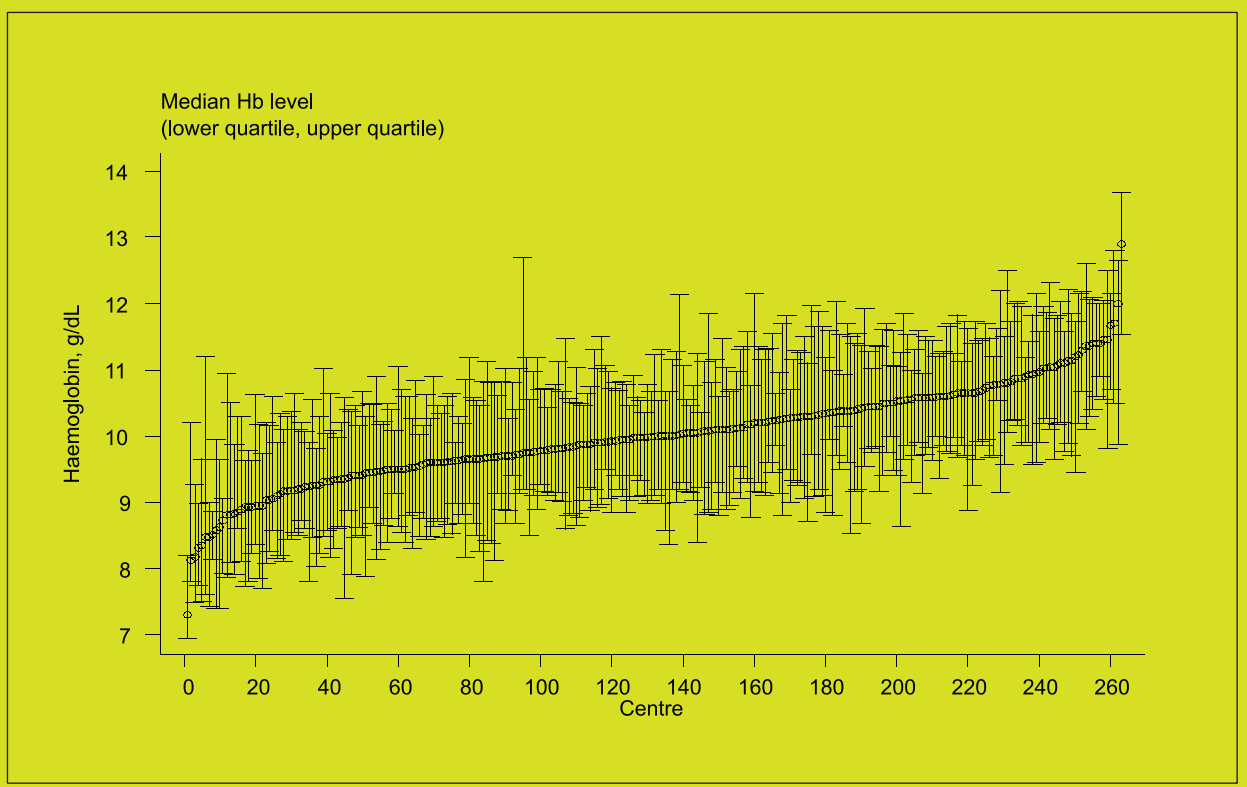
# 14TH REPORT OF THE MALAYSIAN DIALYSIS & TRANSPLANT REGISTRY 2006

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Malaysian Society of Nephrology

Association of Dialysis
Medical Assistants and Nurses

# 14TH REPORT
# OF THE MALAYSIAN
# DIALYSIS & TRANSPLANT REGISTRY
# 2006

Sponsors:

**Malaysian Society of Nephrology**
**Association of Dialysis Medical Assistants and Nurses**

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**Important information:**



This report is also published electronically on the website of the National Renal Registry at: *http://www.msn.org.my/nrr*

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**Baxter Healthcare**

**Fresenius Medical Care**

**Roche**

The staff of the Clinical Research Centre for IT and statistical support

**The National Transplant Registry**

&

**All who have in one way or another supported the National Renal Registry**

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## 2006 to 2008

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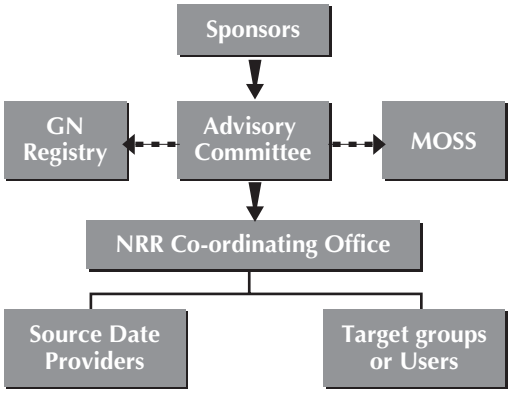
# About the National Renal Registry

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 toEnd 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 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 and MOSS. Interested parties including source data producers, Renal Registry Unit and target groups or users are represented on this committee.

### National Renal 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 of 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 epidemiological, statistical and information technological 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 need 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 rnal 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

Malaysian Organ Sharing System or MOSS has been upgraded to web application named e-MOSS. It was officially launched by Y. B. Dato Dr. Hj. Abd Latiff B Ahmad, the Deputy Minister of Health, Malaysia on 1st September 2006.

It is managed by the MOSS committee established under the Malaysian Society of Nephrology (MSN), with National Renal Registry (NRR) assisting in its daily operations.

### The functions of the MOSS committee are:

1. Make policy decisions concerning MOSS.
2. Secure funding from various sources to support its operation.
3. Designate a place to be the coordinating centre.
4. Canvass the views of nephrologists and other clinical staff involved concerning its policies and operations.
5. Appoint panel of nephrologists to assist in the potential recipient management.

### The objectives of e-MOSS

1. To maintain a list of patients who have voluntarily enrolled as potential recipients in the cadaveric kidney transplantation program in Malaysia.
2. To prioritise the waiting list according to an agreed criteria and its scoring system.
3. To update the waiting lists according to the specified criteria.
4. To provide a list of suitably matched potential recipients when a cadaver organ is available.
5. To facilitate centres to effectively manage the patients' listing.

### The role of e-MOSS:

All patients registered with NRR will be included in the e-MOSS. However, the subsequent management of the patients' lists depends on the participating centres.

1. The doctor caring for dialysis patients who are potential recipients can now efficiently maintain their patients on the lists and update their patients' treatment information regularly.
2. The transplant coordinating centres can now access the potential recipients' listing that is ranked according to the pre-determined criteria. The patient could be easily contactable in the event of organ donation.

### Participation in e-MOSS:

This system is located in a secured site; https://www.macr.org.my/emoss. There are link provided from http://msn.org.my or http://msn.org.my/nrr. All dialysis centres are welcome to be an e-MOSS user.

### How to register with e-MOSS?

1. The dialysis centre needs to register as an e-MOSS user. Registration instruction and its documents are available in this web application.
2. Registered centre can nominate more users. However, the authorization must be from the centre's doctor in-charge.
3. All e-MOSS users need to complete a user agreement form and submit it to NRR for processing.

### Management of e-MOSS:

All patients registered with NRR shall be listed in the e-MOSS on the following day according to the criteria set in the e-MOSS. These are the listing where patients will be grouped:

1. SOS List
2. On Wait List
3. Auto Off List (Pending data update)
4. Temporary Off List
5. Pending Evaluation
6. Ineligible for transplant
7. Death and Transplanted

#### 1. SOS List:

Patients on this list are given specially priority as they as expected to have lifespan of less than a year unless renal transplantations are performed. Only nephrologists can request placement of patients into this list and patient will only be placed into this list after approval is obtained from the MOSS Committee.

**2. On Wait List**

Patients listed here are patients who have met the criteria. These are the potential cadaver organ recipients.

**3. Auto Off List (Pending data update)**

If the viral serology results of a patient who is in the 'On Wait List' are not updated after 6 months, the system will automatically placed the patient into this list. The patient in this list will not be eligible for organ transplantation.

The patient will be placed back into the "On wait list" once the serology results have been updated and the patient will not be penalized.

**4. Temporary Off List**

Doctor in charge should place the patient who is temporarily unfit for a transplant into this list so that he/she will not be contacted in the event of organ donation.

**5. Pending Evaluation**

The potential eligible patients will be listed in the 'Pending List' upon register\ration with NRR. These patients' e-MOSS criteria have not been assessed by centre's doctor.

**6. Ineligible for transplant**

System auto list those patients who do not meet e-MOSS criteria.

**7. Death and Transplanted**

These are patients who had a transplant and the graft is still functioning and those patients who had passed away.

# PARTICIPATING HAEMODIALYSIS CENTRES

## JOHOR

1. Amitabha Haemodialysis Centre Johor Bahru
2. Batu Pahat Hospital
3. Batu Pahat Rotary
4. BP Renal Care (Batu Pahat)
5. BP Renal Care (Kluang)
6. BP Renal Care (Rengit)
7. BP Renal Care (Segamat)
8. BP Renalcare (Yong Peng)
9. Che Eng Khor Centre
10. Haemodialysis Mawar Gemas
11. Hospital Pakar Sultanah Fatimah Muar
12. JB Lions MAA-Medicare Charity Dialysis Centre (1)
13. JB Lions MAA-Medicare Charity Dialysis Centre (2)
14. JJ Lions Dialysis Centre
15. Johor Specialist Hospital
16. Kluang Hospital
17. Kota Tinggi Hospital
18. Mersing Hospital
19. Muar Dialysis
20. Muar Lions Renal Centre
21. Persatuan Membaiki Akhlak-Che Luan Khor_NKF
22. Pertubuhan Hemodialisis Muhibbah (Labis)
23. Pertubuhan Hemodialisis Muhibbah (Segamat)
24. Pontian Hospital
25. Pontian Rotary Haemodialysis Centre
26. Premier Renal Care
27. Prima Dialysis Kluang
28. Pusat Dialisis & Kesihatan Masjid Bandar Baru Uda
29. Pusat Dialisis Nefro Utama (Kota Tinggi)
30. Pusat Dialisis Nefro Utama (Pontian)
31. Pusat Dialisis Perbadanan Islam (Pontian)
32. Pusat Dialisis Waqaf An-nur (Batu Pahat)
33. Pusat Dialisis Waqaf An-nur (Kota Raya)
34. Pusat Hemodialisis Darul Takzim
35. Pusat Hemodialisis Hidayah
36. Pusat Hemodialisis Rotary Kota Tinggi
37. Pusat Hemodialisis Rotary Kulai
38. Pusat Rawatan Perbadanan Islam (Kota Tinggi)
39. Puteri Specialist Hospital
40. Segamat Hospital
41. Sultan Ismail Hospital
42. Sultanah Aminah Hospital (Paed)
43. Sultanah Aminah Hospital
44. Systemic Dialysis Centre (1)
45. Systemic Dialysis Centre (2)
46. Tangkak Hospital
47. Temenggong Seri Maharaja Tun Ibrahim Hospital
48. The Rotary HD Centre (Johor Bahru)
49. Yayasan Pembangunan Keluarga Johor-NKF
50. Yayasan Rotary Kluang
51. Zhi En Dialysis Centre

## KEDAH

52. 807 Rumah Sakit Angkatan Tentera (Sg. Petani)
53. Baling Hospital
54. Buddhist Tzu Chi (Jitra)
55. Kuala Nerang Hospital
56. Kulim Haemodialysis (CS Tan)
57. Kulim Hospital
58. Langkawi Hospital
59. Metro Specialist Hospital
60. Pertubuhan Bakti Fo En Bandar Kulim
61. Pusat Dialisis K K Tan (Kulim)
62. Pusat Dialysis K K Tan (Sg Petani)
63. Pusat Haemodialisis Dr. Ismail
64. Pusat Hemodialisis Beng Siew
65. Pusat Hemodialisis Mergong
66. Pusat Hemodialisis Seroja
67. Pusat Kesihatan Jitra
68. Pusat Rawatan Hemodialisis Yayasan Emkay & Sultanah Bahiyah
69. Putra Medical Centre
70. Rawatan Dialisis Amal Lion_NKF
71. Renal Care (Kedah)
72. Renal Medicare
73. Sik Hospital
74. Strand Specialist Hospital
75. Sultan Abdul Halim Hospital
76. Sultanah Bahiyah Hospital
77. Superkids Trinity-NKF Dialysis Centre
78. Yan Hospital

## KELANTAN

79. Gua Musang Hospital
80. KB Rotary-MAA Charity Dialysis
81. Kuala Krai Hospital
82. Machang Hospital
83. Nephrolife Haemodialysis Centre
84. Pakar Perdana Hospital
85. Pasir Mas Hospital
86. Pusat Dialisis Yayasan Buah Pinggang Kebangsaan (Kota Bharu)
87. Pusat Perubatan Tentera (Kota Bharu)
88. Pusat Rawatan Dialisis Islah (Kota Bharu)
89. Raja Perempuan Zainab II Hospital
90. Renal-Link (Kelantan)
91. Tanah Merah Hospital
92. Tengku Anis Hospital
93. Tumpat Hospital
94. Universiti Sains Malaysia Hospital

## MELAKA

95. 94 Hospital Angkatan Tentera (Terendak)
96 .Alor Gajah Dialysis Centre
97. Alor Gajah Hospital

**MELAKA** *(con't)*

98. Amitabha Centre (Melaka)
99. Damai Medical & Heart Clinic
100. Mahkota Medical Centre
101. Melaka Hospital
102. Pantai Air Keroh Hospital
103. Pusat HD SJAM Bacang Melaka
104. Pusat Hemodialisis Suria (Jasin)
105. Sinar Hemodialisis
106. Tenang Haemodialysis Centre
107. Tenang Haemodialysis Jasin
108. Yakin Jaya
109. Yayasan Kebajikan The Southern Melaka

**NEGERI SEMBILAN**

110. Jelebu Hospital
111. Port Dickson Hospital
112. Pusat Hemodialisis Mawar N. Sembilan (Bahau)
113. Pusat Hemodialisis Mawar N. Sembilan (Lukut)
114. Pusat Hemodialisis Mawar N. Sembilan (Seremban)
115. Pusat Waqaf An -nur (Senawang)
116. Seremban Specialist Hospital
117. Tampin Hospital
118. Tuanku Ampuan Najihah Hospital
119. Tuanku Jaafar Hospital (Paed)
120. Tuanku Jaafar Hospital

**PAHANG**

121. Bentong Hospital
122. Jerantut Hospital
123. Kuala Lipis Hospital
124. Kuantan Clinical Diagnostic Centre
125. MAA-Medicare Charity (Mentakab)
126. Mentakab Haemodialysis Unit
127. Muadzam Shah Hospital
128. Pahang Buddhist Association
129. Pekan Hospital
130. Pusat Hemodialisis Islam Makmur
131. Raub Hospital
132. SJAM-KPS Haemodialysis Centre 9 (Raub)
133. Sultan Haji Ahmad Shah Hospital
134. Tengku Ampuan Afzan Hospital (Paed)
135. Tengku Ampuan Afzan Hospital
136. 96 Hospital Angkatan Tentera (Lumut)

**PERAK**

137. Batu Gajah Hospital
138. Berchaam Dialysis Centre
139. C.S. Loo Kidney & Medical Specialist
140. Changkat Melintang Hospital
141. Emnur Teguh
142. Gerik Hospital
143. Hope Haemodialysis Society Ipoh
144. Ipoh Hospital
145. Ipoh Hospital (Home)
146. Kampar Hospital
147. Kuala Kangsar Hospital
148. MAA-Medicare Charity (Teluk Intan)
149. Parit Buntar Hospital
150. Persatuan Amal Chin Malaysia Barat
151. Pertubuhan Perkhidmatan Haemodialisis Ar-Ridzuan
152. Pertubuhan Perkhidmatan Hemodialisis AIXIN Kerian
153. Pulau Pangkor Hospital
154. Pusat Dialisis Darul Iltizam Taiping
155. Pusat Dialisis Ehsan Perak
156. Pusat Dialisis Intan
157. Pusat Dialisis Kuala Kangsar
158. Pusat Dialisis Mutiara
159. Pusat Dialisis Penawar Permai
160. Pusat Dialisis Taiping (Kamunting)
161. Pusat Dialisis Taiping (Kuala Kangsar)
162. Pusat Dialisis Taiping (Parit Buntar)
163. Pusat Dialisis Taiping
164. Pusat Dialysis Setia
165. Pusat Hemodialisis Darul Iltizam (Ipoh)
166. Pusat Hemodialisis Kampar, Yayasan Nanyang
167. Pusat Hemodialisis Manjung
168. Renal Care (Ipoh Specialist)
169. Selama Hospital
170. Seri Manjung Hospital
171. Sg Siput Hospital
172. Taiping Hospital
173. Tanjung Malim Hospital
174. Tapah Hospital
175. Teluk Intan Hospital
176. Who Peng Cheang Seah
177. Yayasan Akhlak-NKF Taiping
178. Yayasan Dialysis Pendidikan Akhlak Perak-NKF Ipoh

**PERLIS**

179. Tuanku Fauziah Hospital
180. Tuanku Syed Putra Haemodialysis Centre

**PULAU PINANG**

181. AMD Rotary (Penang)
182. Asia Renal Care (Penang)
183. Balik Pulau Hospital
184. Buddhist Tzu Chi Dialysis Centre (Butterworth)
185. Buddhist Tzu Chi HD Centre (Penang)
186. Bukit Mertajam Hospital
187. Bukit Mertajam Specialist Hospital
188. Fo Yi NKF Dialysis Centre
189. Gleneagles Medical Centre
190. Island Hospital
191. K K Tan Specialist (BM)
192. Kepala Batas Hospital
193. Lam Wah Ee Hospital
194. Loh Guan Lye Specialist Centre
195. MAA-Medicare Charity (Butterworth)

## PULAU PINANG *(con't)*

196. Pantai Mutiara Hospital
197. Penang Adventist Hospital
198. Penang Caring Dialysis Society
199. Penang Hospital
200. Penang Hospital (Home)
201. Penang Hospital (Paed)
202. Pertubuhan Dialisis Rotary-Satu Hati
203. Pertubuhan Hemodialisis SPS
204. Province Wellesley Renal Medifund
205. Pusat Haemodialisis Zakat Jawi
206. Pusat Haemodialysis St Anne BM
207. Pusat Hemodialisis Zakat (Balik Pulau)
208. Pusat Hemodialisis Zakat (Bukit Mertajam)
209. Pusat Hemodialisis Zakat (Butterworth)
210. PWRM (BM) Dialysis Centre
211. Renal Link (Penang)
212. Seberang Jaya Hospital (Butterworth)
213. Seberang Perai (Bagan)
214. Sungai Bakap
215. The Penang Community HD Society
216. TSC Renal Care

## SABAH

217. Beaufort Hospital
218. Beluran Hospital
219. Duchess of Kent Hospital
220. Keningau Hospital
221. Kota Belud Hospital
222. Kota Kinabatangan Hospital
223. Kota Marudu Hospital
224. Kudat Hospital
225. Lahad Datu Hospital
226. Likas Hospital
227. MAA-Medicare Charity (Kota Kinabalu)
228. Nobel Dialysis Centre
229. Papar Hospital
230. Persatuan Buah Pinggang Sabah
231. Pusat Hemodialisis Palmcare Malaysia
232. Queen Elizabeth Hospital
233. Ranau Hospital
234. Rotary Tawau Tanjung
235. Sabah Medical Centre
236. Semporna Hospital
237. Sipitang Hospital
238. SJAM-KPS Pusat Hemodialisis Centre 10 (Bintulu)
239. Tambunan Hospital
240. Tawau Hospital
241. Tenom Hospital

## SARAWAK

242. 801 Rumah Sakit Angkatan Tentera (Kuching)
243. Bau Hospital
244. Betong Hospital
245. Bintulu Hospital
246. CHKMUS-MAA Medicare Charity
247. Kanowit Hospital
248. Kapit Hospital
249. KAS-Rotary-NKF
250. Kuching Specialist Hospital
251. Lawas Hospital
252. Limbang Hospital
253. Lundu Hospital
254. Marudi Hospital
255. Miri Hospital
256. Miri Red Crescent Dialysis Centre
257. Mukah Hospital
258. Normah Medical Specialist Centre
259. Rejang Medical Centre
260. Saratok Hospital
261. Sarawak General Hospital
262. Sarikei Hospital
263. Serian Hospital
264. Sibu Hospital
265. Sibu Kidney Foundation
266. Simunjan Hospital
267. SJAM-KPS Haemodialysis Centre 8 (Sibu)
268. Sri Aman Hospital
269. Timberland Medical Centre

## SELANGOR

270. 819 Rumah Sakit Angkatan Tentera
271. Ampang Hospital
272. Ampang Puteri Specialist Hospital
273. Apex Club of Klang-NKF Charity Dialysis Centre
274. Assunta Hospital
275. Bakti-NKF Dialysis Centre
276. Bangi Dialysis Centre
277. Banting Hospital
278. Berjaya NKF Dialysis Centre
279. Caring Dialysis Centre (Tanjong Karang)
280. Damansara Specialist Hospital
281. Haemodialysis Association Klang
282. Haemodialysis Edina
283. Healthcare Dialysis Centre
284. Hemodialisis Yayasan Veteran ATM
285. Kajang Dialysis Centre
286. Kajang Hospital
287. Kelana Jaya Medical Centre
288. Kuala Kubu Bharu Hospital
289. MAA-Medicare Charity (Kajang)
290. Persatuan Dialisis Kurnia PJ
291. PingRong-NKF
292. Pusat Dialisis Aiman (Shah Alam)
293. Pusat Dialisis Mesra (Kuala Selangor)
294. Pusat Dialisis Sijangkang
295. Pusat Dialysis Mesra (Kapar)
296. Pusat Dialysis Mesra KKB
297. Pusat Dialysis Putra Jaya (Semenyih)

## SELANGOR *(con't)*

298. Pusat Hemodialisis Fasa
299. Pusat Hemodialisis Kau Ong Yah Ampang
300. Pusat Hemodialisis Majlis Perbandaran Kelang
301. Pusat Hemodialisis Mawar N. Sembilan (Sepang)
302. Pusat Hemodialisis Mawar N. Sembilan (Seri Kembangan)
303. Pusat Perubatan Primier HUKM
304. Pusat Rawatan Dialisis Islah (Batu Caves)
305. Pusat Rawatan Hemodialisis Felina
306. Rawatan Dialysis Bukit Tinggi
307. Reddy Clinic
308. Renal Associates
309. S.P. Menon Dialysis Centre (Klang)
310. S.P. Menon Dialysis Centre (Petaling Jaya)
311. Selangor Medical Centre
312. Selayang Hospital
313. Serdang Hospital
314. SJAM-KPS Haemodialysis Centre 1 (Raja Muda Musa)
315. SJAM-KPS Haemodialysis Centre 11 (Shah Alam)
316. SJAM-KPS Haemodialysis Centre 2 (Klang)
317. SJAM-KPS Haemodialysis Centre 3 (Banting)
318. SJAM-KPS Haemodialysis Centre 5 (Rawang)
319. SJAM-KPS Haemodialysis Centre 6 (Kuala Selangor)
320. Smartcare Dialysis Centre (Subang Jaya)
321. Sri Kota Medical Centre
322. Subang Jaya Medical Centre
323. Sungai Buloh Hospital
324. Sunway Medical Centre (1)
325. Sunway Medical Centre (2)
326. Syukur Elit Sdn Bhd
327. Tanjung Karang Hospital
328. Tengku Ampuan Jemaah Hospital
329. Tengku Ampuan Rahimah Hospital
330. Universiti Kebangsaan Malaysia Bangi
331. Yayasan Kebajikan SSL (Puchong)
332. Yayasan Kebajikan SSL (Petaling Jaya)

## TERENGGANU

333. Besut Hospital
334. Dungun Hospital
335. Hulu Terengganu Hospital
336. Kemaman Hospital
337. Pusat Dialisis Epic
338. Pusat Dialisis Terengganu / NKF
339. Pusat Hemodialisis Nabilah
340. Pusat Rawatan Dialisis Islah (Kuala Terengganu)
341. Sultanah Nur Zahirah Hospital

## WILAYAH PERSEKUTUAN

342. Labuan Hospital
343. Aiman Dialysis Centre
344. Charis-NKF Dialysis Centre
345. Cheras Dialysis Centre
346. Kg Baru Medical Centre
347. Kuala Lumpur Hospital (Home)
348. Kuala Lumpur Hospital (Paed.)
349. Kuala Lumpur Hospital (Unit 1)
350. Kuala Lumpur Hospital (Unit 3)
351. Kuala Lumpur Hospital (Unit 4)
352. Kuala Lumpur Lions Renal Centre
353. Lifeline Dialysis Clinic
354. MAA-Medicare Charity (Cheras)
355. MAA-Medicare Charity (Kuala Lumpur)
356. National Kidney Foundation Dialysis Centre (Kuala Lumpur)
357. Pantai Indah Hospital
358. Pantai Medical Centre (1)
359. Pantai Medical Centre (2)
360. Poliklinik Komuniti Tanglin
361. Pusat Dialisis Falah
362. Pusat Dialisis Pusat Punggutan Zakat
363. Pusat Hemodialisis Dato' Lee Kok Chee
364. Pusat Hemodialisis Harmoni
365. Pusat Hemodialisis PUSRAWI
366. Pusat Hemodialisis Waz Lian
367. Pusat Hemodialisis Yayasan Felda
368. Pusat Pakar Tawakal
369. Pusat Rawatan Dialisis Nefro Utama (Setapak)
370. Rawatan Haemodialysis Koswip
371. Renal Dialysis Centre
372. Renal Healthcare
373. Renal-Link Sentosa (Sentosa Hospital)
374. Rotary Damansara-NKF Dialysis
375. S.P. Menon Dialysis Centre (Kuala Lumpur)
376. Smartcare Dialysis Clinic (Cheras)
377. The Kidney Dialysis Centre (Jalan Kelang Lama)
378. The Kidney Dialysis Centre (Jalan Ipoh)
379. The Nayang-NKF Dialysis Centre
380. Tung Shin Hospital & Yayasan Nanyang Press
381. Tung Shin Hospital
382. Universiti Kebangsaan Malaysia Hospital
383. University Malaya Medical Centre
384. University Malaya Specialist Centre
385. Putrajaya Hostpital

# PARTICIPATING PERITONEAL DIALYSIS CENTRES

| | Centre Name | State |
|---|---|---|
| 1. | BP Renal Care | Johor |
| 2. | Sultanah Aminah Hospital (Paed) | Johor |
| 3. | Sultanah Aminah Hospital | Johor |
| 4. | Sultanah Bahiyah Hospital | Kedah |
| 5. | Raja Perempuan Zainab II Hospital | Kelantan |
| 6. | Universiti Sains Malaysia Hospital | Kelantan |
| 7. | Damai Medical & Heart Clinic | Melaka |
| 8. | Melaka Hospital | Melaka |
| 9. | Tuanku Jaafar Hospital (Paed) | Negeri Sembilan |
| 10. | Tuanku Jaafar Hospital | Negeri Sembilan |
| 11. | Tengku Ampuan Afzan Hospital | Pahang |
| 12. | 96 Hospital Angkatan Tentera (Lumut) | Perak |
| 13. | Ipoh Hospital | Perak |
| 14. | Penang Hospital (Paed) | P. Pinang |
| 15. | Penang Hospital | P. Pinang |
| 16. | Queen Elizabeth Hospital | Sabah |
| 17. | Sabah Medical Centre | Sabah |
| 18. | Sarawak General Hospital | Sarawak |
| 19. | Selayang Hospital | Selangor |
| 20. | Serdang Hospital | Selangor |
| 21. | Tengku Ampuan Rahimah Hospital | Selangor |
| 22. | Sultanah Nur Zahirah Hospital | Terengganu |
| 23. | Kuala Lumpur Hospital (Paed.) | W. P. Kuala Lumpur |
| 24. | Kuala Lumpur Hospital | W. P. Kuala Lumpur |
| 25. | Universiti Kebangsaan Malaysia Hospital | W. P. Kuala Lumpur |
| 26. | University Malaya Medical Centre | W. P. Kuala Lumpur |

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| | Centre Name | State |
|---|---|---|
| 1. | Batu Pahat Hospital | Johor |
| 2. | Hospital Sultan Ismail Pandan | Johor |
| 3. | Hospital Sultanah Aminah (Paed) | Johor |
| 4. | Kluang Hospital | Johor |
| 5. | Pakar Sultanah Fatimah Muar Hospital | Johor |
| 6. | Pontian Hospital | Johor |
| 7. | Segamat Hospital | Johor |
| 8. | Sultanah Aminah Hospital | Johor |
| 9. | Alor Setar Hospital | Kedah |
| 10. | Kota Bharu Hospital | Kelantan |
| 11. | Universiti Sains Malaysia Hospital | Kelantan |
| 12. | Damai Medical & Heart Clinic | Melaka |
| 13. | Mahkota Medical Centre | Melaka |
| 14. | Melaka Hospital | Melaka |
| 15. | Seremban Hospital | Negeri Sembilan |
| 16. | Tg. Ampuan Afzan Hospital | Pahang |
| 17. | Ipoh Hospital | Perak |
| 18. | Taiping Hospital | Perak |
| 19. | Pulau Pinang Hospital | P. Pinang |
| 20. | Duchess of Kent Hospital | Sabah |
| 21. | Queen Elizabeth Hospital | Sabah |
| 22. | Sabah Medical Centre | Sabah |
| 23. | Tawau Hospital | Sabah |
| 24. | Bintulu Hospital | Sarawak |
| 25. | Miri Hospital | Sarawak |
| 26. | Sarawak General Hospital | Sarawak |
| 27. | Sibu Hospital | Sarawak |
| 28. | Timberland Medical Centre | Sarawak |
| 29. | Ampang Puteri Specialist Hospital | Selangor |
| 30. | Selangor Medical Centre | Selangor |
| 31. | Selayang Hospital | Selangor |
| 32. | Serdang Hospital | Selangor |
| 33. | Subang Jaya Medical Centre | Selangor |
| 34. | Sunway Medical Centre | Selangor |
| 35. | Tan Medical Renal Clinic | Selangor |
| 36. | Tg. Ampuan Rahimah Hospital | Selangor |
| 37. | Kemaman Hospital | Terengganu |
| 38. | Kuala Terengganu Hospital | Terengganu |
| 39. | Kuala Lumpur Hospital | W. P. Kuala Lumpur |
| 40. | Kuala Lumpur Hospital (Paed) | W. P. Kuala Lumpur |
| 41. | Renal Dialysis Centre | W. P. Kuala Lumpur |
| 42. | Universiti Kebangsaan Malaysia Hospital | W. P. Kuala Lumpur |
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# FOREWORD

The Renal Replacement Therapy program in the country continues to grow and we achieved a treatment rate of 118 per million population in 2006. There were nearly 15,000 patients on dialysis at the end 2006. The growth has, as in previous years, been contributed by the combined efforts of the three provider groups – public, non-governmental and private sectors. This success is something we are justifiably proud of. It has attracted the attention of countries which faced similar challenges who want us to share our experience. Nonetheless a number of challenges identified in the previous reports remain. There is still the problem of equity in dialysis provision. Treatment rates have improved in states which were underprovided over the last few years. However the gap between these states and the economically developed ones remains. There is a lack of centres run by NGOs to complement the efforts of the Ministry of Health in the states with low provision rates. It would appear that charitable organizations that fund NGO dialysis centres flourish in areas with higher income and quite rightly so as they depend on population in the area for support.

Last year saw the implementation of the Regulations on Hemodialysis centres of the Private Healthcare Facilities Act. These regulations are meant to ensure that dialysis centres meet the minimum standards which are enforceable by law. It is a welcomed move and officers in the relevant department of the Ministry visited dialysis centres to ensure regulations in the act were enforced. While many may argue that certain provisions of the regulations need revision, the mere fact that a minimum set of standards can be enforced is a big and laudable step in the care of dialysis patients. But nephrologists and all others interested in the care of ESRD patients should set standards of care beyond that of the Act. Data from this report showed that we have done well in most aspects of dialysis practice. Death rate for Hemodialysis patients has remained unchanged over the last 10 years despite more older and diabetic patients being accepted for treatment. There is still considerable variation amongst centres in various parameters that are monitored by the registry. We should set targets for various aspects of dialysis practice that are consistent with those advocated by the international guidelines and work on minimising the variations.

The Registry in its 15th year of existence has collected enormous amount of data that has been useful to various people not the least the practising nephrologists. It has introduced innovations including the "centre report card" where individual centres can gauge its performance against the national average. The registry should now consider collecting data on the cost of dialysis care. The country spends hundreds of millions of ringgit on dialysis and it will help the government as well as the practitioners to have accurate data on the financing of the dialysis program.

The 14th report also shows an alarming trend in the incidence of diabetic nephropathy as a cause of ESRD. Fifty seven percent of new patients accepted for dialysis last year were diabetics. We undoubtedly have the dubious honour of being the number one country in the world when it comes to diabetes as a cause of ESRD. We should consider doing a more detailed study to find whether diabetes is the real cause of ESRD in these patients or present as a co-morbid illness in a patient with some other cause of ESRD. The current method of data collection does not distinguish diabetes as cause or a co-morbid illness.

Renal transplantation continues to stagnate in the country as evidenced by this and the previous years reports. There has been an attempt at revitalizing transplantation including the formulation of a National Organ and Tissue Transplantation policy, the proposed setting up of a Transplantation unit in the Ministry of health to catalyse the Transplantation process and the creation of a budget specific for Transplantation. Nephrologists must play a more active role to promote transplantation. The clamp down by the Chinese authorities on commercial cadaveric transplantation in hospitals in China should be taken as an opportunity to promote live related kidney transplantation.

Finally we thank all those who contributed to the success of this report - the indefatigable Ms Lee Day Guat and her staff, Chapter editors and of course the Report editors Drs Lim Yam Ngo and Lim Teck Onn whose untiring efforts at ensuring an accurate and readable document shows through in this 14th report.

Dr. Rozina Ghazalli
Chairperson, National Renal Registry

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# REPORT SUMMARY

- Intake of new dialysis patients showed a linear increase over the years -from 1136 in 1997 to 3152 in 2006 with corresponding treatment rates of 52 and 118 per million population.
- Prevalent dialysis patients increased from 3698 (171 per million) in 1997 to almost 15000 (550 per million) at year end 2006.
- Transplant rates remain at about 5-7 per million. Patients with functioning renal transplants increased from 1083 (50 per million) to 1725 (65 per million) over the same period.
- Dialysis treatment rates varied from about 56-104 per million state population in the economically underdeveloped states to >140 per million in the more economically advantaged states in 2006.
- From the centre survey carried out at the end of 2006, there were a total of 14946 dialysis patients, 33.7% in MOH centres, 31.1% in non-governmental organizations (NGO) centres and 32.8% in private sector. Almost all patients in NGO and private centres were on centre HD. In MOH, 24% were on chronic PD. HD capacity to patient ratio showed slight reduction in 2006 with the lowest in Kelantan and Terengganu.
- The treatment gap between men and women has remained consistent over the years.
- Dialysis treatment rates for those < 55 years of age had leveled while those >55 years continued to increase. 53% of new dialysis patients were at least 55 years old
- At least 87% of new patients were accepted into centre haemodialysis
- The government continued to fund about 53% of dialysis treatment, NGO funding was 14% in 2006, and self funding had decreased to 27%.
- Proportion of new ESRD patients due to diabetes mellitus increased further to 57% in 2006, followed by hypertension at 6%.
- The annual death rate for those on hemodialysis remained relatively unchanged while the annual death rate on CAPD showed a 15% reduction over the last 10 years.
- Cardiovascular disease and death at home remained the commonest cause of death in 2006 at 28 and 21% respectively; sepsis was third at 13%.
- The overall unadjusted 5 years and 10 years patient survival on dialysis were 57% and 35% respectively. HD patient survival was superior to those on CAPD even after adjusting for age and diabetes. There was wide centre variation with regards to HD patient survival at one year which was more apparent at 5 years. Adjusted patient survival varied widely between CAPD centres at 5-years but not at 1-year.
- Older and diabetic patients had poorer survival on dialysis.
- After adjustment for multiple risk factors, younger patients, lower diastolic BP, lower calcium and phosphate were associated with lower mortality. Low serum albumin, Kt/V, haemoglobin and calcium phosphate product were associated with higher mortality.
- Median QoL index scores on dialysis were satisfactory and HD patients achieved a lower score than CAPD patients. Diabetes Mellitus and older age group were associated with lower median QoL index scores. Higher employment rate amongst HD and CAPD patients who started dialysis earlier
- In 2006, 84% of HD and 74% of CAPD patients were on erythropoietin (EPO). Blood transfusion rate in dialysis patients increase to 18% in 2006. Use of IV Iron has increased. The median weekly EPO dose has increased to 8000 units, in both HD and CAPD patients. Median haemoglobin level increased to 10.5g/L in 2006. Variations were seen in the use of EPO, blood transfusion rates, measures of iron stores and hemoglobin levels in HD and CAPD centres

## REPORT SUMMARY *(con't)*

- Serum albumin levels remained at mean and median of about 40g/L for HD and about 33.5g/L in CAPD patients in 2006. There were wide variations in the proportion of patients with serum albumin >40g/L in both HD and CAPD centres.
- BMI for HD patients has stabilized around 24, but was still increasing for patients on CAPD patients improved. There was some variation in proportion of patients with BMI $\geq$ 18.5 in both HD and PD centres.
- In 2006, there was a trend noted towards increasing predialysis systolic but not diastolic BP in HD patients. BP control in CAPD patients improved slightly over the years. The variation noted among the various HD and PD centres in median systolic or diastolic BP was not wide but there was wide variation in the proportion of patients achieving BP of <140/90 mmHg. BP control in CAPD was much better than in haemodialysis patients
- Improving cholesterol levels were seen in both HD and CAPD patients with lower levels seen in HD patients. Serum triglyceride levels did not show much change over the years and was lower in HD patients. There was some variation in lipid control between dialysis centres.
- In 2006 calcium carbonate remained the major phosphate binder in both HD and CAPD patients. Phosphate control was better in CAPD patients. The target of calcium phosphate product of less than 4.5 mmol2/L2 was achieved more by CAPD patients than HD. Mean iPTH levels was about 220 ng/ml for both HD and CAPD patients in 2006. There was wide variation in serum calcium, phosphate, calcium phosphate product and iPTH among both hemodialysis and CAPD centres.
- The prevalence of Hepatitis B infection has remained unchanged over the years, and was quite similar between HD and CAPD patients. HCV prevalence showed a declining trend to a median of 8% in 2006. The proportion of HCV infected patients varied widely between HD centers. Previous renal transplant and history of blood transfusion were associated with a significantly higher risk of HCV seroconversion Completely assisted HD patients had a significantly lower risk of acquiring HCV infection
- Haemodialysis practices: There was increased use of brachiocephalic fistulae, higher blood flow rates, increased usage of synthetic membranes, increased number of reuse and almost universal use of bicarbonate buffer. Although the prescribed median KT/V was 1.6 in 2006, the delivered median KT/V was only1.4. The percentage of patients with a delivered KT/V > 1.2 and KT/V > 1.3 was 82% and 66% respectively. In 2006, the median urea reduction ratio was 71.9% and the percentage of patients with URR > 65% was 79%. There was wide variation in the proportion of patients with blood flow rates of >250 ml/min, prescribed KT/V of >1.3 and delivered KT/V of >1.2 but less variation in urea reduction ratio among HD centres. Technique survival was better in HD compared to PD, in the younger age groups and the non-diabetics but was not related to the year of starting dialysis.
- Chronic PD practices - In 2006, CAPD remained the commonest mode of PD at 90% but APD use increased to 6%. 92% were on the Baxter disconnect system. 91% were on 4 exchanges a day, 82% used a fill volume of 2 L. The median delivered weekly Kt/V was 2.1, 59% achieved target Kt/V of >2.0 with a 3-fold variation between the highest- and the lowest-performing centres. Technique survival was better for younger patients and non-diabetics but was not related to the year of starting dialysis or gender. Commonest cause of technique failure was peritonitis and membrane failure.
- In 2006, median peritonitis rate was 33 patient-months but varied between 16 and 103 patient-months/episode among centres. Gram positive and Gram negative organisms each accounted for 32% and 22% of peritonitis episodes.

## Renal Transplantation

- There were 161 new renal transplant recipients in 2005 and 1725 with functioning transplants at the end of 2006.
- Mean age of new transplant patients in 2006 was 37 years; 68% were male, 21% diabetic, 7% HbsAg positive and 7% anti-HCV positive at the time of transplantation.
- Commonest known primary renal disease was chronic glomerulonephritis followed by hypertension and diabetes mellitus.
- In 2006, commercial transplants from China constituted 57% of all new renal transplantation, live donor transplantation 21% and local cadaveric transplants contributed only 19%.
- 76% of renal transplant recipients were on cyclosporine, 97% on prednisolone, and 17% were on tacrolimus. 48% were on MMF and 33% on azathioprine
- 34% of the prevalent renal transplant recipients had diabetes mellitus before transplantation, another 8% developed diabetes mellitus post transplantation
- In 2006, 49 (3%) of transplant recipients died and 30 (2%) lost their grafts. Infection, cardiovascular disease and death at home were the commonest causes of death for the last decade and accounted for 41%, 19% and 13% respectively. Renal allograft rejection accounted for 50-78% of graft losses for the last 10 years
- The overall transplant patient survival rate from 1993 to 2006 was 95%, 91%, 88% and 80% at 1 year, 3 years, 5 years and 10 years respectively, while the overall graft survival rate was 92%, 85%, 79% and 63% respectively. Living donor and commercial cadaver grafts had the best patient and graft survival rates.
- In 2006, 85.5% of recipients were hypertensive, 22.9% had diabetes and 57.1% had renal insufficiency fulfilling the criteria for CKD III and above, 13.1% were obese with BMI above 30.

## Paediatric Renal Replacement Therapy

- Intake of new paediatric dialysis patients increased from 41 in 1997 to 88 in 2006 giving a dialysis acceptance rate of 4 per million age related population (pmarp) to 8 pmarp respectively.
- New renal transplant rate was 2 pmarp in 2005 and 2006.
- At the end of 2006 there were a total of 468 patients under 20 on dialysis giving a dialysis prevalence rate 42 pmarp.
- The number of patients with functioning transplants in 2006 was 139 giving a prevalence rate of 12 pmarp.
- Dialysis treatment rates were higher in the economically advantaged states of Malaysia.
- The number of 0-4 year olds provided RRT remained very low.
- Chronic PD was the initial dialysis modality in about 50% of patients. Of this 10-20% were on automated PD..
- About 90% received dialysis in government centres.
- Glomerulonephritis accounted for 24% of ESRD, focal segmental glomerulosclerosis 10%, and SLE 8%. 39% of patients had unknown primary renal disease.
- Patient survival for HD was 95% at 1 year, 84% at 5 years. CAPD patient survival was 95% at 1 year and 79% at 5 years.
- In the last 10 years, live related transplantation constituted slightly more than 50%, and cadaveric transplantation a quarter with another quarter from overseas cadaveric transplantation.
- Transplant patient survival was 98% at 1 year and 94% at 5 years; graft survival was 89% at 1 year and 81% at 5 years.

# ABBREVIATIONS

| | |
|---|---|
| APD | Automated peritoneal dialysis |
| CAPD | Continuous ambulatory peritoneal dialysis |
| CCPD | Continuous cycling peritoneal dialysis |
| CKD | Chronic Kidney Disease |
| CRC | Clinical Research Centre |
| ESRD | End Stage Renal Disease |
| HD | Haemodialysis |
| JNC IV | Joint National Council IV |
| MOH | Ministry of Health |
| MOSS | Malaysian Organ Sharing System |
| NGO | Non-governmental organization |
| NRR | National Renal Registry |
| PD | Peritoneal dialysis |
| pmarp | Per million age related population |
| pmp | Per million population |
| PTDM | Post transplant diabetes mellitus |
| RRT | Renal replacement therapy |
| SDP | Source data producer |
| TX | Transplant |

# CHAPTER 1

# All Renal Replacement Therapy In Malaysia

Lim Yam Ngo
Lim Teck Onn

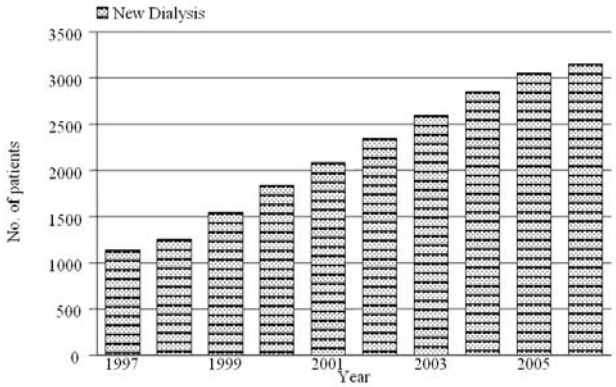
## 1.1 Stock and Flow

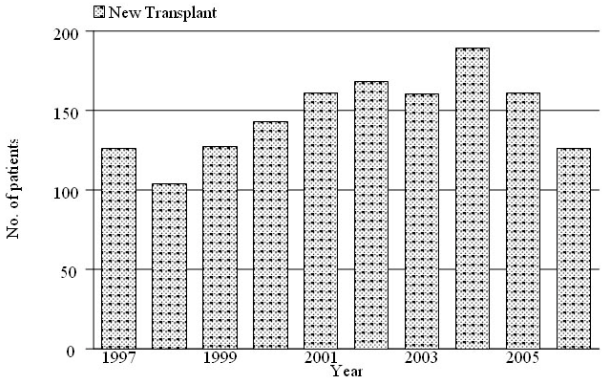
The intake of new dialysis patients continued to increase linearly over the years - from 1136 in 1997 to at least 3152 in 2006. The number of prevalent dialysis patients also increased linearly from 3698 in 1996 to almost 15000 at year end 2006.
The number of new transplant had been increasing since the late 1990s, but with increasing proscription against commercial transplant, is beginning to how a downward trend from the year 2004. Patients with functioning renal transplants showed a moderate increase - from 1083 to 1725 over the same period. (table and figure 1.01)

**Table 1.01:** Stock and Flow of RRT, Malaysia 1997 – 2006

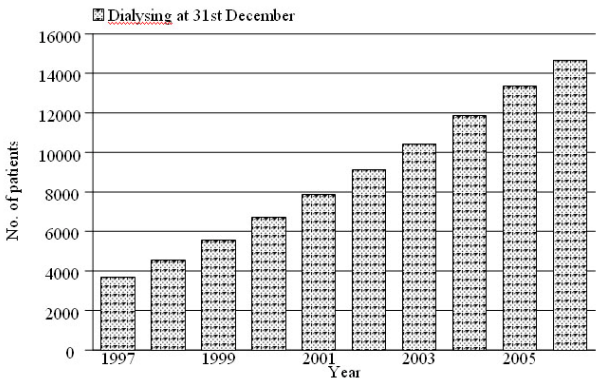
| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| New Transplants | 126 | 104 | 127 | 143 | 161 | 168 | 160 | 189 | 161 | 126 |
| Dialysis deaths | 316 | 376 | 492 | 594 | 816 | 925 | 1153 | 1265 | 1403 | 1575 |
| Transplant deaths | 31 | 26 | 25 | 30 | 37 | 32 | 37 | 41 | 41 | 49 |
| Dialysing at 31st December | 3698 | 4539 | 5538 | 6691 | 7839 | 9114 | 10429 | 11855 | 13337 | 14647 |
| Functioning transplant at 31st December | 1083 | 1111 | 1176 | 1248 | 1330 | 1425 | 1502 | 1590 | 1683 | 1725 |

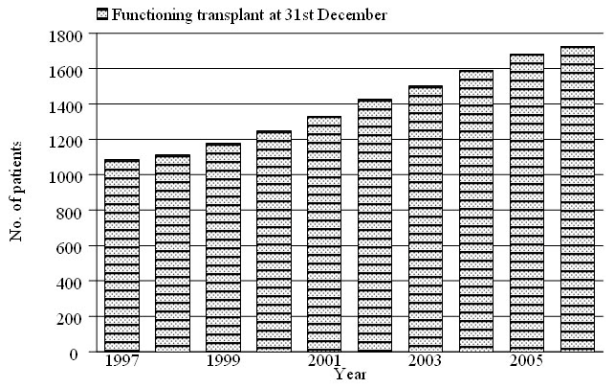
**Figure 1.01:** Stock and Flow of RRT, Malaysia 1997 – 2006
(a) New Dialysis and Transplant patients




(b) Patients Dialysing and with Functioning Transplant at 31st December 1997 – 2006



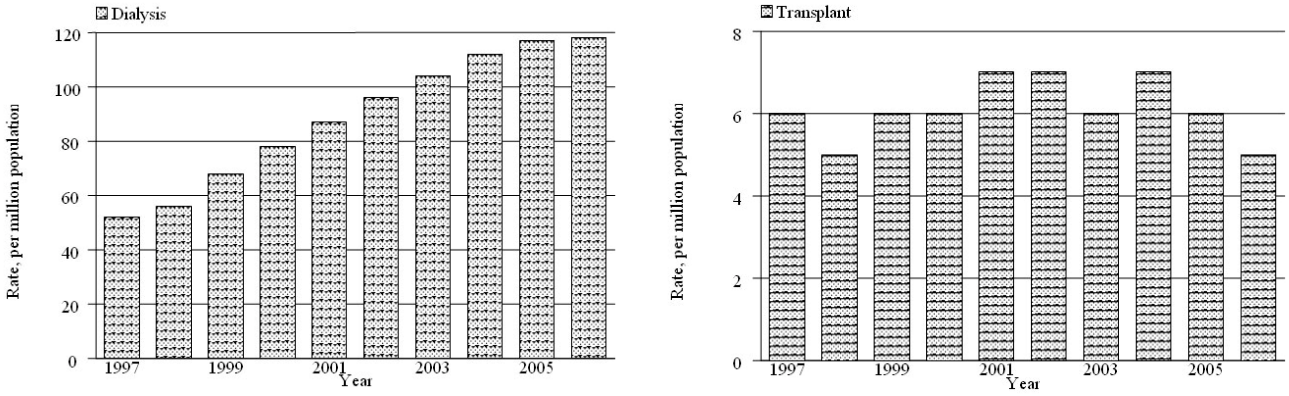
## 1.2 Treatment Provision Rate

Dialysis acceptance rates doubled from 52 in 1997 to 104 in 2003. Since then, the dialysis acceptance rate has exceeded 110 per million population and was 117 in 2005 and at least 118 in 2006. (Data for 2006 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 1997 – 2006

| Acceptance rate | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis | 52 | 56 | 68 | 78 | 87 | 96 | 104 | 112 | 117 | 118 |
| New Transplant | 6 | 5 | 6 | 6 | 7 | 7 | 6 | 7 | 6 | 5 |

**Figure 1.02:** New Dialysis Acceptance and New Transplant Rate 1997 - 2006

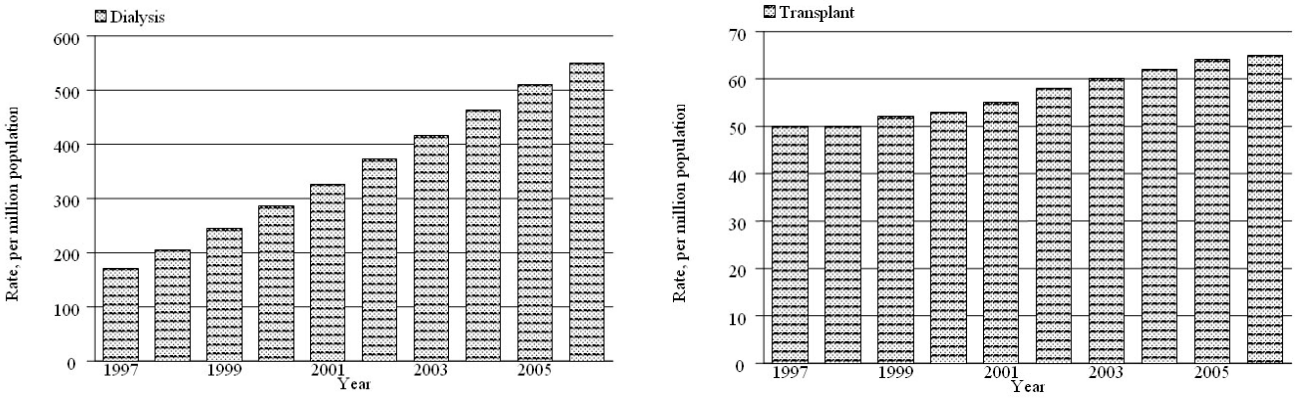



Dialysis prevalence rate increased linearly over the last 10 years, from 171 per million population in 1997 to 510 in 2005 and at least 550 in 2006. The transplant prevalence rate however only showed a slight increase from 50 to 65 per million in 2006. (table and figure 1.03)

**Table 1.03:** RRT Prevalence Rate per million population 1997 – 2006

| Prevalence rate | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| Dialysis | 171 | 205 | 244 | 285 | 326 | 372 | 416 | 463 | 510 | 550 |
| Transplant | 50 | 50 | 52 | 53 | 55 | 58 | 60 | 62 | 64 | 65 |

**Figure 1.03:** Dialysis and Transplant Prevalence Rate per million population 1997 - 2006



# CHAPTER 2

# Dialysis In Malaysia

Lim Yam Ngo
Lim Teck Onn
Lee Day Guat

## SECTION 2.1: PROVISION OF DIALYSIS IN MALAYSIA (registry report)

*Information on provision of dialysis was obtained from data on individual patients reported to the registry shown in section 2.1 as well as from the centre survey carried out at the end of each year shown in section 2.2.*

### 2.1.1 Dialysis treatment provision

In 2005, 3054 patients commenced dialysis, giving a treatment rate of 117 per million population. There were at least 3152 patients accepted for dialysis in 2006 with corresponding treatment rate of 118 per million population. At year end 2006, a total of 14647 patients were reported to the registry as being on dialysis treatment giving a prevalence rate of 550 per million per year. Dialysis patients lost to follow-up which was negligible in the earlier years almost reached 1% in 2006.

**Table 2.1.1:** Stock and flow – Dialysis Patients 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| Died | 316 | 376 | 492 | 594 | 816 | 925 | 1153 | 1265 | 1403 | 1575 |
| Transplanted | 59 | 61 | 69 | 106 | 132 | 143 | 122 | 149 | 120 | 115 |
| Lost to Follow-up | 3 | 8 | 7 | 7 | 8 | 17 | 26 | 36 | 54 | 136 |
| Dialysing at 31st December | 3698 | 4539 | 5538 | 6691 | 7839 | 9114 | 10429 | 11855 | 13337 | 14647 |

**Table 2.1.2:** Dialysis Treatment Rate per million population 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| Acceptance rate | 52 | 56 | 68 | 78 | 87 | 96 | 104 | 112 | 117 | 118 |
| Prevalence rate | 171 | 205 | 244 | 285 | 326 | 372 | 416 | 463 | 510 | 550 |

### 2.1.2.Geographic distribution

The economically advantaged states of Malaysia –Pulau Pinang, Melaka, Johor, Perak, Selangor and W. Persekutuan of Kuala Lumpur, and Negeri Sembilan – continued to have high dialysis treatment rates although the rates appear to be plateauing in the last few years. In 2006, except for Sabah, Sarawak and Kelantan, the other less economically developed states have treatment provision rates touching 100 per million. Pulau Pinang continued to have the highest treatment rate at 181 and Sabah the lowest at 56 per million in 2006.

**Table 2.1.3:** Dialysis Treatment Rate by State, per million state population 1997 – 2006

| State | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| P Pinang | 85 | 113 | 124 | 110 | 126 | 160 | 145 | 212 | 197 | 181 |
| Melaka | 95 | 107 | 88 | 150 | 156 | 171 | 185 | 210 | 168 | 171 |
| Johor | 79 | 71 | 104 | 131 | 138 | 148 | 146 | 156 | 165 | 180 |
| Perak n | 61 | 64 | 75 | 105 | 103 | 114 | 129 | 144 | 164 | 162 |
| Selangor & Kuala Lumpur | 76 | 91 | 102 | 121 | 119 | 126 | 137 | 142 | 147 | 144 |
| Negeri Sembilan | 73 | 95 | 97 | 116 | 110 | 131 | 147 | 158 | 146 | 139 |
| Kedah & Perlis | 55 | 47 | 59 | 69 | 68 | 89 | 106 | 96 | 106 | 96 |
| Terengganu | 36 | 34 | 36 | 37 | 75 | 89 | 67 | 80 | 99 | 97 |
| Pahang | 46 | 36 | 47 | 49 | 52 | 53 | 66 | 72 | 90 | 104 |
| Kelantan | 12 | 15 | 27 | 31 | 60 | 62 | 74 | 64 | 79 | 72 |
| Sarawak | 46 | 33 | 44 | 50 | 67 | 59 | 62 | 73 | 72 | 85 |
| Sabah | 16 | 24 | 32 | 26 | 35 | 37 | 43 | 48 | 46 | 56 |

## SECTION 2.2: DIALYSIS PROVISION IN MALAYSIA (Centre survey report)

Data submission of individual dialysis and transplant patients to the National Renal Registry which was entirely voluntary prior to 2006 is now made compulsory by the Private Health Care Facilities and Services Act 1996 and its Regulations 2006 which was implemented on 1st May 2006. This however only applies to private and NGO centres and data submission from centres managed by the Ministry of Health, Defence or the Universities is still voluntary.

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 for both hemodialysis and peritoneal dialysis at the end of each year. This section reports the results of the centre survey carried out in December 2006. Dialysis provision is expressed in terms of number of centres, HD machines, treatment capacity (one HD machine to 5 patients) and patients.

At the end of 2006, 412 hemodialysis centres and 31 CAPD centres provided dialysis care to 14946 patients. (Data on 14647 inidividual dialysis patients were reported to the Registry giving a dialysis patient ascertainment rate of almost 98%) The Ministry of Health (MOH) provided dialysis to 33.7% of patients, non-governmental organizations (NGO) 31.1% and the private sector at 32.8%. Almost all private dialysis patients received centre haemodialysis treatment compared to the MOH sector where patients on chronic peritoneal dialysis (PD) made up 24% of all dialysis patients. There were no PD patients in NGO centres. (table 2.2.1)

Of the 3 main sectors, the private sector had the largest number of dialysis centres but the NGO centres had the largest HD capacity. (fig 2.2.1 a & b) The Ministry of Health had the lowest HD treatment capacity to patient ratio at 1.47 in 2006 compared to 1.52 in 2005. The HD treatment to patient ratio had increased further in the NGO sector from 1.70 in 2005 to 1.72 in 2006. (fig 2.2.1d)

**Table 2.2.1:** Number of dialysis centres, HD machines and treatment capacity by sector, December 2006

| Sector | HD Centre (No.) | Centre HD machines (No.) | Centre HD capacity (No.) | Centre HD patients (No.) | Centre HD capacity: patient ratio | CAPD Centre (No.) | CAPD patients (No.) | All dialysis patients (No.) |
|---|---|---|---|---|---|---|---|---|
| MOH | 131 | 1133 | 5665 | 3841 | 1.47 | 20 | 1200 | 5041 |
| NGO | 111 | 1603 | 8015 | 4648 | 1.72 | 0 | 0 | 4648 |
| Private (PRV)) | 158 | 1533 | 7665 | 4882 | 1.57 | 7 | 19 | 4901 |
| University (UNI) | 5 | 41 | 205 | 128 | 1.6 | 3 | 129 | 257 |
| Armed Forces (AF) | 7 | 44 | 220 | 96 | 2.29 | 1 | 3 | 99 |
| TOTAL | 412 | 4354 | 21770 | 13595 | | 31 | 1351 | 14946 |

**Figure 2.2.1(a):** Distribution of dialysis centres by Sector, December 2006

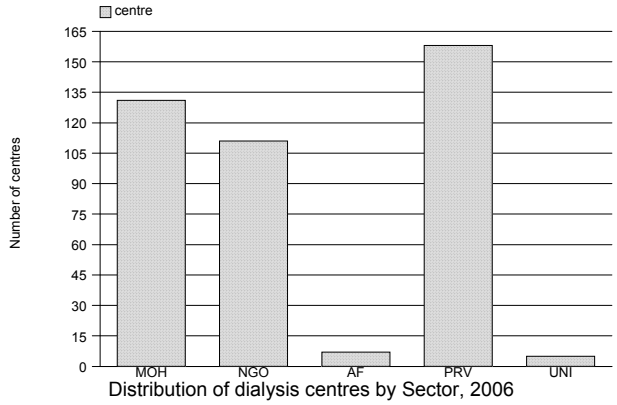



**Figure 2.2.1(b):** Distribution of HD capacity by Sector, December 2006

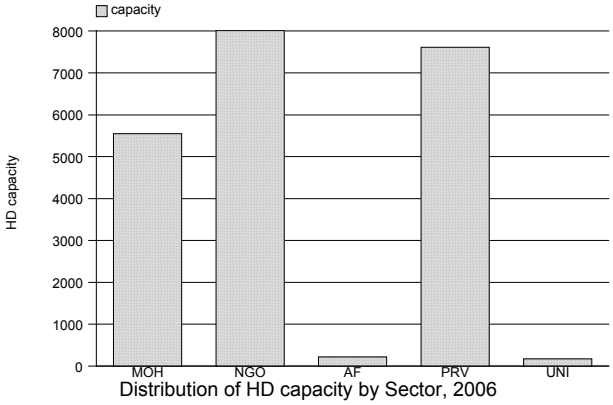



**Figure 2.2.1(c):** Distribution of dialysis patients by Sector, December 2006

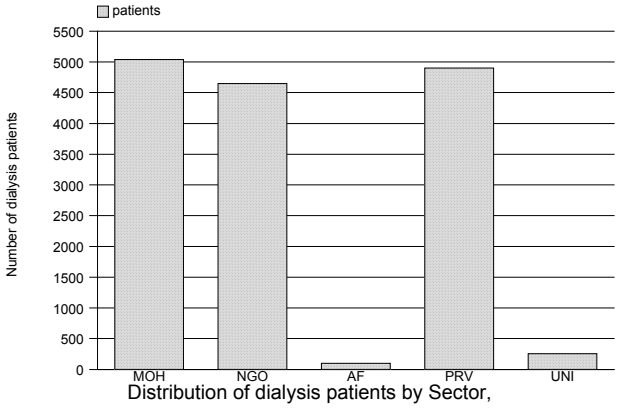
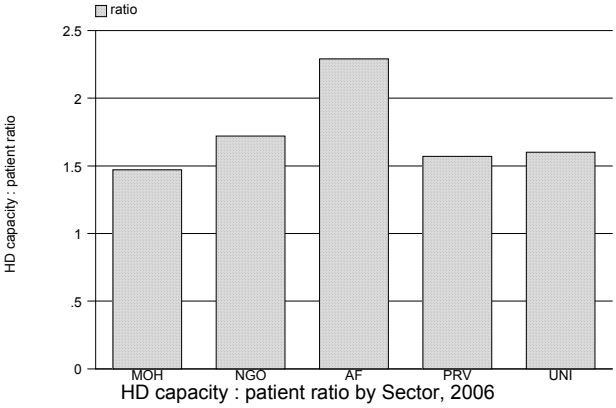



**Figure 2.2.1(d):** HD capacity: patient ratio by Sector, December 2006



### 2.2.2. Geographic distribution

The economically advantaged states except for Negeri Sembilan have centre HD machine to state population ratio above 200 per million state population compared to the economically disadvantaged states where the rate varied between 61 to 114 per million state population. At the end of 2006 dialysis treatment rates ranged from a high of 917 for Pulau Pinang to a low of 202 per million state population for Sabah. The HD capacity to patient ratio did not vary too widely between the states except for the economically disadvantaged states of Kelantan and Terengganu where the ratio was 1.21 and 1.36 respectively. (table and figures 2.2.2.). This is unlike previous years when HD capacity to patient ratio was higher in the economically disadvantaged states compared to the advanced states. The intake of patients has obviously outstripped the increase in number of new machines. These states need more HD machines and other resources to enable them to provide dialysis at rates similar to the more economically advantaged states

**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 2006

| State | Centre HD (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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pulau Pinang (Pe) | 36 | 424 | 284 | 2120 | 1421 | 1247 | 836 | 1.7 | 1369 | 917 |
| Johor (Jo) | 58 | 667 | 210 | 3335 | 1052 | 2332 | 736 | 1.43 | 2585 | 815 |
| Melaka (Me) | 15 | 189 | 261 | 945 | 1303 | 532 | 733 | 1.78 | 557 | 768 |
| Selangor & W.Persekutuan (SF) | 118 | 1349 | 210 | 6745 | 1049 | 3990 | 621 | 1.69 | 4500 | 700 |
| Perak (Pr) | 47 | 476 | 208 | 2380 | 1042 | 1487 | 651 | 1.6 | 1541 | 675 |
| Negeri Sembilan (Ne) | 14 | 154 | 160 | 770 | 801 | 493 | 513 | 1.56 | 556 | 578 |
| Kedah & Perlis (KP) | 30 | 302 | 143 | 1510 | 716 | 904 | 428 | 1.67 | 929 | 440 |
| Trengganu (Tr) | 9 | 85 | 82 | 425 | 408 | 350 | 336 | 1.21 | 425 | 408 |
| Sarawak (Sw) | 28 | 268 | 114 | 1340 | 568 | 884 | 375 | 1.52 | 942 | 400 |
| Pahang (Pa) | 16 | 147 | 101 | 735 | 505 | 427 | 293 | 1.72 | 487 | 335 |
| Kelantan (Ke) | 15 | 105 | 69 | 525 | 343 | 386 | 252 | 1.36 | 433 | 283 |
| Sabah (Sa) | 26 | 188 | 61 | 940 | 305 | 563 | 183 | 1.67 | 622 | 202 |
| Malaysia | 412 | 4354 | 167 | 21770 | 833 | 13595 | 520 | 1.6 | 14946 | 572 |

**Figure 2.2.2(a):** Distribution of dialysis centres by State, December 2006

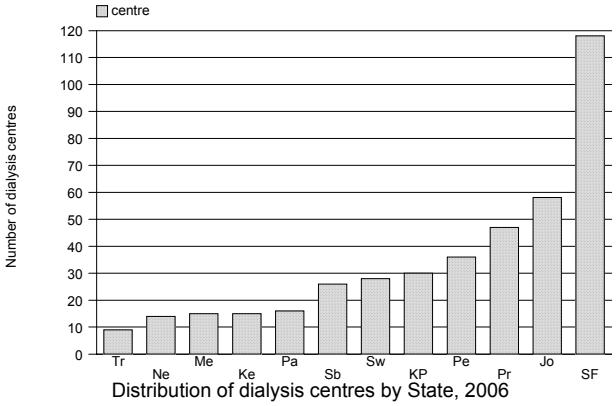



**Figure 2.2.2(b):** Distribution of dialysis patients by State, December 2006

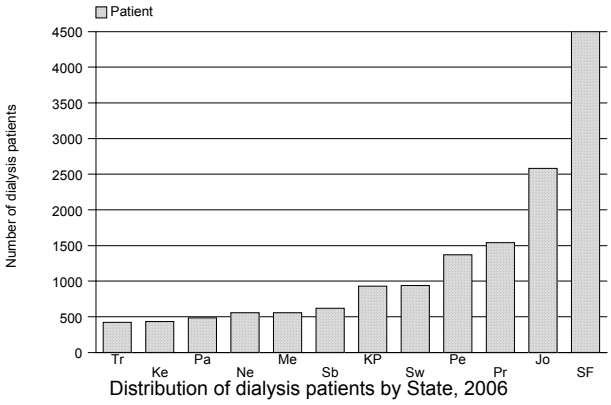



**Figure 2.2.2(c):** Distribution of dialysis treatment by State, December 2006

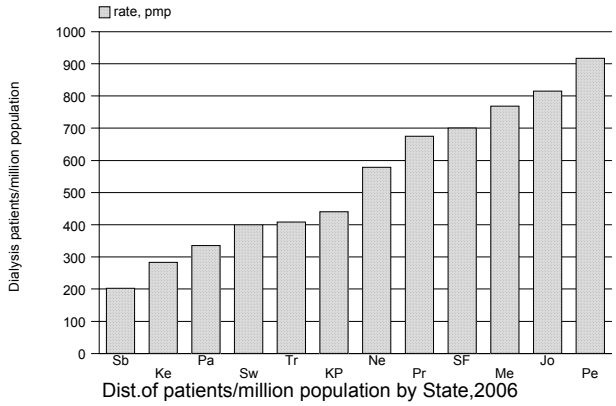
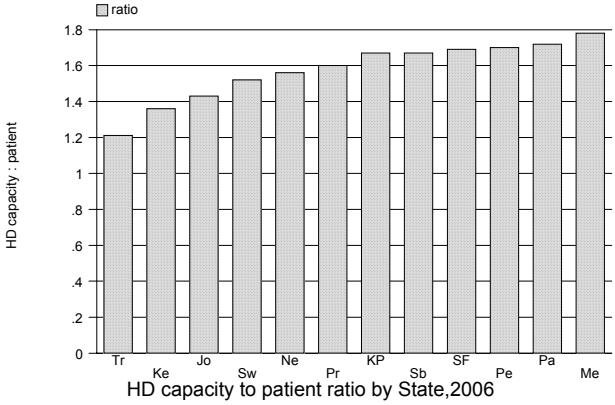



**Figure 2.2.2(d):** HD capacity to patient ratio by State, December 2006



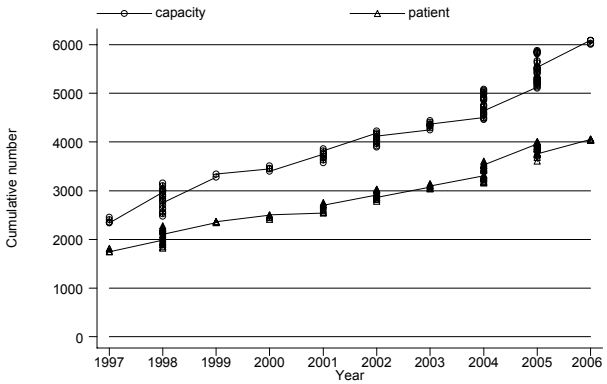
### 2.2.3 Growth in dialysis provision by sector

The number of HD patients more than doubled in the last 10 years in all 3 major sectors providing dialysis.(table 2.2.3). The increase in HD capacity almost paralleled that of increase in number of HD patients for MOH and the private sector but showed a divergence in the NGO sector indicating that gap between HD capacity and patient intake is widening. (figures 2.2.3a-c)

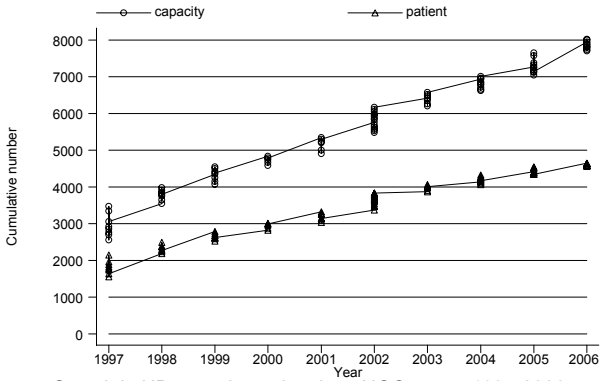
**Table 2.2.3:** Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1997 – 2006

| Sector | Private | | NGO | | MOH | |
|---|---|---|---|---|---|---|
| | Cumulative HD capacity | Cumulative HD patients | Cumulative HD capacity | Cumulative HD patients | Cumulative HD capacity | Cumulative HD patients |
| 1997 | 3115 | 1872 | 3475 | 2148 | 2460 | 1817 |
| 1998 | 3545 | 2188 | 3985 | 2490 | 3160 | 2281 |
| 1999 | 3960 | 2502 | 4545 | 2792 | 3340 | 2365 |
| 2000 | 4105 | 2585 | 4835 | 3012 | 3510 | 2505 |
| 2001 | 4345 | 2697 | 5345 | 3328 | 3865 | 2758 |
| 2002 | 4670 | 2902 | 6165 | 3837 | 4225 | 3036 |
| 2003 | 5360 | 3292 | 6570 | 4063 | 4440 | 3148 |
| 2004 | 6260 | 3928 | 7005 | 4324 | 5085 | 3607 |
| 2005 | 7260 | 4655 | 7650 | 4544 | 5880 | 4009 |
| 2006 | 7665 | 4882 | 8015 | 4648 | 6090 | 4065 |

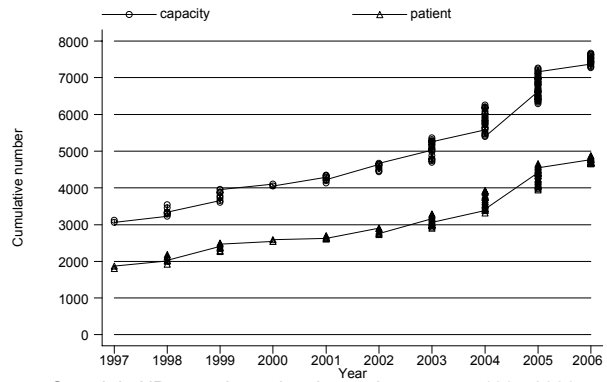
**Figure 2.2.3:** Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1997 – 2006




Growth in HD capacity and patient, MOH sector 1997-2006




Growth in HD capacity and patient, NGO sector 1997-2006




Growth in HD capacity and patient, private sector 1997-2006

## SECTION 2.3: DISTRIBUTION OF DIALYSIS TREATMENT

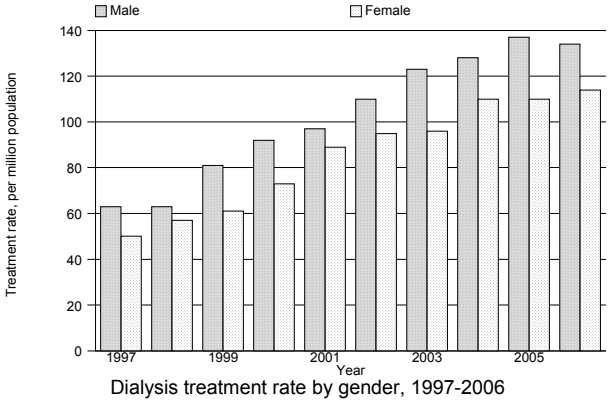
### 2.3.1 Gender distribution

The treatment gap between men and women accepted for dialysis 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. However, figure 2.3.1(ii) shows a convergence in the proportion of prevalent male and female patients. This is probably because of the survival advantage in female patients.

