Median	39.6
• Minimum	11
• Maximum	57
Calcium, mmol/L	N=1492
• Mean	2.4
• SD	0.2
• Median	2.4
• Minimum	1.1
• Maximum	3.3
Phosphate, mmol/L	N=1492
• Mean	1.1
• SD	0.2
• Median	1.1
• Minimum	0.3
• Maximum	2.7

*Extreme values were excluded and missing data was imputed using the mean

Cyclosporine/prednisolone based triple therapy has remained the backbone of maintenance immunosuppressive therapy. In 2004, 80% of renal transplant recipients were on CsA while 98% were on prednisolone. Only 12% were on tacrolimus. However, 36% of the recipients were on MMF as opposed to 43% on azathioprine.

Table 13.3.3: Medication data, 2004

Medication data	Single drug treatment		Drug treatment	
	No.	%	No.	%
All patients	1492	100	1492	100
(i) Immunosuppressive drug(s) treatment				
Prednisolone	14	1	1458	98
Azathioprine	0	0	642	43
Cyclosporine	3	0	1193	80
Tacrolimus (FK506)	0	0	186	12
Mycophenolate mofetil (MMF)	1	0	539	36
Rapamycin (sirolimus)	0	0	5	0
Others	1	0	20	1
(ii) Non-Immunosuppressive drug (s) treatment				
Beta blocker	105	7	654	44
Calcium channel blocker	184	12	798	53
ACE inhibitor	39	3	266	18
AIIRB	16	1	86	6
Anti-lipid	67	4	553	37
Other anti-hypertensives	4	0	132	9

*There are 14 patients without any drug treatment

13.4. Transplant Outcomes

13.4.1 Post-transplant complications

64% of the recipients had hypertension as a co-morbidity before transplantation while another 25% developed hypertension post transplantation (Table 13.4.1). Among these patients, only 23% were on monotherapy while the rest were on multiple drug treatment. For those on combination therapy, majority was on calcium channel blockers (53%) and beta blockers (44%). Only 18% were on ACE inhibitors while another 6% were on AIIRBs.

It is also interesting to note while 12% of the prevalent renal transplant recipients had diabetes mellitus before transplantation (either as primary renal disease or co-morbidity), another 8% of them developed diabetes mellitus post transplantation (PTDM).

Table 13.4.1: Post transplant complications, 2004

Post transplant complications	Complication developed before transplant (regardless of complication after transplantation)		Complication developed only after transplantation	
	No.	%	No.	%
All patients	1492	100	1492	100
Diabetes	174	12	120	8
Cancer	2	0	18	1
Cardiovascular disease + cerebrovascular disorder	77	5	82	5
Hypertension	956	64	370	25

*Hypertension: BP systolic > 140 and BP diastolic > 90
OR have either Beta blocker / Calcium channel blocker / ACE inhibitor / AIIRB / Other anti-hypertensive

13.4.2 Death and Graft loss

In 2004, 32 (2%) of transplant recipients died and 43 (3%) lost their grafts. These rates of transplant death and graft loss have remained constant for the last 10 years (Table 13.4.2).

Table 13.4.2: Transplant Patients Death Rate and Graft Loss, 1975-2004

Year	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
No. at risk	1	3	6	10	23	43	60	81	100	111	135	164	202	262	335	418	505
Transplant death	0	2	3	2	2	5	4	3	14	6	7	8	8	9	10	19	13
Transplant death rate %	0	67	50	20	9	12	7	4	14	5	5	5	4	3	3	5	3
Graft loss	0	0	0	0	2	3	10	6	8	5	8	7	8	12	8	12	18
Graft loss %	0	0	0	0	9	7	17	7	8	5	6	4	4	5	2	3	4
Acute rejection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acute rejection rate %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All losses	0	2	3	2	4	8	14	9	22	11	15	15	16	21	18	31	31
All losses rate %	0	67	50	20	17	19	23	11	22	10	11	9	8	8	5	7	6

Year	92	93	94	95	96	97	98	99	00	01	02	03	04
No. at risk	587	675	799	903	976	1051	1096	1142	1211	1291	1381	1465	1544
Transplant death	16	20	28	16	31	29	23	25	27	35	31	36	32
Transplant death rate %	3	3	4	2	3	3	2	2	2	3	2	2	2
Graft loss	19	23	21	28	28	38	47	36	32	40	38	42	43
Graft loss %	3	3	3	3	3	4	4	3	3	3	3	3	3
Acute rejection	0	0	0	0	0	0	0	0	0	0	0	3	18
Acute rejection rate %	0	0	0	0	0	0	0	0	0	0	0	0	1
All losses	35	43	49	44	59	67	70	61	59	75	69	78	75
All losses rate %	6	6	6	5	6	6	6	5	5	6	5	5	5

*Graft loss=graft failure
*All losses=death/graft loss (acute rejection happens concurrently with graft failure/ death)