**Table 2.3.1(a):** Dialysis Treatment Rate by Gender, per million male or female population 1997 – 2006

| Gender | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | 51 | 63 | 63 | 81 | 92 | 97 | 110 | 123 | 128 | 137 |
| Female | 45 | 50 | 57 | 61 | 73 | 89 | 95 | 96 | 110 | 110 |

**Figure 2.3.1:** Dialysis Treatment by Gender 1997 – 2006



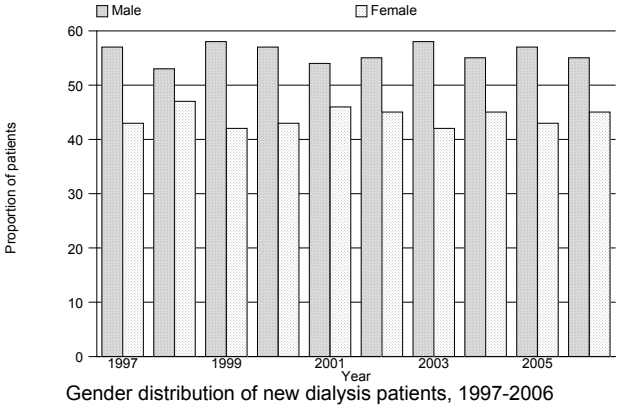

Dialysis treatment rate by gender, 1997-2006

**Table 2.3.1(b):** Gender distribution of Dialysis Patients 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| % Male | 57 | 53 | 58 | 57 | 54 | 55 | 58 | 55 | 57 | 55 |
| % Female | 43 | 47 | 42 | 43 | 46 | 45 | 42 | 45 | 43 | 45 |
| Dialysing at 31st December | 3698 | 4539 | 5538 | 6691 | 7839 | 9114 | 10429 | 11855 | 13337 | 14647 |
| % Male | 57 | 56 | 56 | 56 | 55 | 55 | 55 | 55 | 55 | 55 |
| % Female | 43 | 44 | 44 | 44 | 45 | 45 | 45 | 45 | 45 | 45 |

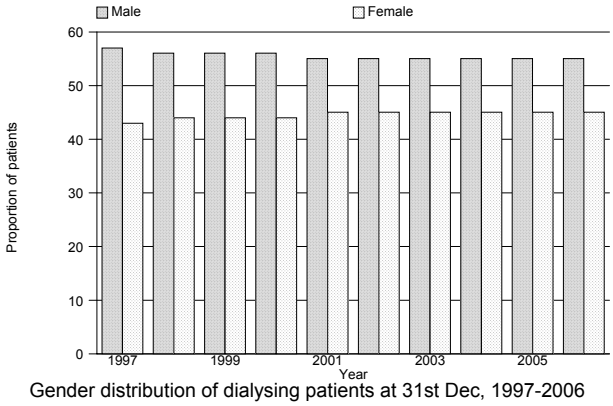
**Figure 2.3.1(b):** Gender Distribution of Dialysis patients 1997 – 2006

(i)New Dialysis patients




Gender distribution of new dialysis patients, 1997-2006

(ii)Dialysing patients at 31st December




Gender distribution of dialysing patients at 31st Dec, 1997-2006

### 2.3.2 Age distribution

Except for those aged 55 years or older which continued to register increase in treatment rates, dialysis treatment rates in the other age groups 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. The treatment rate for patients 65 years and older had exceeded 700 per million in 2006. 53% 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 1997 – 2006

| Age groups (years) | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-14 | 3 | 3 | 3 | 4 | 4 | 5 | 4 | 5 | 5 | 5 |
| 15-24 | 15 | 15 | 16 | 18 | 22 | 28 | 26 | 27 | 30 | 26 |
| 25-34 | 39 | 41 | 42 | 46 | 47 | 55 | 51 | 51 | 56 | 53 |
| 35-44 | 80 | 81 | 85 | 98 | 103 | 100 | 102 | 114 | 110 | 104 |
| 45-54 | 166 | 173 | 225 | 249 | 252 | 275 | 278 | 308 | 293 | 313 |
| 55-64 | 291 | 313 | 30 | 432 | 508 | 534 | 586 | 588 | 641 | 595 |
| >=65 | 213 | 228 | 301 | 347 | 438 | 501 | 584 | 651 | 652 | 710 |

**Figure 2.3.2(a):** Dialysis Treatment Rate by Age Group 1997 - 2006

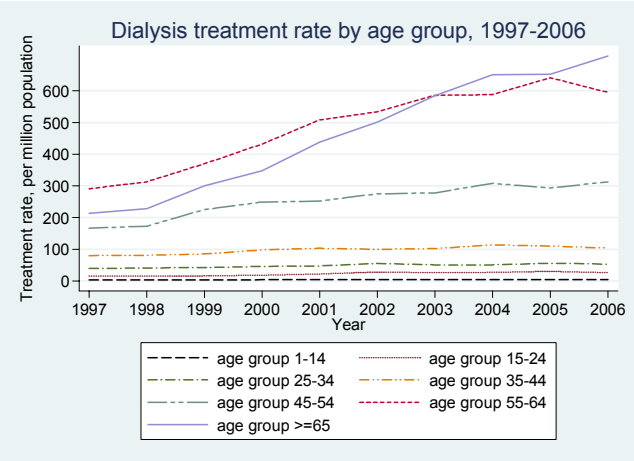
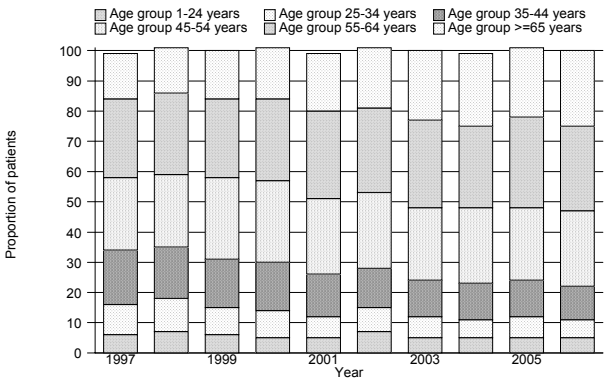



**Table 2.3.2(b):** Percentage Age Distribution of Dialysis Patients 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| % 1-14 years | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| % 15-24 years | 5 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 |
| % 25-34 years | 10 | 11 | 9 | 9 | 7 | 8 | 7 | 6 | 7 | 6 |
| % 35-44 years | 18 | 17 | 16 | 16 | 14 | 13 | 12 | 12 | 12 | 11 |
| % 45-54 years | 24 | 24 | 27 | 27 | 25 | 25 | 24 | 25 | 24 | 25 |
| % 55-64 years | 26 | 27 | 26 | 27 | 29 | 28 | 29 | 27 | 30 | 28 |
| % >=65 years | 15 | 15 | 16 | 17 | 19 | 20 | 23 | 24 | 23 | 25 |
| Dialysing at 31st December | 3698 | 4539 | 5538 | 6691 | 7839 | 9114 | 10429 | 11855 | 13337 | 14647 |
| % 1-14 years | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| % 15-24 years | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| % 25-34 years | 16 | 15 | 14 | 14 | 13 | 12 | 12 | 11 | 10 | 10 |
| % 35-44 years | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 17 | 17 | 16 |
| % 45-54 years | 24 | 24 | 25 | 25 | 25 | 25 | 26 | 26 | 26 | 26 |
| % 55-64 years | 20 | 21 | 22 | 22 | 23 | 24 | 24 | 24 | 25 | 24 |
| % >=65 years | 9 | 10 | 11 | 12 | 13 | 14 | 14 | 15 | 16 | 17 |

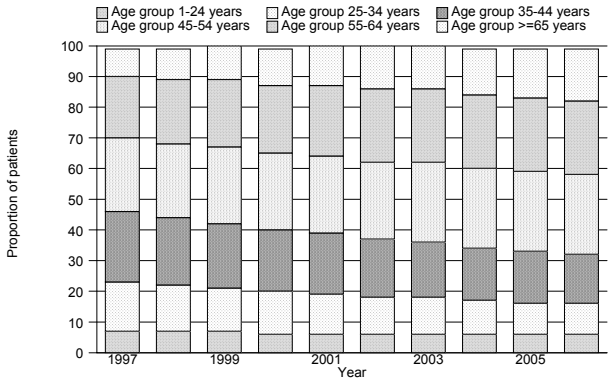
**Figure 2.3.2(b):** Age Distribution of New Dialysis patients 1997 – 2006

(i)New Dialysis patients




Age Distribution of New Dialysis patients, 1997-2006

(ii) Dialysing patients at 31st December




Age Distribution of Dialysing Patients at 31st Dec, 1997-2006

### 2.3.3 Method and Location of dialysis

87% of new patients were accepted into centre haemodialysis in 2006. Home/office HD which accounted for a significant proportion of patients in the earlier years of dialysis therapy has died a natural death. Perhaps the future will see home HD being re-introduced as diurnal or nocturnal HD as practiced by the more wealthy nations. Chronic PD accounted for about 12% of new dialysis patients but only 10% of prevalent dialysis patients in 2006. (table & fig 2.3.3)

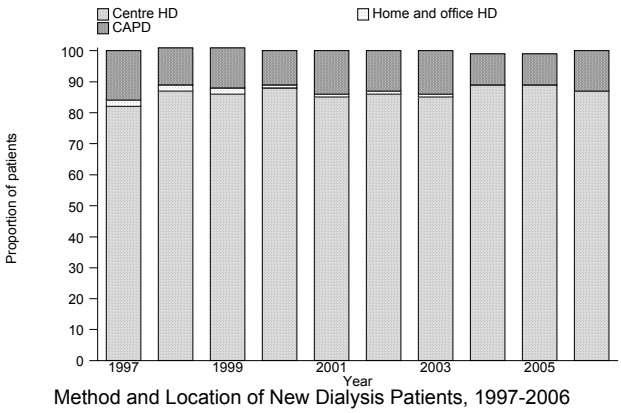
**Table 2.3.3:** Method and Location of Dialysis 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| % Centre HD | 82 | 87 | 86 | 88 | 85 | 86 | 85 | 89 | 89 | 87 |
| % Home and office HD | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| % CAPD | 16 | 12 | 13 | 11 | 14 | 13 | 14 | 10 | 10 | 12 |
| Dialysing at 31st December | 3181 | 3908 | 4785 | 5817 | 6869 | 8072 | 9243 | 10477 | 11739 | 12566 |
| % Centre HD | 85 | 87 | 88 | 89 | 89 | 88 | 87 | 88 | 89 | 89 |
| % Home and office HD | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| % CAPD | 14 | 12 | 11 | 10 | 10 | 11 | 11 | 11 | 10 | 10 |

* Analysis of Dialysing at 31st December is analyzed base on patient annual return

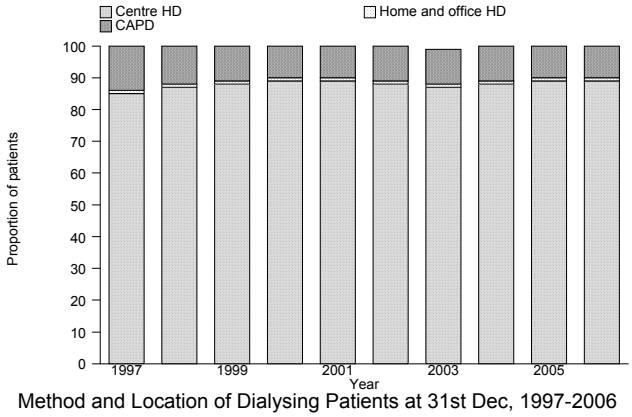
**Figure 2.3.3:** Method and Location of Dialysis Patients 1997– 2006

(a) New Dialysis patients




Method and Location of New Dialysis Patients, 1997-2006

(b) Dialysing patients at 31st December




Method and Location of Dialysing Patients at 31st Dec, 1997-2006

### 2.3.4 Funding for Dialysis Treatment

Funding for dialysis treatment in Malaysia is a complicated process. A patient may need to obtain funds from multiple sources for his dialysis treatment. In the initial years of the registry, data for funding for dialysis treatment were mainly from the initial notification of the patient. In 2006, data on funding was included in the annual returns.

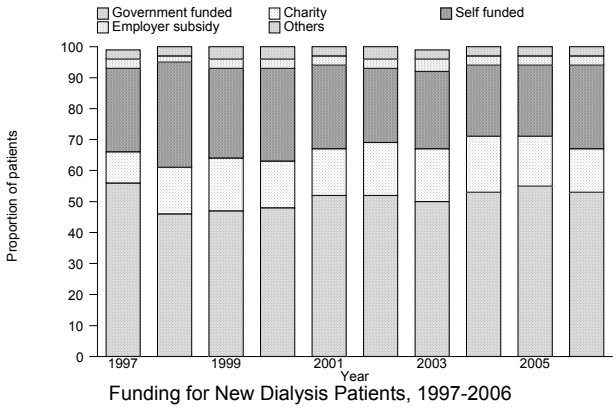
The government continues to be the main payer for dialysis therapy. A quarter of patients paid for their dialysis treatment. The proportion of new patients funded by charity organizations ranged between 14-18% over the last 10 years. (table & fig 2.3.4)

**Table 2.3.4:** Funding for Dialysis Treatment 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| % by Government | 56 | 46 | 47 | 48 | 52 | 52 | 50 | 53 | 55 | 53 |
| % by Charity | 10 | 15 | 17 | 15 | 15 | 17 | 17 | 18 | 16 | 14 |
| % self funded | 27 | 34 | 29 | 30 | 27 | 24 | 25 | 23 | 23 | 27 |
| % subsidized by Employer | 3 | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 |
| % Others | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 3 | 3 | 3 |
| Dialysing at 31st December | 3389 | 4194 | 5151 | 6246 | 7305 | 8497 | 9766 | 11136 | 12693 | 14062 |
| % by Government | 55 | 51 | 48 | 46 | 46 | 45 | 44 | 44 | 46 | 55 |
| % by Charity | 15 | 17 | 20 | 24 | 25 | 27 | 27 | 27 | 22 | 12 |
| % self funded | 24 | 26 | 27 | 26 | 25 | 24 | 25 | 24 | 25 | 25 |
| % subsidized by Employer | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| % Others | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 |

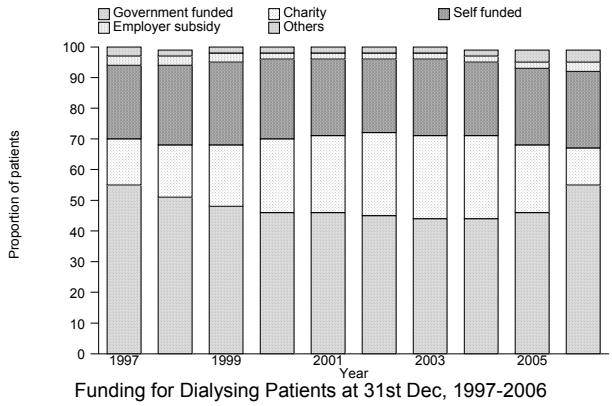
**Figure 2.3.4:** Funding for Dialysis Treatment 1997 – 2006

(a) New Dialysis Patients




Funding for New Dialysis Patients, 1997-2006

(b) Dialysing patients at 31st December




Funding for Dialysing Patients at 31st Dec, 1997-2006

### 2.3.5 Distribution of dialysis patients by sector

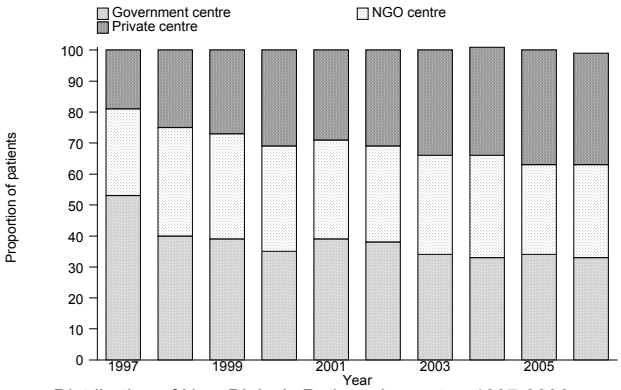
The MOH continued to provide dialysis treatment to one third of new patients, the private sector 36% and the NGO sector 31% in 2006. There was a steady reduction in the proportion of prevalent patients in the MOH from 56% in 1997 to 37% in 2006 with a corresponding increase in the private sector. The proportion of prevalent patients in the NGO sector has remained fairly constant over the years at about 32-33%.

**Table 2.3.5:** Distribution of Dialysis Patients by Sector 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3151 |
| % Government centre | 53 | 40 | 39 | 35 | 39 | 38 | 34 | 33 | 34 | 33 |
| % NGO centre | 28 | 35 | 34 | 34 | 32 | 31 | 32 | 33 | 29 | 31 |
| % Private centre | 19 | 25 | 27 | 31 | 29 | 31 | 34 | 35 | 37 | 36 |
| Dialysing at 31st December | 3698 | 4539 | 5538 | 6691 | 7839 | 9114 | 10429 | 11855 | 13337 | 14646 |
| % Government centre | 56 | 51 | 46 | 43 | 42 | 41 | 40 | 38 | 37 | 37 |
| % NGO centre | 26 | 29 | 31 | 32 | 33 | 33 | 33 | 33 | 32 | 32 |
| % Private centre | 18 | 20 | 23 | 25 | 25 | 26 | 27 | 29 | 30 | 31 |

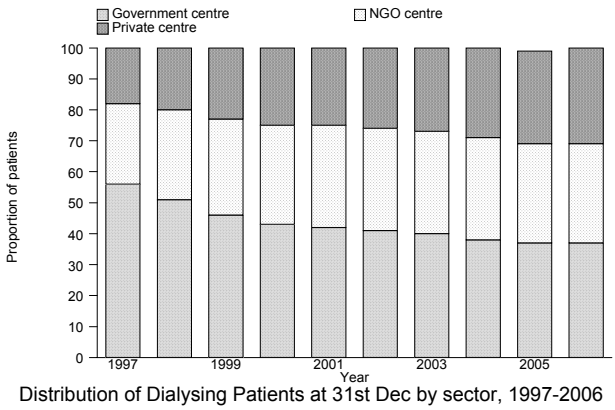
**Figure 2.3.5:** Distribution of Dialysis Patients by Sector 1997 – 2006

(a) New Dialysis Patients




Distribution of New Dialysis Patients by sector, 1997-2006

(b) Dialysing patients at 31st December




Distribution of Dialysing Patients at 31st Dec by sector, 1997-2006

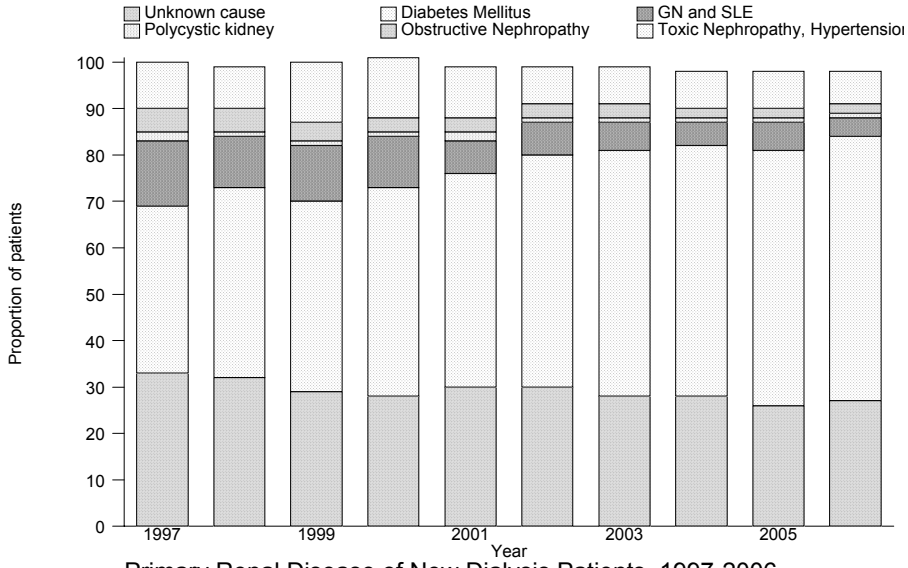
## SECTION 2.4: PRIMARY RENAL DISEASE

Diabetes mellitus continues to be the commonest cause of ESRD and the proportion unfortunately has continued to increase and accounted for 57% of new ESRD in 2006. Hypertension was the second commonest known cause of ESRD at about 6%. The proportion of patients with unknown primary renal disease has slowly decreased and was 27% in 2006. Glomerulonephritis as a cause of ESRD has decreased from 13% in 1997 to only 3% in 2006. Systemic lupus erythematosus (SLE) continue to contribute 1% of new ESRD patients.

**Table 2.4.1:** Primary Renal Disease 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Dialysis patients | 1136 | 1252 | 1544 | 1840 | 2085 | 2348 | 2597 | 2858 | 3054 | 3152 |
| % Unknown cause | 33 | 32 | 29 | 28 | 30 | 30 | 28 | 28 | 26 | 27 |
| % Diabetes Mellitus | 36 | 41 | 41 | 45 | 46 | 50 | 53 | 54 | 55 | 57 |
| % GN | 13 | 10 | 10 | 9 | 6 | 6 | 5 | 4 | 5 | 3 |
| % SLE | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| % Polycystic kidney | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| % Obstructive Nephropathy | 5 | 5 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| % Toxic Nephropathy | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| % Hypertension | 9 | 8 | 11 | 12 | 9 | 7 | 7 | 7 | 7 | 6 |
| % Others | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Figure 2.4.1:** Primary Renal Disease for New Dialysis Patients 1997 – 2006




Primary Renal Disease of New Dialysis Patients, 1997-2006

# CHAPTER 3

# Death and Survival on Dialysis

Wong Hin Seng
Ong Loke Meng
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## SECTION 3.1: DEATH ON DIALYSIS

The number of death in dialysis patients for 2006 was 1575 (annual death rate of 11.3%). One thousand four hundred and eleven haemodialysis patients died in 2006 (annual rate of 11.1%) while 164 died on continuous ambulatory peritoneal dialysis (annual death rate of 13.3%).

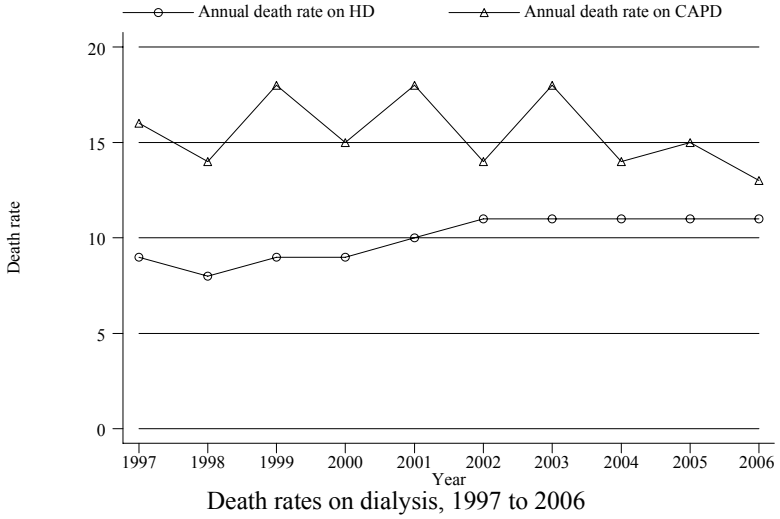
**Table 3.1.1:** Deaths on Dialysis 1997 – 2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| No. of dialysis patients at risk | 3309 | 4119 | 5039 | 6115 | 7265 | 8477 | 9772 | 11142 | 12596 | 13992 |
| Dialysis deaths | 316 | 376 | 492 | 594 | 816 | 925 | 1153 | 1265 | 1403 | 1575 |
| Dialysis death rate % | 10 | 9 | 10 | 10 | 11 | 11 | 12 | 11 | 11 | 11 |
| No. of HD patients at risk | 2838 | 3599 | 4471 | 5487 | 6552 | 7635 | 8784 | 10056 | 11460 | 12762 |
| HD deaths | 242 | 302 | 392 | 502 | 686 | 810 | 975 | 1113 | 1232 | 1411 |
| HD death rate % | 9 | 8 | 9 | 9 | 10 | 11 | 11 | 11 | 11 | 11 |
| No. of CAPD patients at risk | 471 | 520 | 568 | 628 | 713 | 842 | 988 | 1086 | 1137 | 1230 |
| CAPD deaths | 74 | 74 | 100 | 92 | 130 | 115 | 178 | 152 | 171 | 164 |
| CAPD death rate % | 16 | 14 | 18 | 15 | 18 | 14 | 18 | 14 | 15 | 13 |

Figure 3.1.1 shows the annual death rate on dialysis from 1997 till 2006. Despite a higher percentage of diabetics (27% in 1997 to 45% in 2006) and elderly patients (in 1997, 41% were aged more than 55 years compared with 53% in 2006) on dialysis in recent years, the overall annual death rate of patients on dialysis remained remarkable unchanged over the last 10 years.

The annual death rate for those on CAPD showed a downward trend in recent years while the annual death rate for those on haemodialysis remained unchanged over the last 5 years. The annual death rate for those on CAPD has decreased by 15% over the last 10 years (from 15.7% in 1997 to 13.3% in 2006) and this has narrowed the difference in the annual death rate between the two modalities of dialysis (from 7.2% in 1997 to 2.3% in 2006).

**Figure 3.1.1:** Death Rates on Dialysis 1997 – 2006




Death rates on dialysis, 1997 to 2006

The causes of death on dialysis are showed in Table 3.1.2. Cardiovascular disease remained the main cause of death in 2006; accounting for 28%. This has remained unchanged over the last 10 years. Death at home accounted for another 21% and a majority of these deaths were probably secondary to cardiovascular events. Death due to sepsis has decreased by 23% over the last 10 years and now accounting for only 13%.

**Table 3.1.2:** Causes of Death on Dialysis 1997 – 2006

| Year | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Cardiovascular | 85 | 27 | 110 | 29 | 129 | 26 | 177 | 30 | 210 | 26 |
| Died at home | 52 | 16 | 72 | 19 | 107 | 22 | 135 | 23 | 228 | 28 |
| Sepsis | 53 | 17 | 66 | 18 | 84 | 17 | 85 | 14 | 128 | 16 |
| CAPD peritonitis | 5 | 2 | 2 | 1 | 11 | 2 | 21 | 4 | 29 | 4 |
| GIT bleed | 4 | 1 | 7 | 2 | 18 | 4 | 18 | 3 | 18 | 2 |
| Cancer | 9 | 3 | 8 | 2 | 6 | 1 | 8 | 1 | 18 | 2 |
| Liver disease | 3 | 1 | 5 | 1 | 7 | 1 | 14 | 2 | 11 | 1 |
| Others | 32 | 10 | 55 | 15 | 75 | 15 | 91 | 15 | 108 | 13 |
| Unknown | 73 | 23 | 51 | 14 | 55 | 11 | 45 | 8 | 66 | 8 |
| TOTAL | 316 | 100 | 376 | 100 | 492 | 100 | 594 | 100 | 816 | 100 |

| Year | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Cardiovascular | 307 | 33 | 323 | 28 | 332 | 26 | 350 | 25 | 434 | 28 |
| Died at home | 212 | 23 | 290 | 25 | 304 | 24 | 313 | 22 | 327 | 21 |
| Sepsis | 141 | 15 | 183 | 16 | 154 | 12 | 159 | 11 | 199 | 13 |
| CAPD peritonitis | 16 | 2 | 11 | 1 | 13 | 1 | 18 | 1 | 21 | 1 |
| GIT bleed | 24 | 3 | 28 | 2 | 24 | 2 | 28 | 2 | 24 | 2 |
| Cancer | 18 | 2 | 27 | 2 | 19 | 2 | 28 | 2 | 34 | 2 |
| Liver disease | 16 | 2 | 23 | 2 | 29 | 2 | 25 | 2 | 31 | 2 |
| Others | 122 | 13 | 186 | 16 | 326 | 26 | 406 | 29 | 385 | 24 |
| Unknown | 69 | 7 | 82 | 7 | 64 | 5 | 76 | 5 | 120 | 8 |
| TOTAL | 925 | 100 | 1153 | 100 | 1265 | 100 | 1403 | 100 | 1575 | 100 |

## 3.2: PATIENT SURVIVAL ON DIALYSIS

### 3.2.1 Patient survival by type of dialysis modality

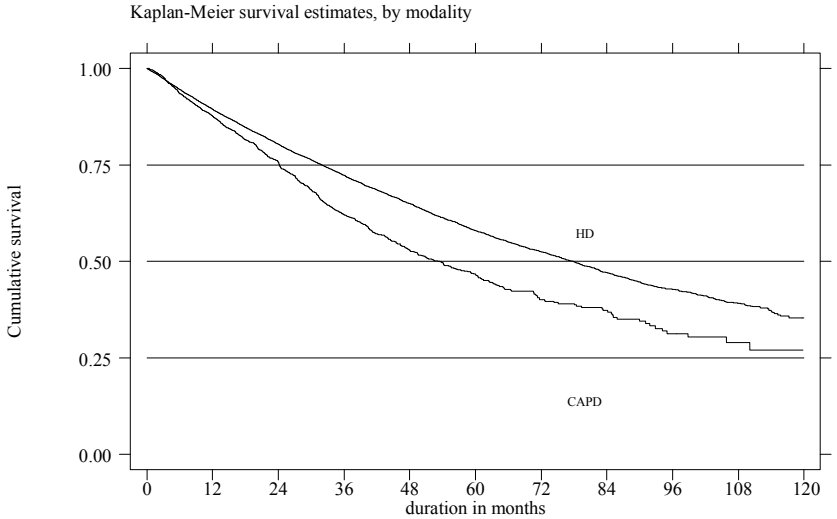
Patient survival by dialysis modalities is showed in Table 3.2.1(a) and Figure 3.2.1(a). The overall unadjusted 5 years and 10 years patient survival on dialysis were 57% and 35% respectively. The unadjusted patient survival was better for those on haemodialysis compared to those on CAPD and this survival difference progressively widened up to 3 years. At 3 years the unadjusted patient survival on haemodialysis was 72% compared 62% in those on CAPD. Beyond 3 years the difference in survival remained at about 10%. Despite adjustment for age and diabetes mellitus [Table 3.2.1(b) and Figure 3.2.1 (b)], patient survival among haemodialysis patients remained superior over CAPD patients. These data contrast with those from the USRDS, Canadian, Australian and the UK registries where patients on PD appeared to have a better survival compared to haemodialysis.

**Table 3.2.1(a):** Unadjusted patient survival by Dialysis modality, 1997-2006

| Dialysis modality | CAPD | | | HD | | | All Dialysis | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2537 | 93 | 0 | 17560 | 95 | 0 | 20097 | 94 | 0 |
| 12 | 2087 | 88 | 1 | 14950 | 89 | 0 | 17037 | 89 | 0 |
| 24 | 1376 | 76 | 1 | 10955 | 80 | 0 | 12331 | 80 | 0 |
| 36 | 847 | 62 | 1 | 7895 | 72 | 0 | 8742 | 71 | 0 |
| 48 | 497 | 53 | 1 | 5592 | 65 | 0 | 6089 | 64 | 0 |
| 60 | 293 | 47 | 1 | 3809 | 58 | 0 | 4102 | 57 | 0 |
| 72 | 160 | 40 | 2 | 2536 | 52 | 1 | 2695 | 51 | 1 |
| 84 | 88 | 37 | 2 | 1578 | 47 | 1 | 1666 | 46 | 1 |
| 96 | 44 | 31 | 2 | 884 | 43 | 1 | 927 | 42 | 1 |
| 108 | 19 | 29 | 3 | 372 | 39 | 1 | 390 | 38 | 1 |
| 120 | 3 | 27 | 3 | 27 | 35 | 1 | 29 | 35 | 1 |

* No. = Number at risk SE=standard error

**Figure 3.2.1(a):** Unadjusted patient survival by Dialysis modality, 1997-2006



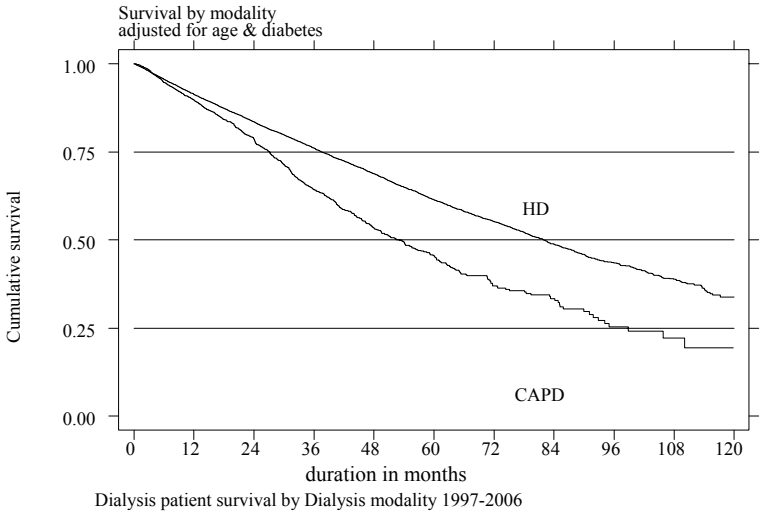

Dialysis patient survival by Dialysis modality 1997-2006

**Table 3.2.1(b):** Adjusted patient survival with age and diabetes by Dialysis modality, 1997-2006

| Dialysis modality | CAPD | | | HD | | | All Dialysis | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2537 | 95 | 0 | 17560 | 96 | 0 | 20097 | 95 | 0 |
| 12 | 2087 | 90 | 1 | 14950 | 91 | 0 | 17037 | 91 | 0 |
| 24 | 1376 | 79 | 1 | 10955 | 84 | 0 | 12331 | 83 | 0 |
| 36 | 847 | 64 | 1 | 7895 | 76 | 0 | 8742 | 75 | 0 |
| 48 | 497 | 53 | 1 | 5592 | 69 | 0 | 6089 | 67 | 0 |
| 60 | 293 | 46 | 1 | 3809 | 61 | 0 | 4102 | 60 | 0 |
| 72 | 160 | 37 | 2 | 2536 | 55 | 1 | 2695 | 54 | 1 |
| 84 | 88 | 33 | 2 | 1578 | 49 | 1 | 1666 | 48 | 1 |
| 96 | 44 | 25 | 2 | 884 | 44 | 1 | 927 | 43 | 1 |
| 108 | 19 | 22 | 3 | 372 | 39 | 1 | 390 | 38 | 1 |
| 120 | 3 | 19 | 3 | 27 | 34 | 1 | 29 | 33 | 1 |

* No. = Number at risk SE=standard error

**Figure 3.2.1(b):** Adjusted patient survival for age and diabetes by Dialysis modality, 1997-2006




Dialysis patient survival by Dialysis modality 1997-2006

### 3.2.2 Patient survival by year of starting dialysis

Table 3.2.2 and Fig 3.2.2 show the unadjusted patient survival by year of entry. The unadjusted 6 months survival of those starting dialysis in 2006 was 94%. Despite a progressive increase in the number of diabetic patients and older people starting dialysis in recent years, the unadjusted patient survival remained constant over the last 10 years with a 1-year and 5-year survival of 88-90% and 56-61% respectively.

**Table 3.2.2:** Unadjusted patient survival by year of entry, 1997-2006

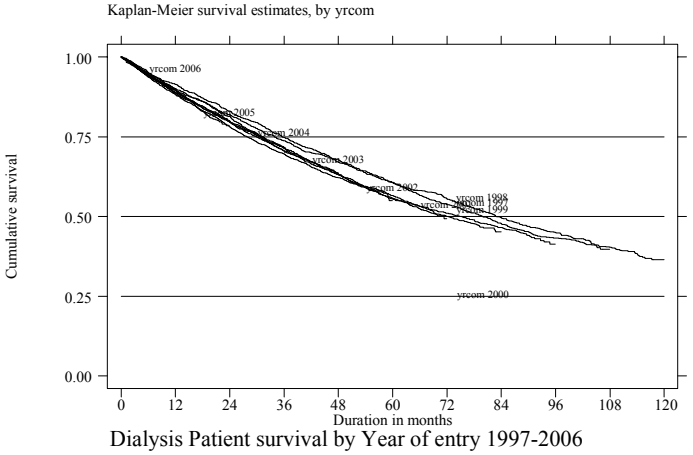
| Year | 1997 | | | 1998 | | | 1999 | | | 2000 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 1133 | 94 | 1 | 1244 | 95 | 1 | 1510 | 95 | 1 | 1807 | 95 | 1 |
| 12 | 1060 | 90 | 1 | 1178 | 91 | 1 | 1410 | 90 | 1 | 1666 | 90 | 1 |
| 24 | 950 | 82 | 1 | 1037 | 83 | 1 | 1213 | 81 | 1 | 1414 | 80 | 1 |
| 36 | 835 | 74 | 1 | 913 | 75 | 1 | 1038 | 72 | 1 | 1224 | 71 | 1 |
| 48 | 735 | 67 | 1 | 802 | 68 | 1 | 895 | 63 | 1 | 1059 | 63 | 1 |
| 60 | 643 | 61 | 1 | 708 | 61 | 1 | 791 | 57 | 1 | 919 | 56 | 1 |
| 72 | 555 | 54 | 2 | 637 | 56 | 1 | 706 | 51 | 1 | 802 | 50 | 1 |
| 84 | 481 | 48 | 2 | 558 | 50 | 1 | 628 | 46 | 1 | - | - | - |
| 96 | 429 | 43 | 2 | 499 | 45 | 1 | - | - | - | - | - | - |
| 108 | 390 | 40 | 2 | - | - | - | - | - | - | - | - | - |
| 120 | 29 | 36 | 2 | - | - | - | - | - | - | - | - | - |

| Year | 2001 | | | 2002 | | | 2003 | | | 2004 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2068 | 94 | 1 | 2350 | 95 | 0 | 2526 | 94 | 0 | 2835 | 95 | 0 |
| 12 | 1884 | 89 | 1 | 2175 | 90 | 1 | 2330 | 89 | 1 | 2606 | 89 | 1 |
| 24 | 1601 | 78 | 1 | 1842 | 80 | 1 | 2016 | 80 | 1 | 2263 | 80 | 1 |
| 36 | 1385 | 70 | 1 | 1598 | 71 | 1 | 1747 | 70 | 1 | - | - | - |
| 48 | 1204 | 62 | 1 | 1398 | 63 | 1 | - | - | - | - | - | - |
| 60 | 1044 | 56 | 1 | - | - | - | - | - | - | - | - | - |

| Year | 2005 | | | 2006 | | |
|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2968 | 94 | 0 | 1665 | 94 | 0 |
| 12 | 2732 | 88 | 1 | - | - | - |

* No. = Number at risk SE=standard error

**Figure 3.2.2:** Unadjusted patient survival by year of entry, 1997-2006




Dialysis Patient survival by Year of entry 1997-2006

### 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 with increasing age. The 9-year unadjusted survival for those who started dialysis at the age of less than 15 years was 72 % compared with 15% in those more than 64 years of age at the time of initiation of dialysis.

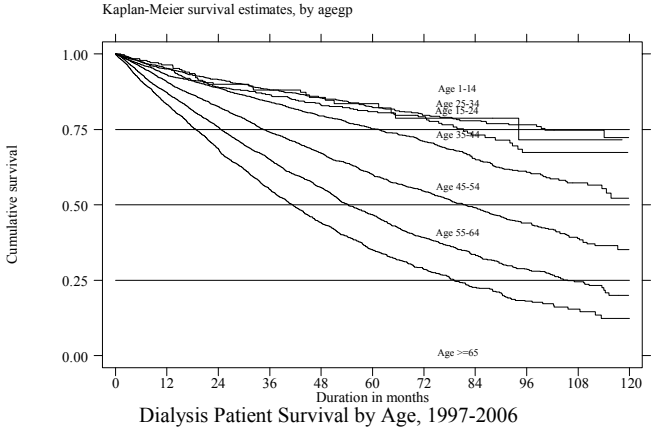
**Table 3.2.3:** Unadjusted patient survival by age, 1997-2006

| 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 | 294 | 98 | 1 | 928 | 97 | 1 | 1649 | 97 | 0 | 2832 | 96 | 0 |
| 12 | 258 | 96 | 1 | 793 | 95 | 1 | 1444 | 95 | 1 | 2467 | 93 | 0 |
| 24 | 182 | 90 | 2 | 568 | 89 | 1 | 1111 | 92 | 1 | 1934 | 89 | 1 |
| 36 | 133 | 88 | 2 | 428 | 86 | 1 | 881 | 88 | 1 | 1502 | 84 | 1 |
| 48 | 94 | 86 | 3 | 305 | 83 | 1 | 677 | 85 | 1 | 1146 | 79 | 1 |
| 60 | 58 | 84 | 3 | 219 | 81 | 2 | 493 | 82 | 1 | 850 | 75 | 1 |
| 72 | 39 | 79 | 4 | 157 | 79 | 2 | 373 | 80 | 1 | 601 | 71 | 1 |
| 84 | 23 | 79 | 4 | 103 | 73 | 3 | 253 | 78 | 1 | 381 | 65 | 1 |
| 96 | 11 | 72 | 8 | 59 | 67 | 3 | 155 | 76 | 2 | 233 | 61 | 2 |
| 108 | 6 | 72 | 8 | 32 | 67 | 3 | 69 | 75 | 2 | 101 | 57 | 2 |
| 120 | - | - | - | 4 | 67 | 3 | 4 | 72 | 3 | 6 | 52 | 3 |

| Age group (years) | 45-54 | | | 55-64 | | | >=65 | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 5083 | 96 | 0 | 5431 | 93 | 0 | 3881 | 91 | 0 |
| 12 | 4329 | 91 | 0 | 4582 | 87 | 0 | 3166 | 83 | 1 |
| 24 | 3218 | 83 | 1 | 3231 | 76 | 1 | 2092 | 69 | 1 |
| 36 | 2303 | 74 | 1 | 2222 | 65 | 1 | 1279 | 55 | 1 |
| 48 | 1643 | 67 | 1 | 1475 | 56 | 1 | 750 | 44 | 1 |
| 60 | 1125 | 60 | 1 | 928 | 47 | 1 | 431 | 35 | 1 |
| 72 | 750 | 54 | 1 | 554 | 39 | 1 | 230 | 29 | 1 |
| 84 | 464 | 49 | 1 | 333 | 33 | 1 | 116 | 23 | 1 |
| 96 | 247 | 44 | 1 | 171 | 29 | 1 | 57 | 18 | 1 |
| 108 | 99 | 39 | 2 | 70 | 24 | 1 | 19 | 15 | 2 |
| 120 | 9 | 35 | 2 | 6 | 20 | 2 | 3 | 12 | 2 |

* No. = Number at risk SE=standard error

**Figure 3.2.3:** Unadjusted patient survival by age, 1997-2006




Dialysis Patient Survival by Age, 1997-2006

### 3.2.4 Patient survival by Diabetic status

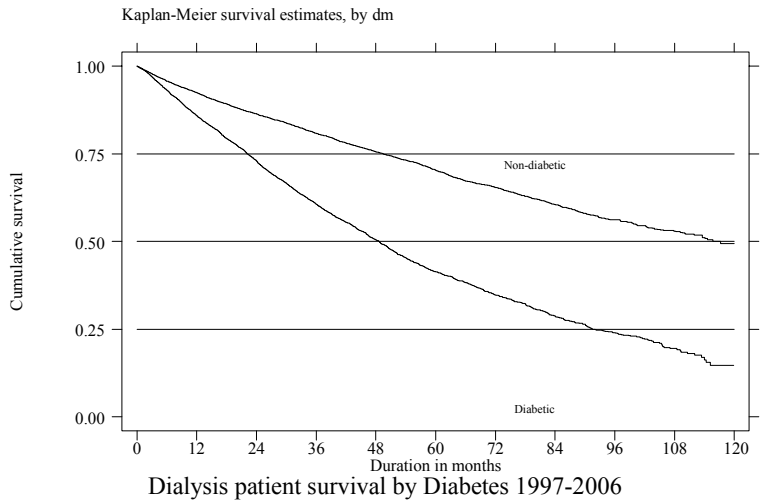
The unadjusted patient survival among diabetic and non-diabetic patients is shown in Table 3.2.4 and Figure 3.2.4. The presence of diabetes mellitus has major impact on patient survival. The difference in the unadjusted patient survival appeared as early as 6 months after initiation of dialysis and increased with the time on dialysis. The 10 years unadjusted patient survival among diabetics and non-diabetics were 49% and 15% respectively, a three fold difference.

**Table 3.2.4:** Unadjusted patient survival by Diabetes status, 1997-2006

| Diabetes status | Non-Diabetic | | | Diabetic | | |
|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 10287 | 96 | 0 | 9810 | 93 | 0 |
| 12 | 8967 | 92 | 0 | 8070 | 86 | 0 |
| 24 | 6887 | 86 | 0 | 5444 | 73 | 0 |
| 36 | 5258 | 81 | 0 | 3484 | 61 | 1 |
| 48 | 3908 | 76 | 0 | 2181 | 51 | 1 |
| 60 | 2805 | 70 | 1 | 1297 | 41 | 1 |
| 72 | 1938 | 65 | 1 | 759 | 35 | 1 |
| 84 | 1256 | 61 | 1 | 410 | 29 | 1 |
| 96 | 718 | 56 | 1 | 210 | 24 | 1 |
| 108 | 328 | 53 | 1 | 63 | 20 | 1 |
| 120 | 25 | 49 | 1 | 5 | 15 | 2 |

* No. = Number at risk SE=standard error

**Figure 3.2.4:** Unadjusted patient survival by Diabetes status, 1997-2006




Dialysis patient survival by Diabetes 1997-2006

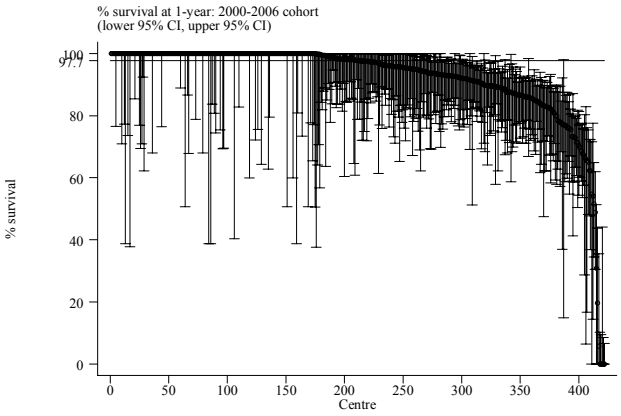
## 3.3 SURVIVAL OF INCIDENT PATIENTS 2000 – 2006 BY CENTRE

### 3.3.1. Survival of incident haemodialysis patients 2000 – 2006 by centre

Figure 3.3.1(a) and Figure 3.3.1(b) show the patient survival (adjusted to age and diabetes) by haemodialysis centres at 1year and at 5 years respectively. The median adjusted patient survival among haemodialysis centres at 1 year and 5 years for the 2000-2006 cohort were 97.7% and 71.9% respectively. There was wide centre variation with regards to patient survival at one year and this became more apparent at 5 years (more than 10 fold different)..

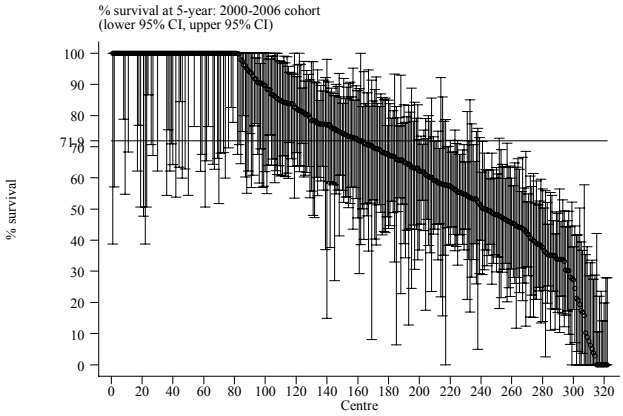
As smaller centres and newer centres tend to have wider confidence interval, data on survival at 1 year and 5 years adjusted for age and diabetes are also shown in funnel plots (Figure 3.3.1(c) and Figure 3.3.1 (d) respectively) to identify outliers. For 1 year survival, 39 (25%) centres lie below 3SD while for 5 years survival 69 (33%) centres are below the 3SD.

**Figure 3.3.1(a):** Variation in % Survival at 1-year adjusted to age and diabetes, 2000-2006



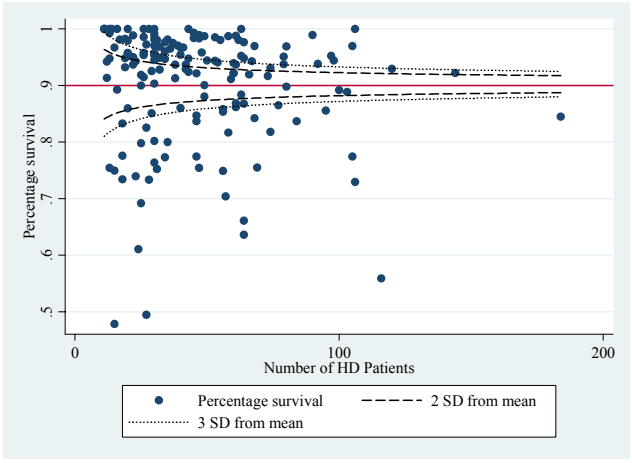

* Horizontal line represents the median % survival among HD centres

**Figure 3.3.1(b):** Variation in % Survival at 5-years adjusted to age and diabetes, 2000-2006



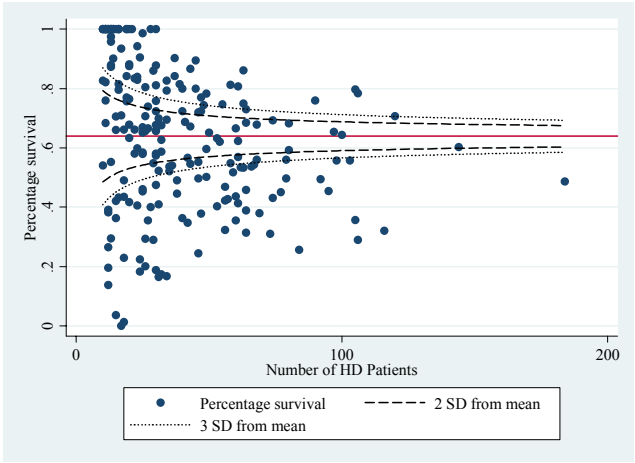

* Horizontal line represents the median % survival among HD centres

**Figure 3.3.1(c):** Funnel plot for adjusted age at 60 and diabetes at 1 year after 90 days survival; 1997-2002 cohorts (HD centres)




*Centres with new patients <10 were excluded from this analysis.

**Figure 3.3.1(d):** Funnel plot for adjusted age at 60 and diabetes at 5 years after 90 days survival; 1997-2002 cohorts (HD centres)



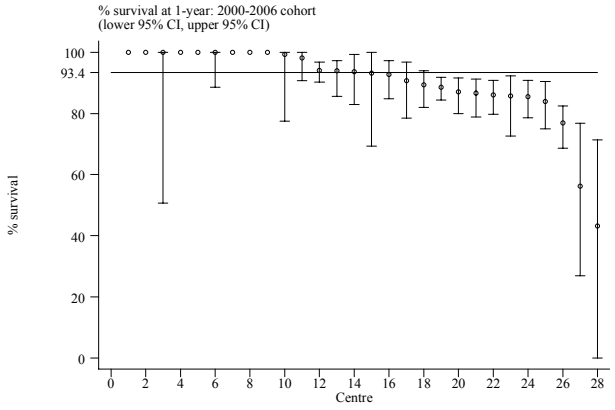

*Centres with new patients <10 were excluded from this analysis.

### 3.3.2. Survival of incidence CAPD patients 2000 – 2006 by centre

The adjusted patient survival (adjusted to age and diabetes) at 1 year and at 5 years according to CAPD centres are shown in Figure 3.3.2(a) and Figure 3.3.2.(b). The median adjusted patient survival among CAPD centres at one year and 5 years for the 2000-2006 cohort were 93.4% and 51.9% respectively. There was no overt centre variation with regards to patient survival at one year. However the adjusted CAPD patient survival at 5 years demonstrated marked centre variation with a 5 fold difference.

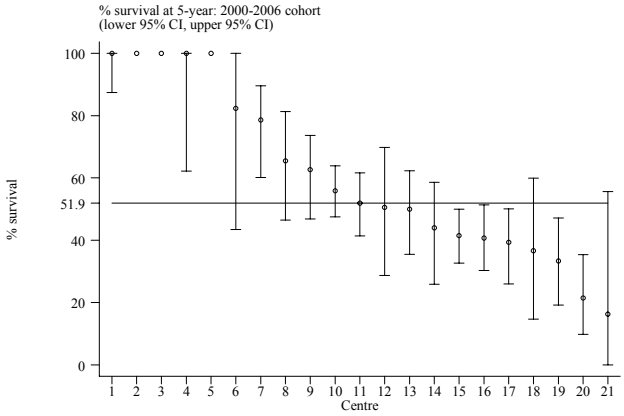
Figure 3.3.2(c) and Figure 3.3.2(d) show the funnel plot for 1 year and 5 years adjusted patient survival among CAPD centres respectively. In both the 1 year and 5 years survival funnel plots, there are 5 centres which lie below the 3SD.

**Figure 3.3.2(a):** Variation in % Survival at 1-year adjusted to age and diabetes, 2000-2006



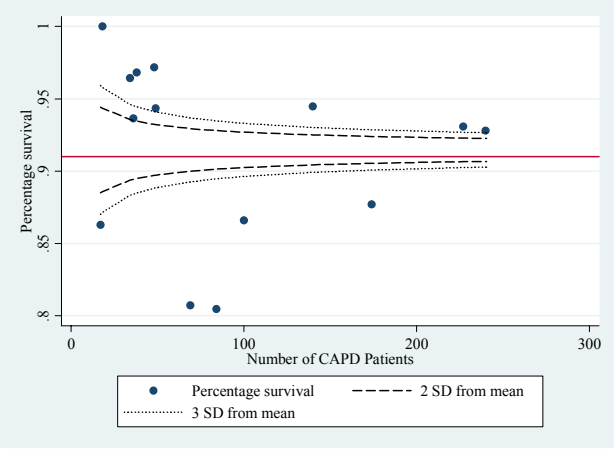

* Horizontal line represents the median % survival among CAPD centres

**Figure 3.3.2(b):** Variation in % Survival at 5-years adjusted to age and diabetes, 2000-2006



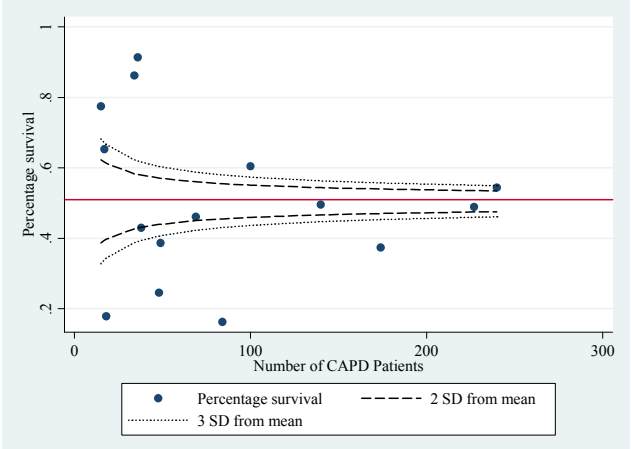

* Horizontal line represents the median % survival among CAPD centres

**Figure 3.3.2(c):** Funnel plot for adjusted age at 60 and diabetes at 1 year after 90 days survival; 1997-2002 cohorts (CAPD centres)




*Centres with new patients <10 were excluded from this analysis.

**Figure 3.3.2(d):** Funnel plot for adjusted age at 60 and diabetes at 5 years after 90 days survival; 1997-2002 cohorts (CAPD centres)




*Centres with new patients <10 were excluded from this analysis.

### 3.4 Adjusted Mortality of dialysis patient

Table 3.4.1 shows the adjusted hazard ratio for mortality of dialysis patients (1997-2006). The 1997-2006 cohort was adjusted for age, gender, primary diagnosis, year commencing dialysis, dialysis modality, body mass index (BMI), serum albumin, serum cholesterol, adequacy of dialysis (KT/V), diastolic blood pressure, haemoglobin, serum calcium, calcium phosphate product, serum phosphate, viral hepatitis status and presence of cardiovascular disease.

Patient characteristics that had significant impact on mortality were age, gender, year commencing dialysis, dialysis modality, BMI, KT/V, diastolic blood pressure and the presence of diabetes or cardiovascular disease. The significant biochemical risk factors for mortality were serum albumin, serum cholesterol, haemoglobin, calcium, calcium phosphate product, phosphate and hepatitis C status.

There were positive correlation between age of patient, diastolic blood pressure (Figure 3.4.1a), serum calcium and serum phosphate (Figure 3.4.1b) with mortality while negative correlation was noted between serum albumin, KT/V (Figure 3.4.1c), haemoglobin concentration (Figure 3.4.1d) and calcium phosphate product with mortality.

**Table 3.4.1:** Adjusted hazard ratio for mortality of dialysis patients (1997-2006 cohort)

| Factors | N | Hazard ratio | 95% CI | P value |
|---|---|---|---|---|
| Age (years): | | | | |
| 0-14(ref.*) | 331 | 1.00 | | |
| 15-24 | 1045 | 1.63 | (1.13, 2.34) | 0.01 |
| 25-34 | 1856 | 1.47 | (1.03, 2.09) | 0.03 |
| 35-44 | 3172 | 2.06 | (1.46, 2.90) | 0.00 |
| 45-54 | 5797 | 2.81 | (2.00, 3.95) | 0.00 |
| 55-64 | 6301 | 3.73 | (2.66, 5.24) | 0.00 |
| ≥65 | 4709 | 5.06 | (3.60, 7.12) | 0.00 |
| Gender: | | | | |
| Male (ref.*) | 12897 | 1.00 | | |
| Female | 10314 | 0.89 | (0.84, 0.94) | 0.00 |
| Primary diagnosis: | | | | |
| Unknown/ Uncertain (ref.*) | 6622 | 1.00 | | |
| Diabetes mellitus | 11285 | 1.60 | (1.50, 1.70) | 0.00 |
| GN/ SLE | 1952 | 0.92 | (0.81, 1.03) | 0.16 |
| Polycystic kidney | 315 | 1.14 | (0.91, 1.45) | 0.26 |
| Obstructive Nephropathy | 763 | 1.09 | (0.94, 1.25) | 0.26 |
| Others | 2274 | 1.06 | (0.96, 1.17) | 0.24 |
| Year start dialysis: | | | | |
| 1997-8 (ref.*) | 2546 | 1.00 | | |
| 1999-2000 | 3563 | 1.06 | (0.98, 1.14) | 0.14 |
| 2001-2002 | 4752 | 1.10 | (1.02, 1.19) | 0.01 |
| 2003-2006 | 12350 | 1.10 | (1.01, 1.18) | 0.02 |
| Modality: | | | | |
| CAPD | 3069 | 1.35 | (1.24, 1.48) | 0.00 |
| HD (ref*) | 20142 | 1.00 | | |
| BMI: | | | | |
| <18.5 | 2257 | 1.52 | (1.37, 1.70) | 0.00 |
| 18.5-<25 | 15615 | 1.34 | (1.26, 1.43) | 0.00 |
| ≥25(ref.*) | 5339 | 1.00 | | |

**Table 3.4.1:** Adjusted hazard ratio for mortality of dialysis patients (1997-2006 cohort) - cont'd

| Factors | N | Hazard ratio | 95% CI | P value |
|---|---|---|---|---|
| Serum albumin (g/L): | | | | |
| <30 | 1347 | 4.21 | (3.77, 4.69) | 0.00 |
| 30-<35 | 2952 | 2.33 | (2.14, 2.54) | 0.00 |
| 35-<40 | 11046 | 1.70 | (1.59, 1.82) | 0.00 |
| ≥40(ref.*) | 7866 | 1.00 | | |
| Serum cholesterol (mmol/L): | | | | |
| <3.2 | 749 | 1.11 | (0.96, 1.28) | 0.17 |
| 3.2-<5.2 | 16703 | 1.16 | (1.10, 1.24) | 0.00 |
| ≥5.2(ref.*) | 5759 | 1.00 | | |
| KT/V | | | | |
| <1.0 | 358 | 1.55 | (1.30, 1.85) | 0.00 |
| 1.0-<1.2 | 1486 | 1.04 | (0.94, 1.16) | 0.44 |
| 1.2-<1.4(ref.*) | 4783 | 1.00 | | |
| 1.4-<1.6 | 6126 | 0.89 | (0.83, 0.95) | 0.00 |
| >=1.6 | 10458 | 0.80 | (0.74, 0.86) | 0.00 |
| Diastolic BP (mmHg): | | | | |
| <70 | 2548 | 0.89 | (0.01, 0.82) | 0.96 |
| 70-<80 | 8465 | 0.95 | (0.90, 1.00) | 0.07 |
| 80-<90(ref.*) | 9358 | 1.00 | | |
| 90-<100 | 2353 | 1.10 | (1.00, 1.21) | 0.04 |
| ≥100 | 487 | 1.96 | (1.67, 2.31) | 0.00 |
| Hemoglobin (g/dL): | | | | |
| <8 | 2378 | 3.07 | (2.74, 3.45) | 0.00 |
| 8-<9 | 3567 | 1.96 | (1.75, 2.19) | 0.00 |
| 9-<10 | 10019 | 2.13 | (1.92, 2.36) | 0.00 |
| 10-<11 | 4084 | 1.09 | (0.97, 1.22) | 0.14 |
| 11-<12 (ref.*) | 2058 | 1.00 | | |
| ≥12 | 1105 | 0.92 | (0.78, 1.09) | 0.32 |
| Serum Calcium (mmol/L): | | | | |
| <2.2 | 6325 | 0.85 | (0.80, 0.90) | 0.00 |
| 2.2-<2.6(ref.*) | 16240 | 1.00 | | |
| ≥2.6 | 646 | 1.63 | (1.43, 1.85) | 0.00 |
| Calcium Phosphate product ($mmol^2/L^2$): | | | | |
| <3.5 | 7163 | 1.00 | (0.91, 1.10) | 0.98 |
| 3.5-<4.5(ref.*) | 10759 | 1.00 | | |
| 4.5-<5.5 | 3668 | 0.69 | (0.62, 0.77) | 0.00 |
| ≥5.5 | 1621 | 0.57 | (0.47, 0.69) | 0.00 |
| Serum Phosphate (mmol/L): | | | | |
| <1.6 | 7879 | 0.90 | (0.82, 0.98) | 0.02 |
| 1.6-<2.0(ref.*) | 10244 | 1.00 | | |
| 2.0-<2.2 | 2190 | 0.98 | (0.87, 1.10) | 0.76 |
| 2.2-<2.4 | 1303 | 1.19 | (1.03, 1.38) | 0.02 |
| 2.4-<2.6 | 794 | 1.23 | (1.00, 1.52) | 0.05 |
| ≥2.6 | 801 | 2.05 | (1.64, 2.56) | 0.00 |
| HBsAg: | | | | |
| Negative(ref.*) | 22259 | 1.00 | | |
| Positive | 952 | 1.09 | (0.98, 1.22) | 0.12 |
| Anti-HCV: | | | | |
| Negative(ref.*) | 22121 | 1.00 | | |
| Positive | 1090 | 0.85 | (0.77, 0.94) | 0.00 |
| Cardiovascular disease (CVD): | | | | |
| No CVD(ref.*) | 18599 | 1.00 | | |
| CVD | 4612 | 1.28 | (1.22, 1.35) | 0.00 |

ref: Reference group

**Figure 3.4.1(a):** Adjusted hazard ratio for mortality of dialysis patients by diastolic blood pressure (1997-2006 cohort)

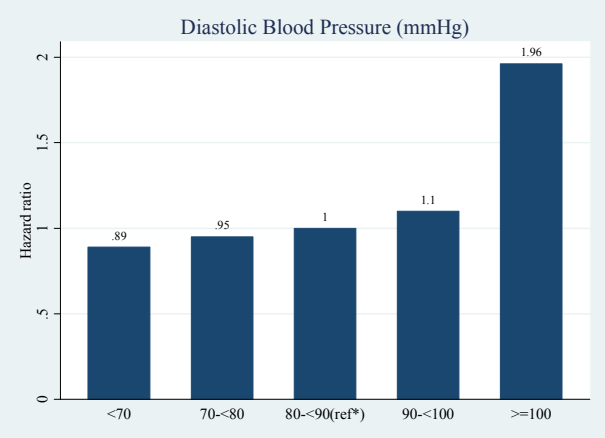



**Figure 3.4.1(b):** Adjusted hazard ratio for mortality of dialysis patients by serum phosphate (1997-2006 cohort)

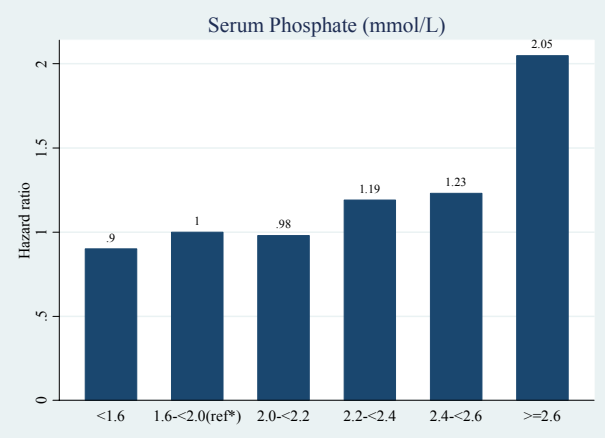



**Figure 3.4.1(c):** Adjusted hazard ratio for mortality of dialysis patients by KT/V (1997-2006 cohort)

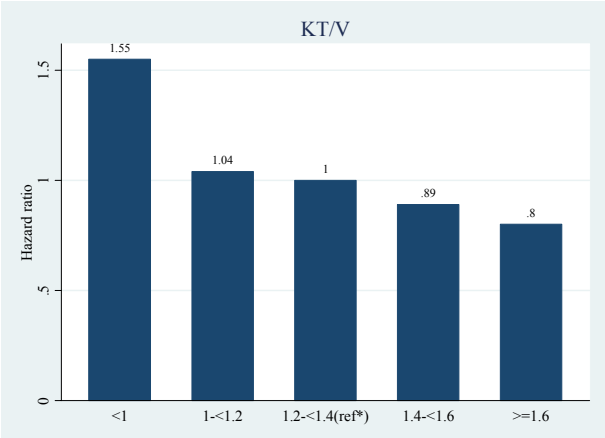
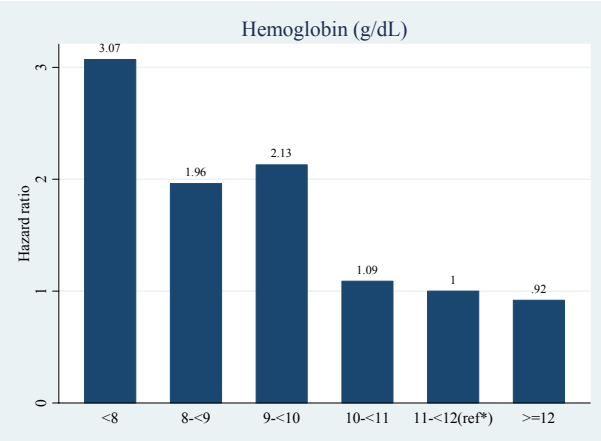



**Figure 3.4.1(d):** Adjusted hazard ratio for mortality of dialysis patients by haemoglobin (1997-2006 cohort)



# CHAPTER 4

# Quality of Life
# &
# Rehabilitation Outcomes

Liu Wen Jiun
Chew Thian Fook
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Zaki Morad B Mohd Zaher

## SECTION A : QoL index score

16476 patients who entered dialysis between 1997-2006 were analysed. 13872 HD patients and 2604 CAPD patients reported median QoL index score of 9 and 10 respectively (Table 4.1, Figure 4.1) Diabetics have a lower median QoL index score (8 versus 10) than non diabetics (Table 4.2, Figure 4. 2) whilst there was no difference seen between gender (Table 4.3, Figure 4.3). There is a trend of lower median QoL index score being associated with older dialysis patients (Table 4.4, Figure 4.4). There are no obvious trends in QoL index seen either in the HD or CAPD cohort over the last 10 years. (Table 4.5, Table 4.6, Fig 4.5 and Figure 4.6)

**Table 4.1:** Cumulative distribution of QoL-Index score in relation to Dialysis modality, All Dialysis patients 1997-2006

| Dialysis modality | CAPD | HD |
|---|---|---|
| Number of patients | 2604 | 13872 |
| 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 1997-2006

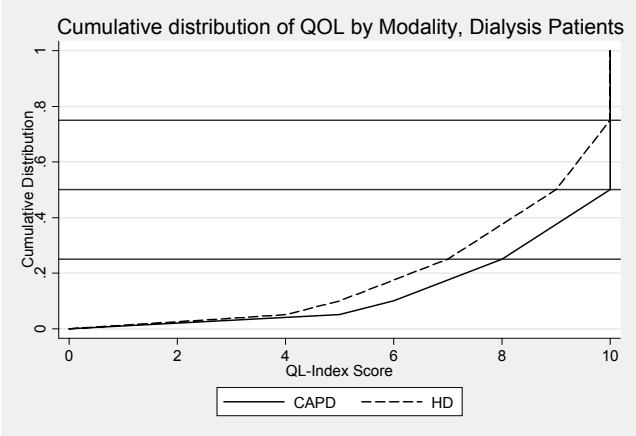



**Table 4.2:** Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, All Dialysis patients 1997-2006

| Diabetes mellitus | No | Yes |
|---|---|---|
| Number of patients | 8764 | 7712 |
| 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 1997-2006

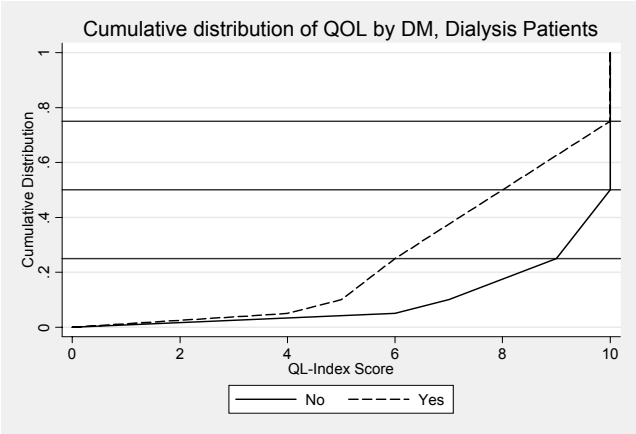


**Table 4.3:** Cumulative distribution of QoL-Index score in relation to Gender, All Dialysis patients 1997-2006

| Gender | Male | Female |
|---|---|---|
| Number of patients | 9128 | 7348 |
| 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 1997-2006

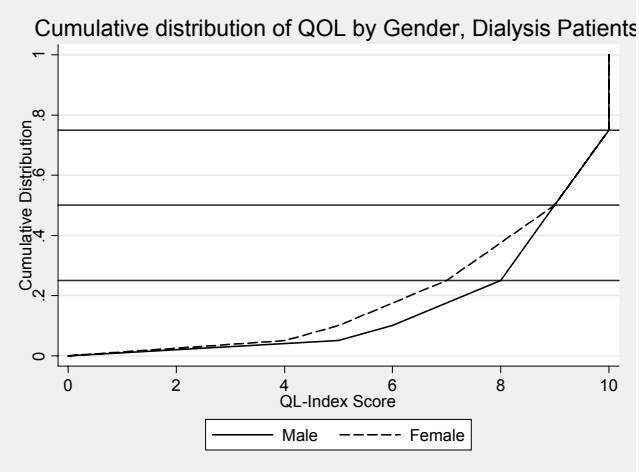



**Table 4.4:** Cumulative distribution of QoL-Index score in relation to Age, All Dialysis patients 1997-2006

| Age group (years) | <20 | 20-39 | 40-59 | >=60 |
|---|---|---|---|---|
| Number of patients | 672 | 2918 | 7960 | 4926 |
| Centile | | | | |
| 0 | 0 | 0 | 0 | 0 |
| 0.05 | 6 | 7 | 5 | 4 |
| 0.10 | 7 | 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 1997-2006

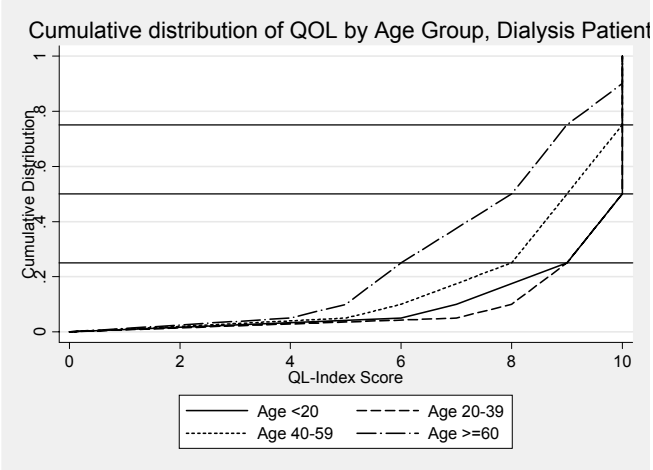


**Table 4.5:** Cumulative distribution of QoL-Index score in relation to Year of entry, HD patients 1997-2006

| Year of Entry | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 730 | 826 | 1027 | 1248 | 1407 | 1600 | 1626 | 1895 | 1883 | 1630 |
| Centile | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0.05 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 4 | 4 |
| 0.10 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 |
| 0.25 (LQ) | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 0.5 (median) | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| 0.75 (UQ) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 0.90 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 0.95 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 1 | 10 | 10 | 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 1997-2006

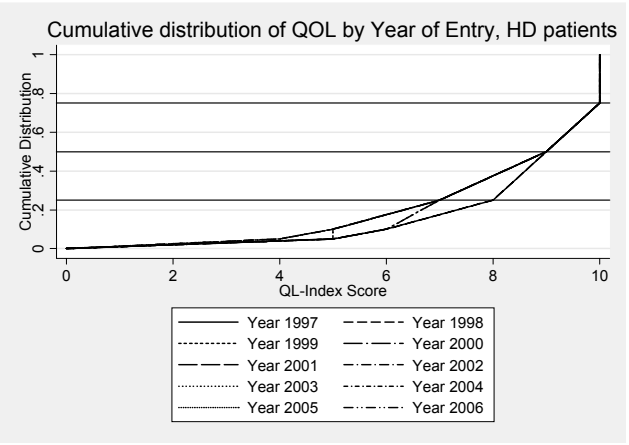



**Figure 4.6:** Cumulative distribution of QoL-Index score in relation to Year of entry, CAPD patients 1997-2006

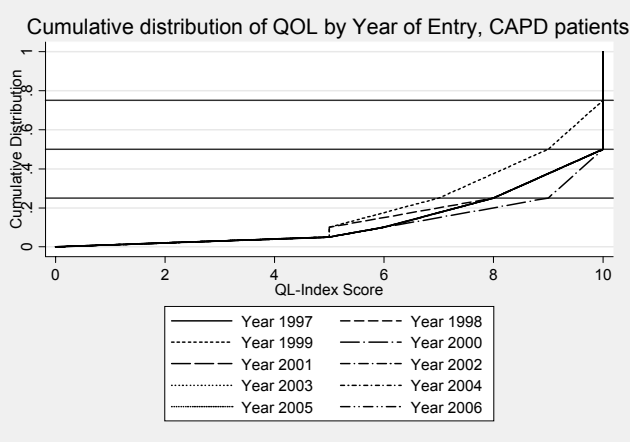



**Table 4.6:** Cumulative distribution of QoL-Index score in relation to Year of entry, CAPD patients 1997-2006

| Year of Entry | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of patient | 162 | 117 | 167 | 188 | 269 | 319 | 369 | 306 | 316 | 391 |
| Centile | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0.05 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 0.10 | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 0.25 (LQ) | 8 | 8 | 7 | 9 | 8 | 8 | 8 | 8 | 8 | 8 |
| 0.5 (median) | 10 | 10 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 0.75 (UQ) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 0.90 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 0.95 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

## SECTION B :WORK RELATED REHABILITATION

Analysis was done on HD patients (n=5680) and CAPD patients (n=861) who entered dialysis between 1997 –2006, (Table 4.7). Only patients who are working for pay and those who are unable to work for pay due to health reasons are included. The proportion of patients on employment are similar in both modalities (HD = 72% vs CAPD 72%)

Amongst HD as well as CAPD patients, the proportion on employment increases with longer duration on dialysis. (Table 4.8 and Table 4.9) This may be confounded by the healthier individuals who survived longer in the earlier cohort and therefore spuriously increased the proportion on employment

**Table 4.7:** Work related rehabilitation in relation to Modality, Dialysis patients 1997-2006

| Modality | CAPD | | HD | |
|---|---|---|---|---|
| | N | % | N | % |
| Number of patients | 861 | | 5680 | |
| Able to return for Full or Part time for pay | 623 | 72 | 4077 | 72 |
| Unable to work for pay* | 238 | 28 | 1603 | 28 |

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

**Table 4.8:** Work related rehabilitation in relation to Year of Entry, HD patients 1997-2006

| Year | | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of patients | | 373 | 421 | 520 | 571 | 574 | 648 | 658 | 708 | 650 | 557 |
| Able to return for Full or Part time for pay | No. | 310 | 337 | 395 | 443 | 414 | 477 | 461 | 469 | 438 | 333 |
| | % | 83 | 80 | 76 | 78 | 72 | 74 | 70 | 66 | 67 | 60 |
| Unable to work for pay* | No | 63 | 84 | 125 | 128 | 160 | 171 | 197 | 239 | 212 | 224 |
| | % | 17 | 20 | 24 | 22 | 28 | 26 | 30 | 34 | 33 | 40 |

* 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 1997-2006

| Year | | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of patients | | 69 | 39 | 47 | 62 | 82 | 116 | 136 | 94 | 109 | 107 |
| Able to return for Full or Part time for pay | No. | 50 | 31 | 35 | 41 | 67 | 89 | 105 | 68 | 73 | 64 |
| | % | 72 | 79 | 74 | 66 | 82 | 77 | 77 | 72 | 67 | 60 |
| Unable to work for pay* | No | 19 | 8 | 78 | 21 | 15 | 27 | 31 | 26 | 36 | 43 |
| | % | 28 | 21 | 26 | 34 | 27 | 23 | 23 | 28 | 33 | 40 |

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

# CHAPTER 5

# Paediatric Renal Replacement Therapy

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

## SECTION A: RRT PROVISION FOR PAEDIATRIC PATIENTS

The paediatric RRT population in this report is defined as patients less than 20 years of age. This report describes the trend of paediatric RRT over the last 10 years.

The number of new patients commencing on dialysis continued to show an increasing trend from 41 in 1997 to 88 in 2006. The dialysis acceptance rate doubled from 4 per million age related population (pmarp) in 1997 to 8 pmarp in 2006 but had plateau at around 7-8 pmarp over the last 5 years. There has been only a modest increase in the number of new transplants in 2006 and the transplant rate remained low at 2 pmarp. The total renal replacement treatment rate was 8 pmarp.

The number of prevalent dialysis patients continued to rise and by the end of 2006 there were a total of 468 children under 20 on dialysis. The equivalent dialysis prevalence rate increased from 13 pmarp in 1997 to 42 pmarp in 2006. The number of patients with functioning transplants has doubled from 71 in 1997 to 139 in 2006 giving a prevalence rate of 7 and 12 pmarp respectively.

**Table 5.01:** Stock and Flow of Paediatric Renal Replacement Therapy 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New HD patients | 21 | 21 | 23 | 12 | 24 | 28 | 33 | 39 | 34 | 46 |
| New CAPD patients | 20 | 28 | 29 | 37 | 39 | 54 | 39 | 41 | 47 | 42 |
| New Transplants | 14 | 6 | 11 | 14 | 8 | 11 | 11 | 9 | 17 | 19 |
| HD deaths | 3 | 3 | 2 | 4 | 1 | 11 | 6 | 10 | 9 | 7 |
| CAPD deaths | 3 | 7 | 2 | 3 | 8 | 8 | 9 | 5 | 9 | 15 |
| Transplant deaths | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| On HD at 31st Dec | 70 | 90 | 106 | 120 | 144 | 162 | 186 | 218 | 241 | 279 |
| On CAPD at 31st Dec | 62 | 73 | 91 | 109 | 123 | 152 | 163 | 176 | 192 | 189 |
| Functioning transplant at 31st December | 71 | 74 | 83 | 90 | 94 | 102 | 107 | 114 | 125 | 139 |

**Figure 5.01a:** Incident cases of RRT by modality in children under 20 years old, 1997-2006

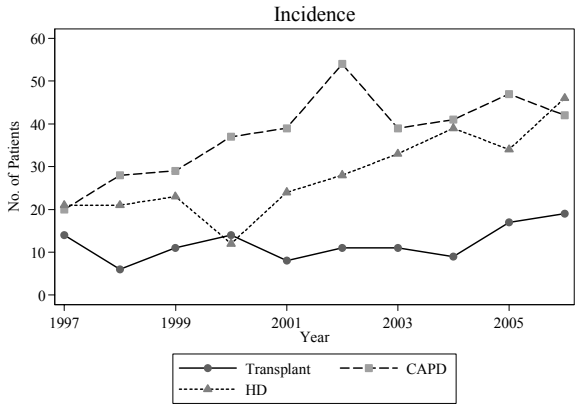



**Figure 5.01b:** Prevalent cases of RRT by modality in children under 20 years old, 1997-2006

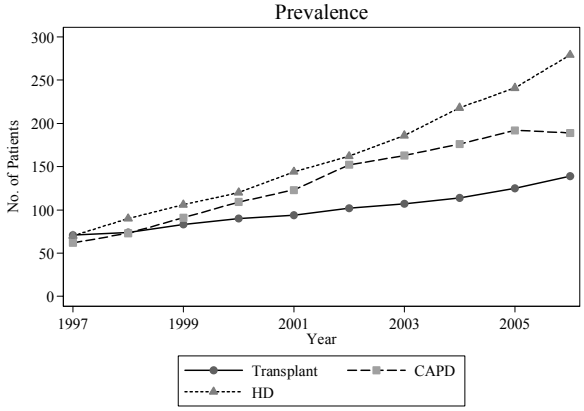
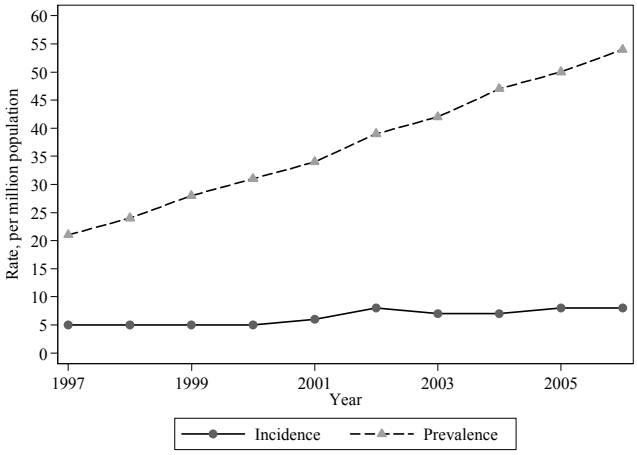


**Table 5.02:** Paediatric Dialysis and Transplant Rates per million age-group population 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| Incidence Rate | | | | | | | | | | |
| New HD | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 4 | 3 | 4 |
| New CAPD | 2 | 3 | 3 | 4 | 4 | 5 | 4 | 4 | 4 | 4 |
| New Transplant | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| All RRT | 5 | 5 | 5 | 5 | 6 | 8 | 7 | 7 | 8 | 8 |
| Prevalence Rate at 31st December | | | | | | | | | | |
| On HD | 7 | 9 | 11 | 12 | 14 | 15 | 17 | 20 | 22 | 25 |
| On CAPD | 6 | 7 | 9 | 11 | 12 | 14 | 15 | 16 | 17 | 17 |
| Functioning Graft | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 10 | 11 | 12 |
| All RRT | 20 | 24 | 28 | 32 | 35 | 39 | 42 | 46 | 50 | 54 |

**Figure 5.02:** Incidence and prevalence rate per million age related population years old on RRT, 1997-2006




## SECTION B: DISTRIBUTION OF PAEDIATRIC DIALYSIS

Table 5.03 shows that the treatment rate is consistently higher for states in the west coast of West Malaysia compared to the east coast or East Malaysia.

**Table 5.03a:** Dialysis Treatment Rate by State, per million state age group population, 1997-2006

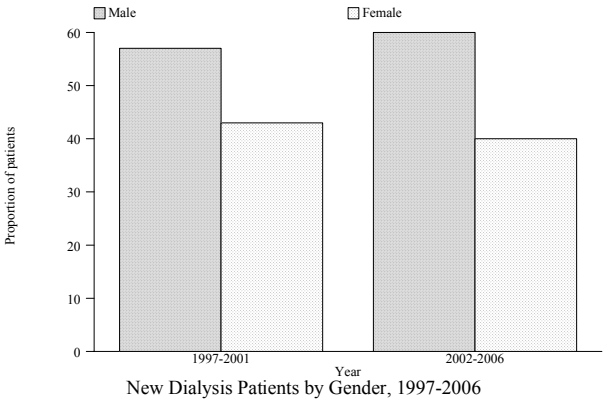
| State | 1997-2001 | 2002-2006 |
|---|---|---|
| Melaka | 7 | 15 |
| Pulau Pinang | 6 | 15 |
| Negeri Sembilan | 10 | 11 |
| Johor Takzim | 8 | 10 |
| Perak Darul Redzuan | 3 | 10 |
| Terengganu Darul Iman | 7 | 9 |
| Kedah & Perlis | 8 | 8 |
| Kelantan Darul Naim | 2 | 8 |
| Pahang Darul Makmur | 6 | 8 |
| Selangor & W. Persekutuan | 8 | 8 |
| Sarawak | 5 | 7 |
| Sabah | 2 | 6 |

**Table 5.03b:** New Dialysis Patients by State, 1997-2006

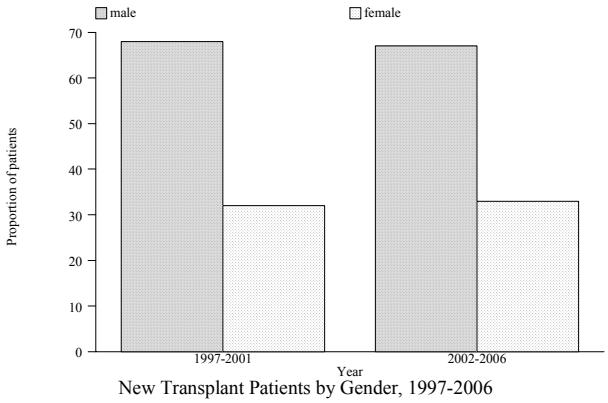
| State | 1997-2001 | 2002-2006 |
|---|---|---|
| Selangor & W. Persekutuan | 80 | 95 |
| Johor Darul Takzim | 45 | 60 |
| Perak Darul Redzuan | 15 | 47 |
| Pulau Pinang | 15 | 40 |
| Sabah | 13 | 38 |
| Kedah & Perlis | 34 | 36 |
| Sarawak | 21 | 36 |
| Kelantan Darul Naim | 9 | 31 |
| Pahang Darul Makmur | 18 | 25 |
| Negeri Melaka | 9 | 23 |
| Negeri Sembilan | 18 | 22 |
| Terengganu Darul Iman | 17 | 21 |

Figure 5.04 shows persistent trend of male predominance amongst the new dialysis and transplant patients. This may be consistent with higher incidence of ESRD among males. However this trend appears more marked among the transplant patients

**Figure 5.04:** Number of New Dialysis and Transplant Patients by gender 1997-2006




New Dialysis Patients by Gender, 1997-2006




New Transplant Patients by Gender, 1997-2006

Figure 5.05 shows that except for the age group 15-19 years old which still showed an increasing trend; the treatment rate has begun to level off for all the other age groups. The number of 0-4 year olds provided chronic dialysis treatment remained very low at around 1 pmarp.

**Figure 5.05:** Dialysis and Transplant Treatment Rate by Age group 1997-2006

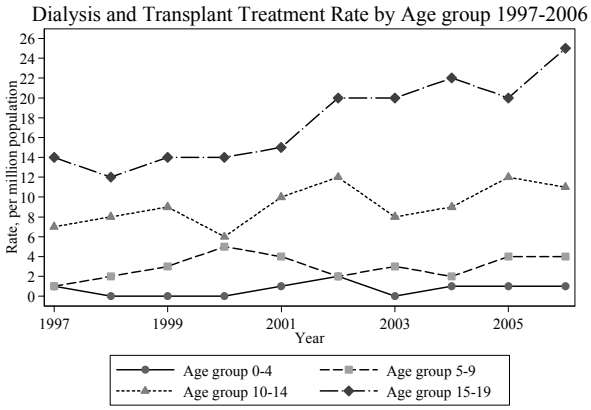
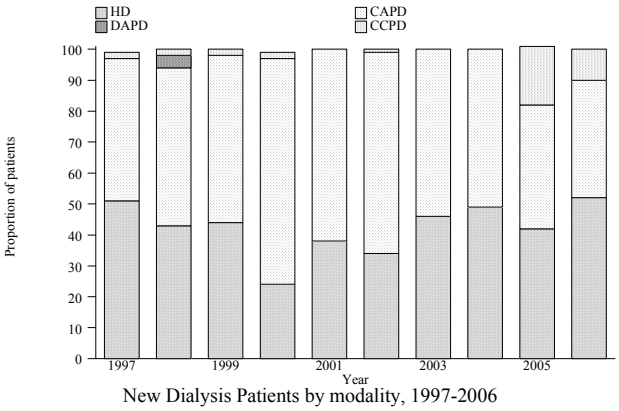



Figure 5.06 shows that CAPD was the preferred mode of initial dialysis modality; however over the last 2 years a significant proportion of children were also started on automated PD as the first modality of dialysis.

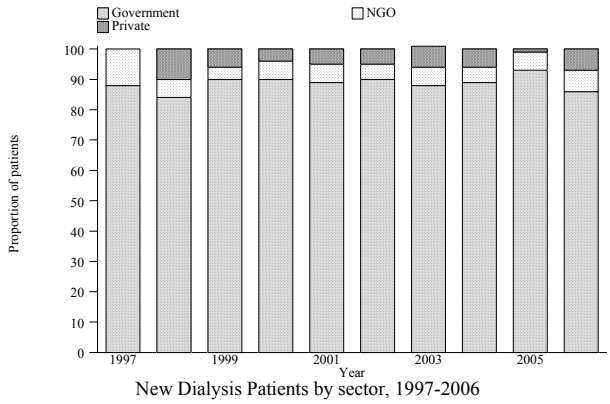
**Figure 5.06:** New Dialysis by treatment modality 1997-2006




New Dialysis Patients by modality, 1997-2006

Figure 5.07 shows that up to 90% of children less than 20 years of age received their dialysis treatment from government centres and hence were government funded.

**Figure 5.07:** New Dialysis by sector 1997-2006




New Dialysis Patients by sector, 1997-2006

## SECTION C: PRIMARY RENAL DIASEASE AND TYPES OF RENAL TRANSPLANTATION

Figure 5.08 shows that glomerulonephritis was the commonest known cause of ESRD accounting for 24% of patients. FSGS on its own accounted for 10% of ESRD. The number of children presenting with ESRD of unknown aetiology was still high at 39%.

**Table 5.08:** Primary renal disease by sex, 1997-2006

| Primary Renal Disease | Male | | Female | | All | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Glomerulonephritis | 99 | 25 | 64 | 23 | 163 | 24 |
| FSGS | 38 | 10 | 27 | 10 | 65 | 10 |
| Refux nephropathy | 23 | 6 | 7 | 3 | 30 | 4 |
| SLE | 13 | 3 | 39 | 14 | 52 | 8 |
| Obstructive uropathy | 33 | 8 | 9 | 3 | 42 | 6 |
| Renal dysplasia | 12 | 3 | 6 | 2 | 18 | 3 |
| Others | 9 | 2 | 10 | 4 | 19 | 3 |
| Hereditary nephritis | 11 | 3 | 1 | 0 | 12 | 2 |
| Cystic kidney disease | 4 | 1 | 4 | 1 | 8 | 1 |
| Drug induced nephropathy | 0 | 0 | 1 | 0 | 1 | 0 |
| Metabolic | 3 | 1 | 1 | 0 | 4 | 1 |
| Unknown | 154 | 39 | 108 | 39 | 262 | 39 |
| Total | 399 | 100 | 277 | 100 | 676 | 100 |

Table 5.09 shows that living related renal transplantation was still the commonest type of transplantation done accounting for 53% of the transplant done among children under 20 years of age. The second commonest source was cadaveric transplant; up to 24%. Another quarter (23%) of renal transplantation was done overseas under the commercial cadaver and living donor programs.

**Table 5.09:** Types of Renal Transplant 1997-2006

| Year | 1997-2001 | | 2002-2006 | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Commercial Cadaver | 8 | 15 | 17 | 20 |
| Commercial Living donor | 3 | 6 | 2 | 3 |
| Living related donor | 29 | 55 | 42 | 53 |
| Cadaver | 13 | 25 | 19 | 24 |
| Living emotionally related | 0 | 0 | 0 | 0 |
| TOTAL | 53 | 100 | 67 | 100 |

## SECTION D: SURVIVAL ANALYSIS

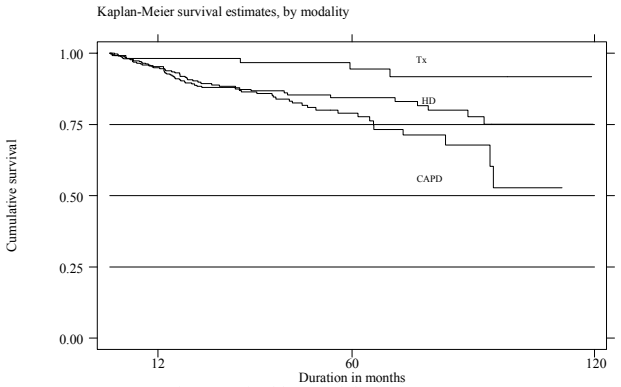
Table and figure 5.10 show that renal transplantation has the best patient survival; 98%, 94% and 92% at 1 year, 5 years and 10 years respectively. Patient survival for HD was 95% at 1 year, 84% at 5 years and 75% at 10 years. CAPD patients showed the worst survival; 95% at 1 year and 79% at 5 years. 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 3-5 years into dialysis.

**Table 5.10:** Patient Survival by Modality of RRT, 1997-2006

| Modality | Transplant | | | CAPD | | | HD | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (years) | No. | % survival | SE | No. | % survival | SE | No. | % survival | SE |
| 1 | 91 | 98 | 1 | 306 | 95 | 1 | 272 | 95 | 1 |
| 5 | 41 | 94 | 3 | 64 | 79 | 3 | 81 | 84 | 2 |
| 10 | 2 | 92 | 4 | - | - | - | 2 | 75 | 5 |

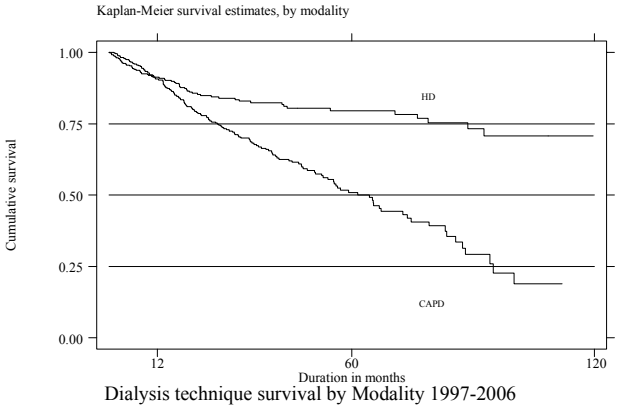
* No. = Number at risk SE = Standard Error

**Figure 5.10:** Patient Survival by Modality of RRT, 1997-2006




Patient survival by Modality 1997-2006

**Figure 5.11:** Dialysis Technique Survival by Modality, 1997-2006




Dialysis technique survival by Modality 1997-2006

Table and figure 5.11 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, 1997-2006

| Modality | CAPD | | | HD | | |
|---|---|---|---|---|---|---|
| Interval (years) | No. | % survival | SE | No. | % survival | SE |
| 1 | 306 | 91 | 2 | 272 | 91 | 2 |
| 5 | 64 | 51 | 3 | 81 | 80 | 3 |
| 10 | - | - | - | 2 | 71 | 5 |

* No. = Number at risk SE = Standard Error

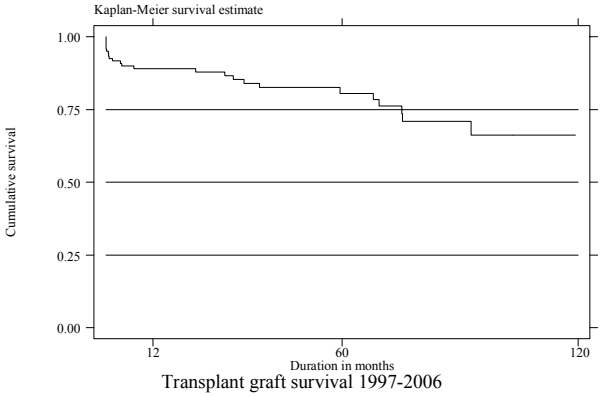
Table and Figure 5.12 below show that the graft survival was 89% at 1 year, 81% at 5 years and 66% at 10 years.

**Table 5.12:** Transplant Graft Survival 1997-2006

| Interval (years) | No. | % survival | SE |
|---|---|---|---|
| 1 | 91 | 89 | 3 |
| 5 | 41 | 81 | 4 |
| 10 | 2 | 66 | 7 |

* No. = Number at risk SE = Standard Error

**Figure 5.12:** Transplant Graft Survival 1997-2006




Transplant graft survival 1997-2006

# CHAPTER 6

# Management of Anaemia In Dialysis Patients

Philip N. Jeremiah
Bee Boon Cheak

## SECTION 6.1: TREATMENT FOR ANAEMIA IN DIALYSIS

From 1997 – 2006, there was an increasing percentage of patients on erythropoietin (EPO); there were more haemodialysis patients on EPO; 84% compared to 74% in CAPD. The percentage of patients requiring blood transfusion however has also increased.

There were a decreasing number of patients on oral iron, with correspondingly significant increase of patients on parenteral iron.

**Table 6.1.1:** Treatment for Anaemia, HD patients 1997-2006

| 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 | 7017 | 71 | 12 | 83 | 8 |
| 2004 | 8064 | 74 | 11 | 80 | 10 |
| 2005 | 9344 | 81 | 14 | 74 | 11 |
| 2006 | 11494 | 84 | 18 | 76 | 16 |

**Table 6.1.2:** Treatment for Anaemia, CAPD patients 1997-2006

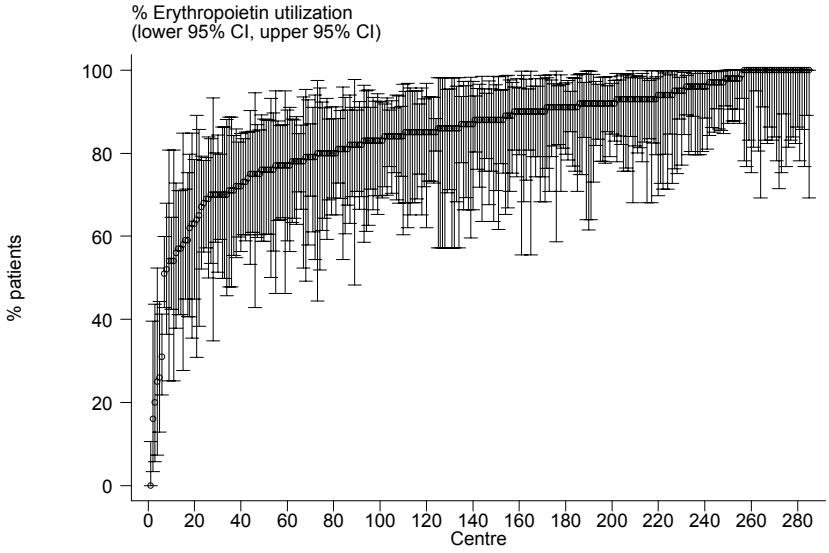
| Year | No. of subjects | % on Erythropoietin | % received blood transfusion | % on oral Iron | % received parenteral Iron |
|---|---|---|---|---|---|
| 1997 | 476 | 37 | 12 | 96 | 3 |
| 1998 | 541 | 44 | 16 | 96 | 3 |
| 1999 | 610 | 44 | 14 | 94 | 0 |
| 2000 | 662 | 46 | 11 | 92 | 4 |
| 2001 | 781 | 45 | 11 | 91 | 2 |
| 2002 | 891 | 49 | 11 | 93 | 2 |
| 2003 | 1230 | 53 | 14 | 87 | 4 |
| 2004 | 1312 | 63 | 15 | 85 | 7 |
| 2005 | 1390 | 72 | 12 | 87 | 8 |
| 2006 | 1550 | 74 | 16 | 83 | 13 |

In 2006, the percentage of patients on EPO among the HD centres varied significantly from 0% to 100%. The median usage of EPO was 88% compared to 45.5% 10 years ago.

**Table 6.1.3:** Variation in Erythropoietin utilization (% patients) among HD centres, 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 7 | 20 | 37.5 | 45.5 | 62.5 | 72 | 92 |
| 1998 | 50 | 0 | 4 | 33 | 49 | 57 | 78 | 86 |
| 1999 | 76 | 6 | 15 | 42 | 52 | 68 | 82 | 90 |
| 2000 | 109 | 0 | 20 | 45 | 56 | 69 | 90 | 100 |
| 2001 | 125 | 0 | 19 | 50 | 62 | 75 | 89 | 100 |
| 2002 | 156 | 14 | 25 | 55.5 | 68.5 | 78 | 92 | 100 |
| 2003 | 178 | 18 | 35 | 60 | 73 | 82 | 95 | 100 |
| 2004 | 207 | 7 | 35 | 65 | 77 | 86 | 96 | 100 |
| 2005 | 236 | 4 | 56 | 74 | 84 | 91 | 100 | 100 |
| 2006 | 285 | 0 | 58 | 79 | 88 | 93 | 100 | 100 |

**Figure 6.1.3:** Variation in Erythropoietin utilization (% patients) among HD centres, 2006

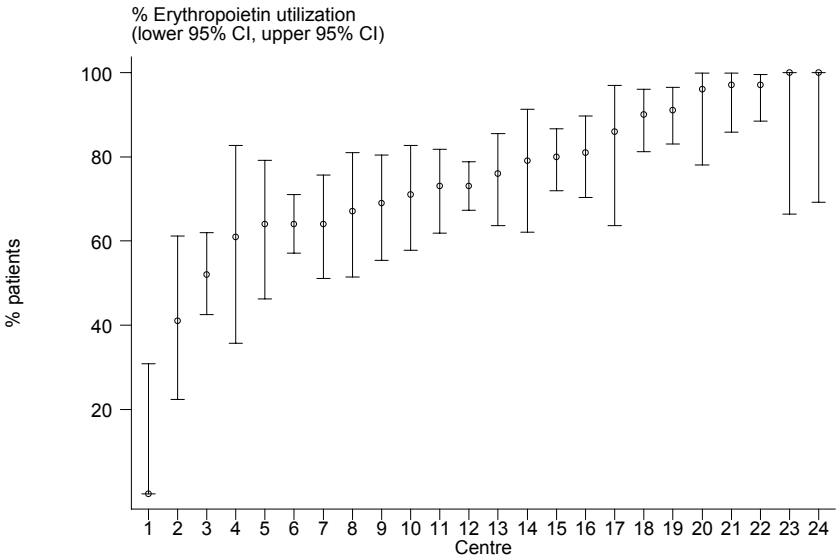



Surprisingly, in CAPD centres too, the variation in EPO utilization was from 0 to 100 %. This was not so in 2005. The median usage of EPO was 74.5% in 2006

**Table 6.1.4:** Variation in Erythropoietin utilization (% patients) among CAPD centres, 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 19 | 19 | 21 | 41 | 49 | 53 | 53 |
| 1998 | 9 | 15 | 15 | 30 | 46 | 55 | 64 | 64 |
| 1999 | 10 | 22 | 22 | 32 | 40.5 | 54 | 79 | 79 |
| 2000 | 11 | 26 | 26 | 33 | 47 | 56 | 67 | 67 |
| 2001 | 12 | 25 | 25 | 33.5 | 46.5 | 56.5 | 84 | 84 |
| 2002 | 15 | 25 | 25 | 41 | 53 | 56 | 68 | 68 |
| 2003 | 19 | 26 | 26 | 38 | 51 | 73 | 92 | 92 |
| 2004 | 19 | 5 | 5 | 55 | 63 | 83 | 97 | 97 |
| 2005 | 21 | 42 | 56 | 59 | 67 | 81 | 97 | 100 |
| 2006 | 24 | 0 | 41 | 64 | 74.5 | 90.5 | 100 | 100 |

**Figure 6.1.4:** Variation in Erythropoietin utilization (%patients) among CAPD centres, 2006



The median weekly EPO dose has increased significantly to 8000 units, in both haemodialysis and CAPD. In HD centres at the 5th and 95th centiles, 5% of centres have their weekly dose at 2000 units and 18,000 units respectively. (Table and Figure 6.1.5 and 6.1.6)

**Table 6.1.5:** Variation in median weekly Erythropoietin dose (u/week) among HD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 30 | 2000 | 2000 | 4000 | 4000 | 4000 | 6000 | 8000 |
| 1998 | 34 | 2000 | 2000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| 1999 | 51 | 2000 | 2000 | 2000 | 4000 | 4000 | 4000 | 4000 |
| 2000 | 78 | 2000 | 2000 | 2000 | 4000 | 4000 | 4000 | 6000 |
| 2001 | 93 | 2000 | 2000 | 2000 | 4000 | 4000 | 5000 | 8000 |
| 2002 | 116 | 2000 | 2000 | 4000 | 4000 | 4000 | 5000 | 6000 |
| 2003 | 137 | 2000 | 2000 | 4000 | 4000 | 4000 | 6000 | 8000 |
| 2004 | 171 | 2000 | 2000 | 4000 | 4000 | 4000 | 6000 | 8000 |
| 2005 | 197 | 2000 | 2000 | 4000 | 4000 | 8000 | 8000 | 18000 |
| 2006 | 238 | 2000 | 2000 | 8000 | 8000 | 8000 | 18000 | 18000 |

**Figure 6.1.5:** Variation in median weekly Erythropoietin dose (u/week) among HD centres 2006

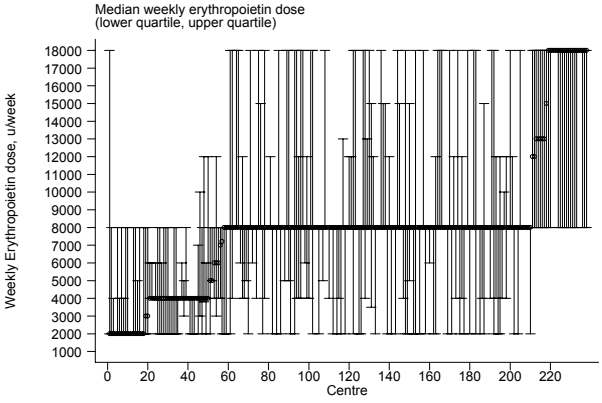



**Figure 6.1.6:** Variation in median weekly Erythropoietin dose (u/week) among CAPD centres 2006

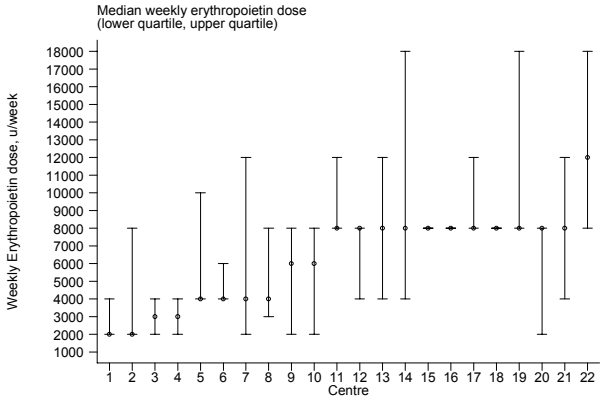



**Table 6.1.6:** Variation in median weekly Erythropoietin dose (u/week) among CAPD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 6 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| 1998 | 6 | 3000 | 3000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| 1999 | 7 | 2000 | 2000 | 2000 | 4000 | 4000 | 4000 | 4000 |
| 2000 | 9 | 2000 | 2000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| 2001 | 11 | 2000 | 2000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| 2002 | 12 | 2000 | 2000 | 3000 | 4000 | 4000 | 4000 | 4000 |
| 2003 | 14 | 2000 | 2000 | 4000 | 4000 | 4000 | 5000 | 5000 |
| 2004 | 13 | 2000 | 2000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| 2005 | 20 | 2000 | 2000 | 3000 | 4000 | 4000 | 8000 | 8000 |
| 2006 | 22 | 2000 | 2000 | 4000 | 8000 | 8000 | 8000 | 12000 |

In HD and CAPD patients, the median requirement of blood transfusion has steadily increased over the last 2 years. (Table and Figure 6.1.7, 6.1.8)

**Table 6.1.7:** Variation in use of blood transfusion (% patients) among HD centres, 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 0 | 0 | 0 | 6.5 | 13.5 | 37 | 71 |
| 1998 | 50 | 0 | 0 | 4 | 9 | 16 | 36 | 48 |
| 1999 | 76 | 0 | 0 | 4 | 10 | 21 | 41 | 56 |
| 2000 | 109 | 0 | 0 | 4 | 11 | 21 | 48 | 75 |
| 2001 | 125 | 0 | 0 | 5 | 12 | 20 | 38 | 50 |
| 2002 | 156 | 0 | 0 | 2.5 | 7 | 14 | 36 | 67 |
| 2003 | 178 | 0 | 0 | 3 | 9 | 19 | 36 | 63 |
| 2004 | 207 | 0 | 0 | 2 | 8 | 17 | 36 | 50 |
| 2005 | 236 | 0 | 0 | 5 | 11 | 20 | 40 | 78 |
| 2006 | 285 | 0 | 0 | 10 | 17 | 30 | 50 | 90 |

**Figure 6.1.7:** Variation in use of blood transfusion (% patients) among HD centres, 2006

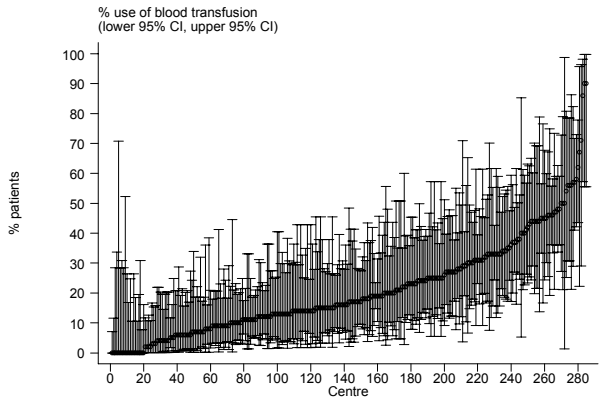



**Figure 6.1.8:** Variation in use of blood transfusion (% patients) among CAPD centres, 2006

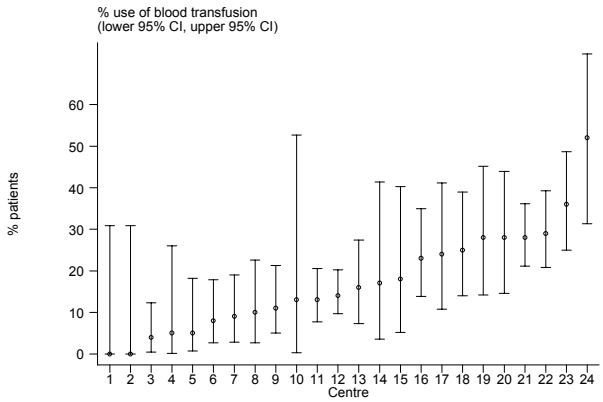



**Table 6.1.8:** Variation in use of blood transfusion (% patients) among CAPD centres, 2006

| 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 | 11 | 17 | 47 | 47 |
| 1999 | 10 | 0 | 0 | 0 | 6.5 | 23 | 47 | 47 |
| 2000 | 11 | 0 | 0 | 0 | 8 | 16 | 43 | 43 |
| 2001 | 12 | 0 | 0 | 0 | 3.5 | 15.5 | 38 | 38 |
| 2002 | 15 | 0 | 0 | 4 | 7 | 21 | 44 | 44 |
| 2003 | 19 | 0 | 0 | 3 | 13 | 21 | 59 | 59 |
| 2004 | 19 | 0 | 0 | 5 | 15 | 20 | 37 | 37 |
| 2005 | 21 | 0 | 0 | 4 | 10 | 17 | 41 | 43 |
| 2006 | 24 | 0 | 0 | 8.5 | 15 | 26.5 | 36 | 52 |

## SECTION 6.2: IRON STATUS ON DIALYSIS

In HD and CAPD patients with or without EPO, the mean and median serum Ferritin was steadily increasing over the years except in 2006, when it decreased. This corresponded to an increase in the use of EPO. Up to 98% of patients have serum ferritin of 100 ng/ml. (Table and Figure 6.2.1 to 6.2.4)

**Table 6.2.1:** Distribution of Serum Ferritin without Erythropoietin, HD patients 1997 –2006

| 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 | 916 | 551.6 | 434.2 | 456.7 | 190 | 827.7 | 87 |
| 2004 | 1044 | 590.1 | 463.4 | 473 | 218 | 908.5 | 89 |
| 2005 | 1012 | 616.5 | 498.4 | 482.5 | 224.5 | 901 | 90 |
| 2006 | 1127 | 562.7 | 488.7 | 407 | 190 | 819.5 | 87 |

**Figure 6.2.1:** Cumulative distribution of Serum Ferritin without Erythropoietin, HD patients 1997-2006

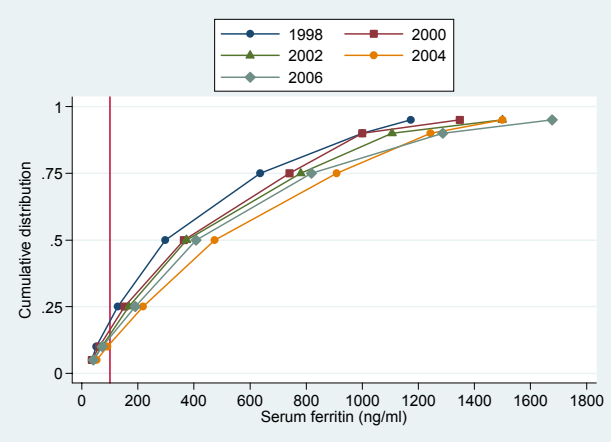



**Figure 6.2.2:** Cumulative distribution of Serum Ferritin without Erythropoietin, CAPD patients 1997-2006

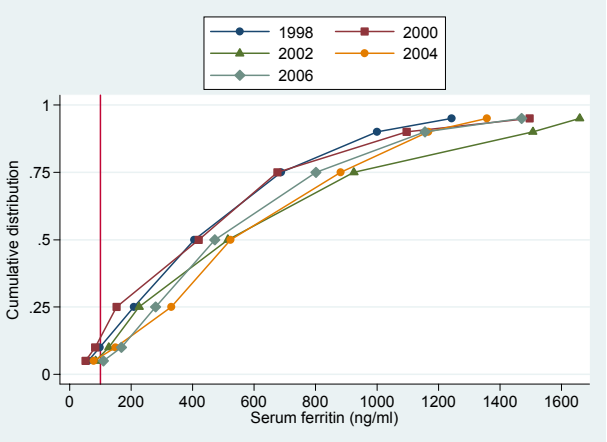



**Table 6.2.2:** Distribution of Serum Ferritin without Erythropoietin, CAPD patients 1997–2006

| 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 | 329 | 602.5 | 429.2 | 503.7 | 269 | 834 | 93 |
| 2004 | 303 | 608.4 | 385.7 | 522.7 | 330 | 882 | 94 |
| 2005 | 225 | 651.4 | 397.8 | 609 | 324 | 913.3 | 96 |
| 2006 | 262 | 582.4 | 407.1 | 471.7 | 279.1 | 801 | 95 |

**Table 6.2.3:** Distribution of Serum Ferritin on Erythropoietin, HD patients 1997 – 2006

| 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 | 1174 | 588.3 | 456.6 | 475.5 | 219 | 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 | 3134 | 640.8 | 428.1 | 562.8 | 298 | 931 | 94 |
| 2004 | 3902 | 669.9 | 460.5 | 571 | 306 | 977 | 94 |
| 2005 | 5114 | 683.2 | 471 | 599.8 | 316 | 972.5 | 93 |
| 2006 | 6714 | 641.6 | 459.3 | 545 | 293.8 | 882 | 93 |

**Figure 6.2.3:** Cumulative distribution of Serum Ferritin on Erythropoietin, HD patients 1997-2006

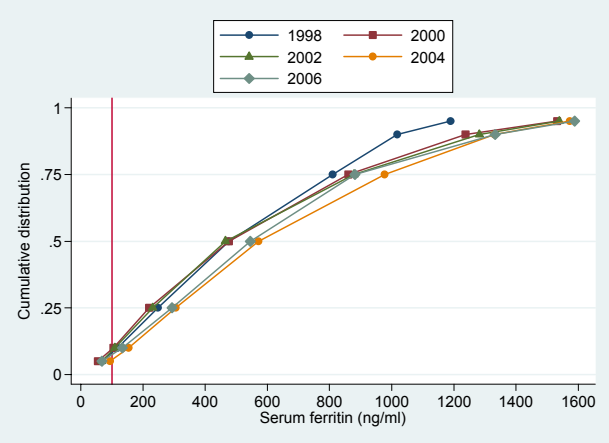



**Figure 6.2.4:** Cumulative distribution of Serum Ferritin on Erythropoietin, CAPD patients 1997-2006

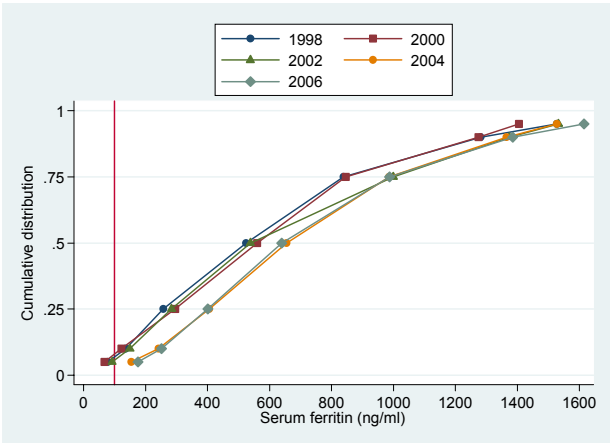



**Table 6.2.4:** Distribution of Serum Ferritin on Erythropoietin, CAPD patients 1997 – 2006

| 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 | 517 | 689.9 | 459.9 | 589 | 304 | 993.2 | 96 |
| 2004 | 540 | 728.8 | 427.2 | 655.6 | 406.3 | 986.7 | 98 |
| 2005 | 767 | 732.9 | 433.6 | 659 | 403.6 | 997.5 | 97 |
| 2006 | 888 | 730.5 | 434.4 | 639.6 | 401.3 | 986.9 | 98 |

The median transferrin saturation has remained the same over the last 10 years, with the mean and median always greater than 30%. Up to 95% of all patients have transferrin saturation greater than 20% (Table and Figure 6.2.5 to 6.2.8)

**Table 6.2.5:** Distribution of transferrin saturation without Erythropoietin, HD patients 1997 –2006

| 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 | 921 | 40.3 | 18.6 | 36 | 27.2 | 51.1 | 91 |
| 2004 | 1031 | 41.2 | 18.1 | 37.5 | 28.5 | 50.1 | 92 |
| 2005 | 1110 | 37.7 | 17.7 | 34.4 | 25.6 | 46.2 | 87 |
| 2006 | 1116 | 36.2 | 16.8 | 33 | 24.6 | 44.1 | 87 |

**Figure 6.2.5:** Cumulative distribution of transferrin saturation without Erythropoietin, HD patients 1997-2006

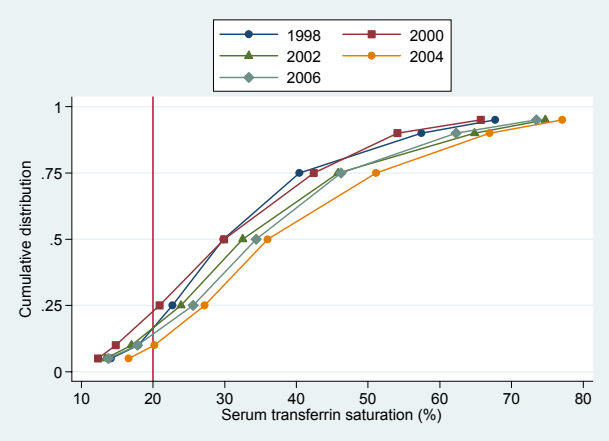



**Figure 6.2.6:** Cumulative distribution of transferrin saturation without Erythropoietin, CAPD patients 1997-2006

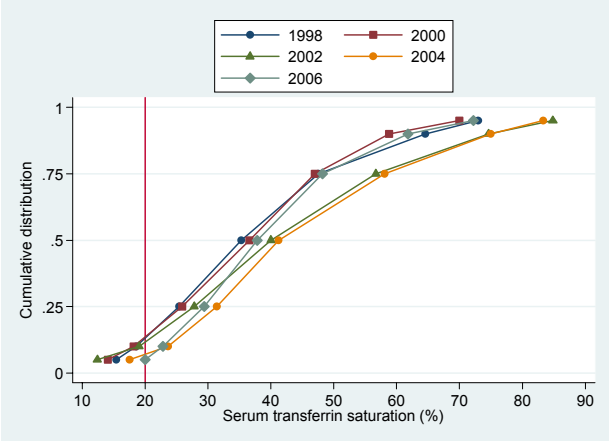



**Table 6.2.6:** Distribution of transferrin saturation without Erythropoietin, CAPD patients 1997–2006

| 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 | 397 | 45.2 | 19.7 | 41.2 | 31.4 | 58.1 | 93 |
| 2004 | 379 | 44.5 | 18.2 | 41.6 | 30.9 | 55.5 | 98 |
| 2005 | 287 | 40.6 | 16.2 | 37.8 | 29.4 | 48.2 | 95 |
| 2006 | 298 | 40.5 | 17.3 | 38 | 27.3 | 46.8 | 95 |

**Table 6.2.7:** Distribution of transferrin saturation on Erythropoietin, HD patients 1997 – 2006

| 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 | 1247 | 34.9 | 16.7 | 30.4 | 23 | 44 | 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 | 2642 | 39.6 | 18.4 | 35.9 | 26.6 | 48.9 | 90 |
| 2004 | 3269 | 39.6 | 17 | 36.1 | 27.8 | 48.1 | 93 |
| 2005 | 4804 | 36.6 | 17.3 | 32.8 | 24.6 | 45 | 87 |
| 2006 | 6393 | 35.2 | 16.4 | 31.7 | 24.1 | 42.1 | 87 |

**Figure 6.2.7:** Cumulative distribution of transferrin saturation on Erythropoietin, HD patients 1997-2006

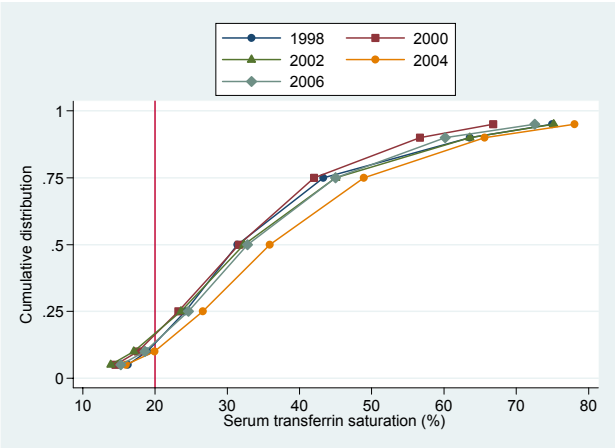



**Figure 6.2.8:** Cumulative distribution of transferrin saturation on Erythropoietin, CAPD patients 1997-2006

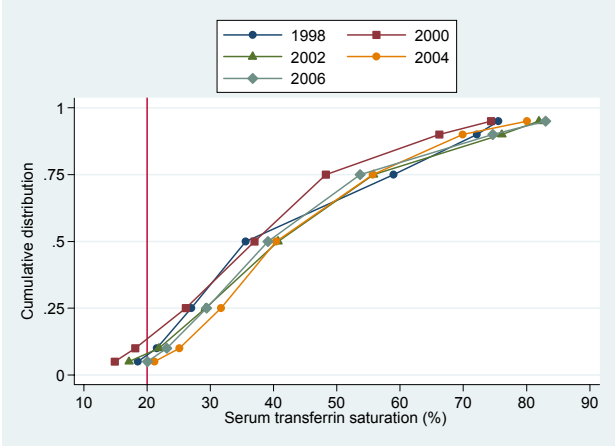



**Table 6.2.8:** Distribution of transferrin saturation on Erythropoietin, CAPD patients 1997 – 2006

| 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 | 460 | 44.6 | 17.8 | 40.4 | 31.7 | 55.7 | 96 |
| 2004 | 697 | 44.7 | 18.7 | 40.8 | 30.8 | 54.5 | 96 |
| 2005 | 820 | 43.5 | 19.3 | 39.1 | 29.4 | 53.7 | 95 |
| 2006 | 916 | 41.7 | 17.5 | 38 | 29.3 | 50.8 | 95 |

From 1997 to 2005, the median for both ferritin and transferrin saturation for all HD centres had increased, except in 2006 when it reduced. There was a wide variation in median ferritin level between HD centres in 2006, ranging from 236 to more than 800 ng /ml. At the median, more than 90% of patients on EPO have serum ferritin levels greater 100 ng/ml and 89% have transferrin saturation greater than 20%. (Table and Figure 6.2.9)

A similar trend, but with higher level of ferritin and transferrin saturation was seen in the CAPD centres. (Table and Figure 6.2.10)

**Table 6.2.9:** Variation in iron status outcomes among HD centres 2006

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 | 291.5 | 414.5 | 495.5 | 623.5 | 792 | 809.3 |
| 1998 | 13 | 205 | 205 | 432 | 468.5 | 560.3 | 722.8 | 722.8 |
| 1999 | 22 | 189.5 | 202 | 355.5 | 419 | 569 | 898.8 | 949.5 |
| 2000 | 41 | 154 | 229 | 387.5 | 548.3 | 683.8 | 813.5 | 1232 |
| 2001 | 52 | 217 | 238.3 | 393.3 | 510.4 | 661.3 | 883.3 | 1191.3 |
| 2002 | 71 | 106.6 | 192 | 364.5 | 475 | 611.6 | 875.3 | 1070.8 |
| 2003 | 98 | 138 | 303.8 | 458.5 | 542.5 | 708.5 | 997 | 1742.8 |
| 2004 | 123 | 112 | 327 | 463.1 | 566 | 735 | 1001.5 | 2000 |
| 2005 | 167 | 1.6 | 249 | 458.3 | 617.5 | 727.5 | 965.8 | 2000 |
| 2006 | 206 | 1.5 | 236 | 417 | 553.6 | 688.8 | 872.6 | 2000 |

**Figure 6.2.9(a):** Variation in median serum ferritin among patients on erythropoietin, HD centres 2006

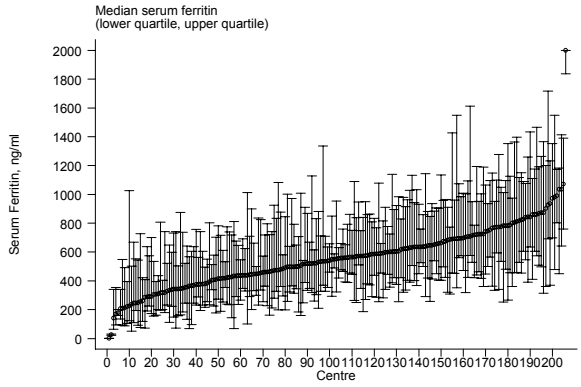
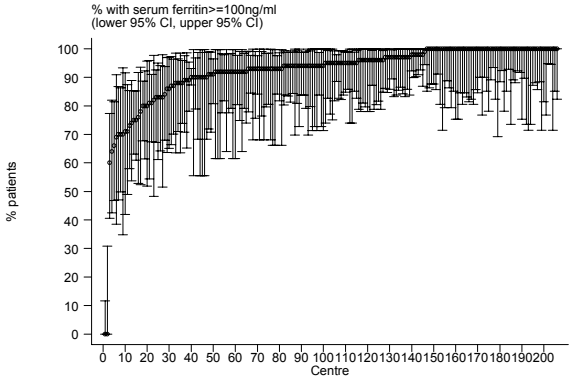



**Figure 6.2.9(b):** Variation in proportion of patients on erythropoietin with serum ferritin ≥100 ng/ml, HD centres 2006




(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 | 73 | 77 | 87 | 91 | 93 | 100 | 100 |
| 1998 | 13 | 75 | 75 | 90 | 91 | 95 | 100 | 100 |
| 1999 | 22 | 73 | 76 | 92 | 96 | 100 | 100 | 100 |
| 2000 | 41 | 70 | 73 | 88 | 94 | 97 | 100 | 100 |
| 2001 | 52 | 71 | 73 | 86.5 | 93 | 97 | 100 | 100 |
| 2002 | 71 | 55 | 73 | 88 | 93 | 97 | 100 | 100 |
| 2003 | 98 | 60 | 75 | 91 | 95 | 100 | 100 | 100 |
| 2004 | 123 | 52 | 84 | 92 | 96 | 100 | 100 | 100 |
| 2005 | 167 | 7 | 79 | 90 | 95 | 100 | 100 | 100 |
| 2006 | 206 | 0 | 71 | 92 | 95 | 100 | 100 | 100 |

(c) Median transferrin saturation among patients on erythropoietin

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 26 | 22.6 | 25.7 | 29.3 | 32 | 37.1 | 68.5 | 69.2 |
| 1998 | 22 | 22.8 | 24.1 | 27.8 | 32.3 | 35.6 | 44.4 | 51.9 |
| 1999 | 26 | 16.4 | 20.7 | 26.9 | 31.8 | 34 | 41.8 | 44.8 |
| 2000 | 42 | 16 | 23.2 | 27.6 | 31.5 | 37.2 | 44.1 | 57.5 |
| 2001 | 54 | 21 | 22.5 | 27.1 | 31.3 | 37 | 48.1 | 76.6 |
| 2002 | 61 | 14.7 | 21 | 25.3 | 29.8 | 36 | 47.5 | 59.7 |
| 2003 | 91 | 19.2 | 24.2 | 30.9 | 34.7 | 41.6 | 57.3 | 70.7 |
| 2004 | 114 | 22.7 | 27.2 | 32.7 | 36.6 | 41.1 | 52.7 | 67.6 |
| 2005 | 150 | 15.2 | 23.6 | 29.1 | 32.1 | 37.1 | 49.5 | 71.7 |
| 2006 | 191 | 14.1 | 23 | 27.5 | 31.6 | 35.7 | 46.6 | 77.2 |

**Figure 6.2.9(c):** Variation in median transferrin saturation among patients on erythropoietin, HD centres 2006

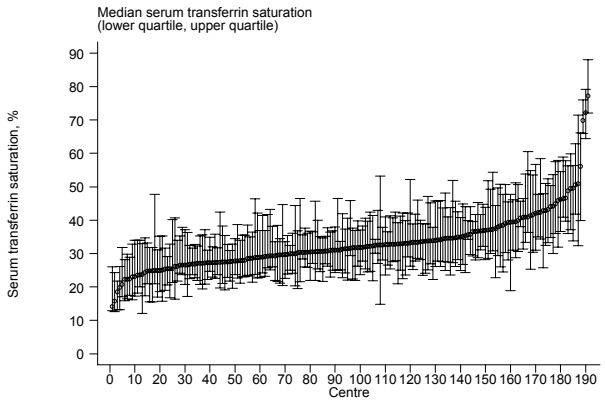
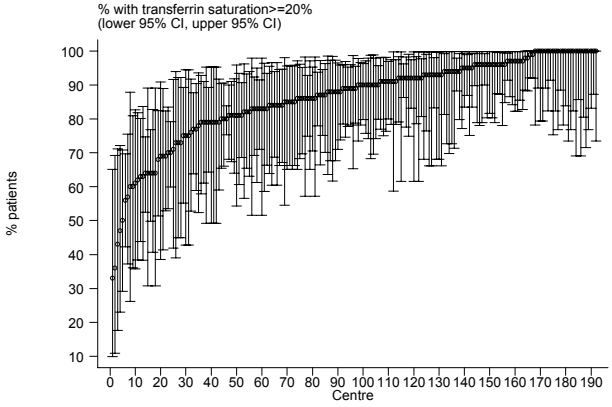



**Figure 6.2.9(d):** Variation in proportion of patients on erythropoietin with transferrin saturation ≥20%, HD centres 2006




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

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 26 | 69 | 75 | 82 | 90 | 93 | 100 | 100 |
| 1998 | 22 | 57 | 64 | 78 | 88 | 97 | 100 | 100 |
| 1999 | 26 | 30 | 57 | 83 | 87 | 94 | 100 | 100 |
| 2000 | 42 | 20 | 60 | 77 | 86 | 94 | 100 | 100 |
| 2001 | 54 | 53 | 59 | 74 | 87.5 | 94 | 100 | 100 |
| 2002 | 61 | 33 | 56 | 70 | 82 | 92 | 100 | 100 |
| 2003 | 91 | 47 | 69 | 85 | 92 | 100 | 100 | 100 |
| 2004 | 114 | 57 | 71 | 91 | 94 | 100 | 100 | 100 |
| 2005 | 151 | 29 | 69 | 83 | 91 | 95 | 100 | 100 |
| 2006 | 192 | 33 | 61 | 81 | 89 | 96 | 100 | 100 |

**Table 6.2.10:** Variation in iron status outcomes among CAPD centres 2006

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 | 418.4 | 418.4 | 468.7 | 534.3 | 606.3 | 663 | 663 |
| 1999 | 5 | 302.8 | 302.8 | 320.4 | 470 | 495.6 | 719.5 | 719.5 |
| 2000 | 6 | 335 | 335 | 437.3 | 653.8 | 745 | 773 | 773 |
| 2001 | 9 | 275.7 | 275.7 | 508 | 581 | 623 | 908 | 908 |
| 2002 | 10 | 372.2 | 372.2 | 437.4 | 475.6 | 618 | 826.5 | 826.5 |
| 2003 | 12 | 307.6 | 307.6 | 441 | 508.5 | 708.3 | 963.6 | 963.6 |
| 2004 | 14 | 312.4 | 312.4 | 518 | 608.3 | 701.3 | 1011 | 1011 |
| 2005 | 18 | 358.1 | 358.1 | 538.2 | 696.5 | 807.9 | 873.8 | 873.8 |
| 2006 | 20 | 371 | 384.1 | 496.9 | 623.8 | 795 | 885.5 | 917.6 |

**Figure 6.2.10(a):** Variation in median serum ferritin among patients on erythropoietin, CAPD centres 2006

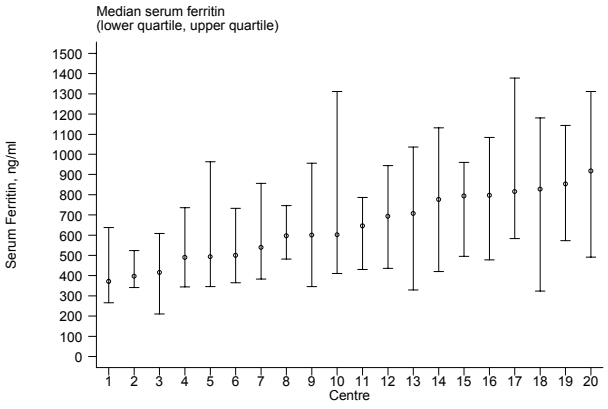
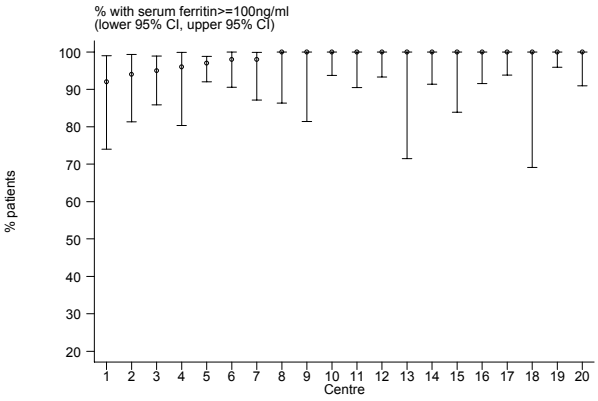



**Figure 6.2.10(b):** Variation in proportion of patients on erythropoietin with serum ferritin ≥100 ng/ml, CAPD centres 2006




(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 | 83 | 83 | 89 | 97.5 | 100 | 100 | 100 |
| 1999 | 5 | 84 | 84 | 92 | 95 | 100 | 100 | 100 |
| 2000 | 6 | 87 | 87 | 88 | 92.5 | 100 | 100 | 100 |
| 2001 | 9 | 80 | 80 | 84 | 95 | 100 | 100 | 100 |
| 2002 | 10 | 91 | 91 | 92 | 95 | 100 | 100 | 100 |
| 2003 | 12 | 86 | 86 | 95.5 | 96 | 98 | 100 | 100 |
| 2004 | 14 | 90 | 90 | 94 | 99.5 | 100 | 100 | 100 |
| 2005 | 18 | 85 | 85 | 94 | 97.5 | 100 | 100 | 100 |
| 2006 | 20 | 92 | 93 | 97.5 | 100 | 100 | 100 | 100 |

(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 | 35.5 | 37 | 41.6 | 46.2 | 46.2 |
| 1999 | 6 | 24 | 24 | 27.2 | 33.6 | 39.4 | 42.4 | 42.4 |
| 2000 | 6 | 23.1 | 23.1 | 26.5 | 36.3 | 37.6 | 52.5 | 52.5 |
| 2001 | 8 | 28.4 | 28.4 | 31.3 | 35.9 | 47.5 | 79.8 | 79.8 |
| 2002 | 9 | 30.5 | 30.5 | 36.5 | 38 | 40.3 | 61 | 61 |
| 2003 | 13 | 31.9 | 31.9 | 35.7 | 41.9 | 47.5 | 64 | 64 |
| 2004 | 17 | 29.1 | 29.1 | 36.1 | 40.8 | 42.8 | 82.3 | 82.3 |
| 2005 | 19 | 31.1 | 31.1 | 35.6 | 38.8 | 46.2 | 74.9 | 74.9 |
| 2006 | 18 | 32.3 | 32.3 | 35.9 | 37.5 | 40.5 | 79.5 | 79.5 |

**Figure 6.2.10(c):** Variation in median transferrin saturation among patients on erythropoietin, CAPD centres 2006

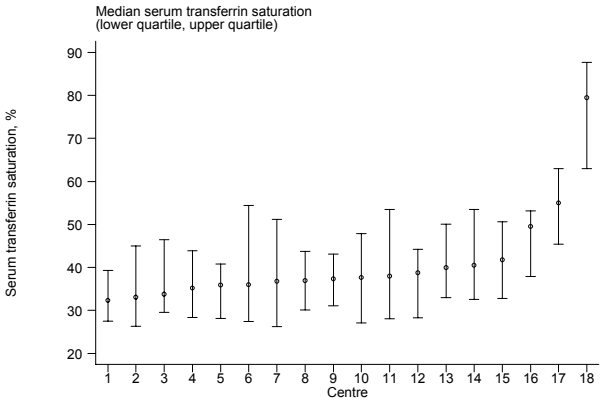
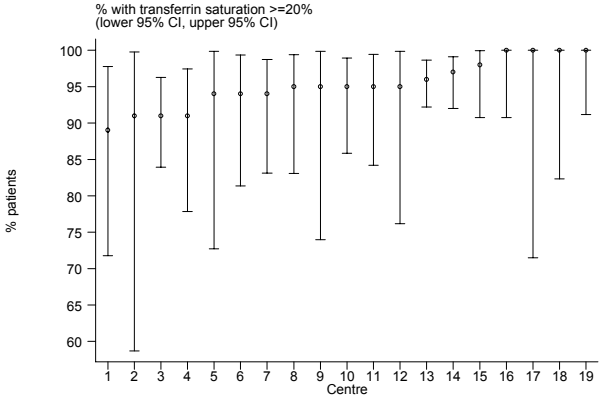



**Figure 6.2.10(d):** Variation in proportion of patients on erythropoietin with transferrin saturation ≥20%, CAPD centres 2006




(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 | 84 | 87.5 | 94 | 100 | 100 |
| 2000 | 6 | 68 | 68 | 74 | 90 | 100 | 100 | 100 |
| 2001 | 8 | 85 | 85 | 92 | 93.5 | 95.5 | 97 | 97 |
| 2002 | 9 | 78 | 78 | 92 | 92 | 98 | 100 | 100 |
| 2003 | 13 | 90 | 90 | 95 | 96 | 100 | 100 | 100 |
| 2004 | 17 | 88 | 88 | 95 | 97 | 100 | 100 | 100 |
| 2005 | 19 | 89 | 89 | 94 | 97 | 100 | 100 | 100 |
| 2006 | 19 | 89 | 89 | 94 | 95 | 98 | 100 | 100 |

## SECTION 6.3: HAEMOGLOBIN OUTCOMES ON DIALYSIS

The mean and median haemoglobin(Hb) concentrations in all dialysis patients with or without EPO were steadily increasing; in 2006 the mean and median haemoglobin ranged from 10 to 10.9g/dl. The percentage of patients with Hb >10 or >11 g/dl was also steadily increasing for patients not on EPO. However the percentage of patients on EPO, with haemoglobin >10 or >11 g /dl were essentially static.