Figure 13.4.2(a): Transplant Recipient Death Rate, 1975-2004

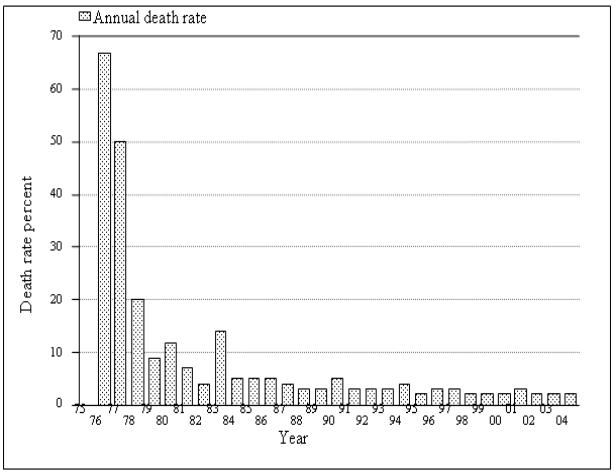
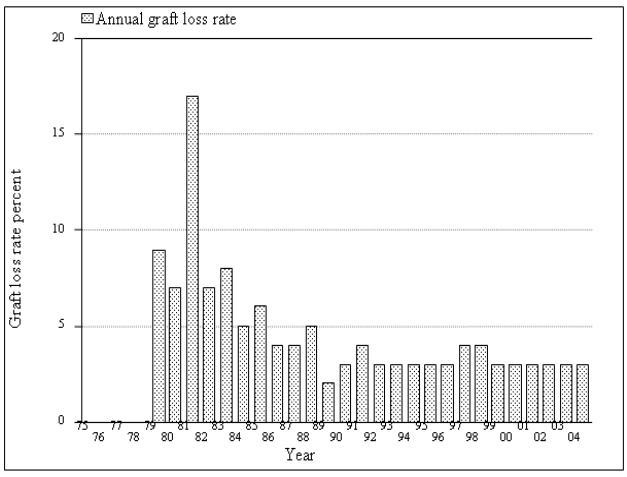


Figure 13.4.2(b): Transplant Recipient Graft Loss Rate, 1975-2004



Infection, cardiovascular disease and death at home were among the commonest causes of death for the last 2 decades and in 2004, they accounted for 29%, 11% and 11% of the causes of death respectively (Table 13.4.3).

Table 13.4.3: Causes of Death in Transplant Recipients, 1975-2004

Year	1985		1986		1987		1988		1989		1990		1991		1992		1993		1994	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Cardiovascular	0	0	1	13	1	11	0	0	1	8	1	5	0	0	2	13	4	19	4	14
Died at home	0	0	0	0	0	0	0	0	1	8	1	5	3	23	0	0	3	14	0	0
Infection	2	29	2	25	3	33	3	33	6	50	11	52	5	38	8	50	7	33	18	62
Graft failure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cancer	0	0	0	0	0	0	0	0	0	0	3	14	0	0	1	6	1	5	0	0
Liver disease	1	14	1	13	0	0	2	22	1	8	0	0	1	8	1	6	1	5	1	3
Accidental death	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	1	14	0	0	0	0	2	22	1	8	4	19	2	15	1	6	1	5	3	10
Unknown	3	43	4	50	5	56	2	22	2	17	1	5	2	15	3	19	4	19	3	10
TOTAL	7	100	8	100	9	100	9	100	12	100	21	100	13	100	16	100	21	100	29	100

Year	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		TOTAL	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	7	41	4	13	3	10	3	13	4	13	10	32	6	15	5	16	9	23	4	11	70	14
Died at home	1	6	3	9	2	7	4	17	6	19	1	3	5	12	5	16	5	13	4	11	44	9
Infection	3	18	18	56	14	48	9	38	7	23	11	35	19	46	9	29	10	26	10	29	184	37
Graft failure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cancer	1	6	2	6	0	0	3	13	3	10	2	6	6	15	4	13	6	15	6	17	39	8
Liver disease	1	6	3	9	2	7	2	8	3	10	1	3	1	2	3	10	2	5	1	3	29	6
Accidental death	1	6	0	0	0	0	0	0	1	3	1	3	1	2	1	3	0	0	0	0	5	1
Others	2	12	1	3	4	14	0	0	5	16	3	10	2	5	2	6	5	13	9	26	54	11
Unknown	1	6	1	3	4	14	3	13	2	6	2	6	1	2	2	6	2	5	1	3	72	14
TOTAL	17	100	32	100	29	100	24	100	31	100	31	100	41	100	31	100	39	100	35	100	497	100

However, death secondary to cancer has become more common over the last 5 years and in 2004, cancer death accounted for 17% of all causes of death. Renal allograft rejection accounted for 50-70% of graft losses for the last 10 years (Table 13.4.4).