For dialysis patients without EPO the percentage of patients with the Hb >10 g/dl ranged from 59% to 70%; whereas the percentage of patient with Hb >11 gm/dl ranged from 42% to 46%.

For dialysis patients on EPO the percentage of patients with the Hb >10 g/dl was at 50%; whereas the percentage of patient with Hb >11 g/dl was around 27%. (Table and Figure 6.3.1 – 6.3.4)

**Table 6.3.1:** Distribution of Haemoglobin Concentration without Erythropoietin, HD patients 1997 – 2006

| 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 | 1802 | 9.7 | 2.1 | 9.5 | 8.3 | 11 | 60 | 40 | 75 | 25 |
| 2004 | 1927 | 10.1 | 2.2 | 9.9 | 8.6 | 11.5 | 53 | 47 | 68 | 32 |
| 2005 | 1672 | 10.5 | 2.3 | 10.3 | 8.9 | 12.1 | 46 | 54 | 62 | 38 |
| 2006 | 1697 | 10.6 | 2.2 | 10.5 | 9 | 12.1 | 41 | 59 | 58 | 42 |

**Figure 6.3.1:** Cumulative distribution of haemoglobin Concentration without Erythropoietin, HD patients 1997-2006

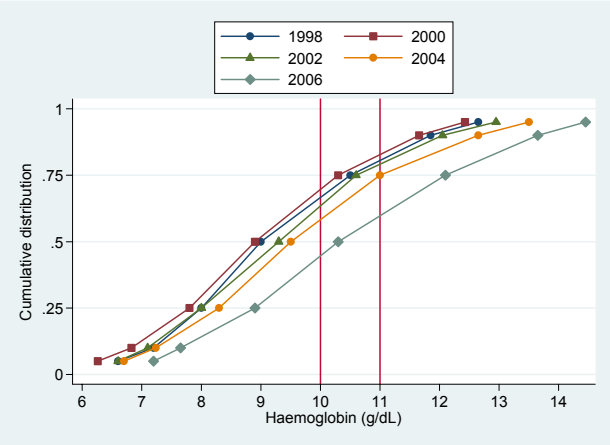



**Figure 6.3.2:** Cumulative distribution of haemoglobin concentration without Erythropoietin, CAPD patients 1997-2006

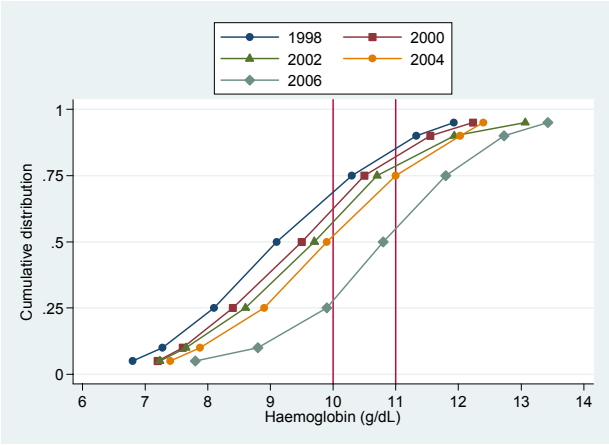



**Table 6.3.2:** Distribution of Haemoglobin Concentration without Erythropoietin, CAPD patients 1997– 2006

| 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 | 542 | 10 | 1.7 | 9.9 | 8.9 | 11 | 52 | 48 | 76 | 24 |
| 2004 | 481 | 10.4 | 1.6 | 10.3 | 9.4 | 11.4 | 42 | 58 | 67 | 33 |
| 2005 | 375 | 10.8 | 1.6 | 10.8 | 9.9 | 11.8 | 28 | 72 | 60 | 40 |
| 2006 | 385 | 10.9 | 1.6 | 10.9 | 10 | 11.8 | 25 | 75 | 54 | 46 |

**Table 6.3.3:** Distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1997 – 2006

| 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 | 2332 | 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 | 4782 | 9.6 | 1.6 | 9.6 | 8.5 | 10.7 | 61 | 39 | 81 | 19 |
| 2004 | 5804 | 9.8 | 1.6 | 9.9 | 8.8 | 10.9 | 54 | 46 | 77 | 23 |
| 2005 | 7213 | 10 | 1.6 | 10 | 8.9 | 11.1 | 50 | 50 | 73 | 27 |
| 2006 | 9311 | 10.1 | 1.6 | 10 | 9 | 11.1 | 50 | 50 | 73 | 27 |

**Figure 6.3.3:** Cumulative distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1997-2006

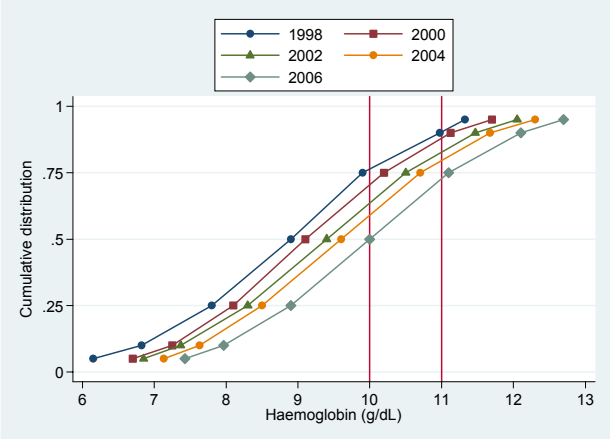



**Figure 6.3.4:** Cumulative distribution of Haemoglobin Concentration on Erythropoietin, CAPD patients 1997-2006

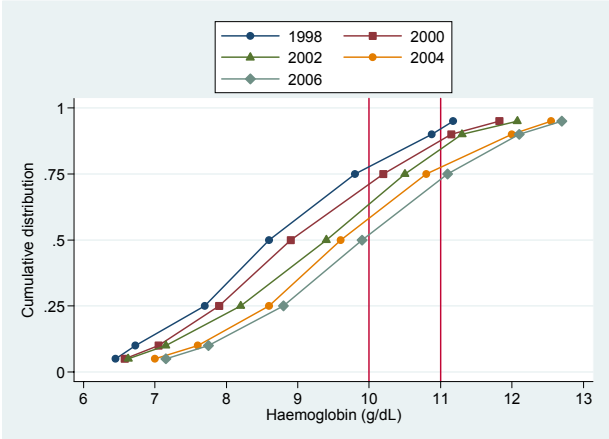



**Table 6.3.4:** Distribution of Haemoglobin Concentration on Erythropoietin, CAPD patients 1997 – 2006

| 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 | 639 | 9.7 | 1.7 | 9.6 | 8.6 | 10.8 | 59 | 41 | 78 | 22 |
| 2004 | 798 | 9.8 | 1.7 | 9.8 | 8.6 | 11 | 54 | 46 | 76 | 24 |
| 2005 | 970 | 9.9 | 1.7 | 9.9 | 8.8 | 11.1 | 53 | 47 | 73 | 27 |
| 2006 | 1119 | 10 | 1.6 | 10.1 | 9 | 11.1 | 50 | 50 | 74 | 26 |

In 2006, for HD patients on EPO, the median Hb in HD centres ranged 7.3 to 12.9 g/dl with the median at 10 g/dl. Similar trend was noted in the CAPD centres with lesser variation.

In 2006 for HD patients on EPO, the proportion of patients with Hb >10 g /dl varied between 0 to 89%, with median at 50%. Similarly for patients with Hb > 11g/dl, the range was from 0 to 80% with the median at 24%. This wide variation was not seen in the CAPD patients.

**Table 6.3.5:** Variation in Haemoglobin outcomes among HD centres 2006
(a) Median haemoglobin level among patients on erythropoietin

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 30 | 7.8 | 7.9 | 8.5 | 8.9 | 9.3 | 10.4 | 10.6 |
| 1998 | 34 | 7.6 | 7.6 | 8.5 | 9 | 9.4 | 10.2 | 10.5 |
| 1999 | 51 | 7.8 | 8.1 | 8.6 | 9 | 9.6 | 10.2 | 10.4 |
| 2000 | 76 | 7.8 | 8.2 | 8.8 | 9.2 | 9.8 | 10.5 | 14.6 |
| 2001 | 92 | 8.1 | 8.4 | 8.9 | 9.5 | 9.9 | 10.6 | 12.2 |
| 2002 | 114 | 8.2 | 8.5 | 9 | 9.4 | 10.1 | 10.8 | 11.4 |
| 2003 | 142 | 7.8 | 8.5 | 9.1 | 9.6 | 10 | 10.7 | 11.6 |
| 2004 | 179 | 7.8 | 8.6 | 9.2 | 9.7 | 10.3 | 11 | 11.2 |
| 2005 | 209 | 8.4 | 8.8 | 9.5 | 10 | 10.5 | 11.2 | 12.2 |
| 2006 | 263 | 7.3 | 8.8 | 9.6 | 10 | 10.5 | 11.2 | 12.9 |

**Figure 6.3.5(a):** Variation in median haemoglobin level among patients on Erythropoietin, HD centres 2006

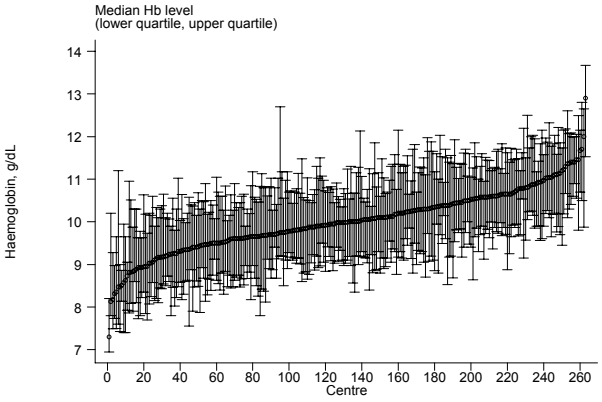
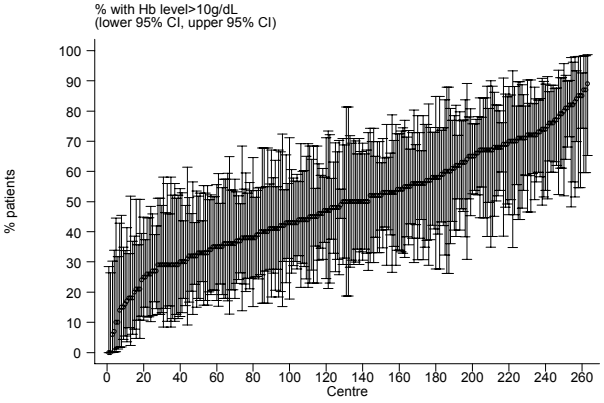



**Figure 6.3.5(b):** Variation in proportion of patients on erythropoietin with haemoglobin level > 10 g/dL, HD centres 2006




(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 | 30 | 0 | 0 | 13 | 21 | 29 | 60 | 82 |
| 1998 | 34 | 0 | 0 | 13 | 27.5 | 38 | 57 | 71 |
| 1999 | 51 | 0 | 5 | 15 | 26 | 38 | 58 | 61 |
| 2000 | 76 | 0 | 5 | 20 | 30.5 | 43.5 | 64 | 97 |
| 2001 | 92 | 5 | 12 | 23.5 | 33 | 46 | 67 | 100 |
| 2002 | 114 | 8 | 15 | 27 | 36 | 50 | 69 | 86 |
| 2003 | 142 | 0 | 12 | 27 | 36 | 50 | 68 | 100 |
| 2004 | 179 | 8 | 17 | 31 | 41 | 58 | 73 | 86 |
| 2005 | 209 | 0 | 20 | 35 | 50 | 63 | 81 | 100 |
| 2006 | 263 | 0 | 18 | 36 | 50 | 65 | 80 | 89 |

(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 | 30 | 0 | 0 | 0 | 7 | 14 | 21 | 33 |
| 1998 | 34 | 0 | 0 | 0 | 7 | 17 | 27 | 38 |
| 1999 | 51 | 0 | 0 | 0 | 8 | 16 | 29 | 39 |
| 2000 | 76 | 0 | 0 | 6.5 | 12.5 | 20 | 31 | 92 |
| 2001 | 92 | 0 | 0 | 8 | 13 | 24.5 | 38 | 60 |
| 2002 | 114 | 0 | 5 | 12 | 18 | 28 | 46 | 71 |
| 2003 | 142 | 0 | 0 | 8 | 15 | 27 | 44 | 61 |
| 2004 | 179 | 0 | 0 | 11 | 19 | 29 | 48 | 56 |
| 2005 | 209 | 0 | 4 | 14 | 24 | 36 | 54 | 75 |
| 2006 | 263 | 0 | 4 | 16 | 24 | 36 | 57 | 80 |

**Figure 6.3.5(c): Variation** in proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, HD centres 2006

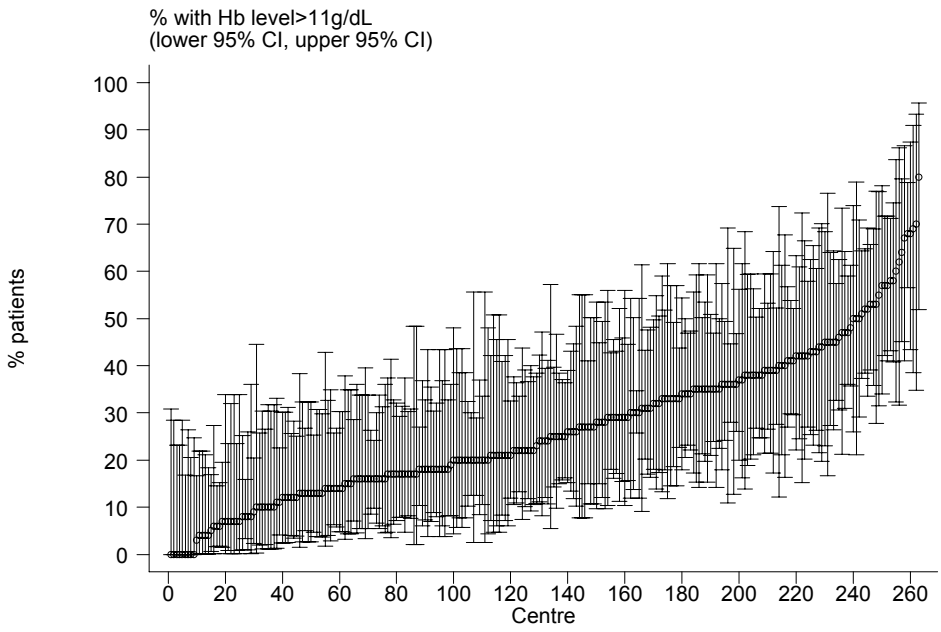


**Table 6.3.6:** Variation in Haemoglobin outcomes among CAPD centres 2006
(a) Median haemoglobin level among patients on erythropoietin

| 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 | 6 | 7.9 | 7.9 | 8.4 | 8.9 | 9.3 | 9.5 | 9.5 |
| 1999 | 7 | 8.1 | 8.1 | 8.4 | 8.7 | 9.3 | 9.5 | 9.5 |
| 2000 | 9 | 8.2 | 8.2 | 8.9 | 9 | 9.3 | 10.3 | 10.3 |
| 2001 | 11 | 8.9 | 8.9 | 9.2 | 9.4 | 9.6 | 9.7 | 9.7 |
| 2002 | 12 | 8.8 | 8.8 | 9.1 | 9.3 | 9.5 | 9.9 | 9.9 |
| 2003 | 16 | 8.4 | 8.4 | 9.3 | 9.5 | 9.9 | 11.2 | 11.2 |
| 2004 | 17 | 8.4 | 8.4 | 9.2 | 9.6 | 10.1 | 11.2 | 11.2 |
| 2005 | 20 | 9 | 9.1 | 9.4 | 9.8 | 10.4 | 11 | 11.1 |
| 2006 | 23 | 8.8 | 9.1 | 9.7 | 10.1 | 10.4 | 10.6 | 11 |

**Figure 6.3.6(a):** Variation in median haemoglobin level among patients on Erythropoietin, CAPD centres 2006

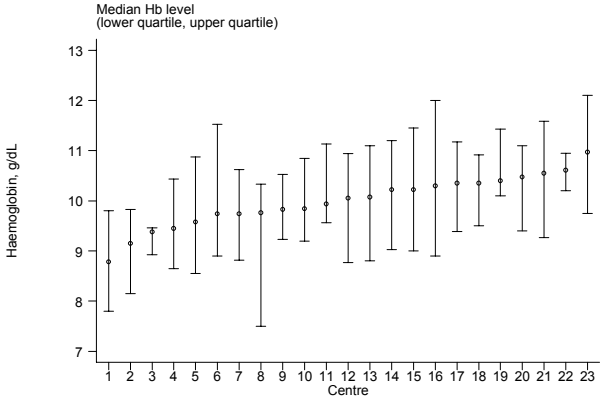
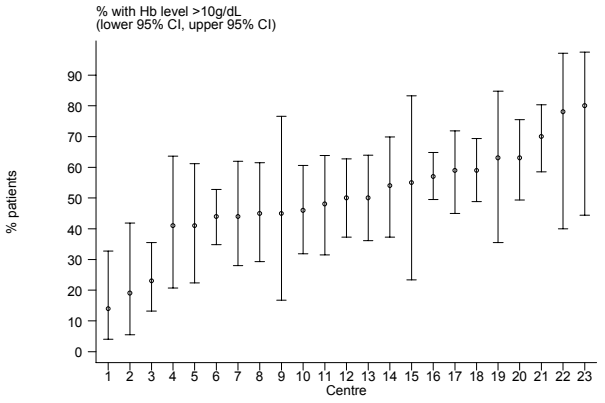



**Figure 6.3.6(b):** Variation in proportion of patients on erythropoietin with haemoglobin level > 10 g/dL, CAPD centres 2006



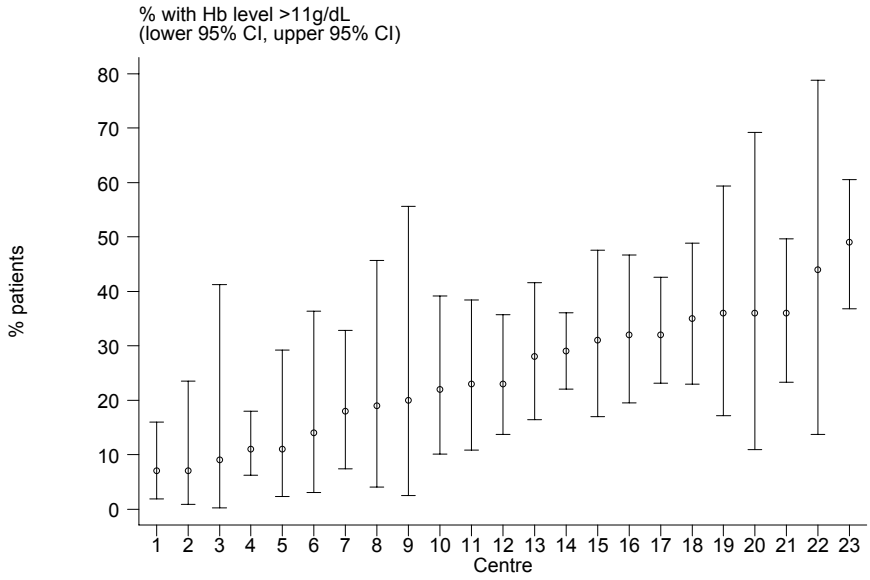

(b) Proportion of patients on erythropoietin with haemoglobin level > 10 g/dL

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 6 | 0 | 0 | 10 | 19 | 31 | 38 | 38 |
| 1998 | 6 | 19 | 19 | 19 | 25.5 | 29 | 40 | 40 |
| 1999 | 7 | 13 | 13 | 20 | 25 | 36 | 40 | 40 |
| 2000 | 9 | 19 | 19 | 30 | 36 | 38 | 55 | 55 |
| 2001 | 11 | 24 | 24 | 31 | 38 | 42 | 47 | 47 |
| 2002 | 12 | 15 | 15 | 25.5 | 31.5 | 36.5 | 48 | 48 |
| 2003 | 16 | 0 | 0 | 27 | 35 | 48.5 | 75 | 75 |
| 2004 | 17 | 13 | 13 | 39 | 44 | 52 | 72 | 72 |
| 2005 | 20 | 21 | 24.5 | 35.5 | 47 | 57.5 | 70 | 76 |
| 2006 | 23 | 14 | 19 | 44 | 50 | 59 | 78 | 80 |

(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 | 6 | 8 | 8 | 8 | 11 | 13 | 16 | 16 |
| 1999 | 7 | 0 | 0 | 8 | 9 | 13 | 16 | 16 |
| 2000 | 9 | 13 | 13 | 17 | 18 | 20 | 24 | 24 |
| 2001 | 11 | 7 | 7 | 10 | 16 | 20 | 23 | 23 |
| 2002 | 12 | 11 | 11 | 13 | 16.5 | 22 | 27 | 27 |
| 2003 | 16 | 0 | 0 | 10.5 | 16.5 | 22.5 | 52 | 52 |
| 2004 | 17 | 0 | 0 | 13 | 19 | 29 | 54 | 54 |
| 2005 | 20 | 7 | 8.5 | 18.5 | 28.5 | 36 | 55.5 | 60 |
| 2006 | 23 | 7 | 7 | 14 | 23 | 35 | 44 | 49 |

**Figure 6.3.6(c):** Variation in proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, CAPD centres 2006



# CHAPTER 7

# Nutritional Status on Dialysis

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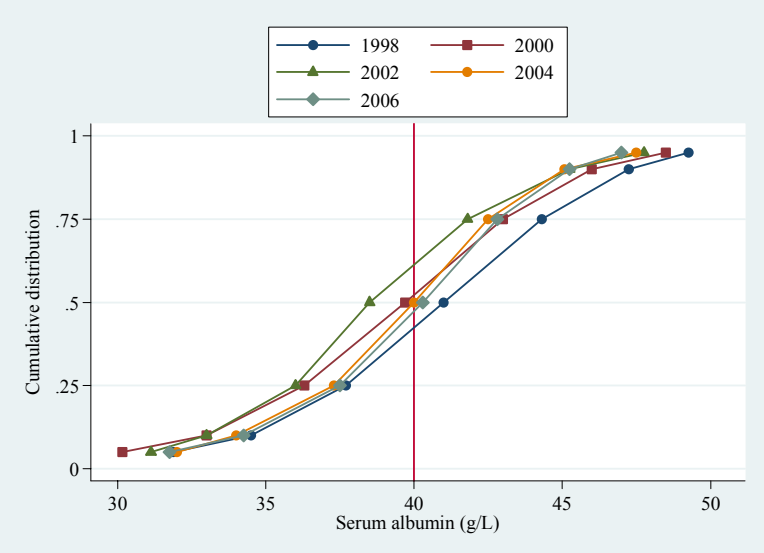
## SECTION 7.1: SERUM ALBUMIN LEVELS ON DIALYSIS

Patient numbers increased by 2057 for HD in 2006. Mean serum albumin levels in 2006 was 39.9 g/L, which is just at the borderline for mortality risk (>40 g/L). However, the overall trend for percentage distribution of patients for serum albumin has remained unchanged since 2003. The percentage of well-nourished patients (serum albumin >40g/L) remained above 50% with the rest of the patients mainly in the 35-40g/L range. Percentage of patients with serum albumin levels <35g/L was only 11-18%.
Improving trends are also shown from the cumulative distribution graph of serum albumin in HD patients for 2006 (Figure 7.1.1).

**Table 7.1.1:** Distribution of serum Albumin, HD patients 1997-2006

| 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 | 3733 | 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 | 6524 | 39.9 | 5.4 | 40 | 37.3 | 42.5 | 3 | 9 | 35 | 52 |
| 2004 | 7581 | 39.9 | 5.3 | 40 | 37 | 42.8 | 3 | 10 | 34 | 53 |
| 2005 | 8706 | 40 | 5.2 | 40.3 | 37.5 | 42.8 | 3 | 9 | 33 | 56 |
| 2006 | 10763 | 39.9 | 5.3 | 40.3 | 37.5 | 42.8 | 3 | 9 | 33 | 54 |

**Figure 7.1.1:** Cumulative distribution of Albumin, HD patients 1997-2006



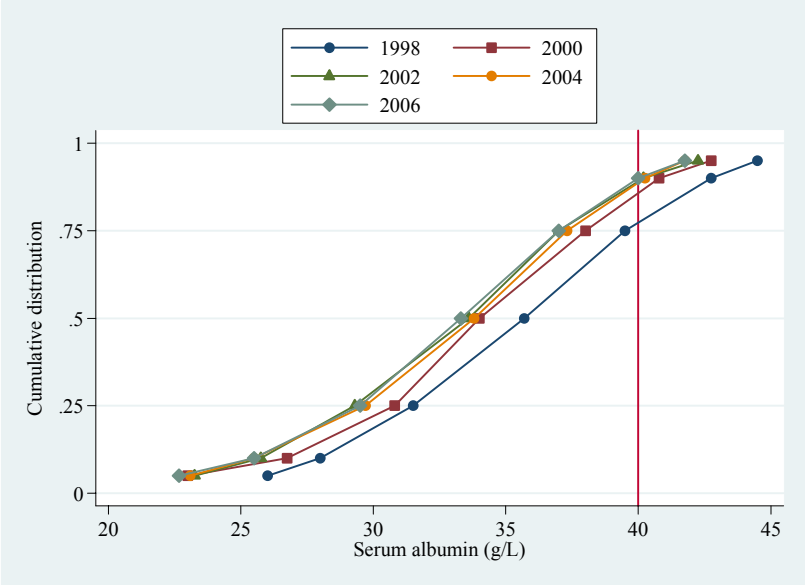
The trend in mean serum albumin levels for patients on CAPD has remained static since 2001 despite initial downward trend noted from 1997-2001. Percentage of patients at increased mortality risk (<35 g/L) also increased initially from 1997 until 2001 (44% in 1997 to 60% by 2001). However the proportion of patients with serum albumin <35g/L has remained static since 2001(56-60%). For the year 2006, mean serum albumin values was 33.5 ± 6.1 g/L. Overall 58% of this population has values less than 35 g/L compared to only 12% at ≥ 40g/L.There was a 2% improvement in the number of patients with serum albumin >40g/L in 2006 compared to 2005. (Table 7.1.2)

The cumulative distribution graph in 2006, reflects the trend that percentage of CAPD patients with serum albumin <35 g/L had remained static since 2002 (Figure 7.1.2). The cumulative distribution of serum Albumin values for 2006 confirms that >50% of the population (of 1497) had level below 35g/L and >75% had level below 40g/L.

**Table 7.1.2:** Distribution of serum Albumin (g/L), CAPD patients 1997-2006

| 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 | 1180 | 33.3 | 5.8 | 33.8 | 29.7 | 37.3 | 26 | 33 | 30 | 11 |
| 2004 | 1284 | 33 | 6 | 33.8 | 29.5 | 37.3 | 27 | 32 | 30 | 11 |
| 2005 | 1346 | 33.2 | 6.4 | 33.3 | 29.5 | 37 | 27 | 33 | 30 | 10 |
| 2006 | 1497 | 33.5 | 6.1 | 33.8 | 30 | 37 | 25 | 33 | 30 | 12 |

**Figure 7.1.2:** Cumulative distribution of Albumin (g/L), CAPD patients 1997-2006



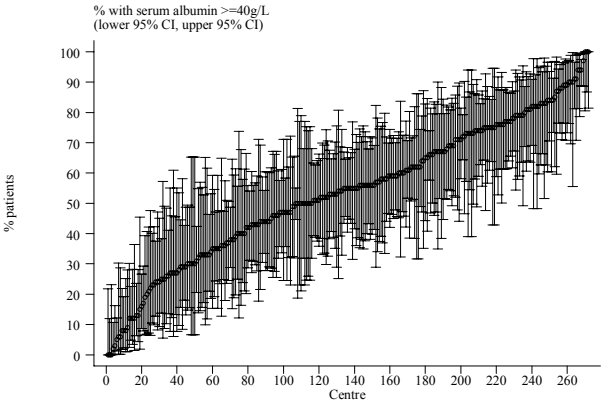
There is a wide variation in the median for HD centres in the proportion of patients with serum albumin ≥40 g/L from 1997-2006. The trend had been encouraging for the past 4 years whereby the median percentages of serum albumin more than 40g/L is above 50%. For the year 2006, the median was 55%.
The best centre had all (100%) patients achieving serum albumin ≥40g/L(target albumin). For all HD centres, a greater than 8-fold variation in meeting the albumin target was observed. (Table 7.1.3)

Figure 7.1.3 indicates the wide variation amongst the 272 HD centers reporting the proportion of patients able to achieve the target serum albumin (≥40g/L) for the year 2006.

**Table 7.1.3:** Variation in Proportion of patients with serum albumin ≥40g/L among HD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 0 | 10 | 32.5 | 61 | 76.5 | 95 | 97 |
| 1998 | 49 | 7 | 15 | 31 | 58 | 80 | 95 | 96 |
| 1999 | 70 | 2 | 8 | 23 | 52 | 65 | 91 | 100 |
| 2000 | 94 | 0 | 8 | 22 | 42.5 | 62 | 82 | 93 |
| 2001 | 116 | 0 | 3 | 17 | 41 | 57 | 82 | 100 |
| 2002 | 142 | 0 | 8 | 26 | 44 | 63 | 86 | 100 |
| 2003 | 166 | 0 | 17 | 39 | 54.5 | 70 | 92 | 100 |
| 2004 | 198 | 0 | 10 | 34 | 57 | 73 | 89 | 100 |
| 2005 | 226 | 4 | 9 | 43 | 56 | 72 | 88 | 100 |
| 2006 | 272 | 0 | 12 | 37 | 55 | 73 | 89 | 100 |

**Figure 7.1.3:** Variation in Proportion of patients with serum albumin ≥40g/L, HD centres 2006



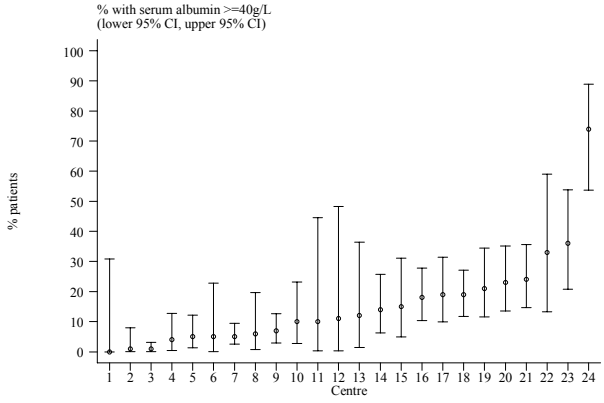

24 CAPD centers participated in2006. The median percentage of centers with serum albumin 40g/L shows a decreasing trend (28% in 1997 to 16% in 2001 and the latest in 2006 was only 11.5%). The median was 11.5 for the year 2006. The maximum proportion of patients achieving the target serum albumin ≥40g/L was 74% whilst majority of centers reported less than 40% of patients achieving this target. For all CAPD centres, greater than 36-fold variation in meeting the albumin target was observed. (Table 7.1.4)

Figure 7.1.4 indicates the wide variation amongst 24 CAPD centres reporting the proportion of patients achieving the target serum albumin ≥40g/L for the year 2006.

**Table 7.1.4:** Variation in Proportion of patients with serum albumin ≥40g/L among CAPD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 5 | 5 | 10 | 28 | 29 | 59 | 59 |
| 1998 | 9 | 3 | 3 | 18 | 27 | 34 | 45 | 45 |
| 1999 | 10 | 2 | 2 | 8 | 14.5 | 18 | 29 | 29 |
| 2000 | 11 | 0 | 0 | 5 | 13 | 28 | 42 | 42 |
| 2001 | 12 | 2 | 2 | 4.5 | 16 | 27 | 36 | 36 |
| 2002 | 15 | 4 | 4 | 7 | 12 | 21 | 36 | 36 |
| 2003 | 19 | 1 | 1 | 9 | 14 | 23 | 55 | 55 |
| 2004 | 19 | 1 | 1 | 8 | 13 | 22 | 34 | 34 |
| 2005 | 21 | 0 | 1 | 6 | 13 | 22 | 27 | 29 |
| 2006 | 24 | 0 | 1 | 5 | 11.5 | 20 | 36 | 74 |

**Figure 7.1.4:** Variation in Proportion of patients with serum albumin ≥40g/L, CAPD centres 2006



## SECTION 7.2: BODY MASS INDEX (BMI) ON DIALYSIS

Table 7.2.1 indicates that overall mean BMI for HD patients from 1997 to 2006 was stabilizing at 23. An improving trend in mean BMI [22.9 in 2000 to 23.3 in 2006] was detected despite a 3-fold increase in patient numbers. The percentage of HD patients with BMI $\geq$ 25 increased from 20% in 1997 to 29% in 2006. This may perhaps reflect an increasing number of overweight diabetic patients coming into dialysis or perhaps an improved dietary intake amongst patients.
For the year 2006 and a HD population of 9495, mean BMI value was 23.3 ± 7.7. Encouragingly, 14% of this group had values less than 18.5 compared to 29% at $\geq$ 25.

Figure 7.2.1 reflects the increasing BMI trends as the curve for 2006 is moving right. About70% of the population (of 9495) were at BMI of 25

**Table 7.2.1:** Distribution of BMI, HD patients 1997-2006

| Year | No of subjects | Mean | SD | Median | LQ | UQ | % patients <18.5 | % patients 18.5-25 | % patients >=25 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1545 | 23.6 | 16.3 | 21.5 | 19.1 | 24.2 | 19 | 61 | 20 |
| 1998 | 1980 | 24.1 | 18.3 | 21.6 | 19.1 | 24.3 | 19 | 60 | 21 |
| 1999 | 2708 | 23.5 | 15.9 | 21.4 | 19.2 | 24.4 | 18 | 61 | 21 |
| 2000 | 3854 | 22.9 | 11.7 | 21.7 | 19.3 | 24.5 | 18 | 60 | 22 |
| 2001 | 4544 | 23 | 11 | 21.9 | 19.3 | 24.7 | 18 | 59 | 23 |
| 2002 | 5090 | 23.2 | 10.6 | 22.1 | 19.5 | 24.9 | 16 | 59 | 24 |
| 2003 | 5971 | 23.1 | 9.7 | 22.1 | 19.5 | 25.1 | 16 | 58 | 26 |
| 2004 | 6749 | 23.3 | 9 | 22.4 | 19.8 | 25.4 | 14 | 58 | 28 |
| 2005 | 7799 | 23.4 | 9 | 22.5 | 19.8 | 25.6 | 14 | 57 | 29 |
| 2006 | 9526 | 23.3 | 7.7 | 22.5 | 19.9 | 25.7 | 14 | 56 | 29 |

**Figure 7.2.1:** Cumulative distribution of BMI, HD patients 1997-2006

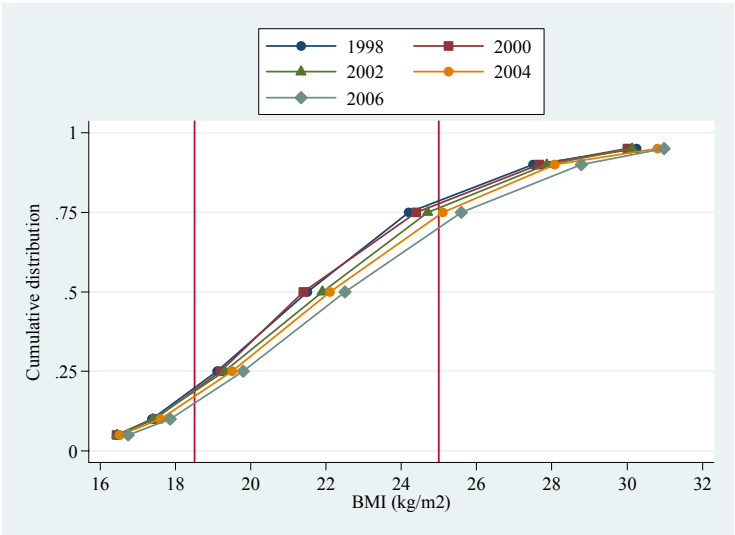


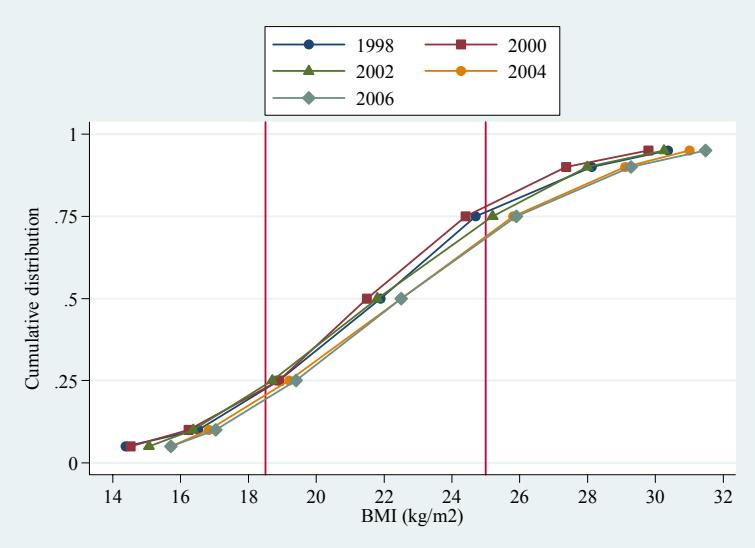
Table 7.2.2. indicates that mean BMI for CAPD patients from 1997 to 2006 was increasing from 22.6 to 23.4 despite a 3-fold increase in patient numbers. The percentage of CAPD patients with BMI ≥ 25 increased from 23% in 1997 to 33% in 2006. Patients with BMI of <18.5 had dropped from 21% in year 1997 to 16% in year 2006.This may perhaps reflect an increased number of overweight diabetic patients coming into dialysis.
For the year 2006 and a CAPD population of 1413 patients, the mean BMI was 23.4 ± 8.2 and only 16% had BMI <18.5.

Figure 7.2.2 reflects increasing BMI trends as the curve for 2006 is moving right. For the year 2006, only about 65% of the population (of 1413) were at a BMI of <25. This figure is lower than 1998 [population =491] and 2000 [population =602] for which >75% of their populations had BMI below 25.

**Table 7.2.2:** Distribution of BMI, CAPD patients 1997-2006

| 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 | 11.1 | 21.3 | 18.7 | 24 | 23 | 57 | 20 |
| 1999 | 552 | 21.7 | 4.5 | 21.5 | 18.9 | 24.4 | 22 | 56 | 22 |
| 2000 | 602 | 21.7 | 4.5 | 21.5 | 18.6 | 24.6 | 25 | 53 | 22 |
| 2001 | 663 | 22.1 | 5 | 21.8 | 18.7 | 25.2 | 23 | 50 | 27 |
| 2002 | 750 | 22.3 | 4.9 | 22.1 | 18.7 | 25.5 | 23 | 47 | 30 |
| 2003 | 1068 | 22.9 | 6.8 | 22.5 | 19.2 | 25.8 | 20 | 50 | 30 |
| 2004 | 1172 | 23.1 | 7.2 | 22.6 | 19.5 | 26 | 18 | 51 | 31 |
| 2005 | 1221 | 23 | 7.1 | 22.5 | 19.4 | 25.9 | 19 | 51 | 30 |
| 2006 | 1413 | 23.4 | 8.2 | 22.6 | 19.7 | 26.1 | 16 | 51 | 33 |

**Figure 7.2.2:** Cumulative distribution of BMI, CAPD patients 1997-2006



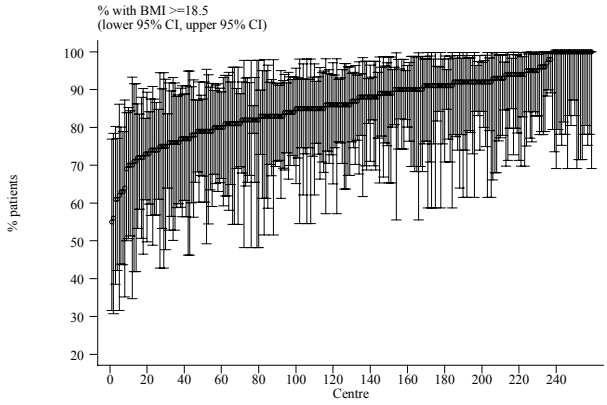
Less variation was observed for BMI measurements amongst 259 HD centers for 2006.
The median of the participating centers achieving BMI of ≥18.5 was 87%. The best centre had all (100%) patients achieving BMI ≥18.5 (target), while the worst centre had 55% of patients achieving this target. For all HD centres, there was a 1.4-fold variation in meeting the target BMI (≥ 18.5). (Table 7.2.3)

Figure 7.2.3 indicates the variation amongst 258 HD centers reporting the proportion of patients achieving the target BMI ( ≥18.5) for the year 2006. The center with the least number of patients of BMI >18.5 recorded a percentage of 55%

**Table 7.2.3:** Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 62 | 64 | 74.5 | 81 | 88 | 100 | 100 |
| 1998 | 48 | 58 | 68 | 75.5 | 81.5 | 86 | 95 | 100 |
| 1999 | 72 | 59 | 67 | 78 | 82 | 90 | 95 | 100 |
| 2000 | 96 | 55 | 67 | 75 | 82 | 89 | 96 | 100 |
| 2001 | 110 | 60 | 68 | 77 | 83 | 89 | 94 | 100 |
| 2002 | 131 | 55 | 67 | 78 | 85 | 90 | 100 | 100 |
| 2003 | 156 | 55 | 69 | 79 | 84 | 91 | 100 | 100 |
| 2004 | 188 | 57 | 68 | 80 | 86 | 91 | 100 | 100 |
| 2005 | 208 | 64 | 70 | 81 | 88 | 93 | 100 | 100 |
| 2006 | 259 | 55 | 71 | 81 | 87 | 92 | 100 | 100 |

**Figure 7.2.3:** Variation in Proportion of patients with BMI ≥18.5, HD centres 2006




There was a stable trend in the proportion of CAPD patients with BMI ≥ 18.5 from 1997 to 2006. For 23 CAPD centers in 2006, the maximum proportion of patients achieving the target BMI(≥ 18.5) was 93% whilst the worst centres reported 30% of the patients achieving this target. This represented a 2.4-fold difference in variation. (Table 7.2.4)

Figure 7.2.4 indicates that only one center reported the lowest proportion of patients achieving the target BMI ≥ 18.5 whilst 18 centers reported higher proportions (>75%).

**Table 7.2.4:** Variation in Proportion of patients with BMI ≥ 18.5 among CAPD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 50 | 50 | 74 | 81 | 88 | 93 | 93 |
| 1998 | 9 | 0 | 0 | 71 | 80 | 89 | 91 | 91 |
| 1999 | 9 | 0 | 0 | 71 | 75 | 83 | 93 | 93 |
| 2000 | 11 | 11 | 11 | 60 | 76 | 88 | 90 | 90 |
| 2001 | 11 | 15 | 15 | 72 | 77 | 88 | 92 | 92 |
| 2002 | 15 | 19 | 19 | 65 | 81 | 85 | 87 | 87 |
| 2003 | 19 | 17 | 17 | 63 | 81 | 88 | 96 | 96 |
| 2004 | 19 | 25 | 25 | 71 | 81 | 89 | 95 | 95 |
| 2005 | 19 | 17 | 17 | 67 | 84 | 88 | 91 | 91 |
| 2006 | 23 | 30 | 38 | 76 | 84 | 91 | 93 | 94 |

**Figure 7.2.4:** Variation in Proportion of patients with BMI ≥18.5, CAPD centres 2006

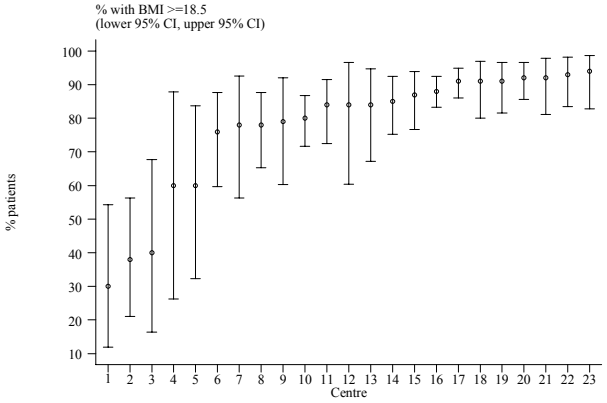


Table 7.2.5 shows that 20 out of 246 HD centres (8.1%) reported patients below BMI of 18.5 and serum albumin of < 30g/L with 7 of these centres (2.8%) at the 95th centile.

Figure 7.2.5 indicates one centre reports 20% of patients falling in this category of severe malnutrition, whilst for 17 of the 20 centres less than 10% of patients were reported in this category

**Table 7.2.5:** Variation in Proportion of patients with BMI ≤ 18.5 and serum albumin ≤ 30 g/dL among HD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 0 | 0 | 0 | 0 | 0 | 4 | 8 |
| 1998 | 48 | 0 | 0 | 0 | 0 | 0.5 | 6 | 8 |
| 1999 | 65 | 0 | 0 | 0 | 0 | 1 | 5 | 10 |
| 2000 | 87 | 0 | 0 | 0 | 0 | 1 | 9 | 28 |
| 2001 | 107 | 0 | 0 | 0 | 0 | 0 | 6 | 10 |
| 2002 | 122 | 0 | 0 | 0 | 0 | 0 | 5 | 13 |
| 2003 | 149 | 0 | 0 | 0 | 0 | 0 | 5 | 10 |
| 2004 | 177 | 0 | 0 | 0 | 0 | 0 | 4 | 9 |
| 2005 | 200 | 0 | 0 | 0 | 0 | 0 | 5.5 | 14 |
| 2006 | 246 | 0 | 0 | 0 | 0 | 0 | 7 | 20 |

**Figure 7.2.5:** Variation in Proportion of patients BMI ≤18.5 and serum albumin ≤ 30 , HD centres 2006

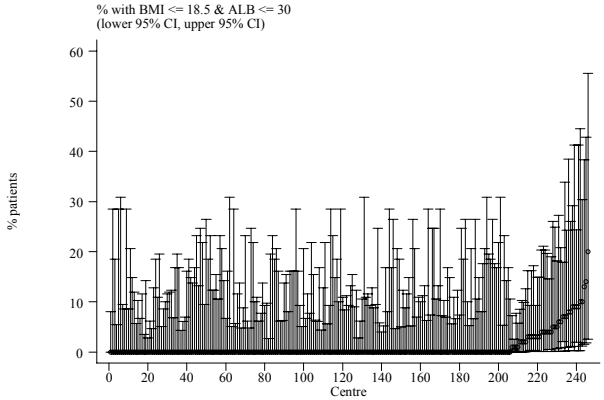


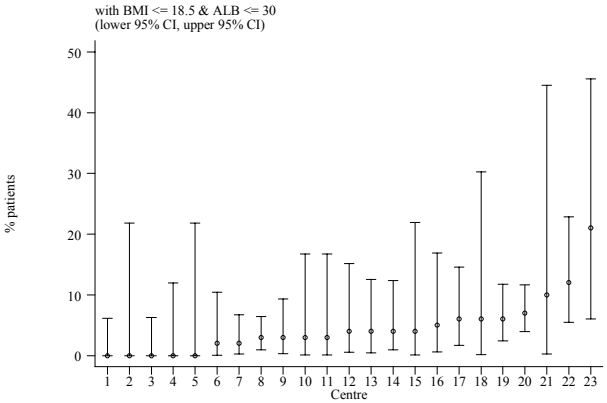

Table 7.2.6 shows that 21 out of 23 CAPD centres (91.3%) reported patients with BMI below 18.5 and serum albumin < 30g/L with 12 of these centres (52.2%) at the 95th centile.

Figure 7.2.6 indicates one centre reported 20% of patients falling in this category of severe of malnutrition, whilst 16 centres reported less than 10% of patients in this category.

**Table 7.2.6:** Variation in Proportion of patients with BMI ≤ 18.5 and serum albumin ≤ 30 g/dL among CAPD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 0 | 0 | 3 | 6 | 7 | 13 | 13 |
| 1998 | 9 | 0 | 0 | 0 | 0 | 3 | 5 | 5 |
| 1999 | 9 | 0 | 0 | 0 | 3 | 6 | 29 | 29 |
| 2000 | 11 | 0 | 0 | 2 | 5 | 10 | 10 | 10 |
| 2001 | 11 | 2 | 2 | 4 | 6 | 9 | 15 | 15 |
| 2002 | 15 | 0 | 0 | 0 | 3 | 7 | 20 | 20 |
| 2003 | 19 | 0 | 0 | 0 | 4 | 8 | 25 | 25 |
| 2004 | 19 | 0 | 0 | 0 | 3 | 6 | 10 | 10 |
| 2005 | 19 | 0 | 0 | 3 | 5 | 8 | 12 | 12 |
| 2006 | 23 | 0 | 0 | 2 | 4 | 6 | 12 | 21 |

**Figure 7.2.6:** Variation in Proportion of patients BMI ≤ 18.5 and serum albumin ≤ 30 g/dL, CAPD centres 2006



# CHAPTER 8

# Blood Pressure Control And Dyslipidaemia

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Lee Wan Tin

## SECTION 8.1: BLOOD PRESSURE CONTROL ON DIALYSIS

In 2006, the predialysis systolic blood pressure remains high and there appears a trend towards increasingly poor blood pressure control predialysis. The mean and median predialysis systolic blood pressure was 151.3 and 151 mmHg respectively.

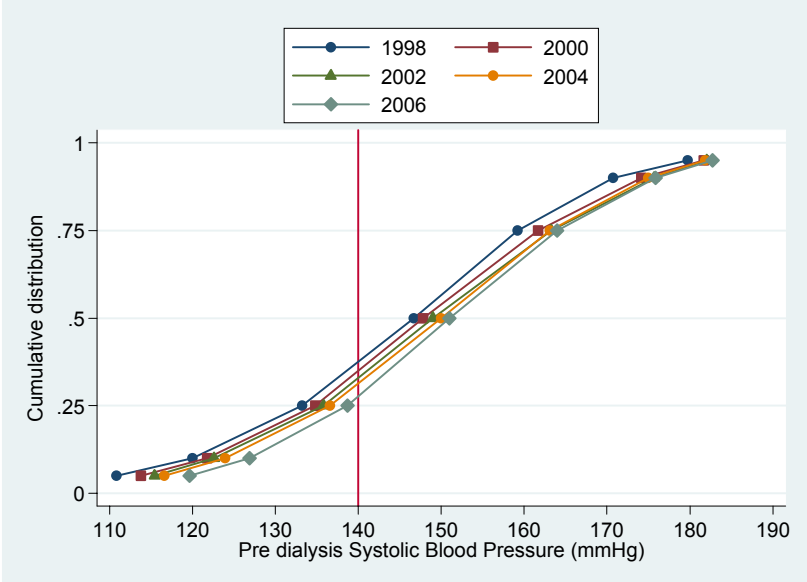
The trend towards an increase in uncontrolled predialysis systolic blood pressure continued in 2006 with the proportion of haemodialysis patients with predialysis systolic BP < 140 mmHg tending lower at 27% compared with 41% a decade ago in 1997. (Table 8.1.1)

This may be a reflection of the increasing numbers of elderly patients coming onto dialysis.

**Table 8.1.1:** Distribution of Pre dialysis Systolic Blood Pressure (mmHg), HD patients 1997-2006

| 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 | 6834 | 149.7 | 20.2 | 149.8 | 136.4 | 162.9 | 7 | 24 | 39 | 23 | 7 |
| 2004 | 7937 | 149.7 | 20 | 150 | 136.6 | 163.1 | 7 | 23 | 39 | 25 | 6 |
| 2005 | 9221 | 149.9 | 19.4 | 149.6 | 137 | 162.8 | 6 | 24 | 40 | 24 | 6 |
| 2006 | 11346 | 151.3 | 19.3 | 151 | 138.7 | 164 | 5 | 22 | 41 | 25 | 7 |

**Figure 8.1.1:** Cumulative distribution of Pre dialysis Systolic Blood Pressure (mmHg), HD patients 1997-2006



In contrast, predialysis systolic blood pressure was better controlled in CAPD patients in 2006, with 54% of CAPD patients having a predialysis systolic BP <140 mmHg (Table 8.1.2). This is better than 47% in 2004 and 51% in 2005.

**Table 8.1.2:** Distribution of Pre dialysis Systolic Blood Pressure (mmHg), CAPD patients 1997-2006

| 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 | 1154 | 140.5 | 20.1 | 140 | 126.7 | 154.1 | 15 | 35 | 32 | 15 | 3 |
| 2004 | 1259 | 141 | 19.8 | 140.9 | 127.4 | 154.5 | 13 | 34 | 36 | 14 | 3 |
| 2005 | 1351 | 140.4 | 20.2 | 139.3 | 127.3 | 153.2 | 13 | 38 | 32 | 14 | 3 |
| 2006 | 1522 | 139.4 | 19.3 | 138.4 | 126.7 | 151.6 | 14 | 40 | 32 | 11 | 2 |

**Figure 8.1.2:** Cumulative distribution of Pre dialysis Systolic Blood Pressure (mmHg), CAPD patients 1997-2006

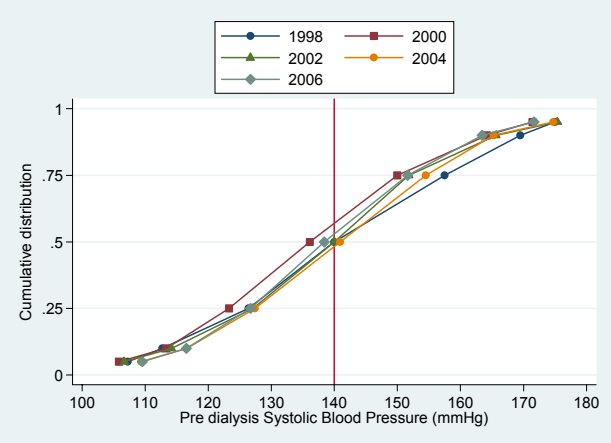
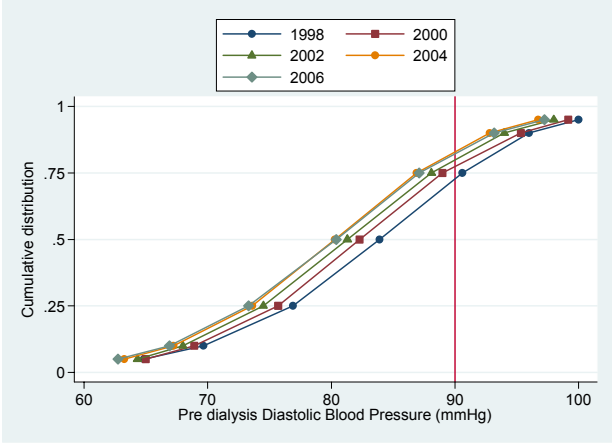



**Figure 8.1.3:** Cumulative distribution of Pre dialysis Diastolic Blood Pressure, HD patients 1997-2005




In comparison with predialysis systolic blood pressure, the predialysis diastolic blood pressure remained well controlled in haemodialysis patients in 2006, with 83% of haemodialysis patients having predialysis diastolic BP < 90 mmHg (Table 8.1.3). This has been stable over the last few years.

**Table 8.1.3:** Distribution of Pre dialysis Diastolic Blood Pressure, HD patients 1997-2006

| 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 | 6832 | 80.6 | 10.2 | 80.8 | 73.9 | 87.2 | 14 | 32 | 37 | 14 | 3 |
| 2004 | 7935 | 80.3 | 10.2 | 80.3 | 73.6 | 86.9 | 15 | 33 | 36 | 14 | 3 |
| 2005 | 9221 | 80.3 | 10.6 | 80.4 | 73.5 | 87 | 15 | 32 | 36 | 14 | 3 |
| 2006 | 11345 | 80.4 | 11 | 80.4 | 73.3 | 87.1 | 16 | 32 | 35 | 14 | 3 |

Similarly, predialysis diastolic blood pressure was also well controlled in CAPD in 2006 with mean and median predialysis diastolic blood pressure at 81.4 mmHg and 81.5 mmHg respectively. 97% of CAPD patients have predialysis diastolic BP < 90 mmHg (Table 8.1.4).

**Table 8.1.4:** Distribution of Pre dialysis Diastolic Blood Pressure (mmHg), CAPD patients 1997-2006

| 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 | 1156 | 82.2 | 10.9 | 82.3 | 75.6 | 89.4 | 12 | 26 | 38 | 19 | 4 |
| 2004 | 1258 | 82.2 | 10.5 | 83 | 75.4 | 89.2 | 11 | 28 | 38 | 18 | 4 |
| 2005 | 1351 | 81.6 | 10.9 | 82.2 | 75 | 88.3 | 12 | 29 | 40 | 15 | 5 |
| 2006 | 1521 | 81.4 | 10.6 | 81.5 | 74.8 | 88 | 13 | 28 | 40 | 15 | 3 |

**Figure 8.1.4:** Cumulative distribution of Pre dialysis Diastolic Blood Pressure (mmHg), CAPD patients 1997-2006

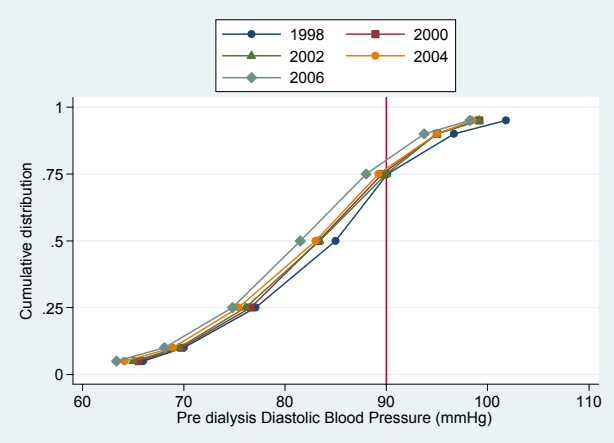
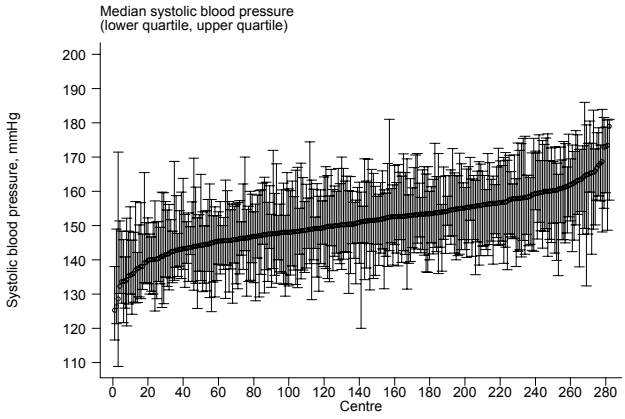



**Figure 8.1.5(a):** Variation in median systolic blood pressure (mmHg) among HD patients, HD centres 2006




The mild variation in median systolic blood pressure among haemodialysis centers was similar to previous year (Table 8.1.5 (a)).

**Table 8.1.5:** Variation in BP control among HD centres 2006

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

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 119.3 | 133.6 | 140.2 | 145.2 | 152.6 | 158 | 163.7 |
| 1998 | 48 | 131.8 | 135 | 141 | 146.3 | 150.9 | 158.7 | 159.2 |
| 1999 | 75 | 134.2 | 137.3 | 142.2 | 148.6 | 154.2 | 163.6 | 167.3 |
| 2000 | 107 | 130.6 | 136.6 | 142.7 | 147.6 | 155.6 | 163.2 | 180 |
| 2001 | 124 | 127.5 | 135.7 | 143 | 148.6 | 154.7 | 161.9 | 173.4 |
| 2002 | 152 | 125 | 137.1 | 143.5 | 149.2 | 154.6 | 163.4 | 170.9 |
| 2003 | 174 | 126.3 | 135.8 | 144.8 | 150.1 | 155.5 | 161.6 | 173.7 |
| 2004 | 204 | 120 | 138.1 | 145 | 150 | 155.2 | 162.5 | 171 |
| 2005 | 235 | 127.5 | 137 | 143.8 | 150.5 | 155.5 | 161 | 169.1 |
| 2006 | 281 | 125.3 | 137.5 | 146 | 151.1 | 156.3 | 163.9 | 179 |

The mild variation in median diastolic blood pressure among haemodialysis centers was also similar to previous years (Table 8.1.5 (b)).

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 | 44 | 76.4 | 80 | 82 | 84.2 | 85.6 | 88 | 93.9 |
| 1998 | 48 | 77.1 | 78.6 | 82 | 83.7 | 85.9 | 88.5 | 90 |
| 1999 | 75 | 70.9 | 77.3 | 81.7 | 83.7 | 86 | 89.4 | 91.8 |
| 2000 | 107 | 75.3 | 76.7 | 80 | 82.3 | 84.7 | 89.3 | 94.4 |
| 2001 | 124 | 73.9 | 76 | 79.8 | 81.9 | 84 | 87.5 | 91.3 |
| 2002 | 152 | 72.6 | 75.5 | 79.2 | 81.3 | 83.6 | 87.3 | 101.4 |
| 2003 | 174 | 72.4 | 74.9 | 78.5 | 80.9 | 83.5 | 86.7 | 97.5 |
| 2004 | 204 | 71.6 | 74 | 78.3 | 80.8 | 83 | 86.8 | 93.4 |
| 2005 | 235 | 67 | 73.1 | 78.1 | 80.8 | 82.8 | 87.1 | 91.8 |
| 2006 | 281 | 67 | 74.4 | 77.6 | 80.8 | 83 | 87.3 | 113.5 |

**Figure 8.1.5(b):** Variation in median diastolic blood pressure (mmHg) among HD patients, HD centres 2006

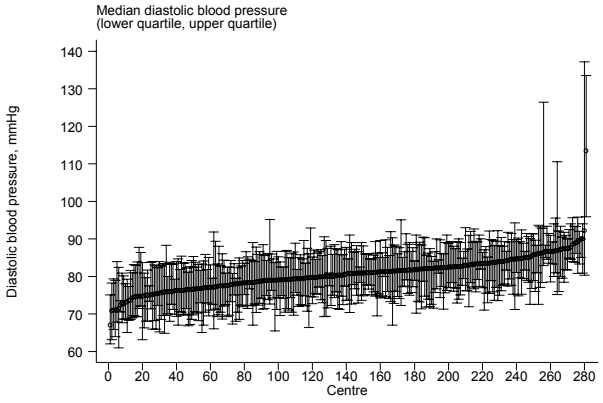
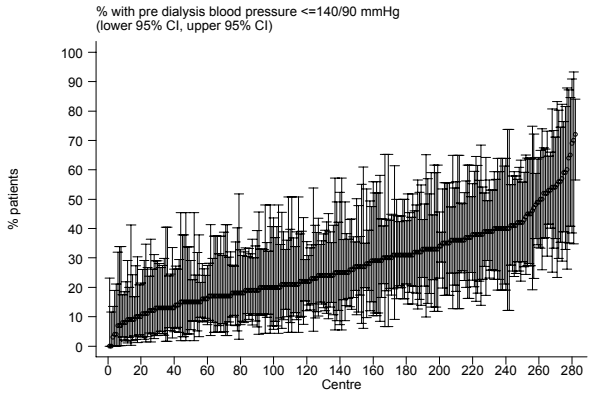



**Figure 8.1.5(c):** Variation in proportion of HD patients with pre dialysis blood pressure ≤ 140/90 mmHg, HD centres 2006




The variation in proportion of haemodialysis patients with predialysis BP < 140/90 mmHg was also similar to previous years (Table 8.1.5 (c)).

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 | 44 | 15 | 17 | 28.5 | 37.5 | 44.5 | 64 | 87 |
| 1998 | 48 | 9 | 20 | 27 | 35 | 42 | 58 | 72 |
| 1999 | 75 | 4 | 11 | 23 | 32 | 41 | 56 | 67 |
| 2000 | 107 | 0 | 13 | 23 | 32 | 43 | 63 | 83 |
| 2001 | 124 | 0 | 11 | 21 | 31 | 43 | 60 | 70 |
| 2002 | 152 | 0 | 10 | 22 | 30 | 41 | 56 | 73 |
| 2003 | 174 | 4 | 11 | 21 | 29 | 38 | 58 | 80 |
| 2004 | 204 | 0 | 10 | 20 | 29 | 37 | 56 | 90 |
| 2005 | 235 | 4 | 10 | 20 | 27 | 40 | 57 | 88 |
| 2006 | 281 | 0 | 9 | 17 | 25 | 36 | 54 | 72 |

Similar to haemodialysis centers, the variation in median predialysis systolic blood pressure was mild and similar to previous years in CAPD centers (Table 8.1.6 (a))

**Table 8.1.6:** Variation in BP control among CAPD centres 2006

(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 | 110.3 | 110.3 | 135 | 138.6 | 141.6 | 147.5 | 147.5 |
| 1999 | 9 | 116.7 | 116.7 | 132.5 | 137.8 | 140 | 152.8 | 152.8 |
| 2000 | 11 | 115.5 | 115.5 | 131.1 | 134.9 | 137.8 | 149.1 | 149.1 |
| 2001 | 11 | 119.6 | 119.6 | 130.7 | 137.5 | 138.8 | 149 | 149 |
| 2002 | 15 | 123.2 | 123.2 | 134.8 | 140 | 144.5 | 148.2 | 148.2 |
| 2003 | 19 | 120.7 | 120.7 | 131.8 | 140.8 | 146.6 | 151.8 | 151.8 |
| 2004 | 19 | 115.9 | 115.9 | 133.3 | 139.5 | 142.5 | 149.7 | 149.7 |
| 2005 | 21 | 109.9 | 116.9 | 134.2 | 136.6 | 138.1 | 147.5 | 158 |
| 2006 | 24 | 110.8 | 116.5 | 130.6 | 136.4 | 141.4 | 146.2 | 155.3 |

**Figure 8.1.6(a):** Variation in median systolic blood pressure (mmHg) among CAPD patients, CAPD centres 2006

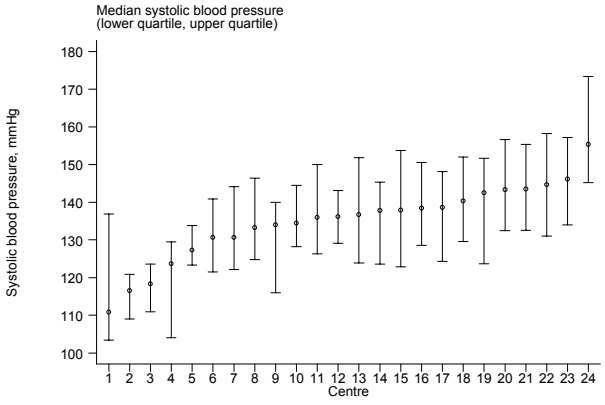
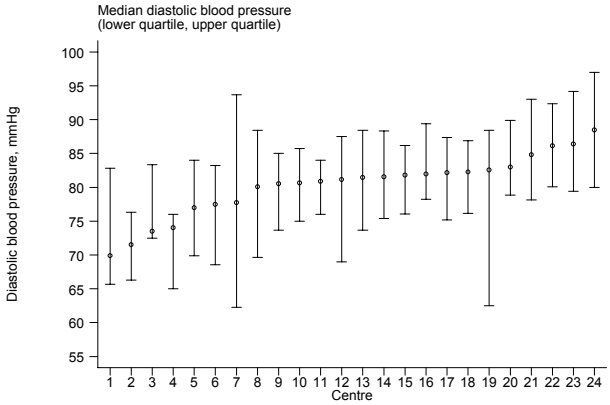



Figure 8.1.6(b): Variation in median diastolic blood pressure (mmHg) among CAPD patients, CAPD centres 2006




The variation in median predialysis diastolic blood pressure was also mild and very similar to previous years (Table 8.1.6 (b)).

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

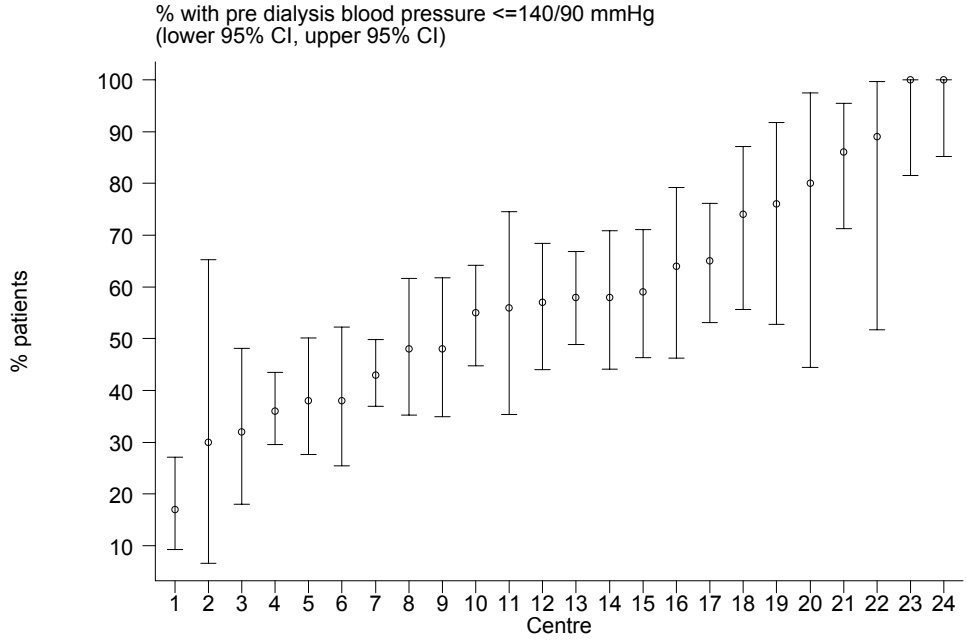
| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 82.5 | 82.5 | 85.3 | 86 | 86 | 88.7 | 88.7 |
| 1998 | 9 | 75 | 75 | 85.2 | 85.5 | 86 | 87 | 87 |
| 1999 | 9 | 77.5 | 77.5 | 82.3 | 84.5 | 85 | 86.7 | 86.7 |
| 2000 | 11 | 73.3 | 73.3 | 80 | 83 | 84.4 | 88 | 88 |
| 2001 | 11 | 79 | 79 | 80.9 | 83 | 84.7 | 88 | 88 |
| 2002 | 15 | 76.8 | 76.8 | 81.8 | 83.3 | 85.5 | 89.5 | 89.5 |
| 2003 | 19 | 73.6 | 73.6 | 81 | 82.9 | 84.4 | 88 | 88 |
| 2004 | 19 | 76 | 76 | 80.6 | 83.1 | 84.4 | 87.5 | 87.5 |
| 2005 | 21 | 64.8 | 75.5 | 80 | 82 | 83.8 | 86 | 86.3 |
| 2006 | 24 | 69.9 | 71.5 | 77.6 | 81.3 | 82.4 | 86.1 | 88.5 |

As in previous years, the proportion of CAPD patients with BP < 140/90 mmHg was high suggesting good BP control in CAPD patients. BP control in CAPD was much better than in haemodialysis patients (Table 8.1.6 ( c)).

(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 | 36 | 36 | 44 | 47 | 49 | 100 | 100 |
| 1999 | 9 | 30 | 30 | 41 | 52 | 60 | 100 | 100 |
| 2000 | 11 | 24 | 24 | 53 | 58 | 65 | 91 | 91 |
| 2001 | 11 | 36 | 36 | 46 | 52 | 65 | 84 | 84 |
| 2002 | 15 | 19 | 19 | 33 | 46 | 56 | 92 | 92 |
| 2003 | 19 | 28 | 28 | 38 | 46 | 66 | 91 | 91 |
| 2004 | 19 | 29 | 29 | 40 | 49 | 59 | 82 | 82 |
| 2005 | 21 | 23 | 29 | 45 | 55 | 67 | 94 | 100 |
| 2006 | 24 | 17 | 30 | 40.5 | 57.5 | 75 | 100 | 100 |

**Figure 8.1.6(c):** Variation in proportion of CAPD patients with pre dialysis blood pressure ≤ 140/90 mmHg, CAPD centres 2006



## SECTION 8.2: DYSLIPIDAEMIA IN DIALYSIS PATIENTS

The previous year's trend of improving total cholesterol levels in HD patients continued in 2006, with 76% of HD patients achieving total cholesterol < 5.3 mmol/l (Table 8.2.1).

**Table 8.2.1:** Distribution of serum Cholesterol, HD patients 1997-2006

| 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 | 1871 | 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 | 5806 | 4.8 | 1.1 | 4.8 | 4.1 | 5.5 | 9 | 59 | 21 | 11 |
| 2004 | 6710 | 4.7 | 1.1 | 4.7 | 4 | 5.4 | 11 | 60 | 21 | 8 |
| 2005 | 7906 | 4.7 | 1.1 | 4.6 | 4 | 5.3 | 12 | 61 | 19 | 8 |
| 2006 | 9977 | 4.6 | 1.1 | 4.6 | 3.9 | 5.3 | 14 | 62 | 17 | 7 |

**Figure 8.2.1:** Cumulative distribution of serum Cholesterol, HD patients 1997-2006

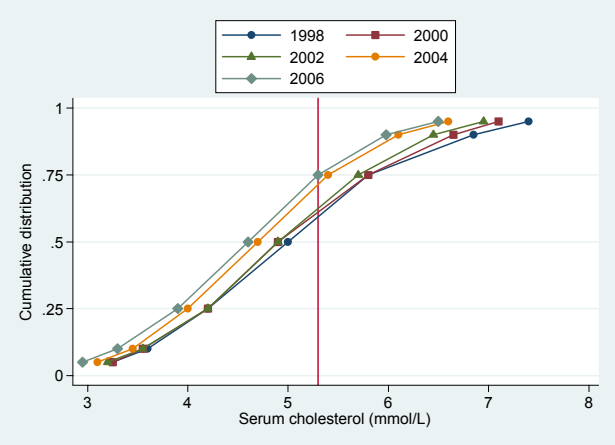
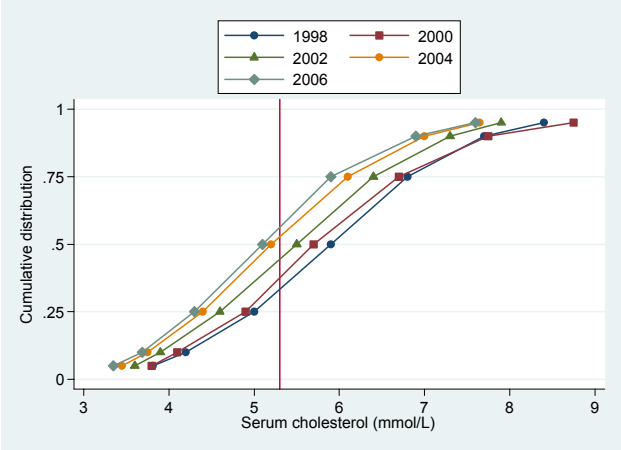



**Figure 8.2.2:** Cumulative distribution of serum Cholesterol, CAPD patients 1997-2006




In 2006, as in previous years, total cholesterol levels in CAPD patients was less optimally controlled in comparison with HD patients, with 57% of CAPD patients achieving total cholesterol < 5.3 mmol/l (Table 8.2.2).

**Table 8.2.2:** Distribution of serum Cholesterol, CAPD patients 1997-2006

| 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 | 1104 | 5.4 | 1.4 | 5.3 | 4.4 | 6.1 | 5 | 45 | 27 | 23 |
| 2004 | 1230 | 5.3 | 1.4 | 5.2 | 4.4 | 6.1 | 5 | 48 | 26 | 21 |
| 2005 | 1242 | 5.2 | 1.3 | 5 | 4.3 | 5.9 | 5 | 55 | 22 | 18 |
| 2006 | 1394 | 5.2 | 1.4 | 5.1 | 4.3 | 5.9 | 6 | 51 | 25 | 18 |

In 2006, serum triglyceride control was better in HD patients than CAPD patients, with 75% of HD patients achieving serum triglyceride levels < 2.3 mmol/l ( Table 8.2.3) compared to 69% of CAPD patients achieving serum triglyceride level <2.3 mmol/l (Table 8.2.4). This trend of better control of triglyceride levels in HD patients has been demonstrated in previous years.

**Table 8.2.3:** Distribution of serum Triglyceride, HD patients 1997-2006

| 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 | 1633 | 2.1 | 1.3 | 1.7 | 1.2 | 2.5 | 49 | 21 | 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 | 4710 | 2 | 1.3 | 1.7 | 1.2 | 2.5 | 48 | 23 | 18 | 11 |
| 2004 | 5607 | 2 | 1.2 | 1.7 | 1.2 | 2.4 | 51 | 23 | 17 | 10 |
| 2005 | 6950 | 2 | 1.3 | 1.7 | 1.2 | 2.4 | 50 | 22 | 18 | 10 |
| 2006 | 9377 | 2 | 1.3 | 1.6 | 1.2 | 2.3 | 54 | 21 | 16 | 9 |

**Figure 8.2.3:** Cumulative distribution of serum Triglyceride (mmol/L), HD patients 1997-2006

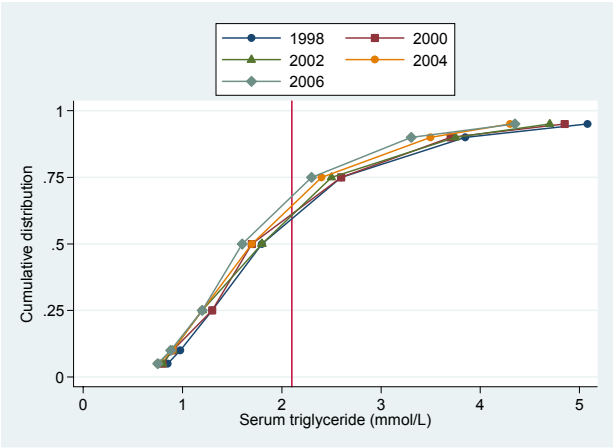



**Figure 8.2.4:** Cumulative distribution of serum Triglyceride, CAPD patients 1997-2006

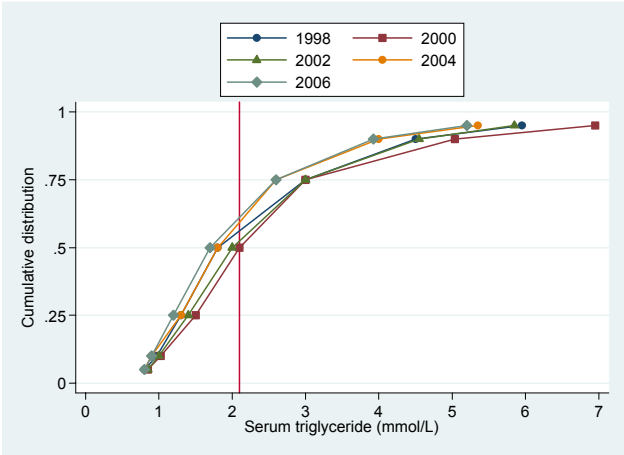



**Table 8.2.4:** Distribution of serum Triglyceride, CAPD patients 1997-2006

| 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 | 1100 | 2.3 | 1.6 | 1.8 | 1.2 | 2.8 | 45 | 20 | 21 | 14 |
| 2004 | 1223 | 2.2 | 1.6 | 1.8 | 1.3 | 2.6 | 47 | 23 | 17 | 13 |
| 2005 | 1241 | 2.2 | 1.5 | 1.8 | 1.3 | 2.7 | 43 | 24 | 18 | 14 |
| 2006 | 1390 | 2.2 | 1.6 | 1.7 | 1.2 | 2.6 | 47 | 22 | 18 | 13 |

The mild variation in median serum cholesterol levels and median serum triglyceride levels among HD centers were similar to previous years (Table 8.2.5 (a) and (c)). It is noted that the median of the proportion of patients with serum cholesterol level < 5.3 mmol/l in HD centers has gradually increased from 56% in 1997 to 75% in 2006 (Table 8.2.5 (b)). The median of the proportion of patients with serum triglyceride level <2.3 mmol/l in HD centers has also gradually increased from 65% in 1997 to 70% in 2006 (Table 8.2.5 (d)).

**Table 8.2.5:** Variation in dyslipidaemia among HD centres 2005
(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 | 30 | 4.2 | 4.4 | 4.7 | 5 | 5.3 | 5.5 | 5.5 |
| 1999 | 47 | 3.5 | 4.2 | 4.6 | 4.8 | 5 | 5.6 | 5.7 |
| 2000 | 77 | 4.2 | 4.3 | 4.7 | 4.9 | 5.2 | 5.5 | 5.9 |
| 2001 | 95 | 4.1 | 4.4 | 4.7 | 5 | 5.2 | 5.6 | 6.3 |
| 2002 | 124 | 4.4 | 4.5 | 4.7 | 4.9 | 5.1 | 5.4 | 6 |
| 2003 | 150 | 4.2 | 4.3 | 4.6 | 4.8 | 5 | 5.3 | 5.8 |
| 2004 | 179 | 3.7 | 4.1 | 4.5 | 4.7 | 4.9 | 5.3 | 6.2 |
| 2005 | 209 | 3.8 | 4.2 | 4.4 | 4.6 | 4.8 | 5.2 | 5.6 |
| 2006 | 253 | 3.5 | 4 | 4.3 | 4.6 | 4.8 | 5.2 | 5.6 |

**Figure 8.2.5(a):** Variation in median serum cholesterol level among HD patients, HD centres 2006

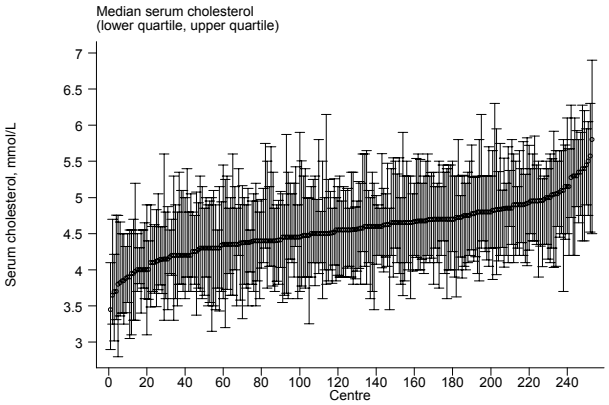
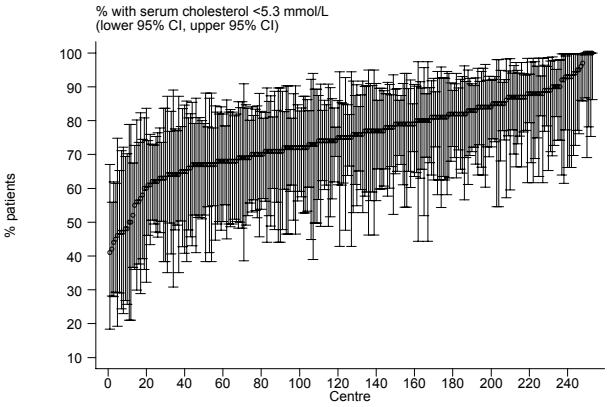



**Figure 8.2.5(b):** Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, HD centres 2006




(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 | 32 | 35 | 49 | 56 | 65 | 81 | 92 |
| 1998 | 30 | 30 | 30 | 51 | 62 | 68 | 86 | 90 |
| 1999 | 47 | 38 | 38 | 57 | 64 | 77 | 85 | 89 |
| 2000 | 77 | 27 | 36 | 52 | 61 | 68 | 86 | 94 |
| 2001 | 95 | 14 | 36 | 53 | 60 | 68 | 79 | 83 |
| 2002 | 124 | 32 | 47 | 56 | 64 | 71 | 77 | 94 |
| 2003 | 150 | 36 | 46 | 60 | 67.5 | 76 | 84 | 92 |
| 2004 | 179 | 36 | 47 | 63 | 71 | 78 | 90 | 94 |
| 2005 | 209 | 29 | 53 | 65 | 74 | 81 | 89 | 100 |
| 2006 | 253 | 41 | 52 | 68 | 75 | 83 | 93 | 100 |

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 | 28 | 1.4 | 1.5 | 1.7 | 1.8 | 2 | 2.1 | 2.3 |
| 1999 | 41 | 1.2 | 1.3 | 1.5 | 1.7 | 1.9 | 2.2 | 2.5 |
| 2000 | 60 | 1.2 | 1.4 | 1.5 | 1.8 | 2 | 2.6 | 3 |
| 2001 | 80 | 1.1 | 1.4 | 1.5 | 1.7 | 2 | 2.3 | 2.5 |
| 2002 | 99 | 1.1 | 1.4 | 1.6 | 1.8 | 2 | 2.5 | 3.2 |
| 2003 | 128 | 1.2 | 1.3 | 1.5 | 1.7 | 1.9 | 2.2 | 2.5 |
| 2004 | 157 | 1 | 1.3 | 1.5 | 1.7 | 1.8 | 2.2 | 2.8 |
| 2005 | 187 | 0.9 | 1.3 | 1.5 | 1.7 | 1.9 | 2.2 | 2.6 |
| 2006 | 243 | 0.9 | 1.2 | 1.5 | 1.6 | 1.8 | 2.2 | 2.9 |

**Figure 8.2.5(c):** Variation in median serum triglyceride level among HD patients, HD centres 2006

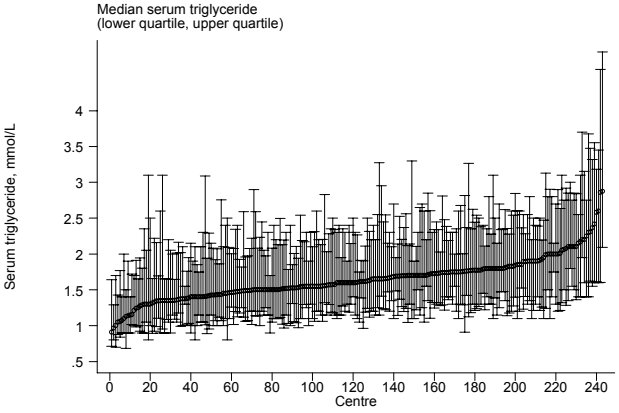



**Figure 8.2.5(d):** Variation in proportion of patients with serum triglyceride < 2.1 mmol/L, HD centres 2006

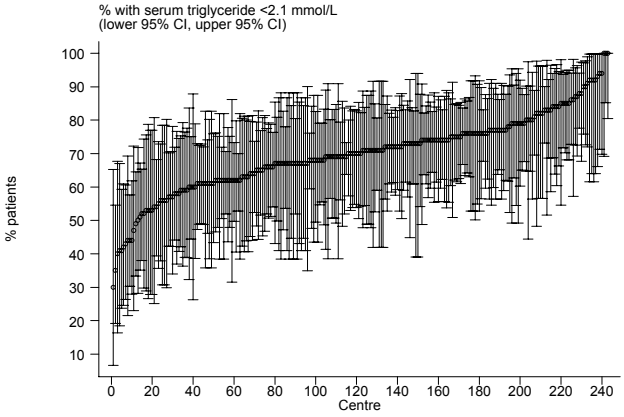



Table 8.2.5(d) Proportion of patients with serum triglyceride < 2.1 mmol/L

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 33 | 23 | 36 | 59 | 65 | 77 | 84 | 87 |
| 1998 | 28 | 44 | 50 | 56.5 | 62.5 | 69.5 | 82 | 82 |
| 1999 | 41 | 36 | 47 | 60 | 67 | 73 | 81 | 91 |
| 2000 | 60 | 23 | 36.5 | 57 | 65.5 | 73.5 | 83 | 85 |
| 2001 | 80 | 38 | 44.5 | 55.5 | 65 | 75 | 83 | 90 |
| 2002 | 99 | 0 | 42 | 54 | 65 | 72 | 81 | 94 |
| 2003 | 128 | 27 | 44 | 56.5 | 67 | 75.5 | 89 | 100 |
| 2004 | 157 | 21 | 47 | 60 | 69 | 78 | 86 | 94 |
| 2005 | 187 | 33 | 45 | 60 | 67 | 73 | 83 | 94 |
| 2006 | 243 | 30 | 50 | 62 | 70 | 76 | 89 | 100 |

In 2006 the variation in median serum cholesterol levels and median serum triglyceride levels among CAPD centers were similar to previous years (Table 8.2.6 (a) and (c)). It is noted that the median of the proportion of patients with cholesterol level < 5.3 mmol/l in CAPD centers has gradually increased markedly from 29% in 1997 to 59% in 2006 (Table 8.2.6 (b)). The median of the proportion of patients with serum triglyceride level 2.3 mmol/l in CAPD centers has also gradually increased from 52% in 1997 to 61.5% in 2006 (Table 8.2.6 (d)).

**Table 8.2.6:** Variation in dyslipidaemia among CAPD centres 2006
(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 | 4.8 | 4.8 | 5.6 | 5.8 | 6.1 | 6.2 | 6.2 |
| 1999 | 8 | 5.1 | 5.1 | 5.4 | 5.7 | 5.8 | 6 | 6 |
| 2000 | 10 | 5.2 | 5.2 | 5.4 | 5.6 | 5.9 | 6.4 | 6.4 |
| 2001 | 10 | 5 | 5 | 5.6 | 5.9 | 6.1 | 6.2 | 6.2 |
| 2002 | 15 | 4.9 | 4.9 | 5.4 | 5.5 | 5.8 | 6.3 | 6.3 |
| 2003 | 19 | 4.5 | 4.5 | 4.9 | 5.3 | 5.8 | 6.1 | 6.1 |
| 2004 | 19 | 4.6 | 4.6 | 4.9 | 5.3 | 5.5 | 6.2 | 6.2 |
| 2005 | 19 | 4.4 | 4.4 | 4.7 | 5 | 5.3 | 6 | 6 |
| 2006 | 23 | 4.2 | 4.5 | 4.8 | 5.1 | 5.4 | 6.1 | 6.2 |

**Figure 8.2.6(a):** Variation in median serum cholesterol level among CAPD patients, CAPD centres 2006

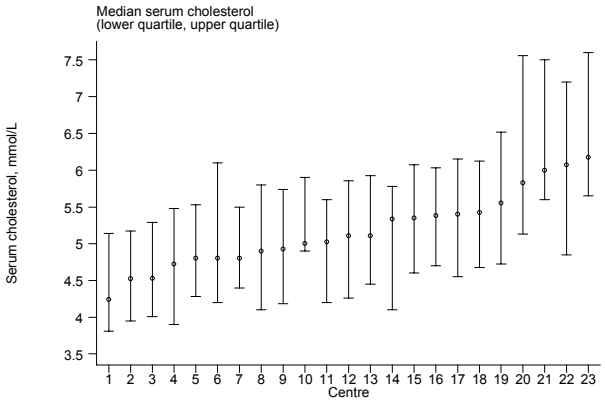



**Figure 8.2.6(b):** Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, CAPD centres 2006

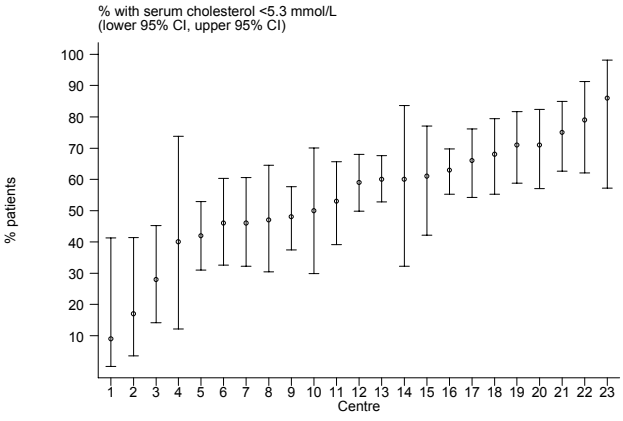



Table 8.2.6(b ) Proportion of patients with serum cholesterol < 5.3 mmol/L

| 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 | 37 | 53 | 53 |
| 1999 | 8 | 10 | 10 | 36.5 | 39.5 | 45 | 56 | 56 |
| 2000 | 10 | 11 | 11 | 18 | 31 | 46 | 54 | 54 |
| 2001 | 10 | 22 | 22 | 30 | 34.5 | 45 | 63 | 63 |
| 2002 | 15 | 16 | 16 | 33 | 42 | 46 | 80 | 80 |
| 2003 | 19 | 8 | 8 | 35 | 47 | 58 | 82 | 82 |
| 2004 | 19 | 9 | 9 | 40 | 50 | 60 | 72 | 72 |
| 2005 | 19 | 28 | 28 | 50 | 60 | 70 | 75 | 75 |
| 2006 | 23 | 9 | 17 | 46 | 59 | 68 | 79 | 86 |

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 | 2.3 | 2.5 | 2.6 | 2.6 |
| 2001 | 10 | 1.5 | 1.5 | 1.9 | 2 | 2.1 | 3 | 3 |
| 2002 | 15 | 1.5 | 1.5 | 1.8 | 1.9 | 2 | 2.4 | 2.4 |
| 2003 | 19 | 1.4 | 1.4 | 1.7 | 1.8 | 2 | 2.3 | 2.3 |
| 2004 | 19 | 1.3 | 1.3 | 1.6 | 1.8 | 1.8 | 2.1 | 2.1 |
| 2005 | 19 | 1.3 | 1.3 | 1.6 | 1.9 | 2 | 2.2 | 2.2 |
| 2006 | 22 | 1.2 | 1.4 | 1.6 | 1.8 | 1.9 | 2.4 | 2.5 |

**Figure 8.2.6(c):** Variation in median serum triglyceride level among CAPD patients, CAPD centres 2006

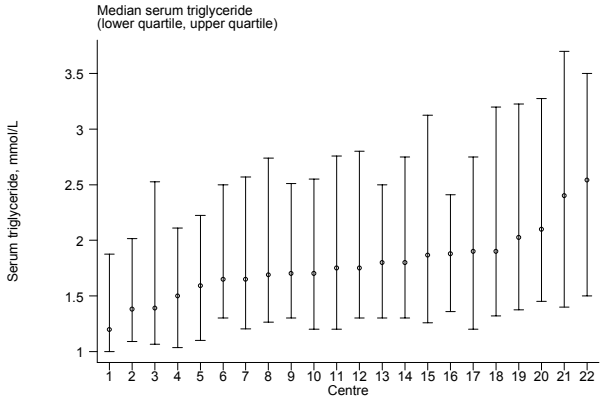



**Figure 8.2.6(d):** Variation in proportion of patients with serum triglyceride < 2.1 mmol/L, CAPD centres 2006

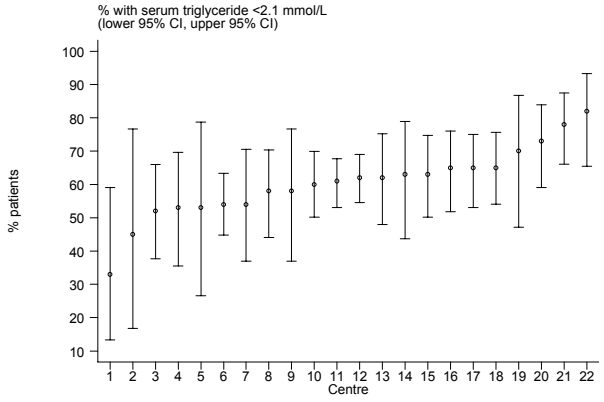



Table 8.2.5(d) Proportion of patients with serum triglyceride < 2.1 mmol/L

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 6 | 40 | 40 | 46 | 52 | 56 | 61 | 61 |
| 1998 | 6 | 51 | 51 | 55 | 61 | 70 | 85 | 85 |
| 1999 | 8 | 37 | 37 | 53.5 | 56 | 60.5 | 64 | 64 |
| 2000 | 10 | 18 | 18 | 42 | 49 | 54 | 62 | 62 |
| 2001 | 10 | 27 | 27 | 50 | 53 | 58 | 68 | 68 |
| 2002 | 15 | 37 | 37 | 52 | 53 | 57 | 78 | 78 |
| 2003 | 19 | 46 | 46 | 54 | 58 | 62 | 91 | 91 |
| 2004 | 19 | 50 | 50 | 60 | 62 | 69 | 89 | 89 |
| 2005 | 19 | 38 | 38 | 53 | 60 | 69 | 89 | 89 |
| 2006 | 22 | 33 | 45 | 54 | 61.5 | 65 | 78 | 82 |

# CHAPTER 9

# Management of Renal Bone Disease in Dialysis Patients

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## SECTION 9.1: TREATMENT OF RENAL BONE DISEASE

In 2006, no major changes were found in the treatment of renal bone disease. Majority of HD patients (92%) and CAPD patients (84%) received calcium carbonate as phosphate binder. From 1997 to 2006, calcium carbonate remained as the main phosphate binder used in both HD and CAPD patients. The percentage of patients on aluminium phosphate binders remained low in both groups of patients. The percentage of patients on Vitamin D therapy was increasing in HD patients since 2001. The number of parathroidectomies done in 2006 was 151 compared to 43 in 2005. The data regarding parathyroidectomies prior to 2005 is not available. (tables 9.1.1 & 9.1.2)

**Table 9.1.1:** Treatment for Renal Bone Disease, HD patients 1997-2006

| 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 | No. of subjects with parathyroid ectomy | % with parathyroid ectomy |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1695 | 1543 | 91 | 417 | 25 | 694 | 41 | NA | NA |
| 1998 | 2141 | 1956 | 91 | 343 | 16 | 652 | 30 | NA | NA |
| 1999 | 2996 | 2693 | 90 | 244 | 8 | 770 | 26 | NA | NA |
| 2000 | 4392 | 3977 | 91 | 239 | 5 | 1084 | 25 | NA | NA |
| 2001 | 5194 | 4810 | 93 | 145 | 3 | 1145 | 22 | NA | NA |
| 2002 | 6108 | 5536 | 91 | 171 | 3 | 1375 | 23 | NA | NA |
| 2003 | 7018 | 6425 | 92 | 118 | 2 | 1690 | 24 | NA | NA |
| 2004 | 8164 | 7408 | 91 | 106 | 1 | 2029 | 25 | NA | NA |
| 2005 | 9351 | 8568 | 92 | 98 | 1 | 2555 | 27 | 43 | 0 |
| 2006 | 11497 | 10600 | 92 | 69 | 1 | 3712 | 32 | 151 | 1 |

NA = not available

**Table 9.1.2:** Treatment for Renal Bone Disease, CAPD patients 1997-2006

| 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 | No. of subjects with parathyroid ectomy done | % with parathyroid ectomy done |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 476 | 393 | 83 | 57 | 12 | 114 | 24 | NA | NA |
| 1998 | 541 | 425 | 79 | 46 | 9 | 110 | 20 | NA | NA |
| 1999 | 610 | 450 | 74 | 36 | 6 | 75 | 12 | NA | NA |
| 2000 | 662 | 522 | 79 | 15 | 2 | 96 | 15 | NA | NA |
| 2001 | 781 | 588 | 75 | 5 | 1 | 84 | 11 | NA | NA |
| 2002 | 891 | 713 | 80 | 6 | 1 | 130 | 15 | NA | NA |
| 2003 | 1231 | 1039 | 84 | 10 | 1 | 238 | 19 | NA | NA |
| 2004 | 1327 | 1124 | 85 | 18 | 1 | 304 | 23 | NA | NA |
| 2005 | 1398 | 1186 | 85 | 13 | 1 | 314 | 22 | 4 | 0 |
| 2006 | 1550 | 1321 | 85 | 7 | 0 | 375 | 24 | 15 | 1 |

NA = not available

## SECTION 9.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level remained at 2.3 mmol/l in HD patients (table 9.2.1 & fig. 9.2.1) and 2.4 mmol/l in CAPD patients (table 9.2.2 & fig 9.2.2). In 2006, 50% of patients on HD and 38% of CAPD patients had achieved the target serum calcium level of 2.1 to 2.37 mmol/l as advocated by K/DOQI guidelines.

**Table 9.2.1:** Distribution of corrected Serum Calcium, HD patients 1997-2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients ≥2.1 & ≤2.37 mmol/L |
|---|---|---|---|---|---|---|---|
| 1997 | 1633 | 2.3 | 0.3 | 2.3 | 2.2 | 2.5 | 40 |
| 1998 | 2060 | 2.3 | 0.3 | 2.3 | 2.2 | 2.5 | 44 |
| 1999 | 2732 | 2.3 | 0.3 | 2.3 | 2.2 | 2.5 | 39 |
| 2000 | 3703 | 2.4 | 0.3 | 2.3 | 2.2 | 2.5 | 42 |
| 2001 | 4618 | 2.4 | 0.2 | 2.4 | 2.2 | 2.5 | 40 |
| 2002 | 5485 | 2.3 | 0.3 | 2.3 | 2.2 | 2.5 | 43 |
| 2003 | 6466 | 2.3 | 0.2 | 2.3 | 2.2 | 2.4 | 46 |
| 2004 | 7536 | 2.3 | 0.2 | 2.3 | 2.2 | 2.4 | 47 |
| 2005 | 8630 | 2.3 | 0.2 | 2.3 | 2.2 | 2.4 | 49 |
| 2006 | 10717 | 2.3 | 0.2 | 2.3 | 2.1 | 2.4 | 50 |

**Figure 9.2.1:** Cumulative distribution of corrected Serum Calcium, HD patients 1997-2006

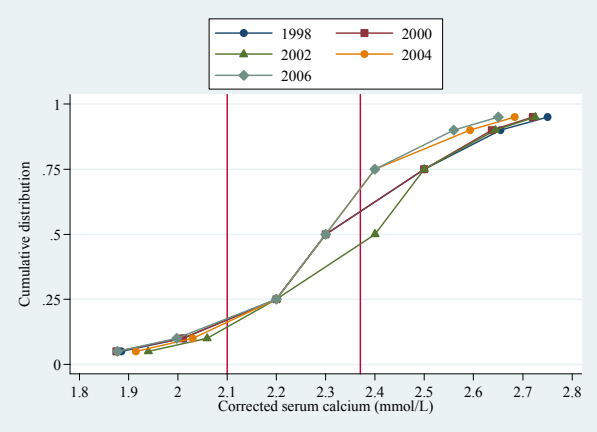



**Figure 9.2.2:** Cumulative distribution of corrected Serum Calcium, CAPD patients 1997-2006

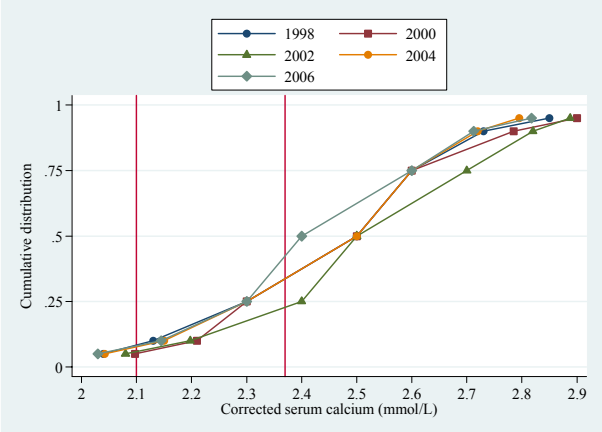



**Table 9.2.2:** Distribution of corrected Serum Calcium, CAPD patients 1997-2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients ≥2.1 & ≤2.37 mmol/L |
|---|---|---|---|---|---|---|---|
| 1997 | 469 | 2.5 | 0.3 | 2.5 | 2.3 | 2.6 | 25 |
| 1998 | 535 | 2.4 | 0.3 | 2.4 | 2.3 | 2.6 | 30 |
| 1999 | 593 | 2.5 | 0.2 | 2.5 | 2.3 | 2.6 | 25 |
| 2000 | 635 | 2.5 | 0.2 | 2.5 | 2.3 | 2.6 | 25 |
| 2001 | 744 | 2.5 | 0.3 | 2.5 | 2.4 | 2.7 | 22 |
| 2002 | 859 | 2.5 | 0.2 | 2.5 | 2.3 | 2.6 | 24 |
| 2003 | 1167 | 2.4 | 0.2 | 2.5 | 2.3 | 2.6 | 27 |
| 2004 | 1276 | 2.5 | 0.2 | 2.5 | 2.3 | 2.6 | 23 |
| 2005 | 1338 | 2.4 | 0.2 | 2.4 | 2.3 | 2.6 | 30 |
| 2006 | 1494 | 2.4 | 0.2 | 2.4 | 2.3 | 2.5 | 38 |

The median serum phosphate levels were higher among HD patients (1.7 mmol/l) compared to CAPD patients (1.6 mmol/l). (tables and figs 9.2.3 & 9.2.4). In 2006, 46 % of patients on HD and 54% of CAPD patients had achieved the target serum phosphate of 1.13 to 1.78 mmol/l as advocated by K/DOQI guidelines.

**Table 9.2.3:** Distribution of Serum Phosphate, HD patients 1997-2006

| Year | No of Subjects | Mean | SD | Median | LQ | UQ | % patients <1.13 mmol/L | % patients ≥1.13 & <1.78 mmol/L | % patients ≥1.78 & ≤2.6 mmol/L | % patients > 2.6 mmol/L |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1649 | 1.9 | 0.5 | 1.9 | 1.6 | 2.3 | 5 | 37 | 48 | 11 |
| 1998 | 2051 | 1.9 | 0.5 | 1.9 | 1.6 | 2.2 | 4 | 35 | 52 | 10 |
| 1999 | 2861 | 1.9 | 0.5 | 1.9 | 1.5 | 2.2 | 7 | 37 | 47 | 9 |
| 2000 | 4080 | 1.9 | 0.6 | 1.8 | 1.5 | 2.2 | 8 | 37 | 46 | 9 |
| 2001 | 4765 | 1.9 | 0.5 | 1.8 | 1.5 | 2.2 | 7 | 40 | 45 | 8 |
| 2002 | 5679 | 1.9 | 0.5 | 1.8 | 1.5 | 2.2 | 7 | 38 | 45 | 10 |
| 2003 | 6588 | 1.8 | 0.5 | 1.8 | 1.5 | 2.2 | 7 | 41 | 43 | 9 |
| 2004 | 7620 | 1.8 | 0.5 | 1.8 | 1.5 | 2.2 | 8 | 42 | 42 | 7 |
| 2005 | 8834 | 1.8 | 0.5 | 1.7 | 1.4 | 2.1 | 9 | 45 | 40 | 6 |
| 2006 | 10963 | 1.8 | 0.5 | 1.7 | 1.4 | 2.1 | 9 | 46 | 39 | 6 |

**Figure 9.2.3:** Cumulative distribution of Serum Phosphate, HD patients 1997-2006

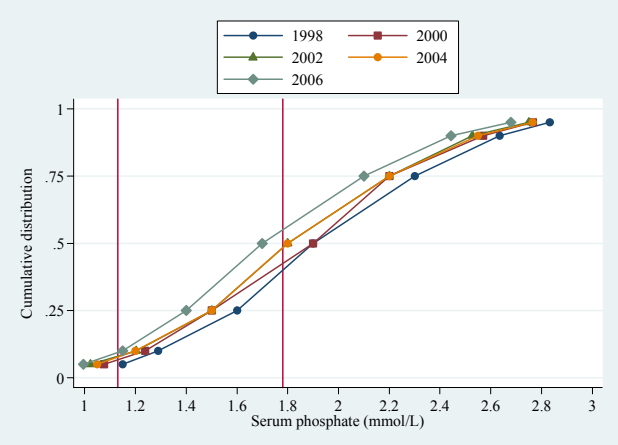



**Figure 9.2.4:** Cumulative distribution of Serum Phosphate, CAPD patients 1997-2006

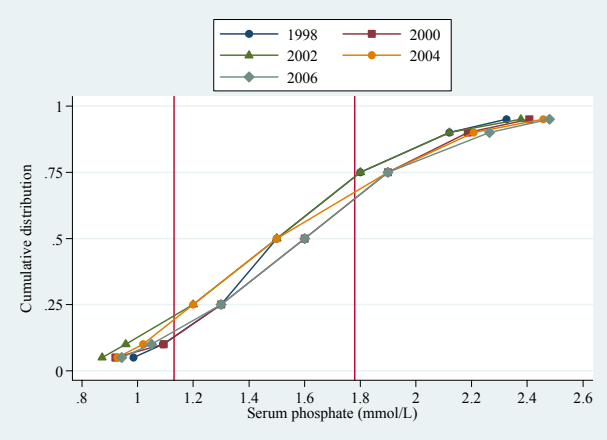



**Table 9.2.4:** Distribution of Serum Phosphate, CAPD patients 1997-2006

| Year | No of Subjects | Mean | SD | Median | LQ | UQ | % patients <1.13 mmol/L | % patients ≥1.13 & <1.78 mmol/L | % patients ≥1.78 & ≤2.6 mmol/L | % patients > 2.6 mmol/L |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 470 | 1.6 | 0.4 | 1.5 | 1.3 | 1.8 | 13 | 58 | 27 | 2 |
| 1998 | 537 | 1.6 | 0.5 | 1.6 | 1.3 | 1.9 | 12 | 55 | 30 | 3 |
| 1999 | 583 | 1.6 | 0.5 | 1.6 | 1.3 | 1.9 | 11 | 56 | 30 | 3 |
| 2000 | 633 | 1.5 | 0.5 | 1.5 | 1.3 | 1.8 | 17 | 55 | 26 | 2 |
| 2001 | 732 | 1.5 | 0.5 | 1.5 | 1.2 | 1.8 | 21 | 53 | 24 | 2 |
| 2002 | 862 | 1.5 | 0.5 | 1.5 | 1.2 | 1.8 | 21 | 52 | 25 | 2 |
| 2003 | 1173 | 1.6 | 0.5 | 1.5 | 1.2 | 1.9 | 16 | 53 | 28 | 3 |
| 2004 | 1278 | 1.6 | 0.5 | 1.6 | 1.3 | 1.9 | 15 | 52 | 29 | 3 |
| 2005 | 1343 | 1.6 | 0.5 | 1.6 | 1.3 | 1.9 | 15 | 52 | 29 | 3 |
| 2006 | 1510 | 1.6 | 0.5 | 1.6 | 1.3 | 1.9 | 13 | 54 | 29 | 4 |

The median corrected calcium phosphate product had declined from 3.9 $mmol^2/L^2$ in 2005 to 3.8 $mmol^2/L^2$ in HD patients and remained at 3.7 $mmol^2/L^2$ in CAPD patients. (tables and figs 9.2.5 & 9.2.6).

**Table 9.2.5:** Distribution of corrected calcium x phosphate product, HD patients 1997-2006

| 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 | 3650 | 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 | 6383 | 4.2 | 1.3 | 4.1 | 3.3 | 5.1 | 30 | 16 | 15 | 13 | 10 | 16 |
| 2004 | 7414 | 4.2 | 1.3 | 4.1 | 3.3 | 5 | 32 | 16 | 15 | 12 | 10 | 15 |
| 2005 | 8496 | 4 | 1.3 | 3.9 | 3.2 | 4.8 | 36 | 17 | 14 | 11 | 9 | 12 |
| 2006 | 10595 | 4 | 1.2 | 3.8 | 3.1 | 4.7 | 38 | 17 | 15 | 11 | 8 | 11 |

**Figure 9.2.5:** Cumulative distribution of corrected Calcium x Phosphate product, HD patients 1997-2006

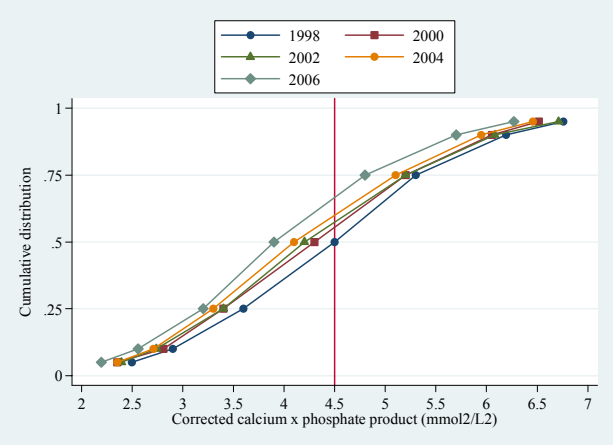



**Figure 9.2.6:** Cumulative distribution of corrected Calcium x Phosphate product, CAPD patients 1997-2006

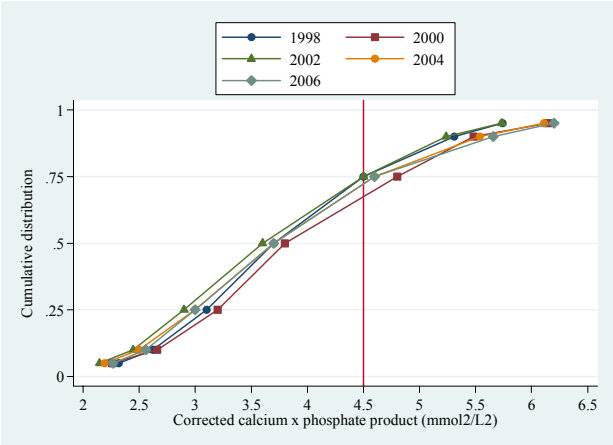



**Table 9.2.6:** Distribution of corrected calcium x phosphate product, CAPD patients 1997-2006

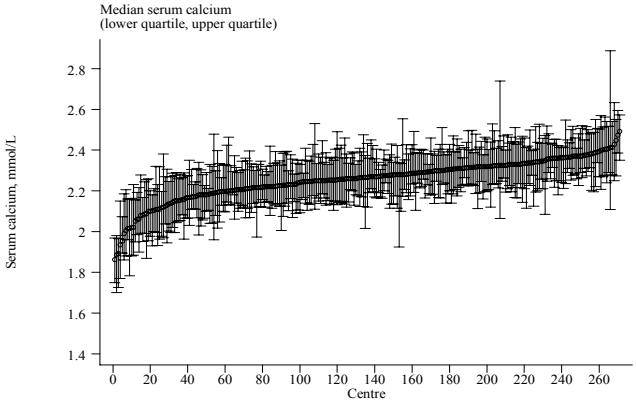
| Year | No of Subjects | Mean | SD | Median | LQ | UQ | % patients <3.5 $mmol^2/L^2$ | % patients ≥3.5 & <4 $mmol^2/L^2$ | % patients ≥4 & <4.5 $mmol^2/L^2$ | % patients ≥4.5 & <5 $mmol^2/L^2$ | % patients ≥5 & <5.5 $mmol^2/L^2$ | % patients ≥5.5 $mmol^2/L^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1162 | 3.9 | 1.2 | 3.7 | 3 | 4.6 | 43 | 17 | 13 | 10 | 8 | 10 |
| 2004 | 1274 | 4 | 1.2 | 3.8 | 3 | 4.7 | 41 | 15 | 14 | 10 | 8 | 12 |
| 2005 | 1333 | 3.9 | 1.3 | 3.7 | 3 | 4.6 | 43 | 15 | 14 | 11 | 6 | 11 |
| 2006 | 1493 | 3.9 | 1.2 | 3.7 | 3.1 | 4.6 | 43 | 17 | 14 | 10 | 7 | 9 |

In 2006, the median corrected serum calcium level among HD patients from 271 centres ranged from 1.9 to 2.5 mmol/l. The median corrected serum calcium level among CAPD patients from 24 centres ranged from 2.2 to 2.6 mmol/ l.(tables 9.2.7a & 9.2.8a).

**Table 9.2.7:** Variation in corrected serum calcium levels among HD centres, 2006
(a) Median serum calcium level among HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 2.1 | 2.2 | 2.3 | 2.3 | 2.4 | 2.5 | 2.5 |
| 1998 | 49 | 2 | 2.1 | 2.3 | 2.3 | 2.4 | 2.5 | 2.5 |
| 1999 | 69 | 1.6 | 2 | 2.3 | 2.3 | 2.4 | 2.5 | 2.6 |
| 2000 | 93 | 2 | 2.1 | 2.3 | 2.3 | 2.4 | 2.6 | 3.2 |
| 2001 | 116 | 2 | 2.1 | 2.3 | 2.4 | 2.4 | 2.5 | 2.6 |
| 2002 | 139 | 1.9 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 |
| 2003 | 164 | 2 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.5 |
| 2004 | 198 | 1.9 | 2.1 | 2.2 | 2.3 | 2.4 | 2.4 | 2.5 |
| 2005 | 222 | 1.8 | 2 | 2.2 | 2.3 | 2.4 | 2.4 | 2.6 |
| 2006 | 271 | 1.9 | 2.1 | 2.2 | 2.3 | 2.3 | 2.4 | 2.5 |

**Figure 9.2.7(a):** Variation in median serum calcium level among HD patients, HD centres 2006




We reviewed the proportion of patients with serum calcium range 2.1 to 2.37 mmol/l. The median was 50% for HD centres (table 9.2.7b) and 47% for CAPD centres (table 9.2.8b) for year 2006. There is great variation between HD centres in the proportion of patients with serum calcium 2.1 to 2.37 mmol/l, ranging from 8% to 88%. The proportion of patients within a centre with serum calcium 2.1 to 2.37 mmol/l among CAPD centres ranges from 0% to 76%.

Table 9.2.7(b) Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 6 | 15 | 29.5 | 42 | 46.5 | 63 | 70 |
| 1998 | 49 | 12 | 21 | 36 | 45 | 53 | 70 | 76 |
| 1999 | 69 | 0 | 10 | 25 | 39 | 46 | 63 | 80 |
| 2000 | 93 | 0 | 13 | 32 | 42 | 48 | 65 | 96 |
| 2001 | 116 | 0 | 12 | 29 | 40 | 50 | 64 | 85 |
| 2002 | 139 | 5 | 17 | 33 | 44 | 54 | 68 | 80 |
| 2003 | 164 | 13 | 24 | 36.5 | 46.5 | 55 | 68 | 83 |
| 2004 | 198 | 7 | 20 | 38 | 47 | 58 | 72 | 82 |
| 2005 | 222 | 0 | 18 | 37 | 49.5 | 57 | 70 | 80 |
| 2006 | 271 | 8 | 30 | 42 | 50 | 60 | 71 | 88 |

**Figure 9.2.7(b):** Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres 2006

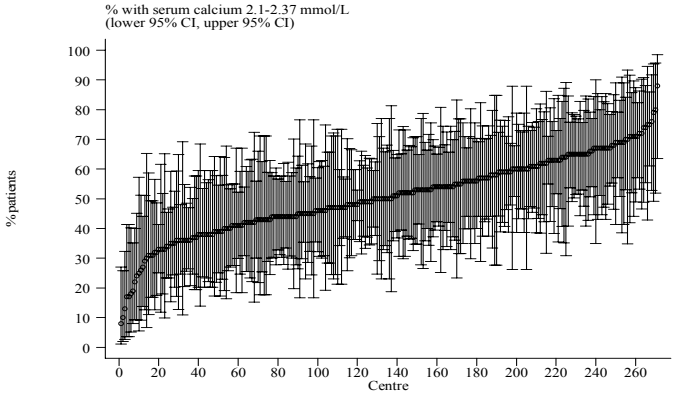


**Table 9.2.8:** Variation in corrected serum calcium levels among CAPD centres, 2006
(a) Median serum calcium level among CAPD patients

| 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 | 2.2 | 2.2 | 2.3 | 2.4 | 2.4 | 2.6 | 2.6 |
| 1999 | 10 | 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 | 15 | 2.4 | 2.4 | 2.4 | 2.4 | 2.5 | 2.6 | 2.6 |
| 2003 | 19 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.6 | 2.6 |
| 2004 | 19 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.5 |
| 2005 | 21 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.6 |
| 2006 | 24 | 2.2 | 2.2 | 2.3 | 2.4 | 2.4 | 2.5 | 2.6 |

**Figure 9.2.8(a):** Variation in median serum calcium level among CAPD patients, CAPD centres 2006

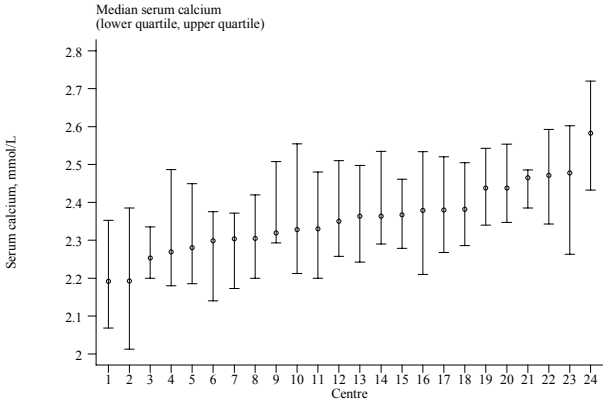
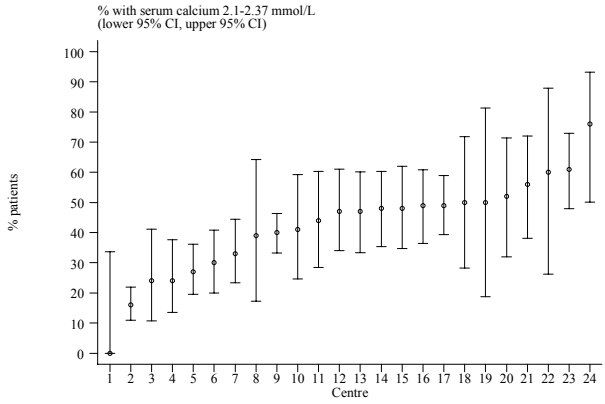



**Figure 9.2.8(b):** Variation in proportion of patients with serum calcium 2.1-2.37 mmol/L, CAPD centres 2006




(b) Proportion of patients with serum calcium 2.1 - 2.37 mmol/L, CAPD centres

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 10 | 10 | 18 | 26 | 29 | 53 | 53 |
| 1998 | 9 | 11 | 11 | 27 | 38 | 40 | 64 | 64 |
| 1999 | 10 | 5 | 5 | 21 | 28 | 31 | 42 | 42 |
| 2000 | 11 | 13 | 13 | 18 | 25 | 33 | 48 | 48 |
| 2001 | 12 | 11 | 11 | 18 | 23.5 | 36 | 38 | 38 |
| 2002 | 15 | 12 | 12 | 20 | 25 | 33 | 46 | 46 |
| 2003 | 19 | 10 | 10 | 19 | 35 | 40 | 64 | 64 |
| 2004 | 19 | 10 | 10 | 18 | 26 | 31 | 50 | 50 |
| 2005 | 21 | 16 | 18 | 24 | 33 | 40 | 45 | 51 |
| 2006 | 24 | 0 | 16 | 31.5 | 47 | 50 | 61 | 76 |

With regards to the proportion of patients with serum phosphate level 1.13-1.78 mmol/L, the CAPD centres have a higher median proportion of patients achieving this target (51.5%) compared with HD centres (46%) (tables 9.2.9a & 9.2.9b).