Table 13.4.4: Causes of Graft Failure, 1975-2004

Year	1985		1986		1987		1988		1989		1990		1991		1992		1993		1994	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Rejection	2	25	3	43	1	13	5	38	1	13	4	31	10	53	9	47	10	43	10	42
Calcineurin toxicity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	1	8	0	0	0	0	0	0	0	0	0	0	1	4
Infection	1	13	0	0	0	0	0	0	0	0	1	8	1	5	0	0	0	0	1	4
Vascular causes	0	0	0	0	0	0	0	0	0	0	1	8	0	0	0	0	1	4	1	4
Recurrent / de novo renal disease	0	0	0	0	0	0	0	0	0	0	2	15	1	5	1	5	1	4	2	8
Others	0	0	0	0	0	0	2	15	0	0	1	8	0	0	1	5	0	0	1	4
Unknown	5	63	4	57	7	88	5	38	7	88	4	31	6	32	8	42	11	48	8	33
TOTAL	8	100	7	100	8	100	13	100	8	100	13	100	19	100	19	100	23	100	24	100

Year	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		TOTAL	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No.	%	No.	%	No.	%	No.	%
Rejection	15	52	14	50	20	53	27	53	23	64	19	59	25	61	22	55	22	50	30	70	280	50
Calcineurin toxicity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other drug toxicity	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Ureteric obstruction	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1
Infection	0	0	0	0	0	0	1	2	0	0	1	3	2	5	0	0	2	5	1	2	16	3
Vascular causes	1	3	1	4	4	11	3	6	1	3	3	9	1	2	0	0	3	7	4	9	24	4
Recurrent / de novo renal disease	0	0	2	7	1	3	1	2	0	0	0	0	2	5	2	5	1	2	1	2	17	3
Others	1	3	0	0	5	13	5	10	0	0	2	6	0	0	4	10	1	2	0	0	23	4
Unknown	11	38	11	39	7	18	14	27	12	33	7	22	11	27	12	30	15	34	7	16	194	35
TOTAL	29	100	28	100	38	100	51	100	36	100	32	100	41	100	40	100	44	100	43	100	559	100

13.4.3 Patient and Graft Survival

The overall transplant patient survival rate from 1993 to 2004 was 95%, 92%, 89% and 80% at 1 year, 3 years, 5 years and 10 years respectively, while the overall graft survival rate was 97%, 93%, 88% and 77% respectively. These survival rates are comparable to the USRDS outcomes.

Table 13.4.5: Patient survival, 1993-2004

Interval (years)	% Survival	SE
1	95	1
3	92	1
5	89	1
10	82	1

SE=standard error

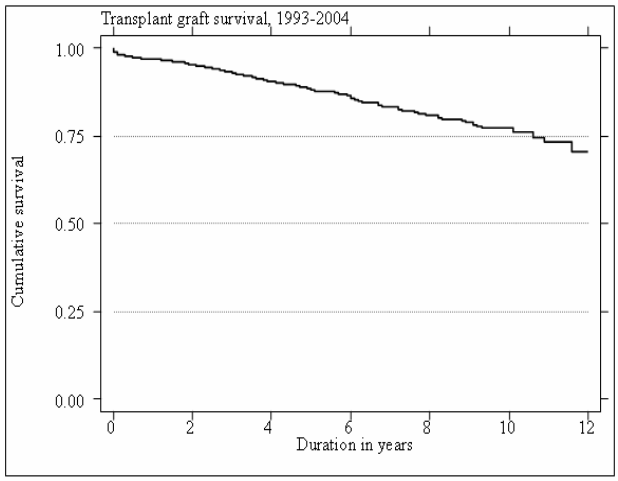
Table 13.4.6: Graft survival, 1993-2004

Interval (years)	% Survival	SE
1	97	0
3	93	1
5	88	1
10	77	2

SE=standard error

Figure 13.4.5: Patient survival, 1993-2004

Figure 13.4.6: Graft survival, 1993-2004



Outcomes of renal transplantation from the four donor groups are shown in Figures 13.4.7 and 13.4.8 and demonstrate substantially different patient & graft survival rates. Living donor grafts had the best patient and graft survival rates. The 1, 3, 5 and 10 year patient survival rate for recipients of living donor grafts were 96%, 95%, 93% and 89% respectively. The graft survival rates also differed between these 4 groups; living and commercial cadaver donor graft had the best outcomes.

The differences in graft survival rates among these 4 groups of donor source were significant even after adjustment for multiple risk factors such as age, gender, ethnicity, year of transplant, smoking status, BMI, diabetes, hepatitis B and C, HLA match, cardiovascular disease and prior dialysis time. Hence other immunological and non immunological factors such as PRA, cold ischaemia time, number of previous transplants, donor factors and the effect of immunosuppressive regime may contribute to the observed differences in outcomes (refer 11th Report of the Malaysian Dialysis & Transplant Registry 2003: Chapter 6).

Table 13.4.7: Patient survival by type of transplant, 1993-2004

Type of Transplant	Commercial Cadaver		Commercial Live Donor		Live Donor		Cadaver	
Interval (years)	% Survival	SE	% Survival	SE	% Survival	SE	% Survival	SE
1	96	1	96	1	96	1	85	3
3	93	1	91	2	95	1	81	3
5	89	1	87	2	93	1	77	4
10	86	2	74	3	89	2	67	8

SE=standard error

Figure 13.4.7: Patient survival by type of transplant, 1993-2004

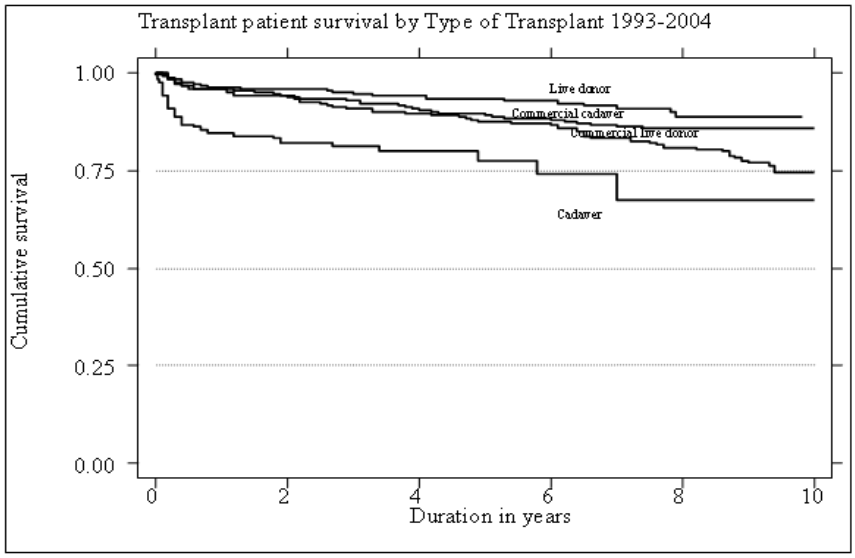
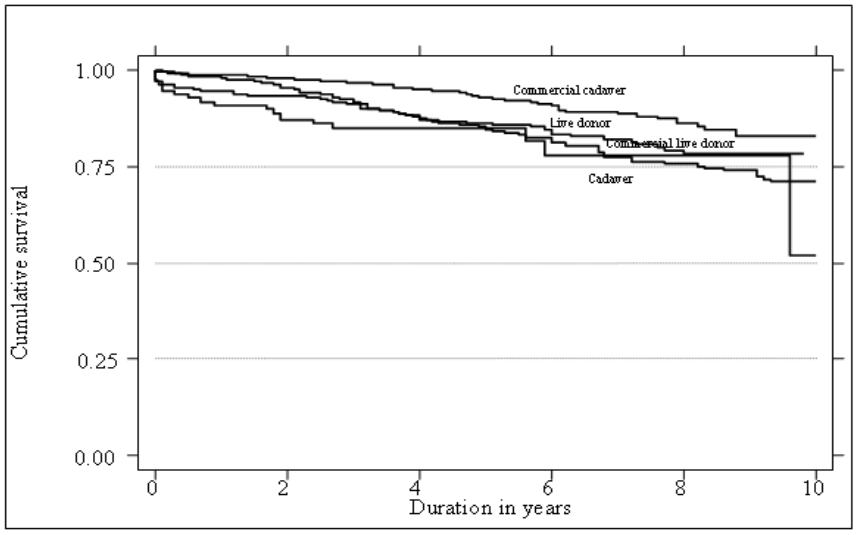


Table 13.4.8: Graft survival by type of transplant, 1993-2004

Type of Transplant	Commercial Cadaver		Commercial Live Donor		Live Donor		Cadaver	
Interval (years)	% Survival	SE	% Survival	SE	% Survival	SE	% Survival	SE
1	98	0	98	1	94	1	91	2
3	97	1	92	2	91	2	85	3
5	93	1	84	2	86	2	85	3
10	83	3	71	3	78	3	52	21

SE=standard error

Figure 13.4.8: Graft survival by type of transplant, 1993-2004



Our data shows that there were higher risk patients among more recent transplants. For example, more recent transplant recipients were older and a greater proportion of them had diabetes. This prompted us to compare the patient and graft survival rates for 1993-1998 cohort and 1999-2004 cohort.