**Table 9.2.9:** Variation in serum phosphate levels among HD centres, 2006
(a) Median serum phosphate level among HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 1.3 | 1.5 | 1.7 | 1.9 | 2.1 | 2.3 | 2.8 |
| 1998 | 49 | 1.5 | 1.5 | 1.8 | 1.9 | 2.1 | 2.2 | 2.6 |
| 1999 | 70 | 1.1 | 1.6 | 1.8 | 1.9 | 2 | 2.1 | 2.1 |
| 2000 | 100 | 1.4 | 1.6 | 1.7 | 1.8 | 2 | 2.2 | 3.7 |
| 2001 | 116 | 1.3 | 1.5 | 1.7 | 1.8 | 1.9 | 2.1 | 2.3 |
| 2002 | 146 | 1.3 | 1.5 | 1.8 | 1.9 | 2 | 2.2 | 2.4 |
| 2003 | 172 | 0.9 | 1.5 | 1.7 | 1.8 | 1.9 | 2.2 | 2.4 |
| 2004 | 197 | 1.3 | 1.5 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 |
| 2005 | 227 | 0.8 | 1.4 | 1.6 | 1.7 | 1.9 | 2.1 | 2.3 |
| 2006 | 274 | 0.9 | 1.4 | 1.6 | 1.7 | 1.8 | 2.1 | 2.5 |

**Figure 9.2.9 (a):** Variation in median serum phosphate level among HD patients, HD centres 2006

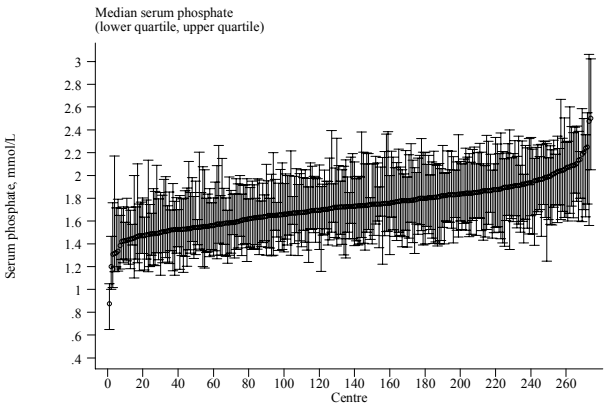
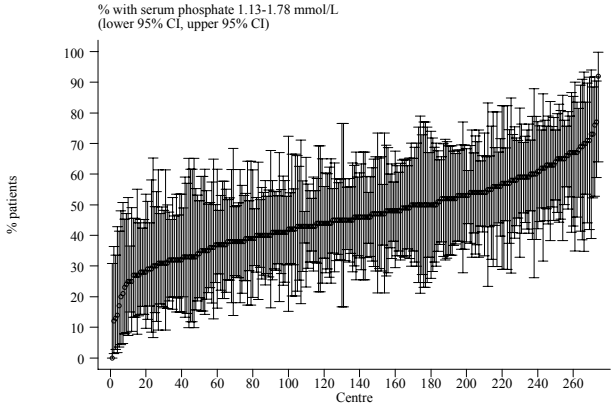



**Figure 9.2.9(b):** Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres 2006




(b) Proportion of patients with serum phosphate 1.13-1.78 mmol/L , HD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 7 | 18 | 27.5 | 37 | 44.5 | 59 | 68 |
| 1998 | 49 | 9 | 17 | 29 | 34 | 44 | 63 | 70 |
| 1999 | 70 | 8 | 17 | 27 | 35 | 44 | 57 | 63 |
| 2000 | 100 | 9 | 18.5 | 29.5 | 37 | 44 | 57.5 | 73 |
| 2001 | 116 | 0 | 21 | 33 | 38 | 47 | 61 | 70 |
| 2002 | 146 | 5 | 14 | 29 | 36 | 46 | 61 | 91 |
| 2003 | 172 | 8 | 19 | 31 | 40 | 48 | 64 | 93 |
| 2004 | 197 | 0 | 19 | 31 | 41 | 53 | 68 | 92 |
| 2005 | 227 | 10 | 24 | 35 | 44 | 53 | 67 | 77 |
| 2006 | 274 | 0 | 27 | 38 | 46 | 54 | 67 | 92 |

**Table 9.2.10:** Variation in serum phosphate levels among CAPD centres, 2006
(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 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.8 | 1.8 |
| 1999 | 9 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 |
| 2000 | 11 | 1.3 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.7 |
| 2001 | 12 | 1.3 | 1.3 | 1.4 | 1.5 | 1.7 | 1.9 | 1.9 |
| 2002 | 15 | 1.4 | 1.4 | 1.4 | 1.5 | 1.6 | 2.1 | 2.1 |
| 2003 | 19 | 1.1 | 1.1 | 1.5 | 1.5 | 1.6 | 1.7 | 1.7 |
| 2004 | 19 | 1.4 | 1.4 | 1.5 | 1.5 | 1.7 | 1.8 | 1.8 |
| 2005 | 21 | 1.4 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 |
| 2006 | 24 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2.1 |

**Figure 9.2.10(a):** Variation in median serum phosphate level among CAPD patients, CAPD centres 2006

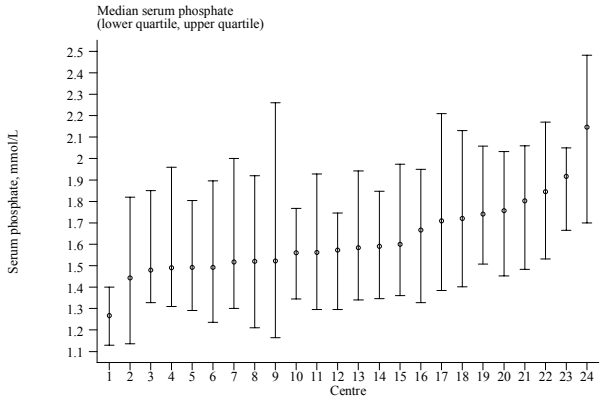
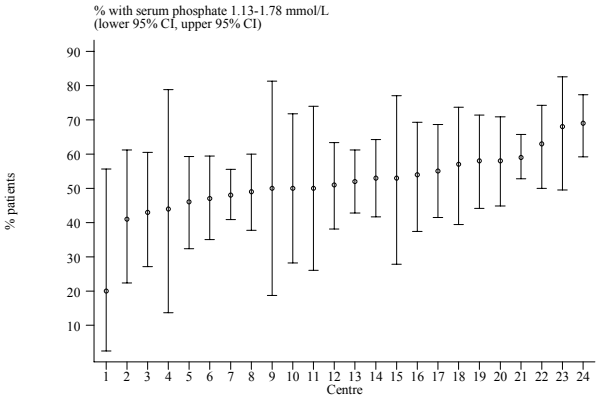



**Figure 9.2.10(b):** Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, CAPD centres 2006




(b) Proportion of patients with serum phosphate 1.13-1.78 mmol/L, CAPD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 53 | 53 | 54 | 58 | 66 | 76 | 76 |
| 1998 | 9 | 43 | 43 | 54 | 60 | 61 | 82 | 82 |
| 1999 | 9 | 45 | 45 | 51 | 58 | 65 | 68 | 68 |
| 2000 | 11 | 46 | 46 | 48 | 53 | 61 | 65 | 65 |
| 2001 | 12 | 40 | 40 | 48.5 | 54 | 58 | 79 | 79 |
| 2002 | 15 | 43 | 43 | 46 | 54 | 60 | 82 | 82 |
| 2003 | 19 | 36 | 36 | 47 | 54 | 60 | 81 | 81 |
| 2004 | 19 | 34 | 34 | 49 | 52 | 64 | 76 | 76 |
| 2005 | 21 | 40 | 43 | 46 | 52 | 58 | 64 | 76 |
| 2006 | 24 | 20 | 41 | 47.5 | 51.5 | 57.5 | 68 | 69 |

A higher number of CAPD centres have median calcium phosphate product of less than 4.5 $mmol^2/L^2$ as compared to HD centres ( 71.5% versus 70%). There is an increasing trend among HD centres achieving a calcium phosphate product of less than 4.5 $mmol^2/L^2$ and the difference between CAPD centres and HD centres is decreasing. (tables and figs 9.2.11 & 9.2.12)

**Table 9.2.11:** Variation in corrected calcium x phosphate product among HD centres, 2006
(a) Median corrected calcium x phosphate product among HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 2.9 | 3.7 | 4.1 | 4.4 | 4.8 | 5.3 | 6.2 |
| 1998 | 49 | 3.2 | 3.3 | 4.1 | 4.5 | 4.7 | 5.3 | 5.3 |
| 1999 | 68 | 2.3 | 3.2 | 4.1 | 4.4 | 4.7 | 5.2 | 5.3 |
| 2000 | 91 | 3.1 | 3.7 | 4 | 4.3 | 4.6 | 5.1 | 6.2 |
| 2001 | 112 | 2.9 | 3.6 | 3.9 | 4.3 | 4.6 | 5 | 5.7 |
| 2002 | 139 | 2.9 | 3.6 | 3.9 | 4.2 | 4.6 | 5.2 | 6.2 |
| 2003 | 164 | 2.1 | 3.4 | 3.8 | 4.1 | 4.5 | 4.9 | 5.7 |
| 2004 | 195 | 2.9 | 3.3 | 3.8 | 4.1 | 4.4 | 5 | 5.5 |
| 2005 | 217 | 2.1 | 3.2 | 3.6 | 3.9 | 4.3 | 4.7 | 5.6 |
| 2006 | 268 | 1.8 | 3.2 | 3.5 | 3.9 | 4.2 | 4.7 | 5.2 |

**Figure 9.2.11(a):** Variation in median corrected calcium x phosphate product among HD patients, HD centres 2006

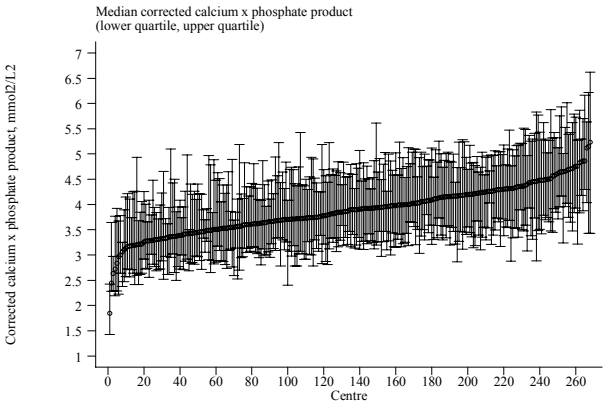
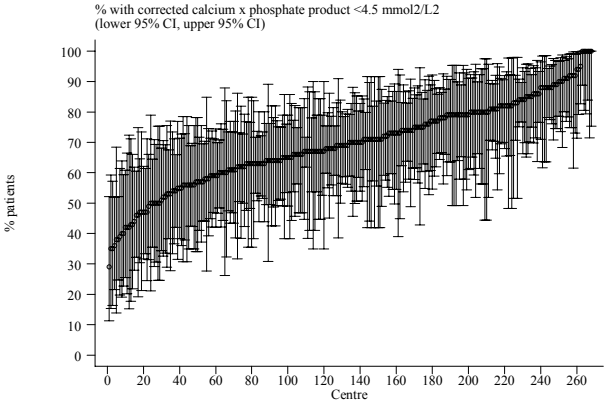



**Figure 9.2.11(b):** Variation in proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, HD centres 2006




(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 | 44 | 15 | 26 | 38.5 | 51.5 | 66 | 77 | 100 |
| 1998 | 49 | 20 | 30 | 40 | 52 | 65 | 83 | 91 |
| 1999 | 68 | 20 | 30 | 47 | 55 | 64 | 90 | 95 |
| 2000 | 91 | 12 | 33 | 47 | 57 | 67 | 80 | 88 |
| 2001 | 112 | 18 | 38 | 47 | 57 | 70.5 | 82 | 91 |
| 2002 | 139 | 14 | 33 | 48 | 57 | 69 | 89 | 100 |
| 2003 | 164 | 25 | 33 | 51.5 | 61.5 | 73 | 88 | 100 |
| 2004 | 195 | 17 | 36 | 53 | 64 | 74 | 91 | 100 |
| 2005 | 217 | 23 | 43 | 58 | 69 | 77 | 90 | 100 |
| 2006 | 268 | 29 | 43 | 61 | 70 | 80 | 91 | 100 |

**Table 9.2.12:** Variation in corrected calcium x phosphate product among CAPD centres, 2006
(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 | 3.4 | 3.4 | 3.6 | 3.7 | 3.9 | 4 | 4 |
| 1999 | 9 | 3.6 | 3.6 | 3.7 | 3.9 | 4.1 | 4.2 | 4.2 |
| 2000 | 11 | 3.4 | 3.4 | 3.5 | 3.7 | 4 | 4.3 | 4.3 |
| 2001 | 12 | 3.1 | 3.1 | 3.4 | 3.7 | 3.8 | 4.3 | 4.3 |
| 2002 | 15 | 3.3 | 3.3 | 3.4 | 3.7 | 4 | 4.9 | 4.9 |
| 2003 | 19 | 2.7 | 2.7 | 3.4 | 3.7 | 4 | 4.1 | 4.1 |
| 2004 | 19 | 3.2 | 3.2 | 3.5 | 3.8 | 4 | 4.4 | 4.4 |
| 2005 | 21 | 3.3 | 3.4 | 3.6 | 3.7 | 4.1 | 4.3 | 4.4 |
| 2006 | 24 | 3 | 3.3 | 3.5 | 3.7 | 4 | 4.4 | 4.8 |

**Figure 9.2.12(a):** Variation in median corrected calcium x phosphate product among CAPD patients, CAPD centres 2006

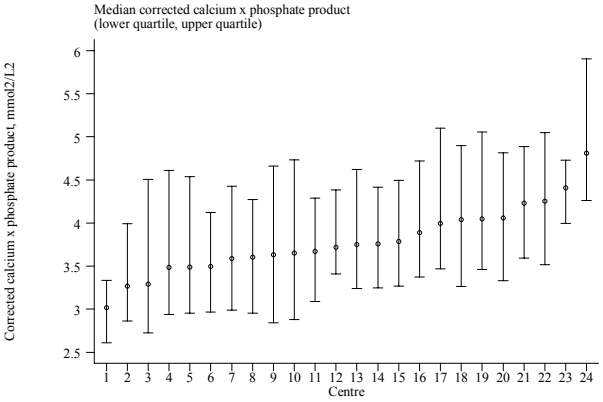



**Figure 9.2.12(b):** Variation in proportion of patients with corrected calcium x phosphate product < 4.5 mmol$^2$/L$^2$, CAPD centres 2006

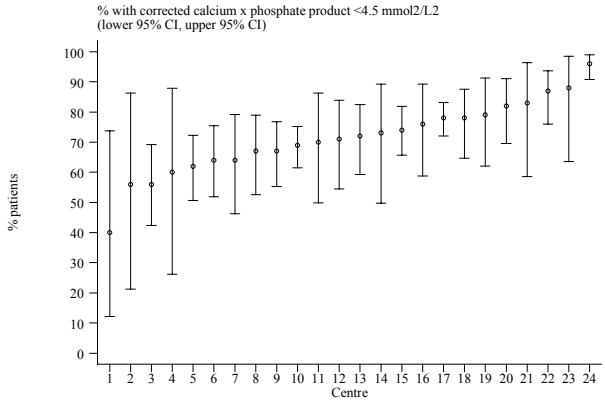



**Table 9.2.12**(b) Proportion of patients with corrected calcium x phosphate product < 4.5 mmol$^2$/L$^2$

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 7 | 70 | 70 | 74 | 78 | 82 | 94 | 94 |
| 1998 | 9 | 66 | 66 | 71 | 73 | 79 | 91 | 91 |
| 1999 | 9 | 59 | 59 | 65 | 72 | 74 | 80 | 80 |
| 2000 | 11 | 65 | 65 | 70 | 73 | 81 | 85 | 85 |
| 2001 | 12 | 50 | 50 | 71.5 | 75 | 80.5 | 84 | 84 |
| 2002 | 15 | 43 | 43 | 65 | 78 | 83 | 88 | 88 |
| 2003 | 19 | 61 | 61 | 64 | 75 | 81 | 100 | 100 |
| 2004 | 19 | 57 | 57 | 67 | 72 | 79 | 91 | 91 |
| 2005 | 21 | 54 | 56 | 63 | 74 | 77 | 85 | 85 |
| 2006 | 24 | 40 | 56 | 64 | 71.5 | 78.5 | 88 | 96 |

## SECTION 9.3: SERUM iPTH

Among patients on HD, the mean iPTH was 220.3 ng/ml while the median was 94.5 ng/ml. Among patients on CAPD, the mean iPTH was 224.57 ng/ml while the median iPTH was 188.9 ng/ml.(table 9.3.1, 9.3.2, 9.3.3, 9.3.4). The majority of patients (61% of HD patients, 54% of CAPD patients) have iPTH level < 150 ng/ml.
Tables and figures 9.3.1 and 9.3.2 (b) and (c) show that diabetics have consistently lower iPTH values than non diabetics.

**Table 9.3.1(a):** Distribution of iPTH, HD patients 1997 - 2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients <150 ng/ml | % patients ≥150 & ≤300 ng/ml | % patients >300 & ≤500 ng/ml | % patients >500 ng/ml |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1088 | 195.1 | 282.9 | 76.8 | 26 | 240.3 | 66 | 13 | 9 | 11 |
| 1998 | 938 | 126.1 | 202 | 44 | 15 | 141 | 76 | 12 | 6 | 6 |
| 1999 | 1533 | 185.6 | 260.7 | 78.9 | 23.5 | 240 | 64 | 16 | 10 | 10 |
| 2000 | 2244 | 149.3 | 230 | 58 | 17.6 | 178.3 | 72 | 13 | 8 | 7 |
| 2001 | 2760 | 141.2 | 219.5 | 57 | 18 | 164.8 | 73 | 15 | 6 | 7 |
| 2002 | 3391 | 161.6 | 248 | 64 | 19 | 191 | 70 | 14 | 8 | 8 |
| 2003 | 4068 | 219.1 | 328.8 | 79 | 24.3 | 263.3 | 64 | 14 | 9 | 14 |
| 2004 | 4748 | 212.1 | 325.6 | 74.3 | 22.6 | 257.3 | 65 | 13 | 9 | 13 |
| 2005 | 5826 | 221.6 | 312.5 | 83.8 | 26.5 | 297 | 61 | 14 | 11 | 14 |
| 2006 | 7645 | 220.3 | 307.8 | 89 | 29.3 | 293.6 | 61 | 14 | 11 | 14 |

**Figure 9.3.1(a):** Cumulative distribution of iPTH, HD patients 1997-2006

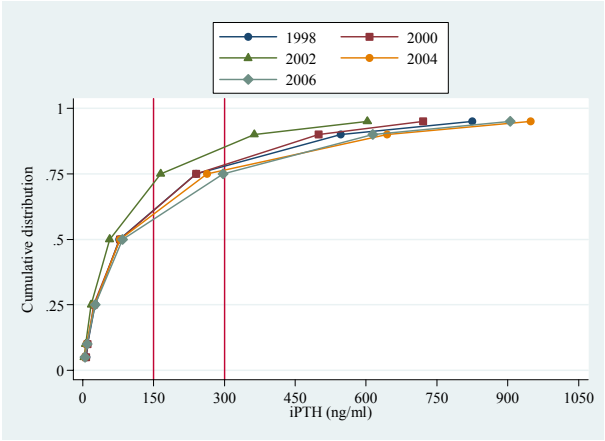



**Figure 9.3.1(b):** Cumulative distribution of iPTH, diabetic HD patients 1997-2006

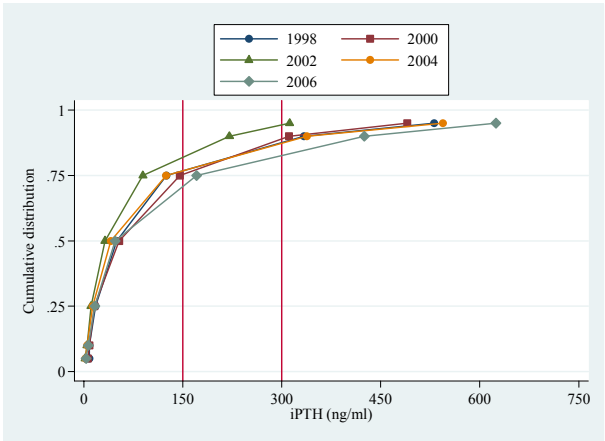



**Table 9.3.1**(b) Distribution of iPTH, diabetic HD patients 1997 - 2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients <150 ng/ml | % patients ≥150 & ≤300 ng/ml | % patients >300 & ≤500 ng/ml | % patients >500 ng/ml |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 200 | 127.8 | 216.6 | 49.5 | 17.5 | 125 | 78 | 11 | 7 | 5 |
| 1998 | 185 | 82.6 | 137.2 | 24 | 11 | 83 | 84 | 9 | 5 | 2 |
| 1999 | 336 | 121.5 | 181.8 | 53.5 | 16 | 145.8 | 75 | 14 | 6 | 5 |
| 2000 | 530 | 87.5 | 137.1 | 35.8 | 11 | 101 | 83 | 9 | 6 | 2 |
| 2001 | 720 | 82.5 | 139.6 | 32 | 10.9 | 89.5 | 83 | 11 | 3 | 2 |
| 2002 | 966 | 92.6 | 161.6 | 35 | 11 | 99 | 83 | 10 | 4 | 3 |
| 2003 | 1244 | 122.5 | 211.2 | 40.6 | 13.4 | 124.8 | 78 | 10 | 6 | 6 |
| 2004 | 1574 | 113.7 | 196.6 | 38 | 14 | 118 | 80 | 10 | 5 | 5 |
| 2005 | 2151 | 151.1 | 248.6 | 47.6 | 16.4 | 171 | 72 | 12 | 8 | 8 |
| 2006 | 3059 | 155.2 | 252.1 | 55 | 20.8 | 174.5 | 72 | 12 | 8 | 7 |

**Table 9.3.1**(c) Distribution of iPTH, non diabetic HD patients 1997 - 2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients <150 ng/ml | % patients ≥150 & ≤300 ng/ml | % patients >300 & ≤500 ng/ml | % patients >500 ng/ml |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 888 | 210.2 | 293.8 | 83.8 | 28.3 | 272.5 | 63 | 14 | 10 | 13 |
| 1998 | 753 | 136.8 | 213.7 | 50 | 17 | 154 | 74 | 12 | 7 | 7 |
| 1999 | 1197 | 203.6 | 276.3 | 93.2 | 26.5 | 267.2 | 61 | 17 | 11 | 11 |
| 2000 | 1714 | 168.4 | 248.8 | 65.6 | 21.8 | 204 | 69 | 14 | 9 | 9 |
| 2001 | 2040 | 162 | 238.1 | 71 | 23.5 | 198 | 69 | 16 | 7 | 8 |
| 2002 | 2425 | 189.1 | 270.2 | 85 | 26 | 236 | 65 | 15 | 10 | 10 |
| 2003 | 2824 | 261.6 | 360.8 | 108 | 33.5 | 331 | 57 | 16 | 10 | 17 |
| 2004 | 3174 | 260.9 | 363.6 | 102.5 | 31 | 340.3 | 58 | 14 | 12 | 17 |
| 2005 | 3675 | 262.9 | 337.7 | 114.6 | 36 | 364.5 | 55 | 15 | 13 | 17 |
| 2006 | 4586 | 263.8 | 333 | 125.3 | 40 | 366 | 54 | 16 | 13 | 18 |

**Figure 9.3.1(c):** Cumulative distribution of iPTH, non diabetic HD patients 1997-2006

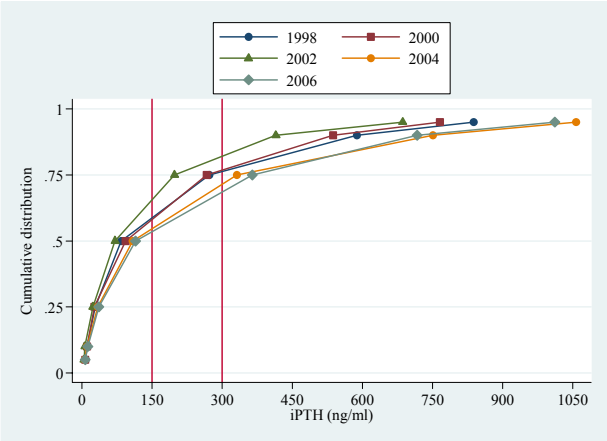



**Figure 9.3.2(a):** Cumulative distribution of iPTH, CAPD patients 1997-2006

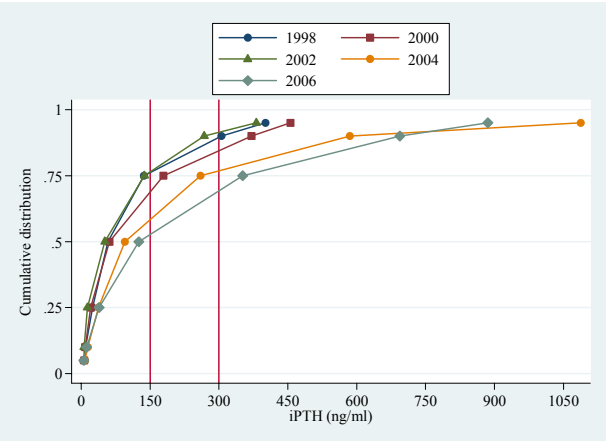



**Table 9.3.2(a):** Distribution of iPTH, CAPD patients 1997 – 2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients <150 ng/ml | % patients ≥150 & ≤300 ng/ml | % patients >300 & ≤500 ng/ml | % patients >500 ng/ml |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 293 | 112.3 | 151 | 58 | 25 | 137 | 78 | 12 | 7 | 3 |
| 1998 | 280 | 93.7 | 117.4 | 47.5 | 18.5 | 126 | 81 | 13 | 5 | 1 |
| 1999 | 365 | 132.8 | 176.4 | 61.5 | 21 | 179.3 | 71 | 15 | 10 | 4 |
| 2000 | 406 | 109.8 | 192.4 | 46.8 | 15.5 | 118 | 80 | 12 | 5 | 4 |
| 2001 | 531 | 108 | 155.8 | 51.5 | 13.5 | 137.6 | 76 | 15 | 6 | 3 |
| 2002 | 681 | 160.6 | 219.1 | 82 | 26 | 196 | 67 | 17 | 8 | 7 |
| 2003 | 938 | 230.3 | 340.3 | 95 | 37.4 | 260 | 61 | 18 | 9 | 12 |
| 2004 | 1115 | 216.4 | 302.9 | 105 | 39.5 | 260 | 60 | 19 | 10 | 11 |
| 2005 | 1071 | 247.1 | 306.4 | 125.3 | 39 | 352 | 54 | 18 | 13 | 15 |
| 2006 | 1264 | 224.7 | 271.9 | 128 | 41.5 | 318.5 | 54 | 20 | 14 | 12 |

**Table 9.3.2**(b) Distribution of iPTH, diabetic CAPD patients 1997 - 2006

| Year | No. of Subjects | Mean | SD | Median | LQ | UQ | % patients <150 ng/ml | % patients ≥150 &≤300 ng/ml | % patients >300 &≤500 ng/ml | % patients >500 ng/ml |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 90 | 61.3 | 66.1 | 39 | 15 | 90.5 | 91 | 7 | 2 | 0 |
| 1998 | 84 | 59.2 | 68.4 | 34.3 | 10.3 | 88.5 | 90 | 7 | 2 | 0 |
| 1999 | 100 | 95.8 | 145.2 | 41 | 17 | 111.6 | 81 | 11 | 5 | 3 |
| 2000 | 114 | 66.2 | 174.5 | 27.7 | 6 | 69 | 89 | 9 | 2 | 1 |
| 2001 | 165 | 65.7 | 87.6 | 33.5 | 7.5 | 82.5 | 87 | 10 | 2 | 1 |
| 2002 | 205 | 101.1 | 155.5 | 60 | 16 | 132 | 80 | 14 | 3 | 2 |
| 2003 | 326 | 122.9 | 175 | 68 | 29 | 154.3 | 74 | 16 | 6 | 4 |
| 2004 | 380 | 131 | 191.4 | 65.5 | 24.4 | 148.3 | 75 | 15 | 4 | 6 |
| 2005 | 367 | 159.4 | 235.6 | 69.2 | 23.9 | 190.5 | 70 | 16 | 7 | 7 |
| 2006 | 462 | 151.7 | 198 | 91.5 | 33 | 187.8 | 67 | 19 | 8 | 5 |

**Figure 9.3.2(b):** Cumulative distribution of iPTH, diabetic CAPD patients 1997-2006

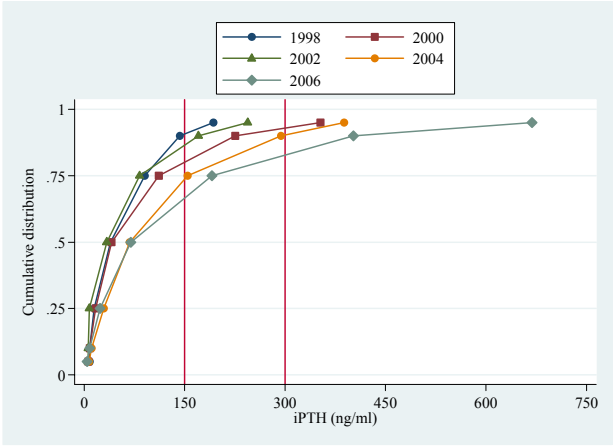



**Figure 9.3.2(c):** Cumulative distribution of iPTH, non diabetic CAPD patients 1997-2006

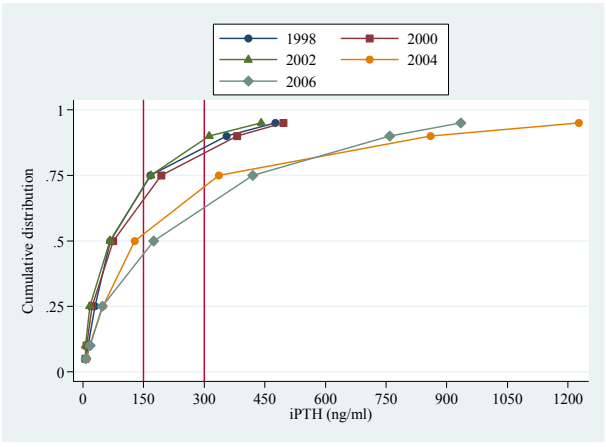



**Table 9.3.2**(c) Distribution of iPTH, non diabetic CAPD patients 1997 - 2006

| Year | No. of Sub-jects | Mean | SD | Median | LQ | UQ | % patients <150 ng/ml | % patients ≥150 &≤300 ng/ml | % patients >300 &≤500 ng/ml | % patients >500 ng/ml |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 203 | 134.9 | 171.3 | 68 | 29.5 | 167 | 72 | 14 | 9 | 4 |
| 1998 | 196 | 108.5 | 130.3 | 57.5 | 22.3 | 139.3 | 77 | 16 | 6 | 2 |
| 1999 | 265 | 146.8 | 185.2 | 75 | 22.5 | 194 | 67 | 16 | 12 | 5 |
| 2000 | 292 | 126.7 | 196.6 | 57.3 | 22.7 | 139 | 76 | 13 | 6 | 5 |
| 2001 | 366 | 127.1 | 175 | 67 | 16.7 | 168 | 72 | 17 | 7 | 4 |
| 2002 | 476 | 186.2 | 237 | 98.5 | 32.3 | 242 | 62 | 19 | 10 | 10 |
| 2003 | 612 | 287.6 | 389.6 | 128 | 50 | 336.5 | 54 | 18 | 10 | 17 |
| 2004 | 735 | 260.6 | 338.6 | 140 | 50 | 329 | 53 | 21 | 12 | 14 |
| 2005 | 704 | 292.8 | 328.4 | 175 | 48.2 | 420 | 46 | 19 | 16 | 19 |
| 2006 | 802 | 266.8 | 298.7 | 167.3 | 50 | 390 | 47 | 21 | 16 | 16 |

A higher number of CAPD centres had median iPTH 150-300 ng/ml as compared to HD centres (21.5% versus 14%). The proportion of patients with iPTH 150-300 ng/ml among HD centres ranged from 0%-33% while the proportion of patients with iPTH 150-300 ng/ml among CAPD centres ranged from 5% to 31% (Fig 9.3.3, 9.3.4)

**Table 9.3.3:** Variation in iPTH among HD centres, 2006
(a) Median iPTH among HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 36 | 8 | 26 | 45.5 | 71.8 | 112.4 | 252.5 | 402.5 |
| 1998 | 30 | 8 | 13 | 24 | 45.5 | 105 | 196.6 | 221 |
| 1999 | 39 | 10 | 17 | 40.3 | 80.3 | 151 | 304.5 | 380 |
| 2000 | 59 | 5.6 | 15 | 31.5 | 48 | 86.7 | 352.5 | 481.8 |
| 2001 | 70 | 7.3 | 12.3 | 27.6 | 55 | 101.8 | 240 | 550 |
| 2002 | 93 | 2.9 | 13 | 28.4 | 54 | 145.5 | 319.3 | 466 |
| 2003 | 113 | 4 | 10.8 | 37 | 92.4 | 188.5 | 375.2 | 624.5 |
| 2004 | 135 | 3.6 | 13 | 29.8 | 76 | 223.5 | 412 | 854 |
| 2005 | 167 | 5.8 | 13.6 | 38 | 96 | 215.3 | 396.8 | 612.3 |
| 2006 | 213 | 9.3 | 16.8 | 40 | 94.5 | 206.2 | 410.5 | 704.5 |

**Figure 9.3.3(a):** Variation in iPTH among HD patients, HD centres 2006

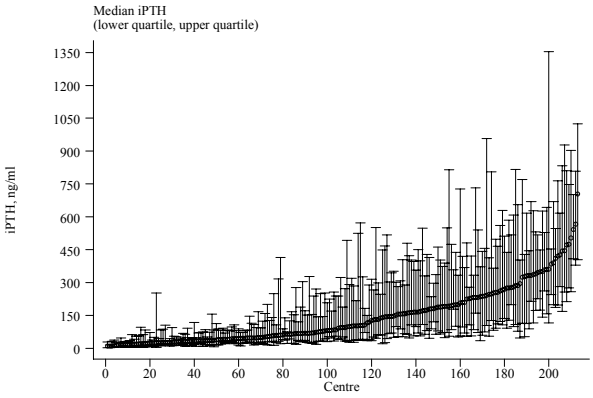



**Figure 9.3.3(b):** Variation in proportion of patients with iPTH 150-300 ng/ml, HD centres 2006

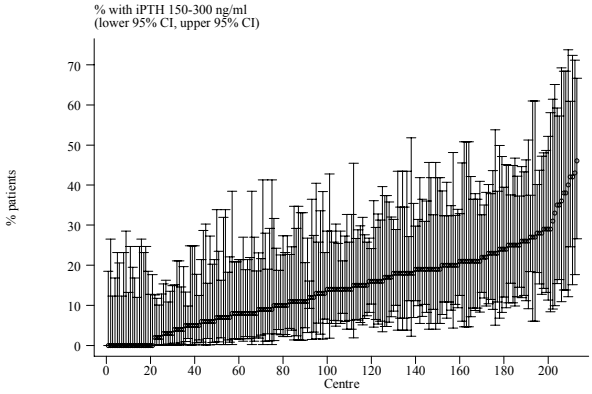



**Table 9.3.3**(b) Proportion of patients with iPTH 150-300 ng/ml

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 36 | 0 | 0 | 8 | 11.5 | 17.5 | 29 | 29 |
| 1998 | 30 | 0 | 0 | 5 | 9.5 | 16 | 26 | 29 |
| 1999 | 39 | 0 | 0 | 9 | 16 | 23 | 36 | 38 |
| 2000 | 59 | 0 | 0 | 4 | 10 | 15 | 33 | 42 |
| 2001 | 70 | 0 | 0 | 6 | 10 | 21 | 35 | 40 |
| 2002 | 93 | 0 | 0 | 2 | 10 | 21 | 31 | 43 |
| 2003 | 113 | 0 | 0 | 7 | 14 | 21 | 38 | 45 |
| 2004 | 135 | 0 | 0 | 5 | 11 | 20 | 38 | 50 |
| 2005 | 167 | 0 | 0 | 6 | 13 | 20 | 33 | 50 |
| 2006 | 213 | 0 | 0 | 7 | 14 | 21 | 33 | 46 |

**Table 9.3.4:** Variation in iPTH among CAPD centres, 2006
(a)Median iPTH among CAPD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 5 | 36.5 | 36.5 | 44.8 | 47 | 81 | 120 | 120 |
| 1998 | 5 | 16 | 16 | 57.5 | 66.3 | 68 | 73 | 73 |
| 1999 | 8 | 16.5 | 16.5 | 52.8 | 74.5 | 87.5 | 263.9 | 263.9 |
| 2000 | 9 | 16 | 16 | 33 | 43.3 | 60.8 | 122 | 122 |
| 2001 | 11 | 15.4 | 15.4 | 42.5 | 56.3 | 91 | 274 | 274 |
| 2002 | 14 | 27.3 | 27.3 | 50 | 81.1 | 107 | 319 | 319 |
| 2003 | 17 | 22.3 | 22.3 | 70 | 131 | 170.5 | 393 | 393 |
| 2004 | 18 | 41 | 41 | 76.3 | 138.8 | 169.3 | 329.1 | 329.1 |
| 2005 | 19 | 25 | 25 | 83.8 | 181 | 321.5 | 496.9 | 496.9 |
| 2006 | 22 | 34.5 | 38.3 | 96 | 188.9 | 230 | 382 | 494 |

**Figure 9.3.4(a):** Variation in median iPTH among CAPD patients, CAPD centres 2006

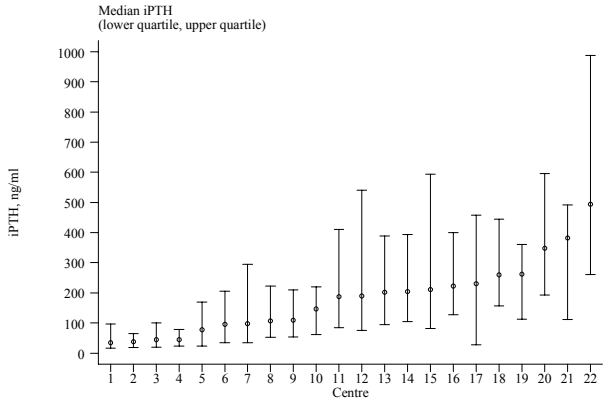



**Figure 9.3.4(b):** Variation in proportion of patients with iPTH 150-300 ng/ml, CAPD centres 2006

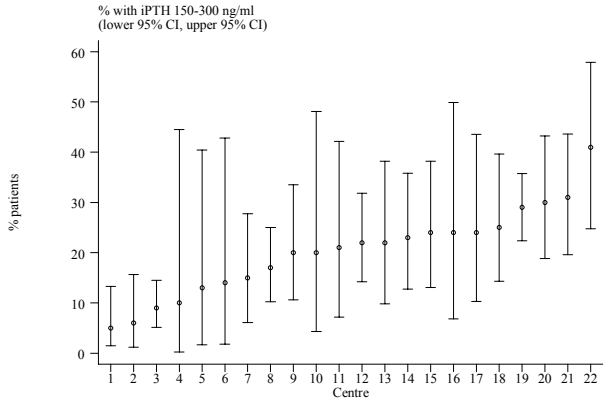



**Table 9.3.4**(b) Proportion of patients with iPTH 150-300 ng/ml

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 5 | 7 | 7 | 10 | 13 | 15 | 27 | 27 |
| 1998 | 5 | 0 | 0 | 13 | 15 | 17 | 24 | 24 |
| 1999 | 8 | 6 | 6 | 7 | 14 | 20.5 | 26 | 26 |
| 2000 | 9 | 0 | 0 | 5 | 12 | 17 | 18 | 18 |
| 2001 | 11 | 0 | 0 | 9 | 14 | 17 | 30 | 30 |
| 2002 | 14 | 0 | 0 | 10 | 15.5 | 21 | 24 | 24 |
| 2003 | 17 | 2 | 2 | 16 | 19 | 23 | 33 | 33 |
| 2004 | 18 | 7 | 7 | 15 | 21 | 26 | 29 | 29 |
| 2005 | 19 | 0 | 0 | 9 | 16 | 23 | 31 | 31 |
| 2006 | 22 | 5 | 6 | 14 | 21.5 | 24 | 31 | 41 |

**Conclusion**

There is no major change in the types of phosphate binders used. Calcium carbonate still remains the major phosphate binder for both HD and CAPD patients in year 2006. The number of patients on aluminium hydroxide is on a decreasing trend. The number of patients on lanthanum and sevelamer is still very small and is not included in this report.

The use of vitamin D has increased. The number of patients on paricalcitol is also very small and is not included in this report. The number of patients who underwent parathyroidectomy has increased by three fold compared to 2005. This may reflect active participation of our endocrine surgeon and is also due to the extension of parathyroidectomy service in other hospitals outside Kuala Lumpur Hospital and Putrajaya Hospital.

Mean corrected serum calcium remains unchanged for both HD (2.3mmol/l) and CAPD (2.4mmol/l) patients since 2002. The availability of low calcium dialysate in hemodialysis helps to keep the mean calcium level lower in HD patients. More CAPD patients achieved target serum calcium (2.1-2.37 mmol/l) compared to year 2005 (from 30 to 38%). Phosphate control continues to be better in CAPD patients. Median corrected serum calcium phosphate product for HD patients shows a decreasing trend from 1997 to 2005 but remained static at 3.9 $mmol^2/l^2$ in 2006. Median corrected serum calcium phosphate product for CAPD patients also remains static but is still lower compared to HD (3.7 $mmol^2/l^2$ vs 3.9 $mmol^2/l^2$). Furthermore, more CAPD patients achieved corrected serum calcium phosphate product of less than 4.5 $mmol^2/l^2$. Differences in dialysis management have resulted in wide variation of outcome results in serum calcium, phosphate and calcium phosphate product.

Mean serum iPTH level remained static in HD patients (220.3ng/ml); however it has decreased from 247.1ng/ml to 224.7ng/ml in CAPD patients between 2005 and 2006. More HD patients have serum iPTH level of <150ng/ml compared to CAPD patients (61% vs 54%). The percentage of patients achieving the target iPTH level of 150-300ng/ml is low. Only 20% of CAPD patients have serum iPTH between 150-300ng/ml while only 14% in the HD population achieved this target. Again a wide variation of serum iPTH was observed due to differences in dialysis management among dialysis centres. As expected, diabetics had lower iPTH values.

Management of renal bone disease seems to have improved among HD patients over last few years but is still not as good as CAPD patients. Unfortunately, the relationship of these factors in relation to cardiovascular disease outcome has not been determined as yet but hopefully will be done in the future.

# CHAPTER 10

# Hepatitis on Dialysis

Teo Sue Mei
Claire Tan Hui Hong
Foo Sui Mei

**Table 10.1:** Prevalence of positive HBsAg and positive Anti-HCV at annual survey, HD patients 1997-2006

| Year | No. of subjects | Prevalence of HBsAg+ (%) | Prevalence of Anti-HCV+ (%) |
|---|---|---|---|
| 1997 | 1694 | 6 | 23 |
| 1998 | 2139 | 6 | 22 |
| 1999 | 2991 | 6 | 23 |
| 2000 | 4386 | 6 | 25 |
| 2001 | 5187 | 6 | 23 |
| 2002 | 6106 | 5 | 20 |
| 2003 | 6977 | 5 | 19 |
| 2004 | 7618 | 5 | 17 |
| 2005 | 8957 | 4 | 14 |
| 2006 | 11116 | 5 | 12 |

**Table 10.2:** Prevalence of positive HBsAg and positive Anti-HCV at annual survey, CAPD patients 1997-2006

| 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 | 1223 | 3 | 4 |
| 2004 | 1200 | 4 | 5 |
| 2005 | 1318 | 4 | 5 |
| 2006 | 1489 | 5 | 4 |

The prevalence of Hepatitis B infection has remained low and was similar when comparing HD and CAPD patients whereas prevalence of HCV was still higher in HD than CAPD patients as a result of the higher risk of nosocomial transmission with HD. However with effective and more stringent implementation of infection control measures, HCV prevalence has continued to decline by 2-3% annually from 2001 onwards.

There was only small center variation in the proportion of hepatitis B positive patients in both HD and CAPD.

**Table 10.3:** Variation in Proportion of patients with positive HBsAg at annual survey among HD centres, 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 0 | 0 | 2.5 | 5 | 9 | 17 | 19 |
| 1998 | 50 | 0 | 0 | 0 | 5 | 9 | 18 | 23 |
| 1999 | 76 | 0 | 0 | 0 | 4 | 9.5 | 19 | 30 |
| 2000 | 109 | 0 | 0 | 0 | 4 | 8 | 15 | 80 |
| 2001 | 125 | 0 | 0 | 0 | 5 | 9 | 15 | 90 |
| 2002 | 156 | 0 | 0 | 0 | 3 | 8 | 14 | 27 |
| 2003 | 178 | 0 | 0 | 0 | 3.5 | 8 | 15 | 64 |
| 2004 | 198 | 0 | 0 | 0 | 3 | 8 | 15 | 100 |
| 2005 | 231 | 0 | 0 | 0 | 1 | 6 | 15 | 100 |
| 2006 | 283 | 0 | 0 | 0 | 0 | 6 | 16 | 94 |

**Figure 10.3:** Variation in Proportion of patients with positive HBsAg among HD centres, 2006

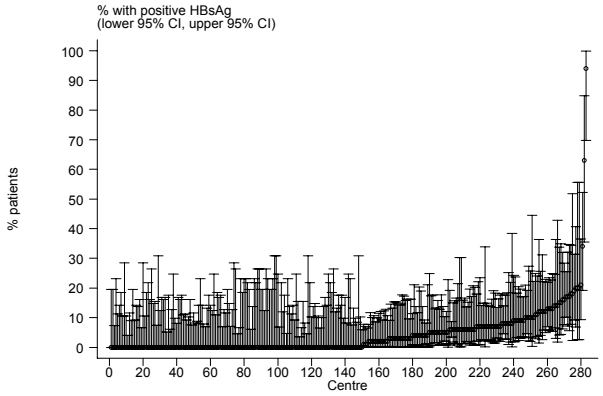


**Table 10.4:** Variation in Proportion of patients with positive HBsAg at annual survey among CAPD centres, 2006

| 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 | 10 | 0 | 0 | 0 | 2 | 2 | 4 | 4 |
| 2000 | 11 | 0 | 0 | 0 | 1 | 4 | 5 | 5 |
| 2001 | 12 | 0 | 0 | 0 | 2 | 3 | 9 | 9 |
| 2002 | 15 | 0 | 0 | 1 | 3 | 6 | 18 | 18 |
| 2003 | 19 | 0 | 0 | 1 | 3 | 6 | 8 | 8 |
| 2004 | 19 | 0 | 0 | 1 | 3 | 6 | 11 | 11 |
| 2005 | 21 | 0 | 0 | 0 | 3 | 5 | 5 | 11 |
| 2006 | 23 | 0 | 0 | 0 | 4 | 6 | 9 | 13 |

**Figure 10.4:** Variation in Proportion of patients with positive HBsAg among CAPD centres, 2006

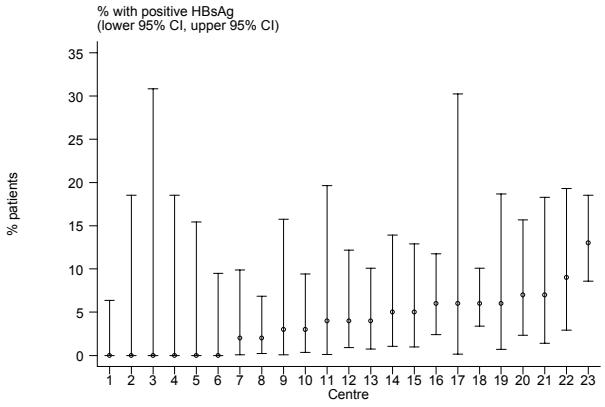
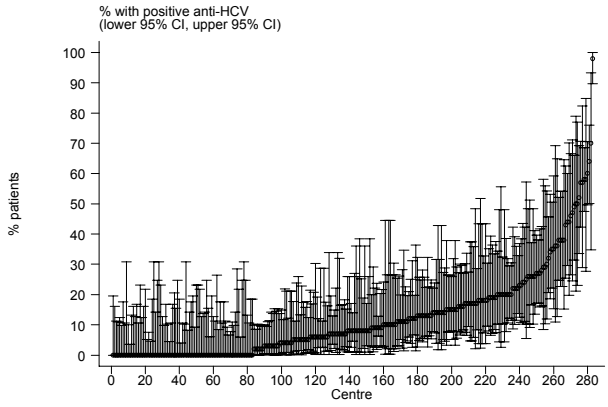



**Figure 10.5:** Variation in Proportion of patients with positive anti-HCV among HD centres, 2006




Even though the median proportion of HCV infected HD patients continued to decline annually from 21% in 1997 to 8% in 2006, there was still wide center variation (table and figure 10.5). This probably reflected the differences in infection control practices and criteria for intake of patients among centers.

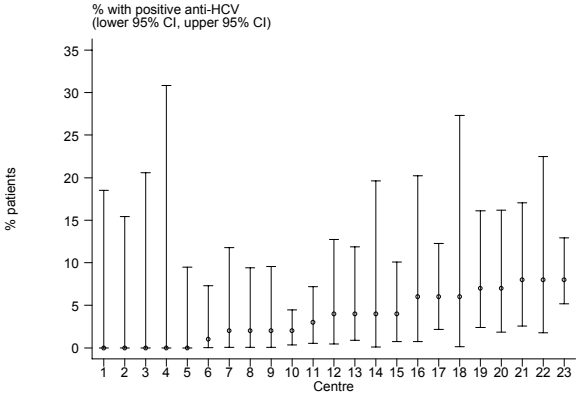
**Table 10.5:** Variation in Proportion of patients with positive anti-HCV at annual survey among HD centres, 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 0 | 0 | 14.5 | 21 | 29 | 47 | 63 |
| 1998 | 50 | 0 | 0 | 9 | 19.5 | 30 | 61 | 79 |
| 1999 | 76 | 0 | 0 | 7 | 19.5 | 32.5 | 60 | 79 |
| 2000 | 109 | 0 | 0 | 9 | 18 | 30 | 70 | 91 |
| 2001 | 125 | 0 | 0 | 7 | 17 | 30 | 64 | 91 |
| 2002 | 156 | 0 | 0 | 5 | 14 | 24.5 | 51 | 96 |
| 2003 | 178 | 0 | 0 | 5 | 13 | 24 | 50 | 96 |
| 2004 | 201 | 0 | 0 | 4 | 11 | 24 | 50 | 100 |
| 2005 | 232 | 0 | 0 | 0 | 9.5 | 19 | 44 | 98 |
| 2006 | 283 | 0 | 0 | 0 | 8 | 17 | 44 | 98 |

**Table 10.6:** Variation in Proportion of patients with positive anti-HCV at annual survey among CAPD centres, 2006

| 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 | 3 | 3 | 8 | 11 | 11 |
| 1999 | 10 | 0 | 0 | 3 | 4 | 7 | 14 | 14 |
| 2000 | 11 | 0 | 0 | 2 | 3 | 8 | 10 | 10 |
| 2001 | 12 | 0 | 0 | 0 | 3 | 4.5 | 7 | 7 |
| 2002 | 15 | 0 | 0 | 0 | 3 | 8 | 12 | 12 |
| 2003 | 19 | 0 | 0 | 1 | 4 | 7 | 9 | 9 |
| 2004 | 19 | 0 | 0 | 0 | 4 | 7 | 10 | 10 |
| 2005 | 21 | 0 | 0 | 1 | 4 | 8 | 10 | 11 |
| 2006 | 23 | 0 | 0 | 1 | 4 | 6 | 8 | 8 |

**Figure 10.6:** Variation in Proportion of patients with positive anti-HCV among CAPD centres, 2006




Similar to Hepatitis B infection, the prevalence of HCV infection was low in CAPD patients and did not vary greatly between centers.

**Table 10.7a:** Risk factors in relation to HD practices for seroconversion to anti-HCV positive among sero-negative patients

| Risk factor | Number of patients | Risk Ratio | 95% CI | | p-value |
|---|---|---|---|---|---|
| Assistance to Perform HD | | | | | |
| (1) Self care[ref] | 151 | 1.000 | | | |
| (2) Partial self care | 108 | 0.701 | ( 0.542 | 0.908 ) | 0.007 |
| (3) Completely assisted | 239 | 0.469 | ( 0.377 | 0.583 ) | 0.000 |
| Dialyzer Reuse | | | | | |
| (1) less than 10[ref] | 161 | 1.000 | | | |
| (2) more than 10 | 362 | 0.733 | ( 0.607 | 0.885 ) | 0.001 |
| Dialyzer Reprocessing System | | | | | |
| (1) Fully Auto[ref] | 275 | 1.000 | | | |
| (2) Semi Auto | 29 | 0.702 | ( 0.478 | 1.030 ) | 0.070 |
| (3) Manual | 29 | 0.710 | ( 0.484 | 1.042 ) | 0.081 |
| (4) No Reuse | 0 | 0.000 | . | . | . |
| Age | | | | | |
| (1) <=20[ref] | 29 | 1.000 | | | |
| (2) 21-40 | 189 | 0.914 | ( 0.619 | 1.432 ) | 0.778 |
| (3) 41-60 | 242 | 0.538 | ( 0.356 | 0.813 ) | 0.003 |
| (4) >60 | 63 | 0.243 | ( 0.154 | 0.385 ) | 0.000 |
| Gender | | | | | |
| (1)Female[ref] | 213 | 1.000 | | | |
| (2)Male | 310 | 1.168 | ( 0.977 | 1.395 ) | 0.088 |
| Diabetes | | | | | |
| (1)No[ref] | 420 | 1.000 | | | |
| (2)Yes | 103 | 0.330 | ( 0.267 | 0.408 ) | 0.000 |
| Previous Renal Transplant | | | | | |
| (1)No[ref] | 474 | 1.000 | | | |
| (2)Yes | 49 | 3.357 | ( 2.426 | 4.645 ) | 0.000 |
| History of Blood Transfusion | | | | | |
| (1)No[ref] | 319 | 1.000 | | | |
| (2)Yes | 204 | 1.287 | ( 1.075 | 1.540 ) | 0.006 |

Risk factors associated with occurrence of HCV seroconversion can be divided into patient-level factors and center-level factors. Patient-level factors such as previous renal transplant and history of blood transfusion were associated with a significantly higher risk of HCV seroconversion. There was also a trend of increasing risk with men and younger patients and lower risk with diabetes.

Completely assisted HD patients had a significantly lower risk of acquiring HCV infection. This was not surprising as these patients were fully assisted by trained HD staffs who were more stringent with infection control measures. However a rather interesting finding was that center-level factors such as increased frequency of dialyser reuse, the use of semi-automated and manual reprocessing systems seemed to be associated with lower risk of acquiring HCV infection. As the number of study patients was small, it is possible that these factors did not actually influence HCV seroconversion, but rather reflected differences in practices among centers. Total segregation and good practice of universal precautions are probably more important contributing factors.

**Table 10.7b:** Risk factors for seroconversion to anti-HCV positive among sero-negative patients in CAPD

| Risk factor | Number of patients | Risk Ratio | 95% CI | p-value |
|---|---|---|---|---|
| Age | | | | |
| (1) <=20[ref] | 4 | | | |
| (2) 21-40 | 8 | 1.553 | ( 0.474 5.095 ) | 0.467 |
| (3) 41-60 | 8 | 0.713 | ( 0.213 2.387 ) | 0.583 |
| (4) >60 | 2 | 0.338 | ( 0.062 1.859 ) | 0.213 |
| Gender | | | | |
| (1)Female[ref] | 9 | | | |
| (2)Male | 13 | 1.384 | ( 0.604 3.171 ) | 0.323 |
| Diabetes | | | | |
| (1)No[ref] | 18 | | | |
| (2)Yes | 4 | 0.334 | ( 0.113 0.986 ) | 0.047 |
| Switched from HD to CAPD | | | | |
| (1)No[ref] | 18 | | | |
| (2)Yes | 4 | 2.215 | ( 0.744 6.591 ) | 0.153 |
| Previous Renal Transplant | | | | |
| (1)No[ref] | 22 | | | |
| (2)Yes | 1 | 1.144 | ( 0.152 8.610 ) | 0.896 |
| History of Blood Transfusion | | | | |
| (1)No[ref] | 11 | | | |
| (2)Yes | 12 | 2.191 | ( 0.961 4.994 ) | 0.062 |

CAPD patients who were switched from HD, had previous renal transplant and blood transfusion had a tendency for increased risk of seroconversion, but these findings did not reach statistical significance as the number of study patients was small.

Conclusion:

Nosocomial transmission in HD has been implicated for the higher HCV prevalence in HD compared to CAPD. Our efforts to curb the epidemic of hepatitis in HD has been shown to be effective with the decreasing prevalence of HCV annually. However there should be further investigations into the mechanism of transmission and aspects of our current HD practices which may put patients at risk of HCV infection.

# CHAPTER 11

# Haemodialysis Practices

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Shahnaz Shah Firdaus Khan
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Norleen Bt Zulkarnain Sim

## SECTION 11.1: VASCULAR ACCESS AND ITS COMPLICATIONS

There was a progressive decline in the percentage of patients having native vascular access from 98% in 1997 to 93% in 2006. The ratio of brachiocephalic fistula (BCF) to arteriovascular fistula (AVF) has increased. In 2006, 25% of native vascular access was BCF. The proportion of patients with artificial graft and permanent catheter remained at 2% respectively. (Table 11.1.1)

**Table 11.1.1:** Vascular Access on Haemodialysis, 1997-2006

| Access types | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Wrist AVF | 1427 | 85 | 1763 | 84 | 2406 | 81 | 3561 | 82 | 4049 | 79 |
| BCF* | 213 | 13 | 273 | 13 | 431 | 14 | 655 | 15 | 897 | 17 |
| Venous graft | 4 | 0 | 6 | 0 | 8 | 0 | 11 | 0 | 19 | 0 |
| Artificial graft | 13 | 1 | 20 | 1 | 34 | 1 | 31 | 1 | 64 | 1 |
| Permanent CVC | 4 | 0 | 8 | 0 | 17 | 1 | 19 | 0 | 25 | 0 |
| Temporary CVC* | 20 | 1 | 37 | 2 | 77 | 3 | 77 | 2 | 90 | 2 |
| Temporary FVC* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 1681 | 100 | 2107 | 100 | 2973 | 100 | 4354 | 100 | 5144 | 100 |

| Access types | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Wrist AVF | 4680 | 78 | 5249 | 75 | 5891 | 73 | 6405 | 69 | 7704 | 68 |
| BCF* | 1068 | 18 | 1359 | 19 | 1693 | 21 | 2169 | 23 | 2793 | 25 |
| Venous graft | 14 | 0 | 23 | 0 | 41 | 1 | 30 | 0 | 22 | 0 |
| Artificial graft | 78 | 1 | 114 | 2 | 150 | 2 | 221 | 2 | 275 | 2 |
| Permanent CVC | 43 | 1 | 62 | 1 | 99 | 1 | 180 | 2 | 229 | 2 |
| Temporary CVC* | 138 | 2 | 180 | 3 | 233 | 3 | 269 | 3 | 291 | 3 |
| Temporary FVC* | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 21 | 0 |
| TOTAL | 6021 | 100 | 6987 | 100 | 8107 | 100 | 9281 | 100 | 11335 | 100 |

* BCF=Brachiocephalic fistula
* CVC= Central venous catheter
* FVC= Femoral venous catheter

**Table 11.1.2:** Difficulties reported with Vascular Access, 1997-2006

| Access difficulty | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Difficulty with needle placement | 55 | 47 | 82 | 4 | 133 | 5 | 146 | 4 | 217 | 5 |
| Difficulty in obtaining desired blood flow rate | 48 | 41 | 60 | 3 | 112 | 5 | 136 | 4 | 239 | 5 |
| Other difficulties | 12 | 10 | 30 | 2 | 55 | 2 | 32 | 1 | 39 | 1 |
| No difficulties | 1 | 1 | 1778 | 91 | 2155 | 88 | 3402 | 92 | 4276 | 90 |
| TOTAL | 116 | 100 | 1950 | 100 | 2455 | 100 | 3716 | 100 | 4771 | 100 |

| Access difficulty | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Difficulty with needle placement | 215 | 4 | 217 | 3 | 255 | 3 | 319 | 4 | 391 | 3 |
| Difficulty in obtaining desired blood flow rate | 235 | 4 | 243 | 4 | 301 | 4 | 354 | 4 | 354 | 3 |
| Other difficulties | 57 | 1 | 60 | 1 | 67 | 1 | 58 | 1 | 45 | 0 |
| No difficulties | 5073 | 91 | 5970 | 92 | 6957 | 92 | 8339 | 92 | 10416 | 93 |
| TOTAL | 5580 | 100 | 6490 | 100 | 7580 | 100 | 9070 | 100 | 11206 | 100 |

Complication rates have remained similar 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, 1997-2006

| Complication | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Thrombosis | 71 | 19 | 69 | 3 | 129 | 5 | 148 | 4 | 209 | 4 |
| Bleed | 23 | 6 | 37 | 2 | 23 | 1 | 30 | 1 | 62 | 1 |
| Aneurysmal dilatation | 121 | 33 | 134 | 6 | 159 | 6 | 208 | 5 | 212 | 4 |
| Swollen limb | 35 | 9 | 36 | 2 | 51 | 2 | 44 | 1 | 67 | 1 |
| Access related infection, local/systemic | 29 | 8 | 21 | 1 | 34 | 1 | 52 | 1 | 49 | 1 |
| Distal limb ischaemia | 4 | 1 | 12 | 1 | 9 | 0 | 26 | 1 | 22 | 0 |
| Venous outflow obstruction | 45 | 12 | 50 | 2 | 71 | 3 | 78 | 2 | 123 | 2 |
| Carpal tunnel | 23 | 6 | 19 | 1 | 35 | 1 | 42 | 1 | 41 | 1 |
| Others | 18 | 5 | 48 | 2 | 64 | 2 | 37 | 1 | 74 | 1 |
| No complications | 0 | 0 | 1636 | 79 | 2119 | 79 | 3237 | 83 | 4204 | 83 |
| TOTAL | 369 | 100 | 2062 | 100 | 2694 | 100 | 3902 | 100 | 5063 | 100 |

| Complication | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Thrombosis | 202 | 3 | 220 | 3 | 284 | 4 | 289 | 3 | 313 | 3 |
| Bleed | 66 | 1 | 54 | 1 | 67 | 1 | 73 | 1 | 68 | 1 |
| Aneurysmal dilatation | 211 | 4 | 199 | 3 | 193 | 2 | 179 | 2 | 244 | 2 |
| Swollen limb | 56 | 1 | 55 | 1 | 77 | 1 | 84 | 1 | 88 | 1 |
| Access related infection, local/systemic | 52 | 1 | 43 | 1 | 70 | 1 | 63 | 1 | 76 | 1 |
| Distal limb ischaemia | 17 | 0 | 13 | 0 | 37 | 0 | 35 | 0 | 30 | 0 |
| Venous outflow obstruction | 101 | 2 | 119 | 2 | 151 | 2 | 170 | 2 | 197 | 2 |
| Carpal tunnel | 44 | 1 | 63 | 1 | 49 | 1 | 55 | 1 | 48 | 0 |
| Others | 118 | 2 | 118 | 2 | 133 | 2 | 109 | 1 | 113 | 1 |
| No complications | 4988 | 85 | 5963 | 87 | 6896 | 87 | 8113 | 88 | 9987 | 89 |
| TOTAL | 5855 | 100 | 6847 | 100 | 7957 | 100 | 9170 | 100 | 11164 | 100 |

## SECTION 11.2: HD PRESCRIPTION

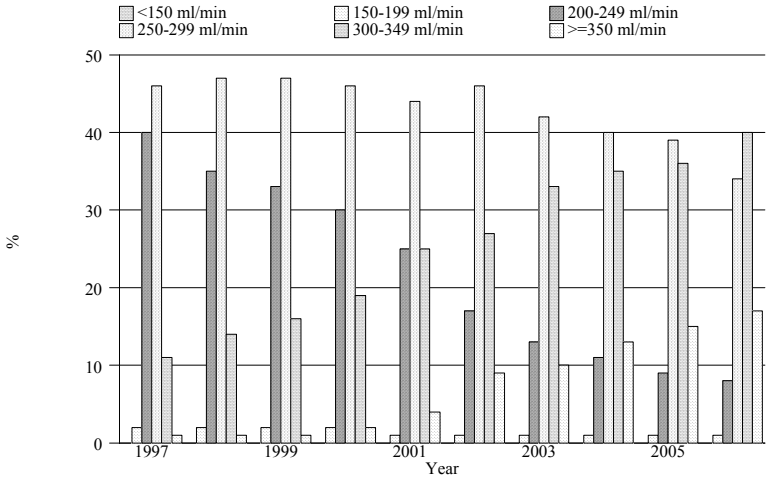
There was an increasing trend towards the use of higher blood flow rates from 1997 to 2006. The proportion of patients with blood flow of 300-349mls/min has increased from 11% to 40% and those with blood flow rates ≥ 350mls/min from 1% to 17%. Fifty seven percent of patients had blood flow rates of ≥ 300mls/min in 2006. (Table 11.2.1 and Fig 11.2.1)

**Table 11.2.1:** Blood Flow Rates in HD centres, 1997– 2006

| Blood flow rates | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| <150 ml/min | 2 | 0 | 4 | 0 | 6 | 0 | 9 | 0 | 7 | 0 |
| 150-199 ml/min | 34 | 2 | 36 | 2 | 65 | 2 | 85 | 2 | 69 | 1 |
| 200-249 ml/min | 649 | 40 | 735 | 35 | 962 | 33 | 1282 | 30 | 1233 | 25 |
| 250-299 ml/min | 734 | 46 | 968 | 47 | 1367 | 47 | 1938 | 46 | 2229 | 44 |
| 300-349 ml/min | 176 | 11 | 298 | 14 | 455 | 16 | 814 | 19 | 1276 | 25 |
| >=350 ml/min | 18 | 1 | 30 | 1 | 31 | 1 | 94 | 2 | 216 | 4 |
| TOTAL | 1613 | 100 | 2071 | 100 | 2886 | 100 | 4222 | 100 | 5030 | 100 |

| Blood flow rates | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| <150 ml/min | 9 | 0 | 4 | 0 | 11 | 0 | 7 | 0 | 5 | 0 |
| 150-199 ml/min | 69 | 1 | 84 | 1 | 86 | 1 | 94 | 1 | 100 | 1 |
| 200-249 ml/min | 973 | 17 | 882 | 13 | 879 | 11 | 814 | 9 | 904 | 8 |
| 250-299 ml/min | 2692 | 46 | 2865 | 42 | 3112 | 40 | 3523 | 39 | 3738 | 34 |
| 300-349 ml/min | 1590 | 27 | 2241 | 33 | 2711 | 35 | 3226 | 36 | 4471 | 40 |
| >=350 ml/min | 505 | 9 | 690 | 10 | 1020 | 13 | 1328 | 15 | 1900 | 17 |
| TOTAL | 5838 | 100 | 6766 | 100 | 7819 | 100 | 8992 | 100 | 11118 | 100 |

**Figure 11.2.1:** Blood Flow Rates in HD centres, 1997–2006



Ninety seven percent of patients were on 3 haemodialysis (HD) sessions / week. The small percentage of patients on 2 HD sessions / week is likely to be patients who were dialyzing in private centres and unable to afford 3 HD sessions / week. (Table 11.2.2)

**Table 11.2.2:** Number of HD Sessions per week, 1997 – 2006

| HD sessions per week | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 1 | 1 | 0 | 1 | 0 | 4 | 0 | 8 | 0 | 8 | 0 |
| 2 | 6 | 0 | 5 | 0 | 153 | 5 | 341 | 8 | 337 | 7 |
| 3 | 1664 | 99 | 2110 | 100 | 2811 | 95 | 3982 | 92 | 4761 | 92 |
| 4 | 9 | 1 | 2 | 0 | 3 | 0 | 10 | 0 | 50 | 1 |
| TOTAL | 1680 | 100 | 2118 | 100 | 2971 | 100 | 4341 | 100 | 5156 | 100 |

| HD sessions per week | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 1 | 10 | 0 | 15 | 0 | 11 | 0 | 7 | 0 | 25 | 0 |
| 2 | 369 | 6 | 343 | 5 | 281 | 3 | 265 | 3 | 267 | 2 |
| 3 | 5603 | 93 | 6558 | 95 | 7709 | 96 | 9010 | 97 | 11148 | 97 |
| 4 | 18 | 0 | 9 | 0 | 30 | 0 | 31 | 0 | 33 | 0 |
| TOTAL | 6000 | 100 | 6925 | 100 | 8031 | 100 | 9313 | 100 | 11473 | 100 |

Majority of patients (99%) were on 4 hours HD session. (Table 11.2.3)

**Table 11.2.3:** Duration of HD, 1997 – 2006

| Duration of HD per session | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| <=3 hours | 7 | 0 | 3 | 0 | 4 | 0 | 8 | 0 | 6 | 0 |
| -3.5 hours | 3 | 0 | 18 | 1 | 9 | 0 | 12 | 0 | 33 | 1 |
| -4 hours | 1594 | 95 | 1993 | 94 | 2735 | 92 | 4053 | 93 | 4956 | 96 |
| -4.5 hours | 69 | 4 | 91 | 4 | 160 | 5 | 189 | 4 | 106 | 2 |
| -5 hours | 8 | 0 | 8 | 0 | 61 | 2 | 77 | 2 | 59 | 1 |
| >5 hours | 1 | 0 | 3 | 0 | 0 | 0 | 13 | 0 | 0 | 0 |
| TOTAL | 1682 | 100 | 2116 | 100 | 2969 | 100 | 4352 | 100 | 5160 | 100 |

| Duration of HD per session | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| <=3 hours | 18 | 0 | 11 | 0 | 23 | 0 | 22 | 0 | 28 | 0 |
| -3.5 hours | 15 | 0 | 7 | 0 | 17 | 0 | 17 | 0 | 7 | 0 |
| -4 hours | 5845 | 98 | 6761 | 98 | 7830 | 97 | 9152 | 98 | 11321 | 99 |
| -4.5 hours | 68 | 1 | 76 | 1 | 119 | 1 | 67 | 1 | 68 | 1 |
| -5 hours | 48 | 1 | 66 | 1 | 47 | 1 | 54 | 1 | 40 | 0 |
| >5 hours | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 0 |
| TOTAL | 5994 | 100 | 6921 | 100 | 8039 | 100 | 9312 | 100 | 11465 | 100 |

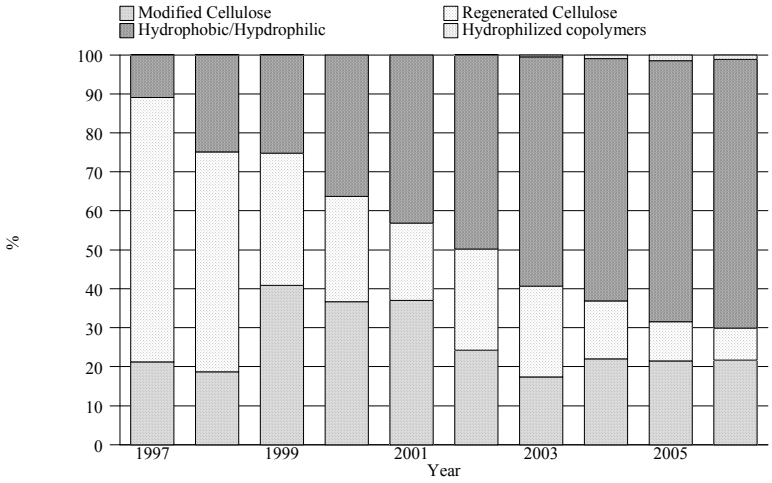
The use of synthetic membrane (hydrophobic/ hydrophilic and hydrophilised copolymer) has increased from 11% in 1997 to 70% in 2006. Regenerated cellulose membrane usage has progressively declined from 67% in 1997 to 8% in 2006. The use of modified cellulose membrane has remained relatively the same. (Table 11.2.4 and Fig. 11.2.4)

**Table 11.2.4:** Dialyser membrane types in HD centres, 1997 – 2006

| Dialyser membrane | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Modified Cellulose | 360 | 21 | 395 | 19 | 1224 | 41 | 1605 | 37 | 1666 | 37 |
| Regenerated Cellulose | 1148 | 68 | 1195 | 56 | 1012 | 34 | 1183 | 27 | 890 | 20 |
| Hydrophobic/Hypdrophilic | 184 | 11 | 524 | 25 | 754 | 25 | 1589 | 36 | 1944 | 43 |
| Hydrophilized copolymers | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 1693 | 100 | 2116 | 100 | 2991 | 100 | 4377 | 100 | 4500 | 100 |

| Dialyser membrane | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Modified Cellulose | 1376 | 24 | 1115 | 17 | 1718 | 22 | 1919 | 21 | 2333 | 22 |
| Regenerated Cellulose | 1473 | 26 | 1502 | 23 | 1150 | 15 | 901 | 10 | 882 | 8 |
| Hydrophobic/Hypdrophilic | 2828 | 50 | 3782 | 59 | 4843 | 62 | 5976 | 67 | 7432 | 69 |
| Hydrophilized copolymers | 1 | 0 | 35 | 1 | 74 | 1 | 132 | 1 | 121 | 1 |
| TOTAL | 5678 | 100 | 6434 | 100 | 7785 | 100 | 8928 | 100 | 10768 | 100 |

**Figure 11.2.4:** Dialyser membrane types in HD centres, 1997 – 2006



Reuse if dialysers is a common practice in Malaysia whereby 95% reuse the dialyser. The frequency of reuse depends on the type of dialyser membrane. Five percent of patients did not reuse dialysers. In 2006, 75% of patients reuse their dialysers 10 times or more. (Table 11.2.5)

**Table 11.2.5:** Dialyser Reuse Frequency in HD centres, 1997- 2006

| Dialyser reuse frequency | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 1* | 21 | 1 | 16 | 1 | 65 | 2 | 116 | 3 | 152 | 3 |
| 2 | 9 | 1 | 5 | 0 | 13 | 0 | 17 | 0 | 15 | 0 |
| 3 | 996 | 63 | 215 | 11 | 191 | 7 | 205 | 5 | 232 | 5 |
| 4 | 174 | 11 | 113 | 6 | 250 | 9 | 477 | 12 | 416 | 9 |
| 5 | 194 | 12 | 137 | 7 | 264 | 10 | 312 | 8 | 357 | 7 |
| 6 | 154 | 10 | 1072 | 55 | 1414 | 51 | 1730 | 43 | 1413 | 29 |
| 7 | 2 | 0 | 37 | 2 | 46 | 2 | 69 | 2 | 85 | 2 |
| 8 | 4 | 0 | 66 | 3 | 122 | 4 | 357 | 9 | 793 | 16 |
| 9 | 30 | 2 | 109 | 6 | 179 | 6 | 101 | 2 | 132 | 3 |
| 10 | 0 | 0 | 84 | 4 | 96 | 3 | 246 | 6 | 400 | 8 |
| 11 | 0 | 0 | 23 | 1 | 6 | 0 | 4 | 0 | 43 | 1 |
| 12 | 0 | 0 | 64 | 3 | 118 | 4 | 333 | 8 | 470 | 10 |
| >=13 | 0 | 0 | 0 | 0 | 0 | 0 | 91 | 2 | 331 | 7 |
| TOTAL | 1584 | 100 | 1941 | 100 | 2764 | 100 | 4058 | 100 | 4839 | 100 |

| Dialyser reuse frequency | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 1* | 197 | 4 | 251 | 4 | 319 | 4 | 196 | 4 | 392 | 5 |
| 2 | 41 | 1 | 19 | 0 | 42 | 1 | 1 | 0 | 5 | 0 |
| 3 | 316 | 6 | 349 | 5 | 194 | 3 | 81 | 2 | 36 | 0 |
| 4 | 337 | 6 | 339 | 5 | 192 | 3 | 85 | 2 | 75 | 1 |
| 5 | 318 | 6 | 267 | 4 | 192 | 3 | 137 | 3 | 187 | 3 |
| 6 | 1216 | 22 | 915 | 14 | 806 | 11 | 555 | 10 | 589 | 8 |
| 7 | 124 | 2 | 71 | 1 | 89 | 1 | 44 | 1 | 63 | 1 |
| 8 | 866 | 16 | 852 | 13 | 809 | 11 | 477 | 9 | 410 | 6 |
| 9 | 59 | 1 | 87 | 1 | 50 | 1 | 46 | 1 | 115 | 2 |
| 10 | 538 | 10 | 880 | 14 | 1160 | 16 | 770 | 15 | 911 | 13 |
| 11 | 36 | 1 | 25 | 0 | 42 | 1 | 12 | 0 | 100 | 1 |
| 12 | 879 | 16 | 1511 | 24 | 1916 | 26 | 1353 | 26 | 2238 | 31 |
| >=13 | 644 | 12 | 819 | 13 | 1644 | 22 | 1548 | 29 | 2161 | 30 |
| TOTAL | 5571 | 100 | 6385 | 100 | 7455 | 100 | 5305 | 100 | 7282 | 100 |

Ninety nine percent of patients were on bicarbonate dialysate buffer in 2006 compared to 67% in 1997. In 2006, 147 patients were still using acetate as a buffer. (Table 11.2.6)

**Table 11.2.6:** Dialysate Buffer used in HD centres, 1997 – 2006

| Dialysate buffer | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Acetate | 551 | 33 | 627 | 30 | 552 | 19 | 393 | 9 | 240 | 5 |
| Bicarbonate | 1123 | 67 | 1492 | 70 | 2429 | 81 | 3969 | 91 | 4920 | 95 |
| TOTAL | 1674 | 100 | 2119 | 100 | 2981 | 100 | 4362 | 100 | 5160 | 100 |

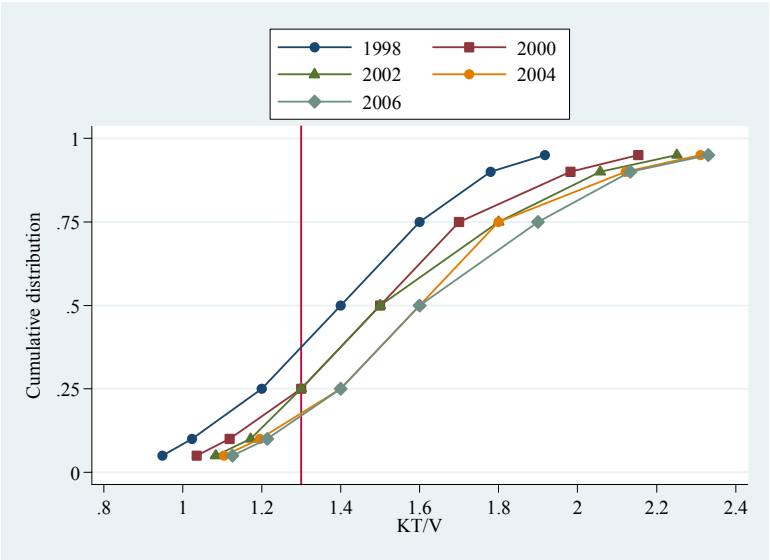
| Dialysate buffer | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Acetate | 138 | 2 | 76 | 1 | 33 | 0 | 58 | 1 | 147 | 1 |
| Bicarbonate | 5880 | 98 | 6815 | 99 | 7957 | 100 | 9268 | 99 | 11457 | 99 |
| TOTAL | 6018 | 100 | 6891 | 100 | 7990 | 100 | 9326 | 100 | 11604 | 100 |

The median prescribed KT/V was 1.6. The percentage of patients with KT/V $\geq$ 1.3 has increased from 60% in 1997 to 84% in 2006. Since 2002, the median KT/V has remained the same. (Table 11.2.7a and Fig. 11.2.7a)

**Table 11.2.7a:** Distribution of prescribed KT/V, HD patients 1997-2006

| Year | No. of subjects | Mean | SD | Median | LQ | UQ | % patients ≤1.3 |
|---|---|---|---|---|---|---|---|
| 1997 | 1558 | 1.4 | 0.3 | 1.4 | 1.2 | 1.6 | 59 |
| 1998 | 2022 | 1.4 | 0.3 | 1.4 | 1.2 | 1.6 | 67 |
| 1999 | 2831 | 1.5 | 0.3 | 1.5 | 1.3 | 1.7 | 73 |
| 2000 | 4087 | 1.5 | 0.4 | 1.5 | 1.3 | 1.8 | 75 |
| 2001 | 4908 | 1.6 | 0.4 | 1.5 | 1.3 | 1.8 | 78 |
| 2002 | 5496 | 1.6 | 0.4 | 1.6 | 1.4 | 1.8 | 81 |
| 2003 | 6516 | 1.6 | 0.4 | 1.6 | 1.4 | 1.8 | 82 |
| 2004 | 7453 | 1.6 | 0.4 | 1.6 | 1.4 | 1.8 | 82 |
| 2005 | 8749 | 1.6 | 0.4 | 1.6 | 1.4 | 1.9 | 83 |
| 2006 | 10919 | 1.7 | 0.4 | 1.6 | 1.4 | 1.9 | 84 |

**Figure 11.2.7a:** Cumulative distribution of prescribed KT/V, HD patients 1997-2006



In 2006, 142 (37.4%) centres returned data on delivered KT/V. Overall delivered KT/V data were reported in 37.9% of HD patients. The methods of measuring KT/V were urea kinetic modeling (64.1%), online modeling (23.5%) and others (12.4%).