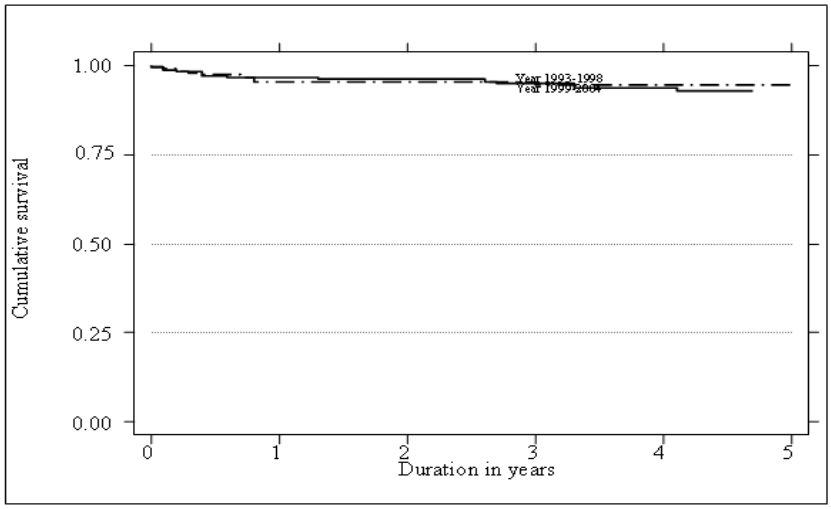
We found that patient survival rate for living related donor renal transplants has remained excellent and unchanged for these two cohorts (Figure 13.4.9).

Table 13.4.9: Patient survival by year of transplant (Living related transplant, 1993-2004)

Year of Transplant	1993-1998		1999-2004	
Interval (years)	% Survival	SE	% Survival	SE
1	97	1	96	2
3	95	2	95	2
5	93	2	95	2

SE=standard error

Figure 13.4.9: Patient survival by year of transplant (Living related transplant, 1993-2004)



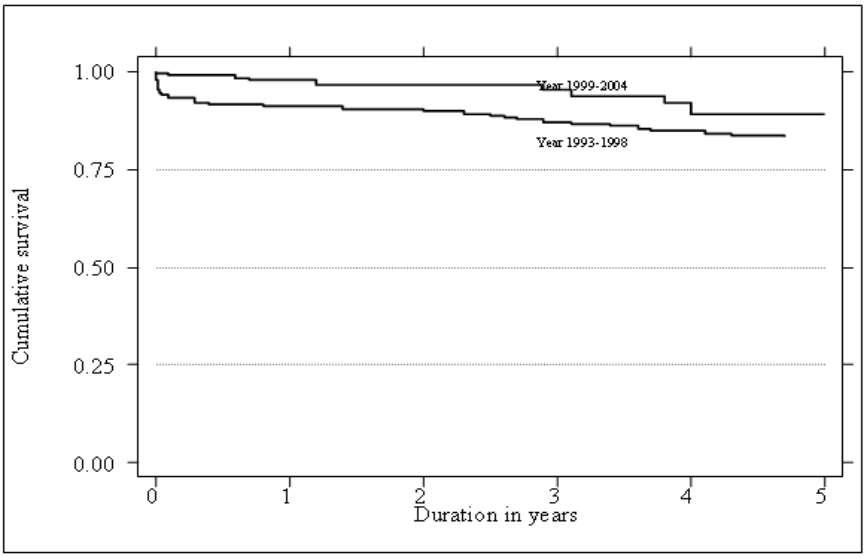
However, the risk of graft failure for living related donor renal transplantation improved for the 1999-2004 cohort compared to the 1993-1998 cohort (Table & Figure 13.4.10). One possible explanation, among others, is the increasing use of newer immunosuppressive agents such as MMF and FK506 in recent years. Therefore, there is a need to determine the effect of exposure to the newer immunosuppressive agents on graft survival.

Table 13.4.10: Graft survival by year of transplant (Living related transplant, 1993-2004)

Year of Transplant	1993-1998		1999-2004	
Interval (years)	% Survival	SE	% Survival	SE
1	91	2	98	1
3	87	2	96	2
5	83	3	89	3

SE=standard error

Figure 13.4.10: Graft survival by year of transplant (Living related transplant, 1993-2004)



Interestingly, our data showed that commercial cadaveric transplants have excellent patient and graft survival rates, which are comparable to living related donor transplants for both 1993-1998 and 1999-2004 cohorts (Figure 13.4.11 and 13.4.12).

Table 13.4.11: Patient survival by year of transplant (Commercial cadaver transplant, 1993-2004)

Year of Transplant	1993-1998		1999-2004	
Interval (years)	% Survival	SE	% Survival	SE
1	94	1	96	1
3	92	2	93	1
5	87	2	92	1

SE=standard error

Table 13.4.12: Graft survival by year of transplant (Commercial cadaver transplant, 1993-2004)

Year of Transplant	1993-1998		1999-2004	
Interval (years)	% Survival	SE	% Survival	SE
1	98	1	99	1
3	97	1	97	1
5	92	2	95	2

SE=standard error

Figure 13.4.11: Patient survival by year of transplant (Commercial cadaver transplant, 1993-2004)