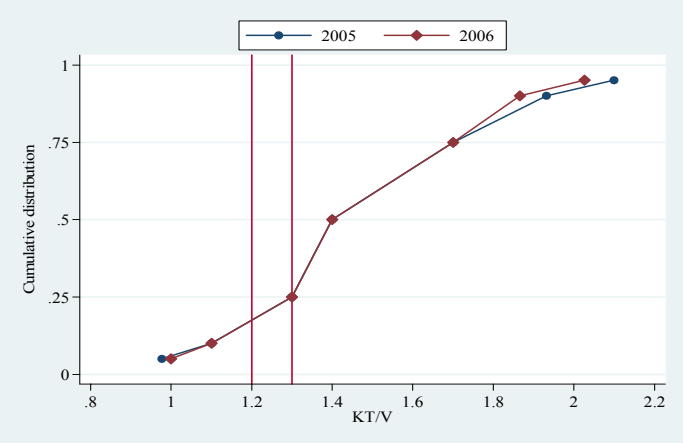
Table 11.2.7b and Fig. 11.2.7b shows that although the prescribed median KT/V was 1.6, the delivered median KT/V was only 1.4. In 2006, the percentage of patients with a delivered KT/V $\geq$ 1.2 and KT/V $\geq$ 1.3 was 82% and 66% respectively.

**Table 11.2.7b:** Distribution of delivered KT/V, HD patients 2005-2006

| Year | No. of subjects | Mean | SD | Median | LQ | UQ | % patients ≤1.2 | % patients ≤1.3 | Variance* |
|---|---|---|---|---|---|---|---|---|---|
| 2005 | 1760 | 1.6 | 2.7 | 1.4 | 1.3 | 1.7 | 82 | 65 | 0 |
| 2006 | 5553 | 1.5 | 1.3 | 1.4 | 1.3 | 1.7 | 82 | 66 | 0 |

* (prescribed KT/V – delivered KT/V)/ prescribed KT/V

**Figure 11.2.7b:** Cumulative distribution of delivered KT/V, HD patients 2005-2006



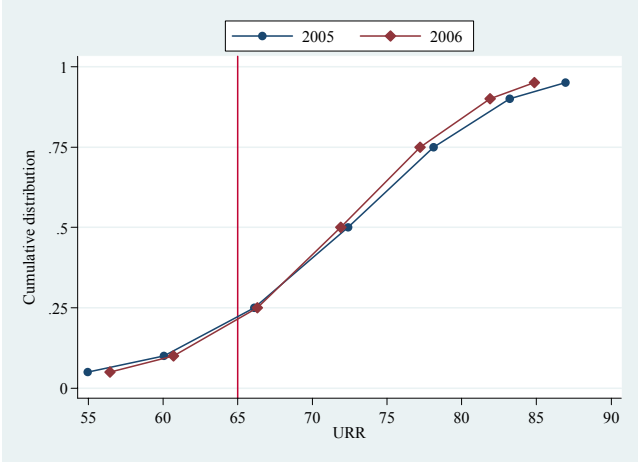

Data returns for Urea Reduction Ratio (URR) were better than that of delivered KT/V. Overall 201 centres (52.9%) representing 55.1% of HD population submitted data on URR. Post dialysis blood sampling methodologies were not requested for and hence not specified.

In 2006, the median URR was 71.9% and the percentage of patients with URR $\geq$ 65% was 79%. (Table 11.2.7c and Fig. 11.2.7c)

**Table 11.2.7c** Distribution of URR, HD patients 2005 – 2006

| Year | No. of subjects | Mean | SD | Median | LQ | UQ | % patients ≤65 |
|---|---|---|---|---|---|---|---|
| 2005 | 2514 | 71.8 | 10.3 | 72.4 | 66.1 | 78.1 | 79 |
| 2006 | 8065 | 71.4 | 9.2 | 71.9 | 66.3 | 77.2 | 79 |

**Figure 11.2.7c** Cumulative distribution of URR, HD patients 2005 - 2006



The median blood flow rates among centres had increased from 250 mls/min in 1997 to 300mls/min in 2006. There is still a wide variation in practices among centres. The median blood flow rates among centres ranges from 220mls/min to 400mls/min. (Table 11.2.8(a) and Fig. 11.2.8 (a))

**Table 11.2.8:** Variation in HD prescription among HD centres 2006

**Table 11.2.8(a)** Median blood flow rates in HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 45 | 200 | 200 | 220 | 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 | 184 | 220 | 250 | 257.5 | 287.5 | 300 | 350 | 400 |
| 2005 | 228 | 200 | 250 | 260 | 300 | 300 | 350 | 400 |
| 2006 | 279 | 210 | 250 | 270 | 300 | 300 | 350 | 400 |

**Figure 11.2.8(a):** Variation in median blood flow rates in HD patients among HD centres 2006

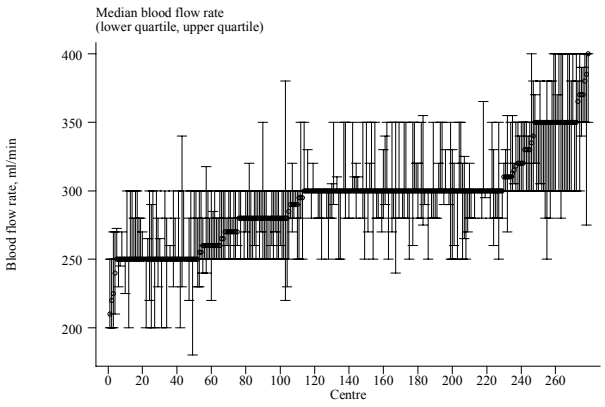
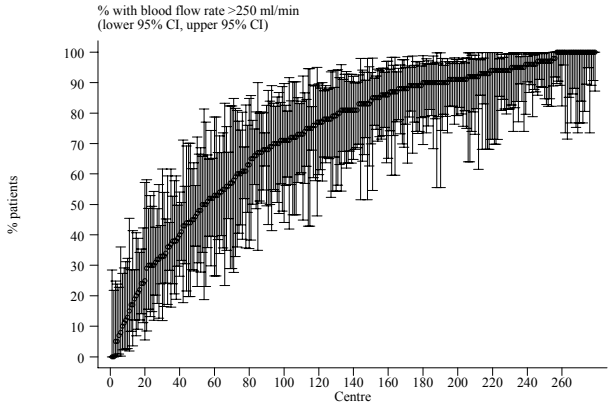



**Figure 11.2.8(b):** Variation in Proportion of patients with blood flow rates > 250 ml/min among HD centres 2006




There was an increase in the proportion of patients with blood flow rates from > 250mls/min. In 2006, 50% of centres had 81% of their patients with blood flow rates of > 250mls/min compared to only 13% in 1997. (Table 11.2.8(b))

There was still a wide variation in the proportion of patients with blood flow rate > 250mls/min among centres. Two centres that had no patients with blood flow rates of > 250mls/min. (Fig. 11.2.8 (b))

**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 | 45 | 0 | 0 | 4 | 13 | 27 | 60 | 64 |
| 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 | 184 | 0 | 17 | 50 | 73 | 86 | 96 | 100 |
| 2005 | 228 | 0 | 17 | 54.5 | 77 | 90.5 | 99 | 100 |
| 2006 | 279 | 0 | 19 | 57 | 81 | 92 | 100 | 100 |

The majority of centres had 100% of their patients with 3 HD sessions/ week. There are some centres with significant proportion of their patients with their patients with less than 3 HD session/ week. (Table 11.2.8(c) and Fig. 11.2.8 (c))

**Table 12.2.8(c)** Proportion of patients with 3 HD sessions per week

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 47 | 80 | 92 | 99 | 100 | 100 | 100 | 100 |
| 1998 | 46 | 80 | 98 | 100 | 100 | 100 | 100 | 100 |
| 1999 | 69 | 17 | 45 | 97 | 100 | 100 | 100 | 100 |
| 2000 | 100 | 25 | 44.5 | 90.5 | 100 | 100 | 100 | 100 |
| 2001 | 118 | 23 | 50 | 92 | 100 | 100 | 100 | 100 |
| 2002 | 137 | 28 | 48 | 94 | 99 | 100 | 100 | 100 |
| 2003 | 160 | 36 | 55 | 97 | 100 | 100 | 100 | 100 |
| 2004 | 188 | 37 | 70 | 98 | 100 | 100 | 100 | 100 |
| 2005 | 231 | 40 | 75 | 99 | 100 | 100 | 100 | 100 |
| 2006 | 283 | 52 | 83 | 98 | 100 | 100 | 100 | 100 |

**Figure 11.2.8(c):** Variation in proportion of patients with 3 HD sessions per week among HD centres 2006

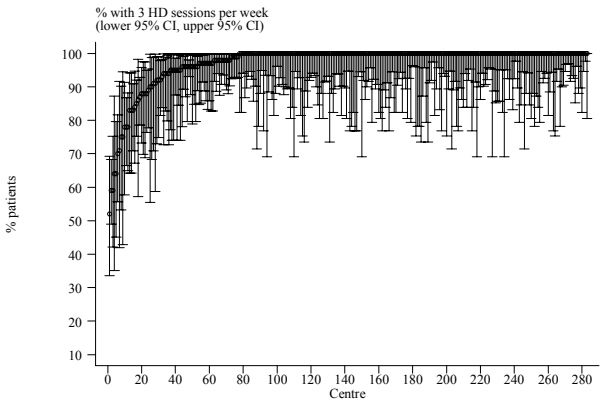
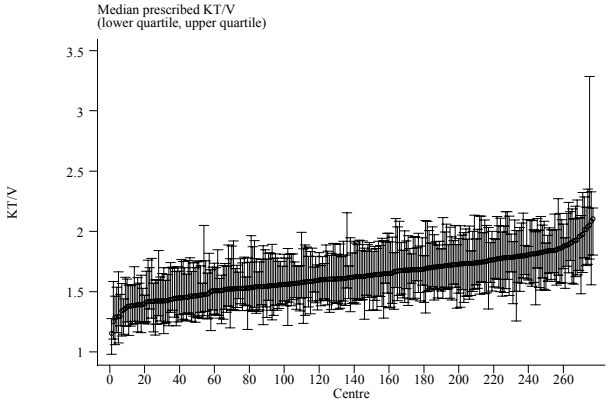



**Figure 11.2.8(d):** Variation in median prescribed KT/V in HD patients among HD centres 2006




The median prescribed KT/V in HD patients was 1.6 in 2006. The minimum prescribed KT/V was 1.2 and maximum prescribed KT/V was 2.1. (Table 11.2.8(d)) The variation of prescribed KT/V among centres (fig. 11.2.8 (d)) was less marked than the variation in proportion of patients with blood flow rates of > 250 mls/min. (fig. 11.2.8(b)).

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

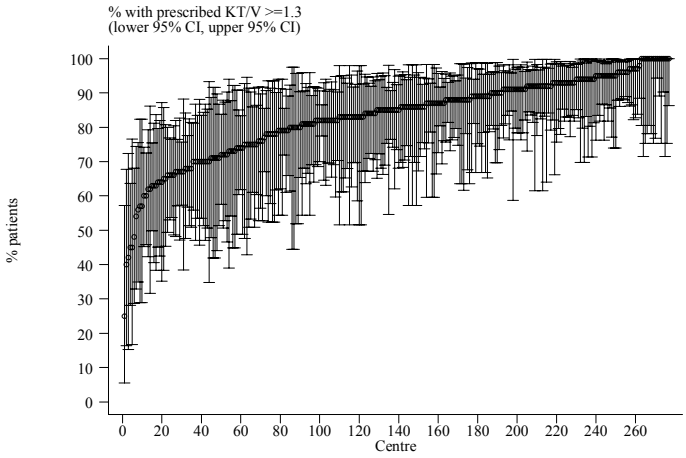
| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 1.2 | 1.2 | 1.3 | 1.4 | 1.4 | 1.5 | 1.8 |
| 1998 | 45 | 1.1 | 1.3 | 1.4 | 1.4 | 1.5 | 1.6 | 1.7 |
| 1999 | 67 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 |
| 2000 | 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 | 181 | 1.2 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2.2 |
| 2005 | 224 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2 |
| 2006 | 277 | 1.2 | 1.4 | 1.5 | 1.6 | 1.7 | 1.9 | 2.1 |

In 2006, half the centres had 85% of their patients with a prescribed KT/V $\geq$ 1.3. However there was variation in proportion of patients with prescribed KT/V $\geq$ 1.3 among the HD centres ranging from below 30% in one centre to 100% in a small number of centres. (Fig. 11.2.8 (e))

**Table 11.2.8(e):** Proportion of patients with prescribed KT/V ≥ 1.3

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 1997 | 44 | 32 | 44 | 51.5 | 59.5 | 70 | 90 | 100 |
| 1998 | 45 | 0 | 46 | 60 | 67 | 74 | 85 | 96 |
| 1999 | 67 | 36 | 50 | 67 | 73 | 83 | 94 | 100 |
| 2000 | 99 | 26 | 47 | 66 | 79 | 86 | 94 | 100 |
| 2001 | 114 | 42 | 52 | 71 | 81.5 | 89 | 96 | 100 |
| 2002 | 132 | 35 | 58 | 74.5 | 82 | 90 | 97 | 100 |
| 2003 | 150 | 30 | 57 | 77 | 84 | 91 | 96 | 100 |
| 2004 | 181 | 28 | 61 | 74 | 83 | 91 | 100 | 100 |
| 2005 | 224 | 47 | 63 | 75 | 85 | 92 | 100 | 100 |
| 2006 | 277 | 25 | 62 | 76 | 85 | 92 | 100 | 100 |

**Figure 11.2.8(e):** Variation in proportion of patients with prescribed KT/V $\geq$ 1.3 among HD centres 2006

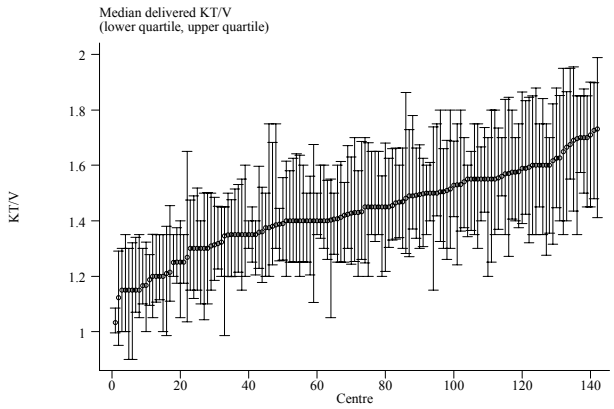



The median delivered KT/V in HD patients was 1.4 in 2006. The minimum delivered KT/V was 1.0 and maximum delivered KT/V was 1.7. There was marked variation of median delivered KT/V among HD centres. (Table 11.2.8 f and fig 11.2.8 f)

**Table 11.2.8(f):** Median delivered KT/V in HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 2005 | 52 | 1.2 | 1.2 | 1.3 | 1.4 | 1.5 | 1.7 | 1.7 |
| 2006 | 142 | 1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.7 | 1.7 |

**Figure 11.2.8(f):** Variation in median delivered KT/V in HD patients among HD centres 2006

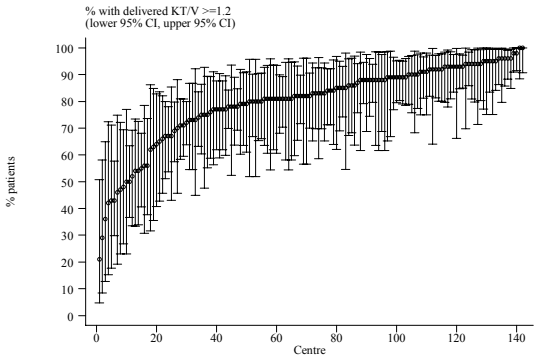


In 2006, 50% of centres had 82.5% of their patients with a delivered KT/V ≥ 1.2. There was however a wide variation in the proportion of patients with a delivered KT/V ≥ 1.2 among centres. Eleven centres had < 50% of their patients with a delivered KT/V ≥ 1.2. Two centres had 100% of their patients with delivered KT/V ≥ 1.2. (Table 11.2.8 g and Fig. 11.8.2 g)

**Table 11.2.8(g)** Proportion of patients with delivered KT/V ≥1.2

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 2005 | 52 | 40 | 53 | 74 | 84 | 90.5 | 100 | 100 |
| 2006 | 142 | 21 | 47 | 75 | 82.5 | 90 | 96 | 100 |

**Figure 11.2.8(g):** Variation in proportion of patients with delivered KT/V ≥ 1.2 among HD centres 2006

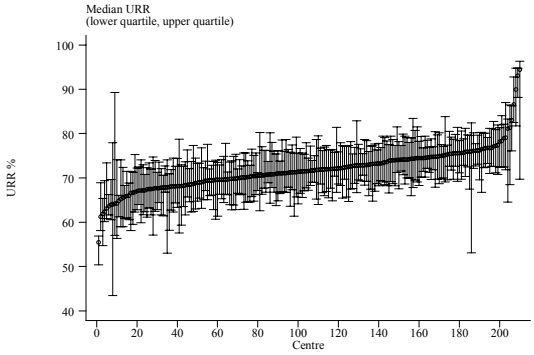



The median URR in HD centres was 71.6% in 2006. The minimum URR was 55.4% and maximum URR was 94.4%. (Table 11.2.8 h) There was variation of median URR among HD centres but the variation was less wide than the variation of delivered KT/V among HD centres as shown by the less steep curve. (fig 11.2.8 h and fig 11.2.8 h)

**Table 11.2.8(h)** Median URR among HD patients

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 2005 | 73 | 61.3 | 66.6 | 69.8 | 71.9 | 74.4 | 85.9 | 96.2 |
| 2006 | 210 | 55.4 | 64.8 | 69.1 | 71.6 | 74.4 | 78.2 | 94.4 |

**Figure 11.2.8(h):** Variation in median URR among HD patients, HD centres 2006

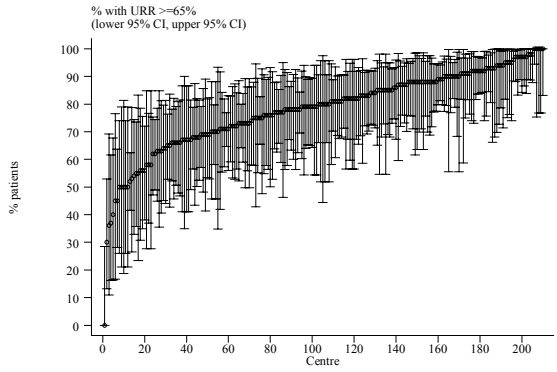



In 2006, 50% of centres had 80% of their patients with URR ≥ 65%. There was however a wide variation in the proportion of patients with URR ≥ 65% among centres. Six centres had < 50% of their patients with a URR ≥ 65%. One centre had no patients with URR ≥ 65%. Four centres had 100% of their patients with a URR ≥ 65%. (Table 11.2.8 j and Fig. 11.8.2 j)

**Table 11.2.8 (i)** Proportion of HD patients with URR ≥ 65%

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 2005 | 73 | 40 | 53 | 70 | 81 | 88 | 100 | 100 |
| 2006 | 210 | 0 | 50 | 70 | 80 | 88 | 97 | 100 |

**Figure 11.2.8(i):** Variation in proportion of patients with URR ≥ 65% among HD centres 2006



## SECTION 11.3: TECHNIQUE SURVIVAL ON DIALYSIS

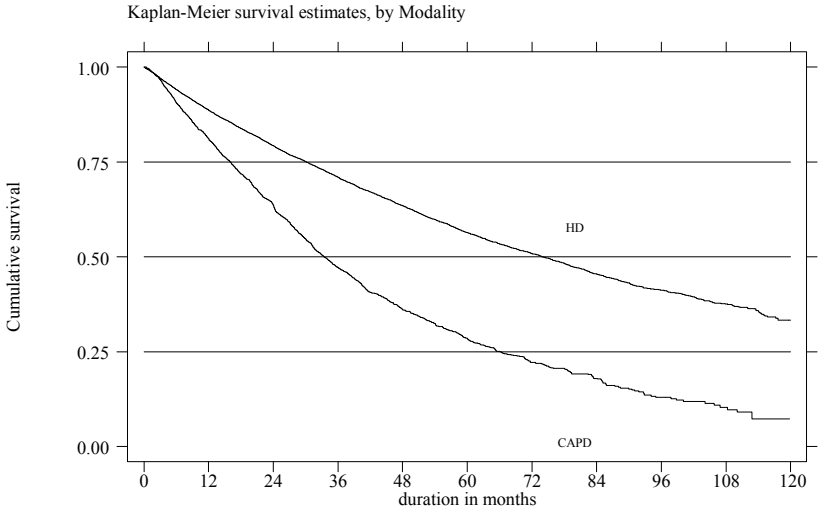
The unadjusted HD technique survival at 1 year, 5 years and 10 years was 89%, 56% and 33% respectively. The CAPD unadjusted technique survival was 81% at 1 year, 29% at 5 years and 7% at 10 years. (Table 11.3.2 and Fig. 11.3.1)

**Table 11.3.1:** Unadjusted technique survival by Dialysis modality, 1997-2006

| Dialysis modality | CAPD | | | HD | | | All Dialysis | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2537 | 91 | 1 | 17560 | 94 | 0 | 20097 | 94 | 0 |
| 12 | 2087 | 81 | 1 | 14950 | 89 | 0 | 17037 | 88 | 0 |
| 24 | 1376 | 64 | 1 | 10955 | 79 | 0 | 12331 | 77 | 0 |
| 36 | 847 | 47 | 1 | 7895 | 71 | 0 | 8742 | 68 | 0 |
| 48 | 497 | 36 | 1 | 5592 | 63 | 0 | 6089 | 60 | 0 |
| 60 | 293 | 29 | 1 | 3809 | 56 | 0 | 4102 | 53 | 0 |
| 72 | 160 | 22 | 1 | 2536 | 51 | 1 | 2695 | 47 | 0 |
| 84 | 88 | 18 | 1 | 1578 | 45 | 1 | 1666 | 42 | 1 |
| 96 | 44 | 13 | 1 | 884 | 41 | 1 | 927 | 37 | 1 |
| 108 | 19 | 10 | 1 | 372 | 38 | 1 | 390 | 34 | 1 |
| 120 | 3 | 7 | 2 | 27 | 33 | 1 | 29 | 30 | 1 |

* No. = Number at risk SE=standard error

**Figure11.3.1:** Unadjusted technique survival by Dialysis modality, 1997-2006




HD Technique Survival 1997-2006

There was no apparent difference in the unadjusted HD technique survival by year of starting dialysis for the years 1997 to 2006. (Table 11.3.2 and fig 11.3.2)

**Table 11.3.2:** Unadjusted technique survival by year of entry, 1997-2006

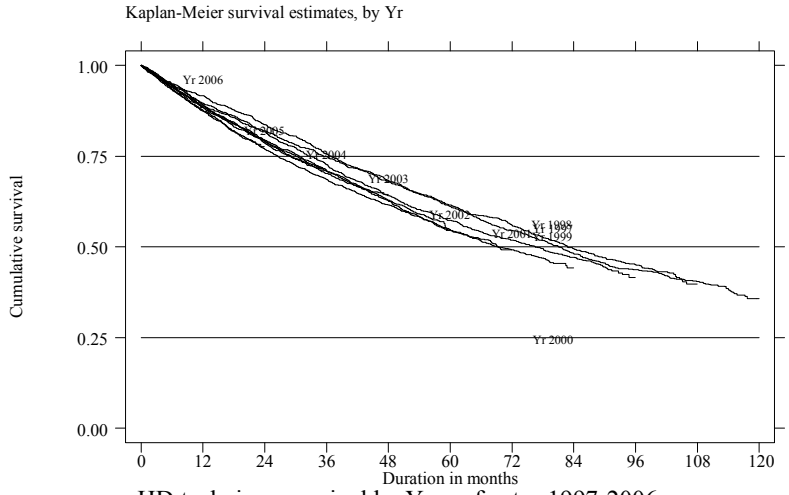
| Year | 1997 | | | 1998 | | | 1999 | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 946 | 93 | 1 | 1101 | 95 | 1 | 1321 | 95 | 1 |
| 12 | 891 | 89 | 1 | 1051 | 92 | 1 | 1236 | 90 | 1 |
| 24 | 810 | 82 | 1 | 942 | 84 | 1 | 1097 | 82 | 1 |
| 36 | 735 | 75 | 1 | 839 | 76 | 1 | 961 | 73 | 1 |
| 48 | 660 | 68 | 1 | 744 | 68 | 1 | 839 | 64 | 1 |
| 60 | 587 | 62 | 2 | 664 | 61 | 1 | 742 | 57 | 1 |
| 72 | 512 | 55 | 2 | 603 | 56 | 1 | 670 | 52 | 1 |
| 84 | 450 | 48 | 2 | 528 | 49 | 2 | 602 | 47 | - |
| 96 | 406 | 44 | 2 | 479 | 45 | 2 | - | - | - |
| 108 | 372 | 40 | 2 | - | - | - | - | - | - |
| 120 | 27 | 36 | 2 | - | - | - | - | - | - |

| Year | 2000 | | | 2001 | | | 2002 | | | 2003 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 1602 | 94 | 1 | 1766 | 93 | 1 | 2009 | 94 | 1 | 2157 | 94 | 0 |
| 12 | 1481 | 89 | 1 | 1620 | 87 | 1 | 1883 | 89 | 1 | 1998 | 88 | 1 |
| 24 | 1277 | 79 | 1 | 1404 | 77 | 1 | 1616 | 79 | 1 | 1764 | 79 | 1 |
| 36 | 1124 | 71 | 1 | 1235 | 69 | 1 | 1435 | 70 | 1 | 1565 | 71 | 1 |
| 48 | 982 | 63 | 1 | 1098 | 62 | 1 | 1274 | 63 | 1 | - | - | - |
| 60 | 853 | 55 | 1 | 966 | 55 | 1 | - | - | - | - | - | - |
| 72 | 756 | 49 | 1 | - | - | - | - | - | - | - | - | - |

| Year | 2004 | | | 2005 | | | 2006 | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2534 | 94 | 0 | 2648 | 93 | 0 | 1482 | 94 | 1 |
| 12 | 2341 | 88 | 1 | 2453 | 88 | 1 | - | - | - |
| 24 | 2050 | 79 | 1 | - | - | - | - | - | - |

* No. = Number at risk SE=standard error

**Figure 11.3.2:** Unadjusted technique survival by year of entry, 1997-2006




HD technique survival by Year of entry 1997-2006

The unadjusted HD technique survival was better in the younger age groups than the older age group, ten years unadjusted HD technique survival in the age group of 25-34, 35-44, 44-54, 55-64 and ≥ 65 years old was 71%, 46%, 36%, 20% and 13% respectively. (Table 11.3.3 and fig 11.3.3)

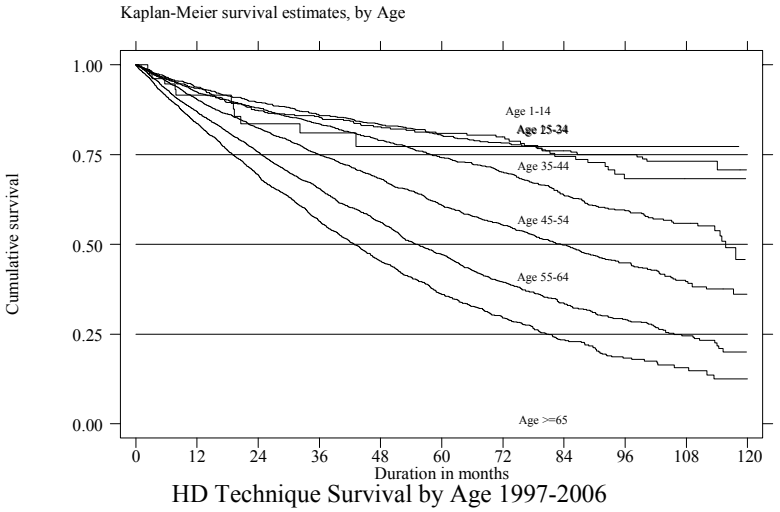
**Table 11.3.3:** Unadjusted technique survival by age, 1997-2006

| 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 | 66 | 95 | 0 | 678 | 96 | 1 | 1412 | 96 | 1 | 2478 | 96 | 0 |
| 12 | 55 | 92 | 0 | 584 | 94 | 1 | 1242 | 94 | 1 | 2169 | 92 | 1 |
| 24 | 41 | 84 | 1 | 430 | 87 | 1 | 961 | 89 | 1 | 1727 | 88 | 1 |
| 36 | 28 | 81 | 1 | 334 | 85 | 1 | 770 | 86 | 1 | 1359 | 84 | 1 |
| 48 | 19 | 77 | 1 | 251 | 83 | 2 | 610 | 83 | 1 | 1051 | 79 | 1 |
| 60 | 13 | 77 | 1 | 190 | 81 | 2 | 444 | 80 | 1 | 803 | 74 | 1 |
| 72 | 11 | 77 | 1 | 141 | 80 | 2 | 347 | 78 | 1 | 575 | 70 | 1 |
| 84 | 9 | 77 | 1 | 97 | 75 | 3 | 235 | 76 | 2 | 367 | 64 | 1 |
| 96 | 5 | 77 | 1 | 56 | 68 | 3 | 144 | 75 | 2 | 226 | 59 | 2 |
| 108 | 3 | 77 | 1 | 31 | 68 | 3 | 65 | 73 | 2 | 98 | 56 | 2 |
| 120 | - | - | - | 4 | 68 | 3 | 4 | 71 | 3 | 4 | 46 | 4 |

| Age group (years) Interval (months) | 45-54 | | | 55-64 | | | >=65 | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 4468 | 95 | 0 | 4888 | 93 | 0 | 3571 | 91 | 0 |
| 12 | 3817 | 90 | 0 | 4154 | 87 | 0 | 2931 | 84 | 1 |
| 24 | 2881 | 82 | 1 | 2958 | 76 | 1 | 1961 | 69 | 1 |
| 36 | 2111 | 75 | 1 | 2068 | 66 | 1 | 1231 | 56 | 1 |
| 48 | 1540 | 68 | 1 | 1393 | 56 | 1 | 730 | 45 | 1 |
| 60 | 1053 | 61 | 1 | 889 | 47 | 1 | 423 | 36 | 1 |
| 72 | 710 | 55 | 1 | 535 | 39 | 1 | 226 | 30 | 1 |
| 84 | 442 | 50 | 1 | 322 | 34 | 1 | 113 | 23 | 1 |
| 96 | 234 | 45 | 1 | 169 | 29 | 1 | 56 | 18 | 1 |
| 108 | 93 | 40 | 2 | 69 | 24 | 1 | 19 | 16 | 2 |
| 120 | 9 | 36 | 2 | 6 | 20 | 2 | 3 | 13 | 2 |

* No. = Number at risk SE=standard error

**Figure 11.3.3:** Unadjusted technique survival by age, 1997-2006




HD Technique Survival by Age 1997-2006

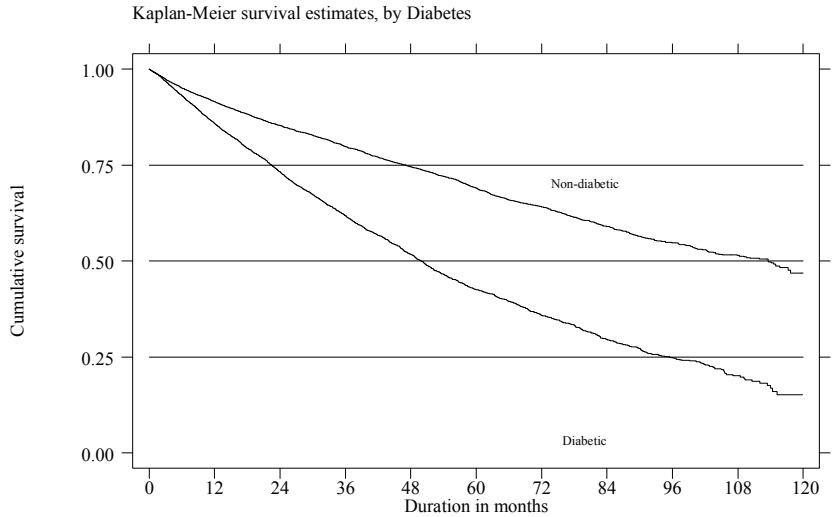
Unadjusted HD technique survival in non diabetics at 1 year, 5 years and 10years was 91%, 69% and 47% respectively. Unadjusted HD technique survival for diabetics was worse than non diabetics with at 86%, 43% and 15% at one, five and ten years respectively. (Table 11.3.4 and Fig 11.3.4)

**Table 11.3.4:** Unadjusted technique survival by Diabetes status, 1997-2006

| Diabetes status | Non-Diabetic | | | Diabetic | | |
|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 8790 | 95 | 0 | 8770 | 93 | 0 |
| 12 | 7690 | 91 | 0 | 7260 | 86 | 0 |
| 24 | 5980 | 85 | 0 | 4975 | 73 | 0 |
| 36 | 4637 | 80 | 0 | 3258 | 62 | 1 |
| 48 | 3519 | 75 | 1 | 2073 | 52 | 1 |
| 60 | 2569 | 69 | 1 | 1240 | 43 | 1 |
| 72 | 1807 | 64 | 1 | 731 | 36 | 1 |
| 84 | 1181 | 59 | 1 | 398 | 30 | 1 |
| 96 | 680 | 55 | 1 | 205 | 25 | 1 |
| 108 | 311 | 51 | 1 | 62 | 20 | 1 |
| 120 | 23 | 47 | 2 | 5 | 15 | 2 |

* No. = Number at risk SE=standard error

**Figure 11.3.4:** Unadjusted technique survival by Diabetes status, 1997-2006




HD Technique Survival by Diabetes 1997-2006

# CHAPTER 12

# Chronic Peritoneal Dialysis Practices

Sunita Bavanandan
Lily Mushahar

## SECTION 1: PERITONEAL DIALYSIS (PD) PRACTICES

### 12.1: Mode of PD (Tables 12.1.1 to 12.1.4)

In 2006, CAPD still remained the commonest mode of PD therapy accounting for 90% of the total. Automated peritoneal dialysis (APD) penetration has been steadily increasing from 1% when it was first introduced in 2004 to 6% at present. As compared to PD practice in certain countries where Icodextrin is widely used in high transporter PD patients, a significant 4% of our patients were still practicing DAPD. This is most likely due to our local financial constraints. Most patients (92%) were on the Baxter disconnect system. The majority of patients (91%) were on 4 exchanges per day but there is a trend for an increased percentage of patients on 3 exchanges a day from 1% in 2004 to 4% presently. This may be a reflection of more aggressive management of advanced chronic kidney disease, with earlier initiation of dialysis allowing incremental dialysis. Conversely, up to 5% of patients were doing 5 exchanges per day. Most patients (82%) used a fill volume of 2L but up to 11% were using larger fill volumes while 7%, mainly paediatric, were on smaller exchange volumes than 2L.

**Table 12.1.1:** Chronic Peritoneal Dialysis Regimes, 1997-2006

| PD regime | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Standard CAPD | 440 | 94 | 492 | 93 | 577 | 96 | 633 | 97 | 755 | 98 |
| DAPD | 26 | 6 | 32 | 6 | 16 | 3 | 16 | 2 | 17 | 2 |
| Automated PD/ CCPD | 4 | 1 | 6 | 1 | 6 | 1 | 5 | 1 | 2 | 0 |
| TOTAL | 470 | 100 | 530 | 100 | 599 | 100 | 654 | 100 | 774 | 100 |

| PD regime | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Standard CAPD | 837 | 97 | 1153 | 97 | 1211 | 96 | 1271 | 93 | 1362 | 90 |
| DAPD | 24 | 3 | 33 | 3 | 39 | 3 | 45 | 3 | 68 | 4 |
| Automated PD/ CCPD | 3 | 0 | 5 | 0 | 12 | 1 | 50 | 4 | 87 | 6 |
| TOTAL | 864 | 100 | 1191 | 100 | 1262 | 100 | 1366 | 100 | 1517 | 100 |

**Table 12.1.2:** CAPD Connectology, 1997-2006

| CAPD Connectology | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| UVXD | 27 | 5 | 10 | 2 | 3 | 1 | 0 | 0 | 0 | 0 |
| Baxter disconnect | 461 | 93 | 511 | 95 | 347 | 58 | 235 | 39 | 436 | 57 |
| B Braun disconnect | 10 | 2 | 18 | 3 | 248 | 41 | 370 | 61 | 324 | 43 |
| Fresenius disconnect | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 498 | 100 | 539 | 100 | 598 | 100 | 605 | 100 | 760 | 100 |

| CAPD Connectology | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| UVXD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Baxter disconnect | 719 | 87 | 1038 | 87 | 1142 | 88 | 1252 | 90 | 1423 | 92 |
| B Braun disconnect | 93 | 11 | 7 | 1 | 14 | 1 | 1 | 0 | 0 | 0 |
| Fresenius disconnect | 11 | 1 | 154 | 13 | 145 | 11 | 111 | 8 | 119 | 8 |
| Others | 0 | 0 | 1 | 0 | 0 | 0 | 28 | 2 | 6 | 0 |
| TOTAL | 823 | 100 | 1200 | 100 | 1301 | 100 | 1392 | 100 | 1548 | 100 |

**Table 12.1.3:** CAPD Number of Exchanges per day, 1997-2006

| No. of Exchanges/ day | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 2 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 |
| 3 | 3 | 1 | 4 | 1 | 4 | 1 | 1 | 0 | 5 | 1 |
| 4 | 454 | 97 | 508 | 96 | 579 | 97 | 624 | 96 | 735 | 95 |
| 5 | 12 | 3 | 16 | 3 | 13 | 2 | 23 | 4 | 31 | 4 |
| TOTAL | 469 | 100 | 530 | 100 | 596 | 100 | 650 | 100 | 772 | 100 |

| No. of Exchanges/ day | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 2 | 0 | 0 | 4 | 0 | 6 | 0 | 3 | 0 | 4 | 0 |
| 3 | 11 | 1 | 14 | 1 | 12 | 1 | 25 | 2 | 55 | 4 |
| 4 | 834 | 96 | 1136 | 96 | 1225 | 95 | 1280 | 94 | 1357 | 91 |
| 5 | 28 | 3 | 32 | 3 | 52 | 4 | 48 | 4 | 74 | 5 |
| TOTAL | 873 | 100 | 1186 | 100 | 1295 | 100 | 1356 | 100 | 1490 | 100 |

**Table 12.1.4:** CAPD Volume per Exchange, 1997– 2006

| Volume per Exchange (L) | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| <1.5 | 24 | 5 | 35 | 7 | 32 | 5 | 46 | 7 | 51 | 7 |
| 1.5-1.9 | 0 | 0 | 20 | 4 | 22 | 4 | 25 | 4 | 27 | 4 |
| 2.0 | 444 | 95 | 476 | 90 | 535 | 91 | 570 | 88 | 684 | 89 |
| >2.0 | 0 | 0 | 0 | 0 | 2 | 0 | 7 | 1 | 9 | 1 |
| TOTAL | 468 | 100 | 531 | 100 | 591 | 100 | 648 | 100 | 771 | 100 |

| Volume per Exchange (L) | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| <1.5 | 64 | 7 | 64 | 5 | 73 | 6 | 85 | 6 | 67 | 4 |
| 1.5-1.9 | 24 | 3 | 36 | 3 | 36 | 3 | 38 | 3 | 45 | 3 |
| 2.0 | 769 | 88 | 1051 | 85 | 1117 | 84 | 1153 | 83 | 1262 | 82 |
| >2.0 | 14 | 2 | 80 | 6 | 101 | 8 | 113 | 8 | 168 | 11 |
| TOTAL | 871 | 100 | 1231 | 100 | 1327 | 100 | 1389 | 100 | 1542 | 100 |

## SECTION 2: SOLUTE CLEARANCE ACHIEVEMENT AND PERITONEAL TRANSPORT

The median delivered weekly Kt/V has remained unchanged at 2.1 since 2003, with 59% of patients achieving K/DOQI recommended Kt/V of more than or equal to 2.0. Comparison between PD centres has shown a narrowing of the gap between the highest- and lowest- performing centers, with less than 3-fold variation in terms of the percentage of patients in each center achieving a Kt/V of > 2.0 per week. Half of the centers were able to have at least 58% of their patients achieving the K/DOQI target (Tables and figures 12.2.1 and 12.2.2).

**Table 12.2.1:** Distribution of delivered KT/V, CAPD patients 2003-2006

| Year | No of Subjects | Mean | SD | Median | LQ | UQ | % patients ≥2.0 per week |
|---|---|---|---|---|---|---|---|
| 2003 | 789 | 3.7 | 19.9 | 2.1 | 1.8 | 2.5 | 59 |
| 2004 | 1068 | 2.8 | 9.9 | 2.1 | 1.8 | 2.5 | 61 |
| 2005 | 1124 | 3.3 | 13.7 | 2.1 | 1.8 | 2.5 | 58 |
| 2006 | 1290 | 2.4 | 3.6 | 2.1 | 1.8 | 2.4 | 59 |

**Figure 12.2.1:** Cumulative distribution of delivered KT/V, CAPD patients 2003-2006

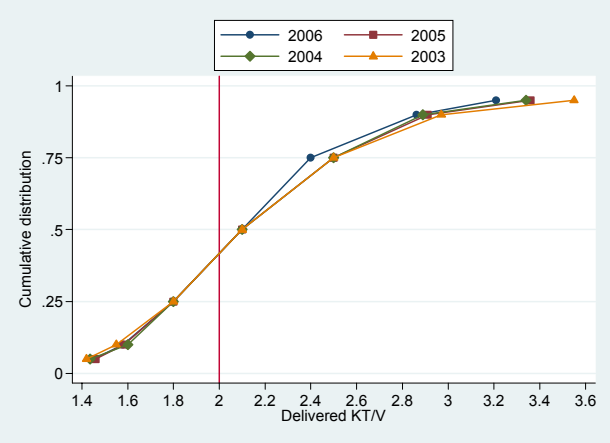



**Figure 12.2.2:** Variation in proportion of patients with KT/V ≥ 2.0 per week among CAPD centres 2006

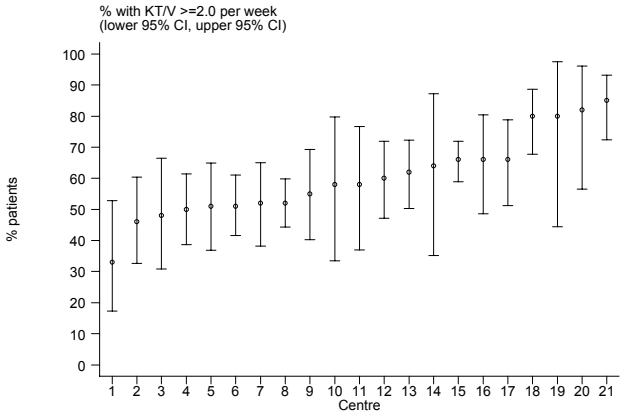



**Table 12.2.2:** Variation in proportion of patients with KT/V ≥ 2.0 per week among CAPD

| 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 |
| 2005 | 18 | 11 | 11 | 50 | 53.5 | 63 | 92 | 92 |
| 2006 | 21 | 33 | 46 | 51 | 58 | 66 | 82 | 85 |

Among incident PD patients low average transport status was commonest (42%) followed by high average transport status (37%). However, a proportion of patients developed changes in their membrane characteristics over time. There was high PET status in 15% of prevalent patients compared to 9% in new PD patients.

**Table 12.2.3:** Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2006

| PET | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| Low | 10 | 6 | 67 | 15 | 69 | 12 | 105 | 12 |
| Low average | 85 | 51 | 187 | 41 | 246 | 41 | 360 | 42 |
| High average | 62 | 37 | 176 | 38 | 223 | 37 | 314 | 37 |
| High | 11 | 7 | 29 | 6 | 62 | 10 | 75 | 9 |
| TOTAL | 168 | 100 | 459 | 100 | 600 | 100 | 854 | 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 2003-2006

| PET | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| Low | 10 | 3 | 39 | 9 | 44 | 13 | 23 | 8 |
| Low average | 174 | 44 | 180 | 42 | 130 | 39 | 106 | 38 |
| High average | 171 | 43 | 168 | 39 | 118 | 35 | 106 | 38 |
| High | 39 | 10 | 41 | 10 | 42 | 13 | 41 | 15 |
| TOTAL | 394 | 100 | 428 | 100 | 334 | 100 | 276 | 100 |

*Prevalent PD patients=patients commencing dialysis before 2003

## SECTION 3: TECHNIQUE SURVIVAL ON PD

In terms of technique survival, CAPD fared worse compared to haemodialysis with Kaplan-Meir cumulative survival curves diverging as early as 6 months. One- , three- and five-year technique survival for CAPD was 81%, 47% and 29% as compared to haemodialysis at 89%, 71% and 56% respectively. Median technique survival time was less than 36 months. Overall these trends in technique survival remained unchanged by year of entry (Tables and figures 12.3.1 and 12.3.2).

The youngest age group between 1-14 years has the best technique survival rate while the oldest age group aged >65years consistently had the worst technique survival (Table and figure 12.3.3). Diabetics have a poorer technique survival than the non-diabetics (Table and figure 12.3.4). However, there was no gender difference (Table and figure 12.3.5).

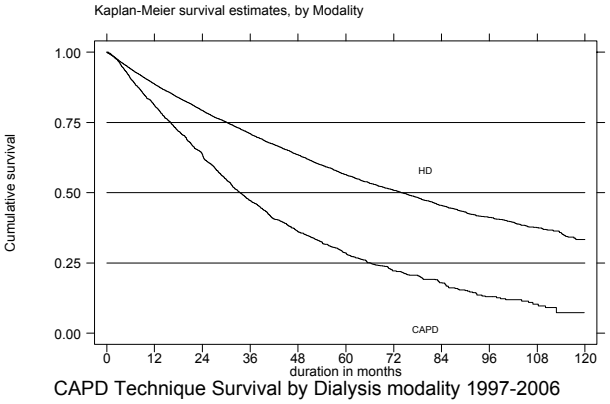
The commonest factor for PD drop-out between 1997-2006 was peritonitis (44%), followed by membrane failure (19%) and technical problems (19%) (Table12.3.9). Patient preference contributed to a further 13% of conversions to HD.

**Table 12.3.1:** Unadjusted technique survival by Dialysis modality, 1997-2006

| Dialysis modality | CAPD | | | HD | | | All Dialysis | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 2537 | 91 | 1 | 17560 | 94 | 0 | 20097 | 94 | 0 |
| 12 | 2087 | 81 | 1 | 14950 | 89 | 0 | 17037 | 88 | 0 |
| 24 | 1376 | 64 | 1 | 10955 | 79 | 0 | 12331 | 77 | 0 |
| 36 | 847 | 47 | 1 | 7895 | 71 | 0 | 8742 | 68 | 0 |
| 48 | 497 | 36 | 1 | 5592 | 63 | 0 | 6089 | 60 | 0 |
| 60 | 293 | 29 | 1 | 3809 | 56 | 0 | 4102 | 53 | 0 |
| 72 | 160 | 22 | 1 | 2536 | 51 | 1 | 2695 | 47 | 0 |
| 84 | 88 | 18 | 1 | 1578 | 45 | 1 | 1666 | 42 | 1 |
| 96 | 44 | 13 | 1 | 884 | 41 | 1 | 927 | 37 | 1 |
| 108 | 19 | 10 | 1 | 372 | 38 | 1 | 390 | 34 | 1 |
| 120 | 4 | 7 | 2 | 54 | 33 | 1 | 57 | 30 | 1 |

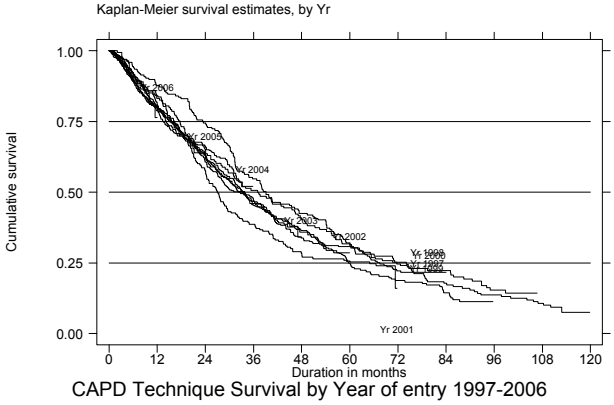
* No. = Number at risk SE=standard error

**Figure 12.3.1:** Unadjusted technique survival by Dialysis modality, 1997-2006




CAPD Technique Survival by Dialysis modality 1997-2006

**Figure 12.3.2:** Unadjusted technique survival by year of entry, 1997-2006




CAPD Technique Survival by Year of entry 1997-2006

**Table 12.3.2:** Unadjusted technique survival by year of entry, 1997-2006

| Year Interval (months) | 1997 No. | 1997 % Survival | 1997 SE | 1998 No. | 1998 % Survival | 1998 SE | 1999 No. | 1999 % Survival | 1999 SE | 2000 No. | 2000 % Survival | 2000 SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 187 | 94 | 2 | 144 | 92 | 2 | 189 | 90 | 2 | 206 | 91 | 2 |
| 12 | 170 | 88 | 2 | 128 | 83 | 3 | 175 | 84 | 3 | 185 | 81 | 3 |
| 24 | 141 | 74 | 3 | 96 | 65 | 4 | 117 | 58 | 3 | 138 | 63 | 3 |
| 36 | 101 | 55 | 4 | 75 | 51 | 4 | 78 | 39 | 3 | 101 | 46 | 3 |
| 48 | 76 | 42 | 4 | 59 | 40 | 4 | 57 | 29 | 3 | 78 | 36 | 3 |
| 60 | 57 | 32 | 3 | 45 | 32 | 4 | 50 | 25 | 3 | 67 | 31 | 3 |
| 72 | 44 | 25 | 3 | 35 | 25 | 4 | 37 | 19 | 3 | 47 | 22 | 3 |
| 84 | 32 | 18 | 3 | 31 | 22 | 3 | 27 | 15 | 3 | 1 | - | - |
| 96 | 24 | 14 | 3 | 21 | 15 | 3 | 1 | - | - | 1 | - | - |
| 108 | 19 | 11 | 2 | 1 | - | - | 1 | - | - | 1 | - | - |
| 120 | 4 | 8 | 2 | 1 | - | - | 1 | - | - | 1 | - | - |

| Year Interval (months) | 2001 No. | 2001 % Survival | 2001 SE | 2002 No. | 2002 % Survival | 2002 SE | 2003 No. | 2003 % Survival | 2003 SE | 2004 No. | 2004 % Survival | 2004 SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 303 | 90 | 2 | 341 | 92 | 1 | 370 | 89 | 2 | 301 | 89 | 2 |
| 12 | 265 | 80 | 2 | 292 | 80 | 2 | 333 | 80 | 2 | 266 | 80 | 2 |
| 24 | 198 | 61 | 3 | 227 | 63 | 3 | 254 | 63 | 2 | 213 | 66 | 3 |
| 36 | 151 | 47 | 3 | 164 | 47 | 3 | 183 | 46 | 2 | 5 | - | - |
| 48 | 107 | 34 | 3 | 125 | 36 | 3 | 1 | - | - | 5 | - | - |
| 60 | 78 | 25 | 2 | 1 | - | - | 1 | - | - | 5 | - | - |

| Year Interval (months) | 2005 No. | 2005 % Survival | 2005 SE | 2006 No. | 2006 % Survival | 2006 SE |
|---|---|---|---|---|---|---|
| 6 | 321 | 89 | 2 | 183 | 92 | 2 |
| 12 | 280 | 79 | 2 | 2 | - | - |

* No. = Number at risk SE=standard error

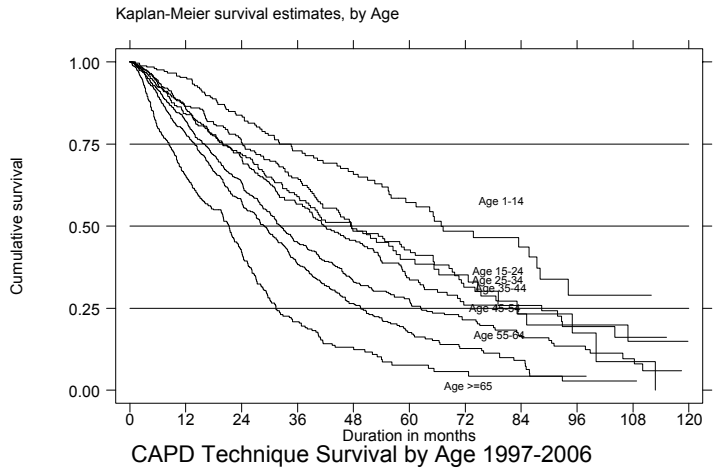
**Table 12.3.3:** Unadjusted technique survival by age, 1997-2006

| 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 | 229 | 98 | 1 | 253 | 93 | 2 | 238 | 93 | 2 | 355 | 94 | 1 |
| 12 | 204 | 95 | 1 | 210 | 84 | 2 | 203 | 86 | 2 | 298 | 86 | 2 |
| 24 | 142 | 84 | 3 | 139 | 72 | 3 | 150 | 75 | 3 | 208 | 71 | 2 |
| 36 | 106 | 73 | 3 | 95 | 59 | 3 | 112 | 65 | 3 | 144 | 57 | 3 |
| 48 | 76 | 66 | 4 | 55 | 48 | 4 | 68 | 49 | 4 | 96 | 46 | 3 |
| 60 | 46 | 57 | 4 | 30 | 40 | 4 | 50 | 43 | 4 | 50 | 34 | 3 |
| 72 | 29 | 48 | 5 | 17 | 35 | 5 | 27 | 31 | 4 | 27 | 26 | 3 |
| 84 | 15 | 44 | 6 | 7 | 23 | 6 | 19 | 26 | 4 | 15 | 23 | 4 |
| 96 | 7 | 29 | 7 | 4 | 17 | 7 | 12 | 19 | 4 | 8 | 20 | 4 |
| 108 | 4 | 29 | 7 | 2 | 9 | 7 | 5 | 16 | 5 | 4 | 15 | 5 |
| 120 | 1 | - | - | 1 | - | - | 1 | - | - | 3 | - | - |

| Age group (years) | 45-54 | | | 55-64 | | | >=65 | | |
|---|---|---|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 615 | 92 | 1 | 543 | 90 | 1 | 310 | 80 | 2 |
| 12 | 513 | 82 | 1 | 428 | 78 | 2 | 236 | 65 | 2 |
| 24 | 338 | 63 | 2 | 274 | 58 | 2 | 131 | 42 | 3 |
| 36 | 192 | 45 | 2 | 155 | 39 | 2 | 49 | 21 | 2 |
| 48 | 104 | 33 | 2 | 83 | 26 | 2 | 21 | 13 | 2 |
| 60 | 73 | 28 | 2 | 40 | 18 | 2 | 9 | 8 | 2 |
| 72 | 41 | 21 | 2 | 20 | 13 | 2 | 5 | 6 | 2 |
| 84 | 23 | 17 | 2 | 11 | 9 | 2 | 4 | 4 | 2 |
| 96 | 14 | 14 | 2 | 3 | 3 | 2 | 2 | 4 | 2 |
| 108 | 7 | 10 | 3 | 2 | 3 | 2 | 1 | - | - |
| 120 | 2 | 6 | 3 | 1 | - | - | 1 | - | - |

* No. = Number at risk SE=standard error

**Figure 12.3.3:** Unadjusted technique survival by age, 1997-2006



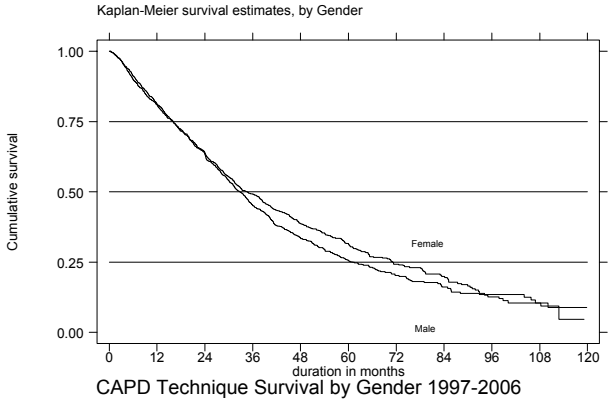

CAPD Technique Survival by Age 1997-2006

**Table 12.3.4:** Unadjusted technique survival by Gender, 1997-2006

| Gender | Male | | | Female | | |
|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 1270 | 91 | 1 | 1267 | 90 | 1 |
| 12 | 1040 | 81 | 1 | 1048 | 81 | 1 |
| 24 | 682 | 63 | 1 | 695 | 64 | 1 |
| 36 | 415 | 45 | 2 | 433 | 49 | 1 |
| 48 | 230 | 34 | 2 | 268 | 39 | 2 |
| 60 | 131 | 26 | 2 | 163 | 31 | 2 |
| 72 | 73 | 20 | 2 | 88 | 24 | 2 |
| 84 | 40 | 16 | 2 | 50 | 20 | 2 |
| 96 | 22 | 13 | 2 | 23 | 14 | 2 |
| 108 | 10 | 11 | 2 | 10 | 10 | 2 |
| 120 | 2 | 5 | 3 | 3 | 9 | 2 |

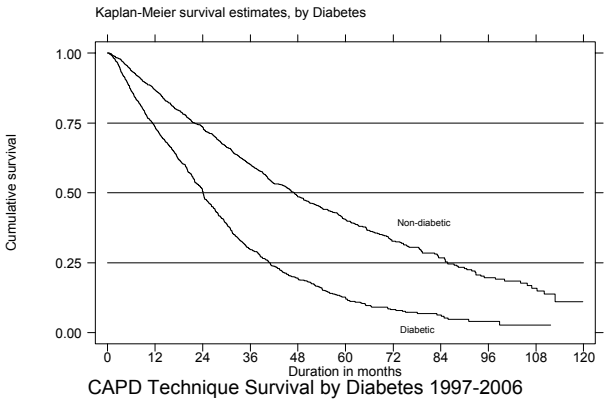
* No. = Number at risk SE=standard error

**Figure 12.3.4:** Unadjusted technique survival by Gender, 1997-2006




CAPD Technique Survival by Gender 1997-2006

**Figure 12.3.5:** Unadjusted technique survival by Diabetes status, 1997-2006




CAPD Technique Survival by Diabetes 1997-2006

**Table 12.3.5:** Unadjusted technique survival by Diabetes status, 1997-2006

| Diabetes status | Non-Diabetic | | | Diabetic | | |
|---|---|---|---|---|---|---|
| Interval (months) | No. | % Survival | SE | No. | % Survival | SE |
| 6 | 1497 | 94 | 1 | 1040 | 86 | 1 |
| 12 | 1277 | 87 | 1 | 810 | 74 | 1 |
| 24 | 909 | 73 | 1 | 469 | 51 | 2 |
| 36 | 621 | 60 | 1 | 227 | 30 | 2 |
| 48 | 389 | 49 | 2 | 109 | 20 | 1 |
| 60 | 236 | 40 | 2 | 58 | 13 | 1 |
| 72 | 132 | 33 | 2 | 29 | 8 | 1 |
| 84 | 76 | 27 | 2 | 13 | 6 | 1 |
| 96 | 39 | 20 | 2 | 6 | 4 | 1 |
| 108 | 18 | 16 | 2 | 3 | 3 | 1 |
| 120 | 4 | 11 | 3 | 1 | - | - |

* No. = Number at risk SE=standard error

**Table 12.3.6:** Reasons for change of dialysis modality to HD, 1997-2006.

| Cause | N | Percentage |
|---|---|---|
| Peritonitis | 287 | 44 |
| Catheter related infection | 21 | 3 |
| Membrane failure | 123 | 19 |
| Technical problem | 55 | 8 |
| Patient preference | 88 | 13 |
| Others | 52 | 8 |
| Unknown | 27 | 4 |
| Total | 653 | 100 |

## SECTION 4: PD PERITONITIS

The median peritonitis rate was 33 patient-months per episode (Table 12.4.1). There was a wide variation between centre with the highest and lowest peritonitis rates of 16 vs 103 patient-months per episode. Gram-positive organisms accounted for 32% of peritonitis episodes while 22% were due to gram positive organisms. Fungal organisms accounted for 4% of cases and mycobacterial infection rates remained low (1%). The culture–negative rate increased to 39% compared with 30% in 2005 (Table 12.4.2). There was a trend for increased peritonitis rates with increasing age and diabetic status but gender did not appear to have any influence (Table 12.4.3).

Catheter removal rate was highest in fungal infection (75%), followed by pseudomonas (36%) and staphylococcus aureus (21%) infections. Pseudomonas aeruginosa peritonitis has the highest mortality outcome of 23% compared to other organisms (Table 12.4.4).