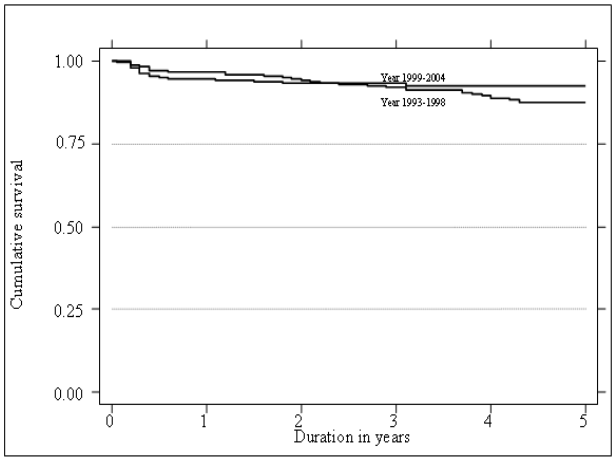
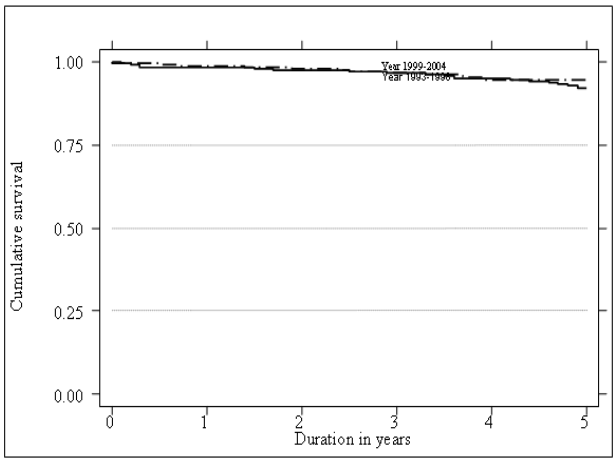


Figure 13.4.12: Graft survival by year of transplant (Commercial cadaver transplant, 1993-2004)



APPENDIX 1: DATA MANAGEMENT

Introduction

Data integrity of a register begins from the data source, data collection tools, data verification and data entry process. Data held in a registry is never perfect. Caution should be used when interpreting the results.

Data source

The initial phase of the data collected in the Register covered all Renal Replacement Therapy (RRT) patients in the Ministry of Health program since its inception in the early 1970s. The Register subsequently received the data from other sector of RRT providers like the private, non-government organization (NGO), armed forces and the university.

The Register continues to actively ascertain new RRT centres in the country. The mechanism of ascertainment is through feedback from the dialysis related company, current Source Data Provider (SDP) and public propagandas. This will gradually and eventually result in a complete RRT centre database. The identified RRT centre is invited to participate in data collection. Those RRT centres which have expressed interest in participating will be recruited.

The NRR currently receives data from 347 SDP comprising 278 HD centers, 23 CAPD centers and 46 centers that provide follow-up care for post transplant patients. This represents an estimated coverage of 86.1% of potential SDP as shown in the table below. Of these, about 17.9% did not submit the annual returns on the treatment parameters and Work Related Rehabilitation & Quality of Life Survey.

	Known dialysis centre (N)	Submitting data in 2004 (N)	Submitting annual returns (N)	submitted any data (%)
Haemodialysis	318	278	225	87.4
Peritoneal Dialysis	26	23	22	88.4
Transplant	59	46	-	77.9
All modality	403	347		86.1

Data collection

The data collection tools are designed to mimic the data capture format in the patient case notes to facilitate the data transcription and minimise transcription error. All the SDPs are provided with instructions on data collection and submission to the Register.

The Register collects the RRT patients' demographic details, clinical data, dialysis treatment data, transplant data, peritonitis data and outcome data. The Register holds individual patient's identifiable data that allow complete follow-up despite unit transfers or change of modality which are especially common among the RRT patients. These patients are monitored and tracked through from the time they were registered and commenced their RRT treatment till their death. For those patients who were lost to follow-up, the Register will verify their outcome with the National Vital Registration System. Patient Profiles are submitted to the Register throughout the year. The identity of patients in the database is not released publicly or in the registry reports.

Centre-specific reports are generated and forwarded to SDP on a quarterly basis. This has generated increased feedback from SDP and improved the patient ascertainment rate and the accuracy of the data transmitted to the Registry.

At the end of each year, the Register conducts a survey on the Staff and Facility Profile. The survey questionnaire provides summary information about the number of patients on various treatments. This acts as the basis to calculate the patient ascertainment rate.

Database System

The Register initial database was created in DBASE IV in a single computer environment. It was then upgraded to Microsoft Access as a client server application. Currently the NRR data system is a Pentium Xeon 2.4 with dual processors, with a total of 1GB RAM memory and 72GB of RAID-5 (Redundant Array of Independent Disks, level 5). In view of capacity ability, performance and security issues of Microsoft Access, it was subsequently migrated to SQL Server 2000 in the year 2004.

Data management personnel

The data management personnel in the Register office are trained base on the standard operating procedures (SOP). The data entry process is also designed to enhance data quality. Quality assurance procedures are in place at all stages to ensure the quality of data.

Visual review, Data entry and de-duplication verification, Data Editing

On receiving the CRF submitted by SDP, visual review is performed to check for obvious error or missing data in the important fields. Data entry will not be performed if a critical variable on the CRF is missing or ambiguous. The CRF is returned to the SDP for verification.

After passing the duplicate check, the data is than entered and coded where required. Edit checks are performed against pre-specified validation rules to detect missing values, out of range values or inconsistent values. Any data discrepancy found is verified against the source CRF and resolved within the Register office where possible. Otherwise the specific data query report will be generated and forwarded to the SDP to clarify and resolve the data discrepancy.

Data coding, data cleaning / data analysis

Most of the data fields have auto data coding. Those data in text fields will be manually coded by the Register manager. A final edit check run is performed to ensure that data is clean. All queries are resolved before database is locked to ensure data quality and integrity. Data is subsequently exported to the statistician for analysis

Limitation:

The majority of the RRT centres in this country are still paper based. Currently there is no satisfactory active electronic patient information system in the various centres. Computer literacy among staff is still low.

The data submission to the Register is totally voluntary and is done manually using the standard data collection tools. The process is tedious and time consuming for the SDP and the Register office. Some SDP have difficulty submitting data on time for inclusion in the yearly report. This inevitably results in slight differences when the existing data is been reported in subsequent year. Work to improve the timely data submission is ongoing.

Data release and publication policy

One of the primary objectives of the Registry is to make data available to the renal community. There are published data in the annual data report in the website: http://www.msn.org.my/nrr. This report is copyrighted. However it may be freely reproduced without the permission of the National Renal Registry. Acknowledgment would be appreciated. Suggested citation is: YN Lim, TO Lim (Eds). Twelfth Report of the Malaysian Dialysis and Transplant Registry 2004. Kuala Lumpur 2005

A distinction is made between use of NRR results (as presented in NRR published report) and use of NRR data in a publication. The former is ordinary citation of published work. NRR, of course encourages such citation whether in the form of presentation or other write-ups. The latter constitutes original research publication.
NRR position is as follows:
The NRR does not envisage independent individual publication based entirely on NRR published results, without further analyses or additional data collection.
NRR however agrees that investigator shall have the right to publish any information or material arising in part out of NRR work. In other words, there must be additional original contribution by the investigator in the work intended for publication.
NRR encourages the use of its data for research purpose. Any proposed publication or presentation (e.g. manuscript, abstract or poster) for submission to journal or scientific meeting that is based in part or entirely on NRR data should be sent to the NRR prior to submission. NRR will undertake to comment on such documents within 4 weeks. Acknowledgement of the source of the data would also be appreciated.
Any formal publication of a research based in part or entirely on NRR data in which the input of NRR exceeded that of conventional data management and provision will be considered as a joint publication by investigator and the appropriate NRR personnel.

Any party who wish to request data for a specific purpose that requires computer-run should make such requests in writing (by e-mail, fax, or classic mail) accompanied by a Data Release Application Form and signed Data Release Agreement Form. Such request will require approval by the Advisory Board before the data can be released.

Distribution of report

The MSN has made a grant towards the cost of running the registry and the report printing to allow distribution to all members of the association and the source data producers. The report will also be distributed to relevant Health Authorities and international registries.

Further copies of the report can be made available with donation of RM60.00 to defray the cost of printing. The full report is also available in the registry web site: http://www.msn.org.my/nrr

ANALYSIS SETS, STATISTICAL METHODS AND DEFINITIONS

Analysis sets

This refers to the sets of cases whose data are to be included in the analysis.
Six analysis sets were defined:

1. ***Dialysis patients notification between 1995 and 2004***
   This analysis set consists of patients commencing dialysis between 1995 and 2004. This analysis set was used for the analysis in Chapter 1, 2 and 3.

2. ***Dialysis patients notification between 1990 and 2004***
   This analysis set consists of patients with age commencing dialysis less than 20 years old between 1990 and 2004. This analysis set was used for the analysis in Chapter 5.

3. ***Dialysis patients between 1997 and 2004***
   Since 1993, the NRR conducted an annual survey on all dialysis patients to collect data on dialysis and drug treatment, clinical and laboratory measurements. All available data were used to describe the trends in these characteristics.
   However, in the early years, the data collected from annual survey were relatively incomplete. Hence, for any analyses in relation to these characteristics, we used only data from 1997 onwards when the data were more complete. Remaining missing data in this analysis set was imputed using first available observation carried backward or last observation carried forward. This analysis set was used for the analysis in Chapters 6 to 12.

4. ***Rehabilitation outcomes***
   Analysis is confined to the relevant population. Hence we exclude the following groups.
   (i) Age less than or equal to 21 years
   (ii) Age more than or equal to 55 years
   (iii) Homemaker
   (iv) Full time student
   (v) Retired
   This analysis set was used for the analysis in Chapter 4.

5. ***Centre Survey data***
   Section 2.2 in the report was based on annual centre survey data between 1999 to 2004 rather than individual patient data reported to the Registry.