**Table 12.4.1:** Variation in peritonitis rate (pt-month/epi) among CAPD centres 2006

| Year | No. of centres | Min | 5th Centile | LQ | Median | UQ | 95th Centile | Max |
|---|---|---|---|---|---|---|---|---|
| 2000 | 12 | 10.9 | 10.9 | 18 | 21.5 | 27.6 | 1019.7 | 1019.7 |
| 2001 | 11 | 13.4 | 13.4 | 18.5 | 22.7 | 30.9 | 55.5 | 55.5 |
| 2002 | 13 | 14.3 | 14.3 | 20.2 | 25.3 | 34.4 | 49 | 49 |
| 2003 | 13 | 16.5 | 16.5 | 22.8 | 30.1 | 41.6 | 253 | 253 |
| 2004 | 15 | 0 | 0 | 23.2 | 32.6 | 41.8 | 47.7 | 47.7 |
| 2005 | 15 | 23.6 | 23.6 | 28 | 35.7 | 41.8 | 66.3 | 66.3 |
| 2006 | 21 | 16.1 | 21 | 27.7 | 33 | 61.4 | 88.5 | 102.9 |

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

**Figure 12.4.1:** Variation in peritonitis rate among CAPD centres 2006

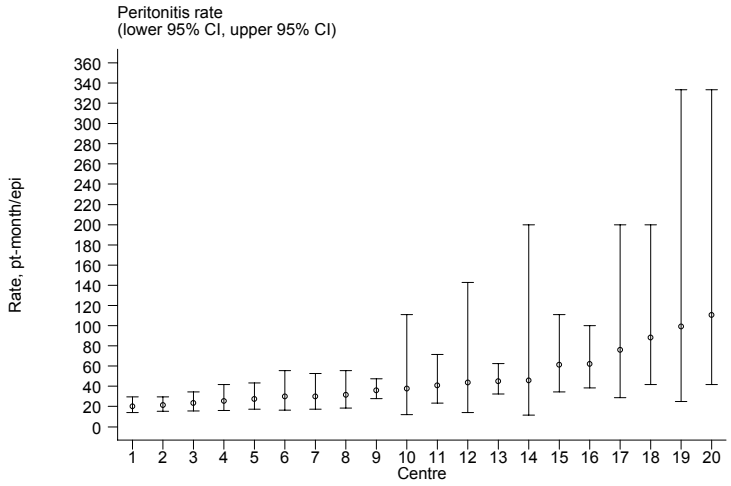


**Table 12.4.2:** Causative organism in PD peritonitis, 2000-2006

| Microorganism | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| (A) Gram Positives | | | | | | | | | | | | | | |
| ● Staph. Aureus | 35 | 11 | 41 | 13 | 62 | 17 | 45 | 12 | 51 | 14 | 40 | 12 | 50 | 14 |
| ● Staph Coagulase Neg. | 39 | 13 | 34 | 11 | 41 | 11 | 52 | 14 | 43 | 12 | 47 | 15 | 35 | 10 |
| ● Strep | 12 | 4 | 13 | 4 | 9 | 2 | 11 | 3 | 11 | 3 | 6 | 2 | 13 | 4 |
| ● Others | 4 | 1 | 6 | 2 | 7 | 2 | 15 | 4 | 4 | 1 | 8 | 2 | 13 | 4 |
| (B) Gram Negatives | | | | | | | | | | | | | | |
| ● Pseudomonas | 19 | 6 | 14 | 4 | 23 | 6 | 20 | 5 | 28 | 8 | 27 | 8 | 23 | 6 |
| ● Others | 45 | 15 | 56 | 18 | 67 | 19 | 75 | 21 | 83 | 22 | 86 | 27 | 58 | 16 |
| (C) Polymicrobial | 9 | 3 | 10 | 3 | 8 | 2 | 3 | 1 | 2 | 1 | 0 | 0 | 1 | 0 |
| (D) Others | | | | | | | | | | | | | | |
| ● Fungal | 19 | 6 | 21 | 7 | 12 | 3 | 12 | 3 | 15 | 4 | 7 | 2 | 16 | 4 |
| ● Mycobacterium | 6 | 2 | 4 | 1 | 1 | 0 | 3 | 1 | 4 | 1 | 2 | 1 | 4 | 1 |
| ● Others | 2 | 1 | 14 | 4 | 14 | 4 | 13 | 4 | 8 | 2 | 3 | 1 | 11 | 3 |
| (E) No growth | 119 | 39 | 99 | 32 | 118 | 33 | 115 | 32 | 123 | 33 | 96 | 30 | 142 | 39 |
| TOTAL | 309 | 100 | 312 | 100 | 362 | 100 | 364 | 100 | 372 | 100 | 322 | 100 | 366 | 100 |

**Table 12.4.3:** Factors influencing peritonitis rate, 2000-2006

| Factors | N (No. at risk) | Annualised rate: Epi/ pt-year | (95% CI) | |
|---|---|---|---|---|
| **Age (years):** | | | | |
| <=14 | 69 | 0.405 | (0.33 | 0.498) |
| 15-24 | 38 | 0.465 | (0.354 | 0.612) |
| 25-34 | 82 | 0.416 | (0.35 | 0.495) |
| 35-44 | 94 | 0.444 | (0.373 | 0.528) |
| 45-54 | 143 | 0.523 | (0.455 | 0.6) |
| 55-64 | 121 | 0.571 | (0.489 | 0.667) |
| >=65 | 51 | 0.663 | (0.52 | 0.845) |
| **Gender:** | | | | |
| Male | 282 | 0.492 | (0.444 | 0.545) |
| Female | 316 | 0.482 | (0.44 | 0.528) |
| **Diabetes:** | | | | |
| No | 414 | 0.456 | (0.421 | 0.494) |
| Yes | 184 | 0.591 | (0.519 | 0.674) |

**Table 12.4.4:** Outcome of peritonitis by Causative organism, 2006

| Causative Organism | Outcome | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Resolved | | Not resolved, catheter removed | | Death | | Total | |
| | No. | % | No. | % | No. | % | No. | % |
| Gram Positives | | | | | | | | |
| ● Staph. Aureus | 33 | 69 | 10 | 21 | 5 | 10 | 48 | 100 |
| ● Staph Coagulase Neg. | 28 | 85 | 1 | 3 | 4 | 12 | 33 | 100 |
| Gram Negatives | | | | | | | | |
| ● Pseudomonas | 9 | 41 | 8 | 36 | 5 | 23 | 22 | 100 |
| ● Others | 35 | 60 | 11 | 19 | 12 | 21 | 58 | 100 |
| Others | | | | | | | | |
| ● Fungal | 1 | 6 | 12 | 75 | 3 | 19 | 16 | 100 |
| ● Mycobacterium | 0 | 0 | 2 | 50 | 2 | 50 | 4 | 100 |
| No growth | 94 | 68 | 21 | 15 | 23 | 17 | 138 | 100 |

# CHAPTER 13

# Renal Transplantation

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## 13.1 STOCK AND FLOW

New renal transplant patients showed a modest increase from 126 transplants per year in 1997 to 161 per year in 2005. By end of 2006, the number of functioning renal transplants reported to NRR has increased to 1725 (Table 13.1.1).

**Table 13.1.1:** Stock and Flow of Renal Transplantation, 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New transplant patients | 126 | 104 | 127 | 143 | 161 | 168 | 160 | 189 | 161 | 126 |
| Died | 31 | 26 | 25 | 30 | 37 | 32 | 37 | 41 | 41 | 49 |
| Graft failure | 38 | 49 | 36 | 32 | 40 | 38 | 41 | 44 | 20 | 30 |
| Lost to follow up | 0 | 1 | 1 | 9 | 2 | 3 | 5 | 16 | 7 | 5 |
| Functioning graft at 31st December | 1083 | 1111 | 1176 | 1248 | 1330 | 1425 | 1502 | 1590 | 1683 | 1725 |

**Figure 13.1.1:** Stock and Flow of Renal Transplantation, 1975-2006

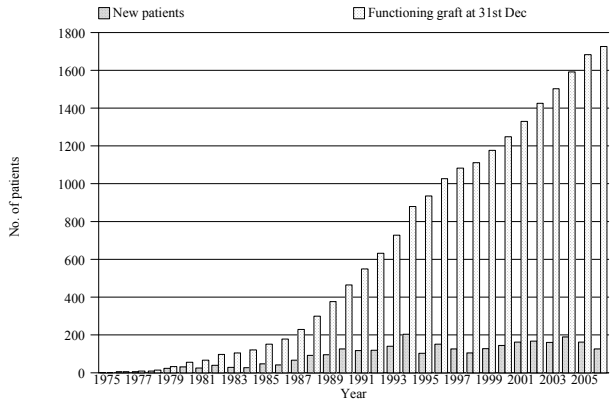
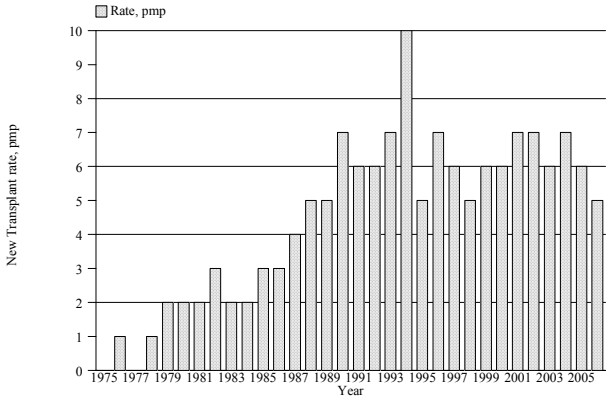



**Figure 13.1.2:** New transplant rate, 1975-2006




Incident rate for renal transplantation stabilised at a modest rate of 5-7 per million population for the last decade (Table 13.1.2), while the transplant prevalence rate maintained at 50-65 per million population for the last 10 years (Table 13.1.3).

**Table 13.1.2:** New transplant rate per million population (pmp), 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New transplant patients | 126 | 104 | 127 | 143 | 161 | 168 | 160 | 189 | 161 | 126 |
| New transplant rate, pmp | 6 | 5 | 6 | 6 | 7 | 7 | 6 | 7 | 6 | 5 |

**Table 13.1.3:** Transplant prevalence rate per million population (pmp), 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| Functioning graft at 31st December | 1083 | 1111 | 1176 | 1248 | 1330 | 1425 | 1502 | 1590 | 1683 | 1725 |
| Transplant prevalence rate, pmp | 50 | 50 | 52 | 53 | 55 | 58 | 60 | 62 | 64 | 65 |

**Figure 13.1.3:** Transplant prevalence rate, 1975-2006

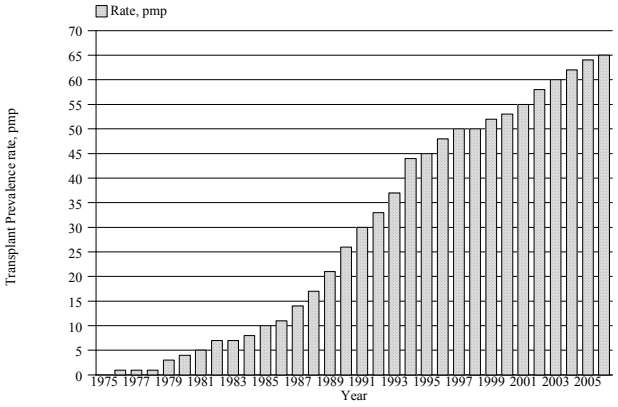



**Table 13.1.4:** Place of transplantation, 1997-2006

| Year | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| HKL | 29 | 23 | 33 | 32 | 36 | 28 | 28 | 20 | 33 | 20 |
| UMMC | 6 | 5 | 7 | 7 | 16 | 13 | 19 | 13 | 23 | 14 |
| Selayang Hospital | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 11 | 7 |
| Other local | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 2 | 4 | 2 |
| China | 79 | 63 | 50 | 48 | 62 | 49 | 80 | 56 | 82 | 51 |
| India | 7 | 6 | 7 | 7 | 5 | 4 | 9 | 6 | 7 | 4 |
| Other overseas | 3 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 1 | 1 |
| Unknown | 2 | 2 | 4 | 4 | 5 | 4 | 0 | 0 | 0 | 0 |
| TOTAL | 126 | 100 | 104 | 100 | 127 | 100 | 143 | 100 | 161 | 100 |

| Year | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | No. | % | No. | % | No. | % | No. |
| HKL | 28 | 17 | 26 | 16 | 20 | 11 | 32 | 20 | 34 | 27 | 331 | 20 |
| UMMC | 14 | 8 | 6 | 4 | 7 | 4 | 7 | 4 | 5 | 4 | 117 | 7 |
| Selayang Hospital | 11 | 7 | 11 | 7 | 11 | 6 | 5 | 3 | 7 | 6 | 60 | 4 |
| Other local | 1 | 1 | 1 | 1 | 2 | 1 | 5 | 3 | 2 | 2 | 19 | 1 |
| China | 102 | 61 | 111 | 69 | 136 | 72 | 107 | 66 | 71 | 56 | 985 | 61 |
| India | 12 | 7 | 4 | 3 | 11 | 6 | 5 | 3 | 6 | 5 | 79 | 5 |
| Other overseas | 0 | 0 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 13 | 1 |
| Unknown | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 12 | 1 |
| TOTAL | 168 | 100 | 160 | 100 | 189 | 100 | 161 | 100 | 126 | 100 | 1616 | 100 |

## 13.2 RECIPIENTS' CHARACTERISTICS

**Table 13.2.1:** Renal Transplant Recipients' Characteristics, 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| New Transplant Patients | 126 | 104 | 127 | 143 | 161 | 168 | 160 | 189 | 161 | 126 |
| Age at transplant (years), Mean | 36 | 37 | 37 | 40 | 41 | 41 | 42 | 41 | 38 | 37 |
| Age at transplant (years), SD | 12 | 11 | 13 | 13 | 13 | 13 | 13 | 13 | 14 | 16 |
| % Male | 63 | 58 | 61 | 64 | 63 | 57 | 66 | 62 | 70 | 68 |
| % Diabetic (co-morbid / primary renal disease) | 11 | 9 | 10 | 15 | 19 | 15 | 22 | 21 | 19 | 21 |
| % HBsAg positive | 6 | 6 | 4 | 5 | 5 | 7 | 8 | 5 | 4 | 7 |
| % Anti-HCV positive | 7 | 18 | 11 | 8 | 15 | 9 | 10 | 8 | 2 | 7 |

The mean age for new transplant recipients is between 36+6 years to 42+13 years over the last 10 years (Table 13.2.1). Men are still in the majority among renal transplant recipients and they made up 68% of all recipients in year 2006. Over the last 10 years, the proportion of diabetic transplant recipients has increased, from 11% in 1997 to about 21% in 2006.

In 2006, 7% were HbsAg positive and 7% 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 3-7% for the last 5 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 2-10% for the last 5 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%.

Chronic glomerulonephritis was the primary cause of ESRF in 25-37% for the last 5 years (Table 13.2.2). As expected, patients with diabetes mellitus had become increasingly frequent renal transplant recipients, from 7% in 1997 to 17% in 2006. Majority of renal transplant recipients still presented late with unknown primary renal disease, contributing to 30-44% of all the recipients for the last 5 years.

**Table 13.2.2:** Primary causes of end stage renal failure, 1997-2006

| Year | 1997 | | 1998 | | 1999 | | 2000 | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| New transplant patients | 126 | 100 | 104 | 100 | 127 | 100 | 143 | 100 |
| Glomerulonephritis | 30 | 24 | 28 | 27 | 41 | 32 | 49 | 34 |
| Diabetes Mellitus | 9 | 7 | 5 | 5 | 10 | 8 | 16 | 11 |
| Hypertension | 5 | 4 | 5 | 5 | 7 | 6 | 18 | 13 |
| Obstructive uropathy | 3 | 2 | 4 | 4 | 4 | 3 | 3 | 2 |
| ADPKD | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 2 |
| Drugs/toxic nephropathy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hereditary nephritis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unknown | 63 | 50 | 55 | 53 | 62 | 49 | 54 | 38 |
| Others | 18 | 14 | 10 | 10 | 6 | 5 | 12 | 8 |

| Year | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| New transplant patients | 161 | 100 | 168 | 100 | 160 | 100 | 189 | 100 | 161 | 100 | 126 | 100 |
| Glomerulonephritis | 42 | 26 | 53 | 32 | 54 | 34 | 62 | 33 | 46 | 29 | 47 | 37 |
| Diabetes Mellitus | 23 | 14 | 16 | 10 | 26 | 16 | 32 | 17 | 27 | 17 | 21 | 17 |
| Hypertension | 17 | 11 | 24 | 14 | 25 | 16 | 51 | 27 | 38 | 24 | 26 | 21 |
| Obstructive uropathy | 3 | 2 | 2 | 1 | 2 | 1 | 4 | 2 | 3 | 2 | 4 | 3 |
| ADPKD | 1 | 1 | 3 | 2 | 5 | 3 | 4 | 2 | 3 | 2 | 1 | 1 |
| Drugs/toxic nephropathy | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 |
| Hereditary nephritis | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Unknown | 61 | 38 | 68 | 40 | 58 | 36 | 83 | 44 | 48 | 30 | 38 | 30 |
| Others | 23 | 14 | 15 | 9 | 12 | 8 | 27 | 14 | 18 | 11 | 15 | 12 |

## 13.3 TRANSPLANT PRACTICES

In 2006, commercial transplants from China constituted 57% of all new renal transplantation (dropped from 65% in2005). While live donor transplantation made up 21% in 2006, local cadaveric transplants contributed 19% (increased from 6% in 2005) of all new renal transplantation in 2006 (Table 13.3.1).

**Table 13.3.1:** Type of Renal Transplantation, 1997-2006

| Year | 1997 | | 1998 | | 1999 | | 2000 | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| Commercial Cadaver | 80 | 66 | 51 | 52 | 62 | 51 | 80 | 56 |
| Commercial Live Donor | 7 | 6 | 4 | 4 | 4 | 3 | 9 | 6 |
| Live Donor (genetically related) | 27 | 22 | 27 | 27 | 40 | 33 | 21 | 15 |
| Live Donor (emotionally related) | 0 | 0 | 2 | 2 | 5 | 4 | 6 | 4 |
| Cadaver | 8 | 7 | 15 | 15 | 10 | 8 | 27 | 19 |
| Total | 122 | 100 | 99 | 100 | 121 | 100 | 143 | 100 |

| Year | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Commercial Cadaver | 82 | 51 | 102 | 61 | 112 | 70 | 141 | 76 | 104 | 65 | 68 | 57 |
| Commercial Live Donor | 6 | 4 | 11 | 7 | 3 | 2 | 5 | 3 | 8 | 5 | 2 | 2 |
| Live Donor (genetically related) | 32 | 20 | 30 | 18 | 25 | 16 | 21 | 11 | 37 | 23 | 22 | 18 |
| Live Donor (emotionally related) | 4 | 2 | 3 | 2 | 5 | 3 | 2 | 1 | 3 | 2 | 4 | 3 |
| Cadaver | 37 | 23 | 22 | 13 | 15 | 9 | 17 | 9 | 9 | 6 | 23 | 19 |
| Total | 161 | 100 | 168 | 100 | 160 | 100 | 186 | 100 | 161 | 100 | 119 | 100 |

*Commercial Cadaver (China, India, other oversea) *Commercial live donor (living unrelated) *Cadaver (local)

**Table 13.3.2:** Biochemical data, 2004-2006

| Biochemical parameters | Summary | 2004 | 2005 | 2006 |
|---|---|---|---|---|
| Creatinine, umol/L | N | 1550 | 1635 | 1559 |
| | Mean | 132 | 133.7 | 135.3 |
| | SD | 63.8 | 65.4 | 80.4 |
| | Median | 120 | 120 | 119 |
| | Minimum | 38 | 35 | 13.2 |
| | Maximum | 817 | 763 | 1152 |
| Hb, g/dL | N | 1550 | 1635 | 1559 |
| | Mean | 12.9 | 12.8 | 12.7 |
| | SD | 1.9 | 1.9 | 1.9 |
| | Median | 12.9 | 12.9 | 12.8 |
| | Minimum | 4.9 | 5.5 | 3.3 |
| | Maximum | 19.7 | 19 | 19.8 |
| Albumin, g/L | N | 1550 | 1635 | 1559 |
| | Mean | 39.4 | 39.5 | 39.5 |
| | SD | 1 | 0.5 | 0.7 |
| | Median | 39.4 | 39.4 | 39.4 |
| | Minimum | 22 | 34 | 29 |
| | Maximum | 50 | 46 | 48 |
| Calcium, mmol/L | N | 1550 | 1635 | 1559 |
| | Mean | 2.4 | 2.3 | 2.3 |
| | SD | 0.2 | 0.2 | 0.2 |
| | Median | 2.3 | 2.3 | 2.3 |
| | Minimum | 1.1 | 1.2 | 1.1 |
| | Maximum | 3.3 | 3.3 | 3.1 |

**Table 13.3.2:** Biochemical data, 2004-2006 (cont'd)

| Biochemical parameters | Summary | 2004 | 2005 | 2006 |
|---|---|---|---|---|
| Phosphate, mmol/L | N | 1550 | 1635 | 1559 |
| | Mean | 1.1 | 1.1 | 1.1 |
| | SD | 0.2 | 0.2 | 0.2 |
| | Median | 1.1 | 1.1 | 1.1 |
| | Minimum | 0.3 | 0.3 | 0.4 |
| | Maximum | 2.7 | 3.3 | 3.5 |
| Alkaline Phosphate (ALP), U/L | N | 1550 | 1635 | 1559 |
| | Mean | 79.5 | 78.9 | 78.1 |
| | SD | 46.5 | 46.6 | 42.6 |
| | Median | 73 | 73 | 70 |
| | Minimum | 10 | 18 | 6.3 |
| | Maximum | 994 | 831 | 700 |
| ALT, U/L | N | 1550 | 1635 | 1559 |
| | Mean | 31.4 | 30.8 | 29.9 |
| | SD | 32.6 | 30.9 | 30.7 |
| | Median | 25 | 24 | 21 |
| | Minimum | 4 | 4 | 4 |
| | Maximum | 563 | 613 | 433 |
| Total cholesterol, mmol/L | N | 1550 | 1635 | 1559 |
| | Mean | 5.5 | 5.4 | 5.3 |
| | SD | 1.1 | 1 | 1.1 |
| | Median | 5.4 | 5.4 | 5.4 |
| | Minimum | 2.6 | 2.1 | 2 |
| | Maximum | 20 | 13.1 | 14.7 |
| LDL cholesterol, mmol/L | N | 1550 | 1635 | 1559 |
| | Mean | 3.1 | 3 | 3 |
| | SD | 0.7 | 0.8 | 0.8 |
| | Median | 3 | 3 | 3 |
| | Minimum | 1 | 0.9 | 1 |
| | Maximum | 8.5 | 9.2 | 11.1 |
| HDL cholesterol, mmol/L | N | 1550 | 1635 | 1559 |
| | Mean | 1.6 | 1.6 | 1.6 |
| | SD | 0.4 | 0.5 | 0.5 |
| | Median | 1.6 | 1.6 | 1.6 |
| | Minimum | 0.2 | 0.2 | 0.2 |
| | Maximum | 4.3 | 5.6 | 5.8 |
| Systolic Blood Pressure, mmHg | N | 1550 | 1635 | 1559 |
| | Mean | 132.2 | 133.3 | 130.8 |
| | SD | 15.9 | 16.9 | 16 |
| | Median | 130 | 130 | 130 |
| | Minimum | 80 | 80 | 66 |
| | Maximum | 200 | 220 | 210 |
| Diastolic Blood Pressure, mmHg | N | 1550 | 1635 | 1559 |
| | Mean | 80.3 | 80.5 | 79 |
| | SD | 9.6 | 9.2 | 9.8 |
| | Median | 80 | 80 | 80 |
| | Minimum | 40 | 50 | 30 |
| | Maximum | 121 | 127 | 120 |

Cyclosporine/prednisolone based triple therapy has remained the backbone of maintenance immunosuppressive therapy. In year 2006, 76% of renal transplant recipients were on cyclosporine while 97% were on prednisolone. Only 17% were on tacrolimus. However, 48% of the recipients were on MMF as opposed to 33% on azathioprine.

**Table 13.3.3:** Medication data, 2004-2006

| Medication data | Single drug treatment | | | | | | Combined drug treatment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | | 2005 | | 2006 | | 2004 | | 2005 | | 2006 | |
| | N | % | N | % | N | % | N | % | N | % | N | % |
| All patients | 1416 | 100 | 1562 | 100 | 1470 | 100 | 1416 | 100 | 1562 | 100 | 1470 | 100 |
| (i) Immunosuppressive drug(s) treatment | | | | | | | | | | | | |
| Prednisolone | 13 | 1 | 12 | 1 | 7 | 0 | 1394 | 98 | 1528 | 98 | 1433 | 97 |
| Azathioprine | 0 | 0 | 1 | 0 | 0 | 0 | 603 | 43 | 605 | 39 | 492 | 33 |
| Cyclosporin A | 4 | 0 | 4 | 0 | 5 | 0 | 1135 | 80 | 1221 | 78 | 1111 | 76 |
| Tacrolimus (FK506) | 0 | 0 | 0 | 0 | 0 | 0 | 185 | 13 | 224 | 14 | 252 | 17 |
| Mycophenolate Mofetil (MMF) | 1 | 0 | 0 | 0 | 0 | 0 | 524 | 37 | 682 | 44 | 704 | 48 |
| Rapamycin | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 8 | 1 | 6 | 0 |
| Others | 1 | 0 | 0 | 0 | 0 | 0 | 16 | 1 | 10 | 1 | 18 | 1 |
| (ii) Non-Immunosuppressive drug(s) treatment | | | | | | | | | | | | |
| Beta blocker | 104 | 7 | 105 | 7 | 77 | 5 | 650 | 46 | 667 | 43 | 594 | 40 |
| Calcium channel blocker | 188 | 13 | 195 | 12 | 199 | 14 | 795 | 56 | 822 | 53 | 784 | 53 |
| ACE inhibitor | 35 | 2 | 60 | 4 | 39 | 3 | 272 | 19 | 342 | 22 | 292 | 20 |
| AIIRB | 11 | 1 | 20 | 1 | 27 | 2 | 76 | 5 | 160 | 10 | 139 | 9 |
| Anti-lipid | 74 | 5 | 67 | 4 | 154 | 10 | 567 | 40 | 601 | 38 | 672 | 46 |
| Other anti-hypertensive | 5 | 0 | 5 | 0 | 11 | 1 | 130 | 9 | 158 | 10 | 159 | 11 |

In 2006, 65% of the recipients had hypertension as co-morbidity before transplantation while another 22% developed hypertension post transplantation (Table 13.4.1). Among these patients, only 30% 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 (40%). Only 20% were on ACE inhibitors while another 9% were on AIIRBs.

## 13.4 TRANSPLANT OUTCOMES

### 13.4.1 Post-transplant complications

**Table 13.4.1:** Post transplant complications, 2004-2006

| Post transplant complications | Complication developed before transplant (regardless of complication after transplantation | | | | | | Complication developed only after transplantation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | | 2005 | | 2006 | | 2004 | | 2005 | | 2006 | |
| | N | % | N | % | N | % | N | % | N | % | N | % |
| All patients | 1558 | 100 | 1637 | 100 | 1559 | 100 | 1558 | 100 | 1637 | 100 | 1559 | 100 |
| Diabetes (either as Primary Renal Disease or co-morbid) | 520 | 33 | 532 | 32 | 527 | 34 | 128 | 8 | 123 | 8 | 125 | 8 |
| Cancer | 3 | 0 | 2 | 0 | 1 | 0 | 17 | 1 | 19 | 1 | 20 | 1 |
| Cardiovascular disease + cerebrovascular disorder | 208 | 13 | 209 | 13 | 207 | 13 | 83 | 5 | 45 | 3 | 45 | 3 |
| Hypertension | 1010 | 65 | 1047 | 64 | 1016 | 65 | 397 | 25 | 439 | 27 | 346 | 22 |

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

In 2006, 34% of the prevalent renal transplant recipients had diabetes mellitus before transplantation (either as primary renal disease or co-morbidity), while another 8% of them developed diabetes mellitus post transplantation (PTDM).

## 13.4.2 Deaths and Graft loss

In 2006, 49 (3%) transplant recipients died and 30 (2%) lost their grafts. These rates of transplant death and graft loss have remained constant for the last 10 years (Table 13.4.2). Infection, cardiovascular disease and death at home were among the commonest causes of death for the last decade and in 2006, they accounted for 41%, 19% and 13% of the causes of death respectively (Table 13.4.3). Death secondary to cancer has become more common from 2001 to 2004, whereby cancer death accounted for 13% to 18% of all causes of death during that period. However, in 2006, death due to cancer has dropped to 7% of all deaths. Renal allograft rejection accounted for 50-78% of graft losses for the last 10 years (Table 13.4.4).

**Table 13.4.2:** Transplant Patients Death Rate and Graft Loss, 1997-2006

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| No. at risk | 1054 | 1096 | 1143 | 1211 | 1288 | 1377 | 1463 | 1545 | 1636 | 1703 |
| Transplant death | 31 | 26 | 25 | 30 | 37 | 32 | 37 | 41 | 41 | 49 |
| Transplant death rate % | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| Graft loss | 38 | 49 | 36 | 32 | 40 | 38 | 41 | 44 | 20 | 30 |
| Graft loss rate % | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 |
| Acute rejection | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 19 | 14 | 17 |
| Acute rejection rate % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| All losses | 69 | 75 | 61 | 62 | 77 | 70 | 81 | 104 | 75 | 96 |
| All losses rate % | 7 | 7 | 5 | 5 | 6 | 5 | 6 | 7 | 5 | 6 |

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

**Figure 13.4.2(i):** Transplant Recipient Death Rate, 1975-2006

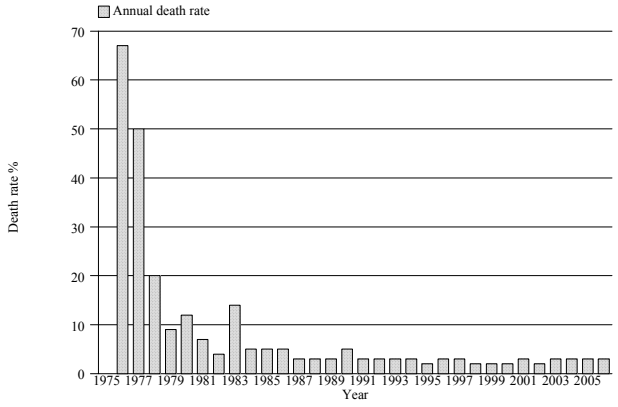



**Figure 13.4.2(ii):** Transplant Recipient Graft Loss Rate, 1975-2006

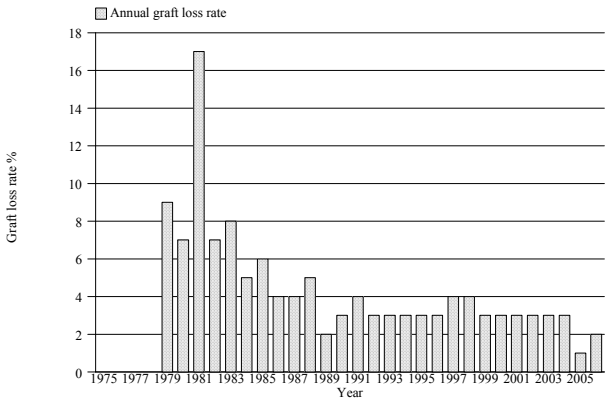


**Table 13.4.3:** Causes of Death in Transplant Recipients, 1997-2006

| Year | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Cardiovascular | 4 | 13 | 3 | 11 | 4 | 13 | 10 | 29 | 7 | 16 | 5 | 16 | 9 | 23 | 4 | 9 | 5 | 12 | 10 | 19 |
| Died at home | 2 | 6 | 4 | 15 | 6 | 19 | 1 | 3 | 5 | 12 | 5 | 16 | 5 | 13 | 6 | 13 | 4 | 10 | 7 | 13 |
| Infection | 14 | 45 | 10 | 37 | 7 | 23 | 12 | 35 | 20 | 47 | 9 | 28 | 11 | 28 | 11 | 24 | 22 | 52 | 22 | 41 |
| Graft failure | 1 | 3 | 0 | 0 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 |
| Cancer | 0 | 0 | 3 | 11 | 3 | 10 | 2 | 6 | 6 | 14 | 4 | 13 | 6 | 15 | 8 | 18 | 4 | 10 | 4 | 7 |
| Liver disease | 2 | 6 | 2 | 7 | 3 | 10 | 1 | 3 | 1 | 2 | 3 | 9 | 2 | 5 | 3 | 7 | 3 | 7 | 4 | 7 |
| Accidental death | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Others | 4 | 13 | 2 | 7 | 5 | 16 | 3 | 9 | 2 | 5 | 3 | 9 | 5 | 13 | 10 | 22 | 3 | 7 | 4 | 7 |
| Unknown | 4 | 13 | 3 | 11 | 2 | 6 | 2 | 6 | 1 | 2 | 2 | 6 | 2 | 5 | 1 | 2 | 1 | 2 | 3 | 6 |
| TOTAL | 31 | 100 | 27 | 100 | 31 | 100 | 34 | 100 | 43 | 100 | 32 | 100 | 40 | 100 | 45 | 100 | 42 | 100 | 54 | 100 |

**Table 13.4.4:** Causes of Graft Failure, 1997-2006

| Year | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Rejection | 21 | 54 | 28 | 53 | 23 | 64 | 19 | 59 | 25 | 61 | 22 | 55 | 22 | 50 | 33 | 70 | 18 | 78 | 23 | 66 |
| Calcineurin toxicity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 |
| Other drug toxicity | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 |
| Ureteric obstruction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Infection | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 3 | 2 | 5 | 0 | 0 | 2 | 5 | 1 | 2 | 1 | 4 | 3 | 9 |
| Vascular causes | 4 | 10 | 3 | 6 | 1 | 3 | 3 | 9 | 1 | 2 | 0 | 0 | 3 | 7 | 4 | 9 | 2 | 9 | 3 | 9 |
| Recurrent/de novo renal disease | 1 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 5 | 2 | 5 | 1 | 2 | 1 | 2 | 0 | 0 | 1 | 3 |
| Others | 5 | 13 | 5 | 9 | 0 | 0 | 2 | 6 | 0 | 0 | 4 | 10 | 1 | 2 | 0 | 0 | 1 | 4 | 2 | 6 |
| Unknown | 7 | 18 | 15 | 28 | 12 | 33 | 7 | 22 | 11 | 27 | 12 | 30 | 15 | 34 | 7 | 15 | 1 | 4 | 2 | 6 |
| TOTAL | 39 | 100 | 53 | 100 | 36 | 100 | 32 | 100 | 41 | 100 | 40 | 100 | 44 | 100 | 47 | 100 | 23 | 100 | 35 | 100 |

## 13.5 Patient and Graft Survival

**Table 13.5.1:** Patient survival, 1993-2006

| Interval (years) | No. | % Survival | SE |
|---|---|---|---|
| 1 | 1778 | 95 | 1 |
| 3 | 1342 | 91 | 1 |
| 5 | 971 | 88 | 1 |
| 10 | 349 | 80 | 1 |

* No.=Number at risk SE=standard error

**Figure 13.5.1:** Patient survival, 1993-2006

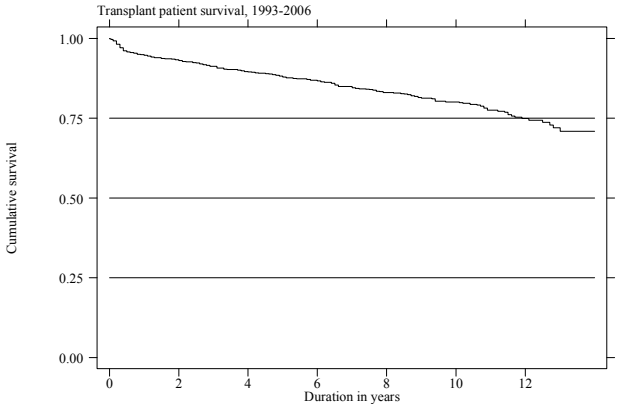



**Table 13.5.2:** Graft survival, 1993-2006

| Interval (years) | No. | % survival | SE |
|---|---|---|---|
| 1 | 1778 | 92 | 1 |
| 3 | 1342 | 85 | 1 |
| 5 | 971 | 79 | 1 |
| 10 | 349 | 63 | 1 |

* No.=Number at risk SE=standard error

**Figure 13.5.2:** Graft survival, 1993-2006


The overall transplant patient survival rate from 1993 to 2006 was 95%, 91%, 88% and 80% at 1 year, 3 years, 5 years and 10 years respectively, while the overall graft survival rate was 92%, 85%, 79% and 63% respectively.

Outcomes of renal transplantation from the four donor groups are shown in Figures 13.5.3 and 13.5.4 and demonstrate substantially different patient and graft survival rates. Living donor grafts maintained 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%, 94% and 90% respectively. The graft survival rates also differed between these 4 groups; living and commercial cadaver donor graft had the best outcomes.

**Table 13.5.3:** Patient survival by type of transplant, 1993-2006

| Type of Transplant | Commercial Cadaver | | | Commercial Live Donor | | | Live Donor | | | Cadaver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interval (years) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 1 | 935 | 96 | 1 | 285 | 96 | 1 | 398 | 96 | 1 | 131 | 84 | 2 |
| 3 | 659 | 92 | 1 | 240 | 90 | 1 | 323 | 95 | 1 | 100 | 79 | 3 |
| 5 | 428 | 87 | 1 | 203 | 87 | 2 | 252 | 94 | 1 | 71 | 76 | 4 |
| 10 | 117 | 83 | 2 | 126 | 72 | 3 | 100 | 90 | 2 | 7 | 70 | 5 |

* No.=Number at risk SE=standard error

**Table 13.5.4:** Graf survival by type of transplant, 1993-2006

| Type of Transplant | Commercial Cadaver | | | Commercial Live Donor | | | Live Donor | | | Cadaver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interval (years) | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE | No. | % Survival | SE |
| 1 | 935 | 94 | 1 | 285 | 93 | 1 | 398 | 92 | 1 | 131 | 76 | 3 |
| 3 | 659 | 89 | 1 | 240 | 82 | 2 | 323 | 88 | 2 | 100 | 68 | 4 |
| 5 | 428 | 82 | 1 | 203 | 73 | 3 | 252 | 84 | 2 | 71 | 64 | 4 |
| 10 | 117 | 70 | 2 | 126 | 52 | 3 | 100 | 69 | 3 | 7 | 48 | 8 |

* No.=Number at risk SE=standard error

**Figure 13.5.3:** Patient survival by type of transplant, 1993-2006

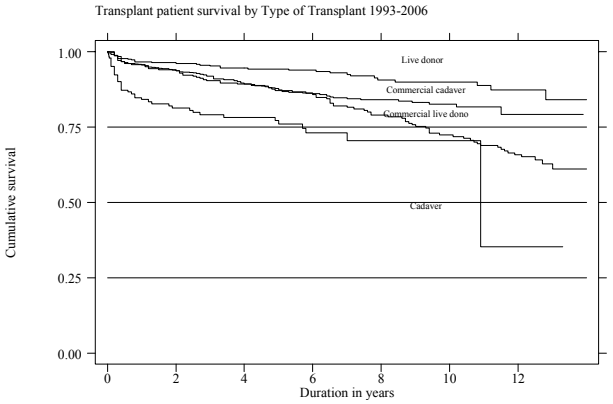
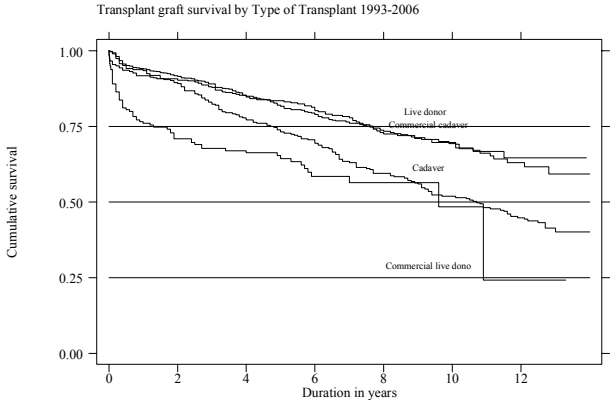



**Figure 13.5.4:** Graf survival by type of transplants, 1993-2006




The patient and graft survival rates for 1993-1998 cohort and 1999-2005 cohort were compared. Patient survival rate for living related donor renal transplants has remained excellent and unchanged for these two cohorts (Figure 13.5.5).

**Figure 13.5.5:** Patient survival by year of transplant (Living related transplant, 1993-2006)

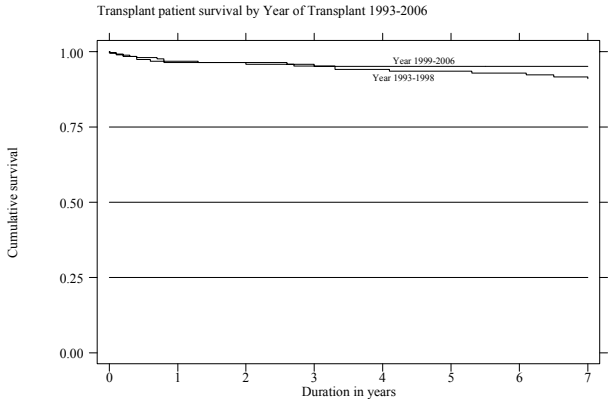



**Table 13.5.5:** Patient survival by year of transplant (Living related transplant, 1993-2006)

| Year of Transplant | 1993-1998 | | | 1999-2006 | | |
|---|---|---|---|---|---|---|
| Interval (years) | No. | % Survival | SE | No. | % Survival | SE |
| 1 | 181 | 97 | 1 | 218 | 96 | 1 |
| 3 | 169 | 95 | 2 | 155 | 95 | 1 |
| 5 | 159 | 93 | 2 | 94 | 95 | 1 |
| 7 | 147 | 91 | 2 | 37 | 95 | 1 |

* No.=Number at risk SE=standard error

Interestingly, the risk of graft failure for living related donor renal transplantation improved for the 1999-2006 cohort compared to the 1993-1998 cohort (Table & Figure 13.5.6). One possible explanation, among others, is the increasing use of newer immunosuppressive agents such as MMF and FK506 in recent years.

**Table 13.5.6:** Graf survival by year of transplant (Living related transplant, 1993-2006)

| Year of Transplant | 1993-1998 | | | 1999-2006 | | |
|---|---|---|---|---|---|---|
| Interval (years) | No. | % Survival | SE | No. | % Survival | SE |
| 1 | 181 | 88 | 2 | 218 | 94 | 1 |
| 3 | 169 | 83 | 3 | 155 | 92 | 2 |
| 5 | 159 | 78 | 3 | 94 | 89 | 2 |
| 7 | 147 | 73 | 3 | 37 | 83 | 3 |

* No.=Number at risk SE=standard error

**Figure 13.5.6:** Graft survival by year of transplant (Living related transplant, 1993-2006)


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 1999-2006 cohorts (Figure 13.5.7 and 13.5.8).

**Table 13.5.7:** Patient survival by year of transplant (Commercial cadaver transplant, 1993-2006)

| Year of Transplant | 1993-1998 | | | 1999-2006 | | |
|---|---|---|---|---|---|---|
| Interval (years) | No. | % Survival | SE | No. | % Survival | SE |
| 1 | 288 | 94 | 1 | 648 | 96 | 1 |
| 3 | 275 | 92 | 2 | 384 | 92 | 1 |
| 5 | 247 | 87 | 2 | 181 | 87 | 2 |
| 7 | 225 | 84 | 2 | 50 | 85 | 2 |

* No.=Number at risk SE=standard error

**Figure 13.5.7:** Patient survival by year of transplant (Commercial cadaver transplant, 1993-2006)

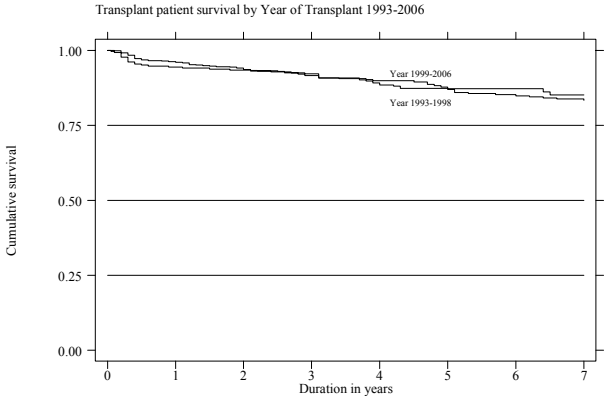
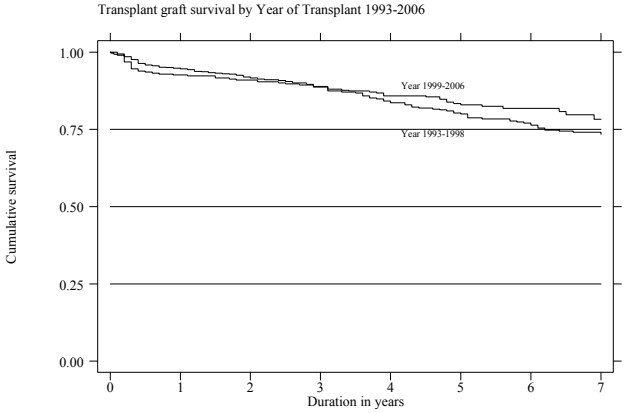



**Table 13.5.8:** Graft survival by year of transplant (Commercial cadaver transplant, 1993-2006)

| Year of Transplant | 1993-1998 | | | 1999-2006 | | |
|---|---|---|---|---|---|---|
| Interval (years) | No. | % Survival | SE | No. | % Survival | SE |
| 1 | 288 | 93 | 1 | 648 | 95 | 1 |
| 3 | 275 | 89 | 2 | 384 | 89 | 1 |
| 5 | 247 | 80 | 2 | 181 | 83 | 2 |
| 7 | 225 | 73 | 3 | 50 | 78 | 3 |

* No.=Number at risk SE=standard error

**Figure 13.5.8:** Graft survival by year of transplant (Commercial cavader transplant, 1993-2006)



## 13.6 CARDIOVASCULAR RISK IN RENAL TRANSPLANT RECIPIENTS

### 13.6.1 Risk factors for Ischaemic Heart Disease.

In year 2006, 85.5% of recipients were hypertensive, 22.9% had diabetes and 57.1% had renal insufficiency fulfilling the criteria for CKD III and above. A majority had 2 or more cardiovascular risk factors with 10.2% having 3 major risk factors.

**Table 13.6.1:** Risk factors for IHD in renal transplant recipients at year 2004, 2005, and 2006

| | 2004 | 2005 | 2006 |
|---|---|---|---|
| Diabetes | 27 (1.9) | 19 (1.3) | 21 (1.4) |
| Hypertension** | 504 (34.3) | 513 (33.5) | 452 (31.5) |
| CKD | 121 (8.2) | 142 (9.3) | 169 (11.8) |
| Diabetes + Hypertension** | 146 (9.9) | 157 (10.2) | 144 (10.0) |
| Diabetes + CKD | 21 (1.4) | 20 (1.3) | 18 (1.3) |
| CKD + Hypertension** | 530 (36.1) | 540 (35.2) | 484 (33.8) |
| Diabetes + CKD + Hypertension** | 120 (8.2) | 141 (9.2) | 146 (10.2) |

** Hypertension: BP systolic > 140 and BP diastolic >90
OR have either Beta blocker / Calcium channel blocker/ ACE inhibitor/ AIIRB / Other anti-hypertensive drugs
GFR(mL/min/1.73m2) = 1.2*(140-age(year))* weight(kg) / creatinine(μmol/L) if male
GFR(mL/min/1.73m2) = 0.85*(1.2*(140-age(year))* weight(kg) / creatinine(μmol/L) ) if female.
CKD stage III – GFR, 30- 60
CKD stage IV – GFR, 15- 30
CKD stage V – GFR, < 15

**Figure 13.6.1(a):** Venn Diagram for Pre and Post Transplant Complications (in %) at year 2004

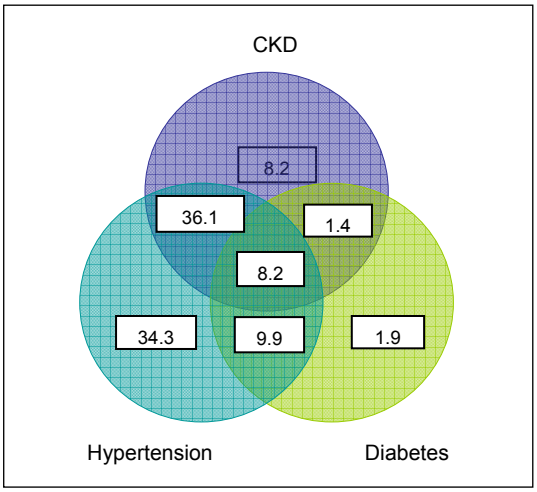



**Figure 13.6.1(b):** Venn Diagram for Pre and Post Transplant Complications (in %) at year 2005

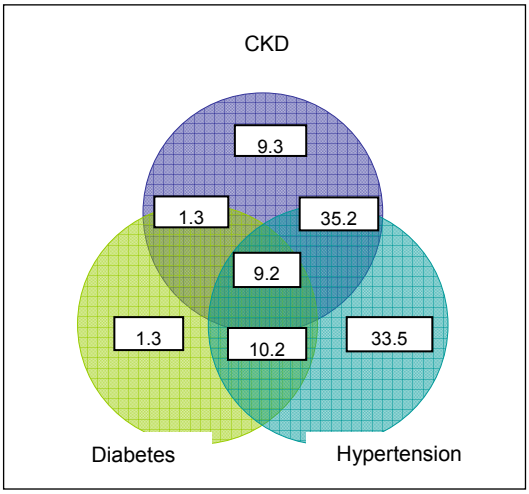
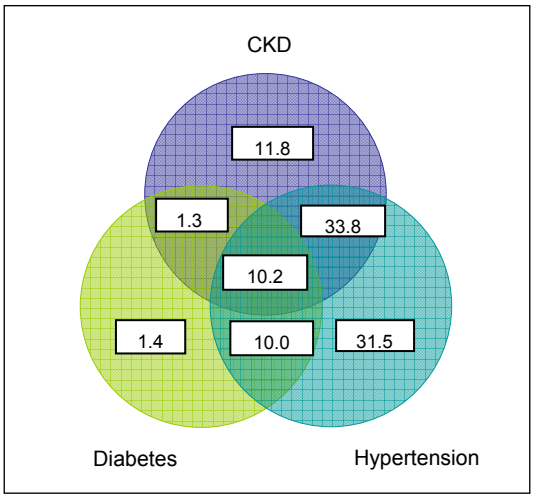



**Figure 13.6.1(c):** Venn Diagram for Pre and Post Transplant Complications (in %) at year 2006



### 13.6.2 Blood Pressure classification according to JNC VI criteria, 2004, 2005, and 2006

In 2006, 5.8% had stage II systolic hypertension while another 1.2% had stage III systolic hypertension despite being on treatment. Four percent had stage II diastolic hypertension while another 0.3% had stage III diastolic hypertension despite being on treatment.

**Table 13.6.2(a):** Systolic BP, 2004 – 2006

| Year | 2004<br>No. (%) | 2005<br>No. (%) | 2006<br>No. (%) |
|---|---|---|---|
| Systolic BP <120 | 207 (13.4) | 233 (14.3) | 241 (15.5) |
| Systolic BP <130 | 341 (22.0) | 318 (19.4) | 393 (25.2) |
| Systolic BP 130-139 | 459 (29.6) | 475 (29.1) | 463 (29.7) |
| Systolic BP 140-159 | 418 (27.0) | 452 (27.6) | 352 (22.6) |
| Systolic BP 160-179 | 102 (6.6) | 133 (8.1) | 91 (5.8) |
| Systolic BP >=180 | 23 (1.5) | 24 (1.5) | 19 (1.2) |

**Table 13.6.2(b):** Diastolic BP, 2004 – 2006

| Year | 2004<br>No. (%) | 2005<br>No. (%) | 2006<br>No. (%) |
|---|---|---|---|
| Diastolic BP<80 | 513 (33.1) | 522 (31.9) | 600 (38.5) |
| Diastolic BP<85 | 602 (38.8) | 657 (40.2) | 580 (37.2) |
| Diastolic BP 85-89 | 48 (3.1) | 73 (4.5) | 73 (4.7) |
| Diastolic BP 90-99 | 319 (20.6) | 308 (18.8) | 241 (15.5) |
| Diastolic BP 100-109 | 56 (3.6) | 65 (4.0) | 61 (3.9) |
| Diastolic BP ≥110 | 12 (0.8) | 10 (0.6) | 4 (0.3) |

**Figure 13.6.2(a):** Systolic BP, 2004 - 2006

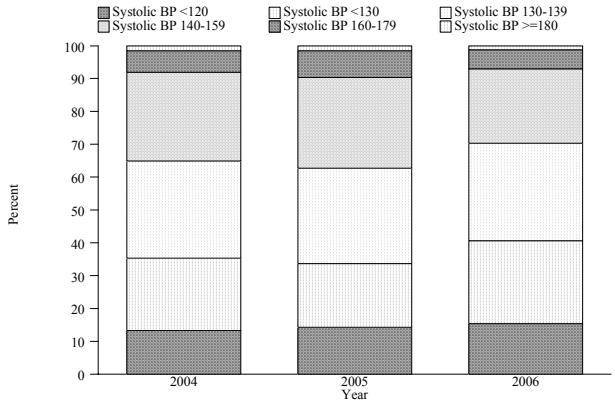



**Figure 13.6.2(b):** Diastolic BP, 2004 - 2006

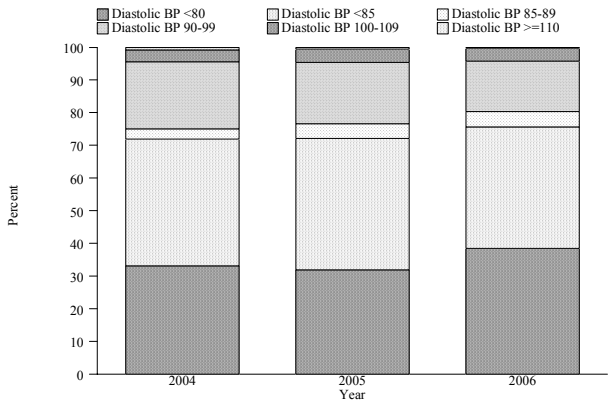
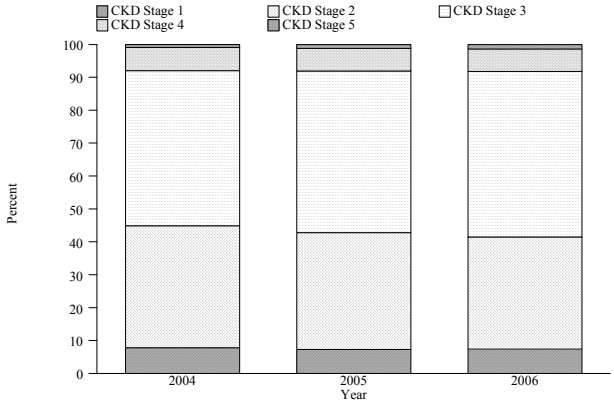


Table 13.6.3 shows classification of renal function according to CKD classification. Estimated GFR is calculated using the Cockroft and Gault equation. In 2006, 50.4% had CKD III while another 8.2% had CKD IV or V.

**Table 13.6.3:** CKD stages, 2004 - 2006

| | 2004 | 2005 | 2006 |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| CKD stage 1 | 120 (7.8) | 118 (7.3) | 114 (7.4) |
| CKD stage 2 | 571 (37.1) | 578 (35.5) | 528 (34.1) |
| CKD stage 3 | 727 (47.2) | 800 (49.2) | 779 (50.4) |
| CKD stage 4 | 109 (7.1) | 112 (6.9) | 105 (6.8) |
| CKD stage 5 | 13 (0.8) | 19 (1.2) | 21 (1.4) |

**Figure 13.6.3:** CKD stages by year

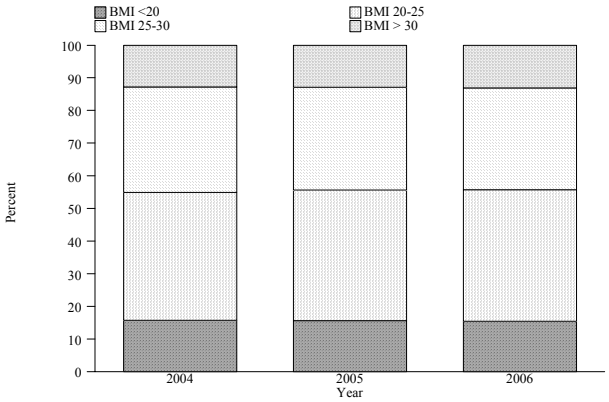



In year 2006, 31.1% were overweight while another 13.1% were obese with BMI above 30.

**Table 13.6.4:** BMI, 2004 – 2006

| Year | 2004 | 2005 | 2006 |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| BMI <20 | 243 (15.7) | 255 (15.6) | 241 (15.5) |
| BMI 20-25 | 609 (39.3) | 655 (40.1) | 629 (40.3) |
| BMI 25-30 | 500 (32.3) | 514 (31.4) | 485 (31.1) |
| BMI > 30 | 198 (12.8) | 211 (12.9) | 204 (13.1) |

**Figure 13.6.4:** BMI by year




In year 2006, 23% had LDL cholesterol ≥3.4 mmol/L, 58.9% had total cholesterol >5.2 while 6.5% had HDL cholesterol <1.

**Table 13.6.5(a):** LDL, 2004 – 2006

| | 2004 | 2005 | 2006 |
|---|---|---|---|
| | No. (%) | No. (%) | No. (%) |
| LDL < 2.6 | 282 (18.2) | 418 (25.6) | 487 (31.2) |
| LDL 2.6-3.4 | 944 (60.9) | 862 (52.7) | 713 (45.7) |
| LDL >= 3.4 | 324 (20.9) | 355 (21.7) | 359 (23.0) |

**Figure 13.6.5(a):** LDL by year

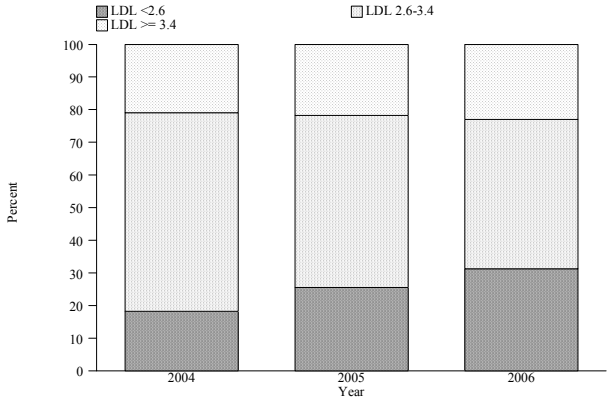


**Table 13.6.5(b):** Total Cholesterol, 2004 - 2006

| 4Year | 2004<br>No. (%) | 2005<br>No. (%) | 2006<br>No. (%) |
|---|---|---|---|
| Total Cholesterol <4.1 | 113 (7.3) | 159 (9.7) | 159 (10.2) |
| Total Cholesterol 4.1-5.1 | 413 (26.6) | 455 (27.8) | 482 (30.9) |
| Total Cholesterol 5.2-6.2 | 751 (48.5) | 774 (47.3) | 677 (43.4) |
| Total Cholesterol 6.3- 7.2 | 197 (12.7) | 173 (10.6) | 171 (11.0) |
| Total Cholesterol > 7.2 | 76 (4.9) | 74 (4.5) | 70 (4.5) |

**Figure 13.6.5(b):** Total Cholesterol by year

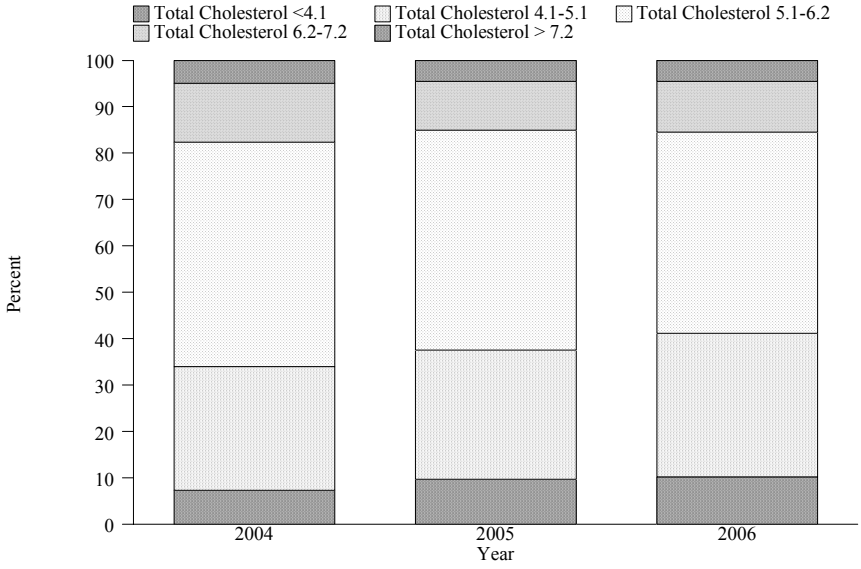
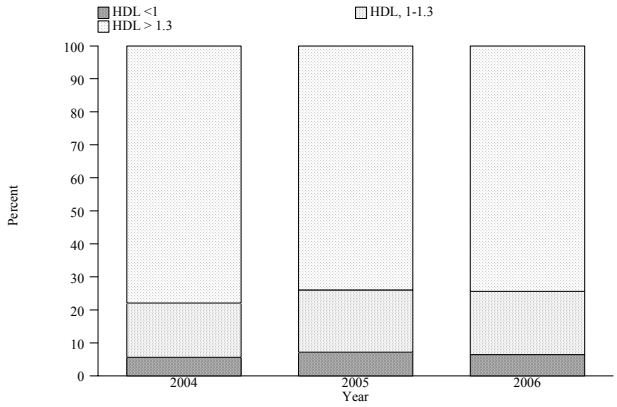



**Table 13.6.5(c):** HDL, 2004 - 2006

| Year | 2004<br>No. (%) | 2005<br>No. (%) | 2006<br>No. (%) |
|---|---|---|---|
| HDL <1 | 87 (5.6) | 118 (7.2) | 101 (6.5) |
| HDL 1-1.3 | 255 (16.5) | 308 (18.8) | 299 (19.2) |
| HDL >1.3 | 1208 (77.9) | 1209 (73.9) | 1159 (74.3) |

**Figure 13.6.5(c):** HDL by year



Majority of patients were on more than one anti-hypertensive drug with 34% on 2 anti-hypertensives while 18% required 3. In 2005, despite being on treatment, a substantial number of patients had SBP ≥160 (11%) and DBP≥90 (25%) (Table 13.6.6d and 13.6.6e)

**Table 13.6.6(a):** Treatment for hypertension, 2004 – 2006

| Year | No. | % on anti-hypertensives | % on 1 anti-hypertensive drug | % on 2 anti-hypertensives | % on 3 anti-hypertensives |
|---|---|---|---|---|---|
| 2004 | 1550 | 87 | 30 | 34 | 18 |
| 2005 | 1635 | 85 | 28 | 30 | 19 |
| 2006 | 1559 | 86 | 34 | 26 | 17 |

**Table 13.6.6(b):** Distribution of Systolic BP without anti-hypertensives, 2004 – 2006

| Year | No. | Mean | SD | Median | LQ | UQ | % Patients ≥ 160 mmHg |
|---|---|---|---|---|---|---|---|
| 2004 | 179 | 126.3 | 13.6 | 130 | 120 | 130 | 4 |
| 2005 | 229 | 126.9 | 15 | 130 | 120 | 137 | 3 |
| 2006 | 184 | 124.1 | 14.4 | 120 | 118.5 | 130 | 4 |

**Table 13.6.6(c):** Distribution of Diastolic BP without anti-hypertensives, 2004 – 2006

| Year | No. | Mean | SD | Median | LQ | UQ | % Patients ≥ 90 mmHg |
|---|---|---|---|---|---|---|---|
| 2004 | 179 | 78.9 | 9.1 | 80 | 73 | 80 | 17 |
| 2005 | 229 | 79 | 9 | 80 | 70 | 80 | 18 |
| 2006 | 184 | 76.6 | 10.2 | 80 | 70 | 80 | 11 |

**Table 13.6.6(d):** Distribution of Systolic BP on anti-hypertensives, 2004 – 2006

| Year | No. | Mean | SD | Median | LQ | UQ | % Patients ≥ 160 mmHg |
|---|---|---|---|---|---|---|---|
| 2004 | 1312 | 133.1 | 16.3 | 130 | 120 | 140 | 9 |
| 2005 | 1350 | 134.5 | 17.3 | 130 | 120 | 143 | 11 |
| 2006 | 1321 | 131.7 | 16.3 | 130 | 120 | 140 | 8 |

**Table 13.6.6(e):** Distribution of Diastolic BP on anti-hypertensives, 2004 – 2006

| Year | No. | Mean | SD | Median | LQ | UQ | % Patients ≥ 90 mmHg |
|---|---|---|---|---|---|---|---|
| 2004 | 1312 | 80.5 | 9.9 | 80 | 74 | 90 | 27 |
| 2005 | 1350 | 80.8 | 9.4 | 80 | 76 | 90 | 25 |
| 2006 | 1321 | 79.3 | 9.9 | 80 | 70 | 86 | 22 |

# APPENDIX 1: DATA MANAGEMENT

## Introduction

Data integrity of a register begins from the data source, data collection tools, data verification and data entry process. Registry data is never as perfect as the clinical trail data. 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 sectors of RRT providers like the private, non-government organization (NGO), armed forces and the universities.

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.

Participation in the National Renal Registry which was entirely voluntary prior to 2006 is now made compulsory by the Private Health Care Facilities and Services Act 1996 and its Regulations 2006 which was implemented in 1st Maly 2006. This however only applies to private and NGO centres and data submission from centres managed by the Ministry of Health, Defence or the Universities is still voluntary. RRT centres which have expressed interest in participating will be recruited as SDP.

In the year 2006, there were 38 new haemodilaysis centres. Thus, this is an average of 3 new centres per month. Within the same year 6 centres had ceased operation. This may be partly due to the Private Health Care Facilities and Services Act 1996 and its Regulations 2006. The number of RRT centres is shown in the table below. The participating rate for government centres was 100%. The data submission rate of 83.87% and 66.15% for PD and Transplant centres are due to centres reporting that they provide these services but do not have patients on regular follow-up.

| | At December 2006 Known centres (N) | Agreed to Participate (N) | Submitting data in 2006 (N) | Submitting annual returns (N) | Submitted data (%) |
|---|---|---|---|---|---|
| Haemodialysis | 423 | 415 | 385 | 332 | 92.77 |
| Peritoneal Dialysis | 31 | 31 | 26 | 26 | 83.87 |
| Transplant | 65 | 65 | 48 | 41 | 66.15 |
| All modality | 519 | 511 | 459 | 399 | 80.93 |

**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 patient transfers from one centre to another 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 final 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 Register.

At the end of each year, centres submit their patients' information related to dialysis and drug treatment, clinical and laboratory measurements for the year. Work related rehabilitation and Quality of life Assessment was performed for all patients during the last clinic follow-up.

The Register also conducts an annual centre survey on the staffing 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 case report form (CRF) submitted by SDP, visual review is performed to check for obvious error or missing data in the compulsory 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 dataset is locked and exported to the statistician for analysis

**Limitation:**
NRR data submission is still paper base. The majority of the RRT centres do not have electronic patient information system. Computer literacy among staff is still low.

The data submission to the Register is still mainly on voluntary basis using the standard data collection tools. Some SDP choose not to participate in data collection on the patient treatment data for various reasons. We sincerely hope with the enforcement of the Private Health Care Facilities and Services Act 1996 and its Regulations 2006 which was implemented in 1st May 2006, participation rate from private and NGO centres shall improve in the coming years.

**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 registry's annual 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). Fourteenth Report of the Malaysian Dialysis and Transplant Registry 2006. Kuala Lumpur 2007

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.

Participating centre is now able to down load own centre's data from the secured web-site from link from *www.msn.org.my/nrr*. 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 Malaysian Society of Nephrology 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 www.msn.org.my/nrr*.

## APPENDIX II: ANALYSIS SETS, STATISTICAL METHODS AND DEFINITIONS

### ANALYSIS SETS

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

1. Dialysis patients notification between 1997 and 2006

This analysis set consists of patients commencing dialysis between 1997 and 2006. This analysis set was used for the analysis in Chapter 1, 2 and 3. Sections 2.3.3 & 2.3.4 were tabulated based on Dialysis patients' notification and Annual return.

Patients with age commencing dialysis less than 20 years old between 1997 and 2006 was used for the analysis in Chapter 5.

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 analysis 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.

2.Rehabilitation outcomes
Chapter 4 analysis set was 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

3.Centre Survey data
Section 2.2 in the report was based on annual centre survey data between 1997 to 2006 rather than individual patient data reported to the Registry.

4.Peritonitis data
Analysis was confined to CAPD patients who were on peritoneal dialysis from 31$^{st}$ 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.

***Risk ratio***

The relative measure of the difference in risk between the exposed and unexposed populations in a cohort study. The relative risk is defined as the rate of disease among the exposed divided by the rate of the disease among the unexposed. A relative risk of 2 means that the exposed group has twice the disease risk as the unexposed group.

Multinomial logistic regression model was used to estimate the independent effect of each factor, expressed as risk ratio, on the event of interest. Sero-converters are defined as patient with anti-HCV negative at his first dialysis year convert to anti-HCV positive in the subsequent year.

***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.

The analysis is confined to all dialysis patients regardless they switched modalities. For example, if the patient is on CAPD for the first 2 years and then switches to HD, the survival duration on HD is calculated as if he is a new patient on HD. In addition, the calculation of survival on CAPD of that patient is censured as if he has been lost to follow-up.

***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 >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 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 2006. 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 2006 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, 5th percentile, lower quartile, median, upper quartile, 95th 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.

***Funnel plot***

Analysis confined to new dialysis patients from year 1997-2002. The figure is included to assess whether survival probability adjusted to age 60 and diabetes of each centre is likely to be different from the national average. Centres with patients less 10 will be excluded from the analysis.

# NATIONAL RENAL REGISTRY

PROMOTING THE QUALITY OF DIALYSIS CARE

*Thank You !*

Your data is contributing to a higher standard of dialysis care in MALAYSIA