6. ***Peritonitis data***
   Analysis was confined to CAPD patients who were on peritoneal dialysis from 31st Dec 1999.
   This analysis set was used for the analysis in Section 12.4.

Statistical methods

Population treatment rates (new treatment or prevalence rates)

Treatment rate is calculated by the ratio of the count of number of new patients or prevalent patients in a given year to the mid-year population of Malaysia in that year, and expressed in per million-population. Results on distribution of treatment rates by state are also expressed in per million-population since states obviously vary in their population sizes.

Death rate calculation

Annual death rates were calculated by dividing the number of deaths in a year by the estimated mid-year patient population.

Odds ratio

The odds of an event is the probability of having the event divided by the probability of not having it. The odds ratio is used for comparing the odds of 2 groups. If the odds in group 1 is O1 and group 2 is O2, then odds ratio is O1/O2. Thus the odds ratio expresses the relative probability that an event will occur when 2 groups are compared.

With multiple factors, logistic regression model was used to estimate the independent effect of each factor, expressed as odds ratio, on the event of interest.

Survival analysis

The unadjusted survival probabilities were calculated using the Kaplan-Meier method, in which the probability of surviving more than a given time can be estimated for members of a cohort of patients without accounting for the characteristics of the members of that cohort.

In order to estimate the difference in survival of different subgroups of patients within the cohort, a stratified proportional hazards model (Cox) was used where appropriate. The results from Cox model are interpreted using a hazard ratio. Adjusted survival probabilities are with age, gender, primary diagnosis and time on RRT used as adjusting risk factors. For diabetics compared with non-diabetics, for example, the hazard ratio is the ratio of the estimated hazards for diabetics relative to non-diabetics, where the hazard is the risk of dying at time t given that the individual has survival until this time. The underlying assumption of a proportional hazards model is that the ratio remains constant throughout the period under consideration.

Technique failure is defined as occurrence of death or transfer to another modality of dialysis. Similarly, graft failure is defined as occurrence of death or returned to dialysis.

Analysis of trend of intermediate results

For summarizing intermediate results like continuous laboratory data, we have calculated summary statistics like mean, standard deviation, median, lower quartile, upper quartile and the cumulative frequency distribution graph is plotted over year. Cumulative distribution plot shows a listing of the sample values of a variable on the X axis and the proportion of the observations less than or greater than each value on the Y axis. An accompanying table gives the Median (50% of values are above or below it), upper quartile (UQ, 25% of values above and 75% below it), lower quartile (LQ, 75% of values above and 25% below it). Other percentiles can be read directly off the cumulative distribution plot. The table also shows percent of observations above or below a target value, or with an interval of values; the target value or interval obviously vary with the type of laboratory data. For example, interval of values for prescribed KT/V is $\geq$1.3 and that for haemoglobin is <10, 10-11 and >11 g/l. The choice of target value is guided by published clinical practice guidelines, for example, the DOQI guideline; or otherwise they represent consensus of the local dialysis community.

Centre survey data

In contrast to other results reported in this report, Section 2.2 was based on centre survey data rather than individual patient data reported to the Registry. This is to provide an up-to-date information on patient and centre census in the country and thus overcome the inevitable time lag between processing individual patient data and subsequent reporting of results. The survey was conducted in the month of December 2004. Centre response rate to survey was 100%. Standard error estimates are not reported because no sample was taken. Results on distribution by state are also expressed in per million-population since states obviously vary in their population sizes. State population data are based on 2004 census projection. It is very difficult to estimate the amount of cross boundary patient flow; this source of error is therefore not accounted for in computing states estimates. However, we minimize the bias by combining states (Selangor and Wilayah Persekutuan, Kedah and Perlis) based on geographical considerations. HD treatment capacity is derived by assuming on average patients underwent 3 HD sessions per week and a centre can maximally operate 2.5 shifts per day. A single HD machine can therefore support 5 patients' treatment. Obviously HD treatment capacity is calculated only for centre HD. The ratio of the number of centre HD capacity to number of centre HD patient is a useful measure of utilization of available capacity.

Centre variation

To compare the variation of the intermediate results between centres, graph describing intermediate results in each centre are presented. The 95% confidence intervals have been calculated using the normal approximation of the Poisson to show the variation of proportion in centres. Lower quartile and upper quartile are instead plotted in comparison of variation in median among centres. In the analysis, centres with less than ten patients were combined in a pooled centre. An accompanying table gives the summary statistics like minimum, 5^{th} percentile, lower quartile, median, upper quarter, 95^{th} percentile and maximum value among centres over year.

Centres with intermediate results for <10 patients were combined into one composite centre.

Peritonitis rate

The occurrence of peritonitis is expressed as number of episode per patient-month of observation; peritonitis rate in short. Relapse peritonitis is defined as peritonitis caused by the same organism occurring within 6 weeks of diagnosis of previous peritonitis.