15TH REPORT
OF THE MALAYSIAN
DIALYSIS & TRANSPLANT REGISTRY
2007

Sponsors :
Malaysian Society of Nephrology
Association of Dialysis Medical Assistants and Nurses

The National Renal Registry is funded with grants from :
The Ministry of Health Malaysia
Ain Medicare
Baxter Healthcare
Fresenius Medical Care
Roche

August 2008

ISSN 1675-8862

Published by:

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This report is also published electronically on the website of the National Renal Registry at:

http://www.msn.org.my/nrr

ACKNOWLEDGEMENTS

The National Renal Registry would like to thank the following :

All the nephrologists and staff of the dialysis and transplant follow-up centres for their hard work and participation,

The Ministry of Health, Malaysia for support seen and unseen,

Our industry sponsors for their generous support :-

Ain Medicare

Baxter Healthcare

Fresenius Medical Care

Roche

The staff of the Clinical Research Centre particularly Lim Jie Ying, Hoo Lin Ping and Azizah Alimat

Members of the National Transplant Registry who have kindly contributed to this Report

&

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

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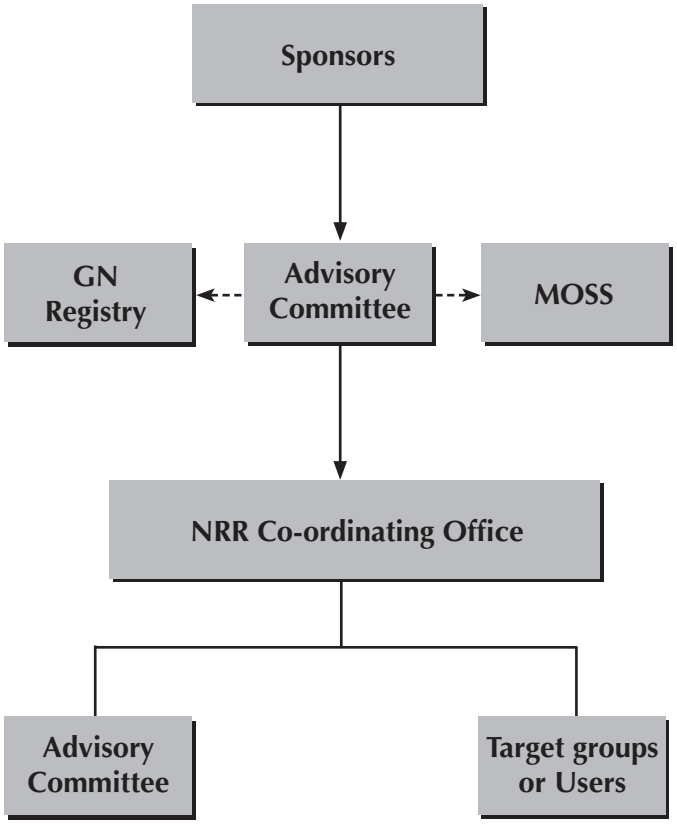
ABOUT THE NATIONAL RENAL REGISTRY

The National Renal Registry (NRR) has its origin in the Dialysis and Transplant Registry established by the Department of Nephrology in 1992. Its ownership was subsequently transferred to the Malaysian Society of Nephrology in 1995. The sponsors of NRR are the Malaysian Society of Nephrology (MSN) and the Association of Dialysis Medical Assistants and Nurses (ADMAN).

The objectives of the NRR are to :

1. Determine the disease burden attributable to End Stage Renal Disease (ESRD), and its geographic and temporal trends in Malaysia.
2. Determine the outcomes, and factors influencing outcomes of Renal Replacement Therapy (RRT).
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 :



Owner

The Malaysian Society of Nephrology

Sponsors

The Malaysian Society of Nephrology is the sponsor of the National Renal Registry and the Malaysian Organ Sharing System (MOSS). The Association of Dialysis Medical Assistants and Nurses (ADMAN) has been invited to be the co-sponsor.

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

ABOUT MOSS

Malaysian Organ Sharing System or MOSS was started in 1997. In 2006, it was upgraded to a web application named e-MOSS and was officially launched by Y. B. Dato Dr. Hj. Abd Latiff B Ahmad, the Deputy Minister of Health, Malaysia on 1st September 2006.

MOSS is managed by the MOSS sub-committee of the MOSS/NRR committee established under the Malaysian Society of Nephrology (MSN).

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 enable cadaver organs to be allocated in a fair and equitable manner.
5. To facilitate centres to effectively manage their patients on the transplant waiting list

The functions of the MOSS sub-committee are :

1. Make operational decisions concerning MOSS.
2. Secure views of nephrologists and other clinical staff regarding its policies and operations.
3. Identify nephrologists to assist in the potential recipient management.

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 effectively 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 links 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 the 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 special 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 participating centre did not submit the Annual Return (Haemodialysis & Peritoneal Dialysis) of a patient who is in the 'On Wait List', 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" subsequently if 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.

Transplant nephrologists will place the patient who is temporarily unfit for a transplant into this list if he/she is not fit for a transplant when contacted during the organ donation event.

5. Pending Evaluation

The potential eligible patients will be listed in the 'Pending List' upon registration with NRR. The doctor in-charge needs to assess the suitability of the patients for a transplant to enable the patient to be listed in the Wait list.

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 2007

JOHOR

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

KEDAH

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

KELANTAN

83. Gua Musang Hospital, HD Unit
84. KB Rotary-MAA Charity Dialysis, HD Unit
85. Kuala Krai Hospital, HD Unit
86. Machang Hospital, HD Unit
87. Pakar Perdana Hospital, HD Unit
88. Pasir Mas Hospital, HD Unit
89. Pusat Dialisis Yayasan Buah Pinggang Kebangsaan (Kota Bharu), HD Unit
90. Pusat Perubatan Tentera (Kota Bharu), HD Unit
91. Pusat Rawatan Dialisis Islah (Kota Bharu), HD Unit
92. Raja Perempuan Zainab II Hospital, HD Unit
93. Renal-Link (Kelantan), HD Unit
94. Tanah Merah Hospital, HD Unit
95. Tengku Anis Hospital, HD Unit
96. Tumpat Hospital, HD Unit
97. USM Hospital, HD Unit

PARTICIPATING HAEMODIALYSIS CENTRES 2007 (cont.)

MELAKA

98. 94 Hospital Angkatan Tentera (Terendak), HD Unit
99. Alor Gajah Dialysis Centre, HD Unit
100. Alor Gajah Hospital, HD Unit
101. Amitabha Centre (Melaka), HD Unit
102. Damai Medical & Heart Clinic, HD Unit
103. Mahkota Medical Centre, HD Unit
104. Melaka Hospital, HD Unit
105. Pantai Air Keroh Hospital, HD Unit
106. Pusat Dialisis Giat Kurnia (Masjid Tanah), HD Unit
107. Pusat Dialysis Comfort, HD Unit
108. Pusat HD SJAM Bacang Melaka, HD Unit
109. Pusat Hemodialisis SJAM Pulau Sebang, HD Unit
110. Pusat Hemodialisis Suria (Jasin), HD Unit
111. Sinar Hemodialisis, HD Unit
112. Tenang Haemodialysis Centre, HD Unit
113. Tenang Haemodialysis Jasin, HD Unit
114. Yakin Jaya, HD Unit
115. Yayasan Kebajikan The Southern Melaka, HD Unit

NEGERI SEMBILAN

116. Haemodialysis Mawar Gemas, HD Unit
117. Jelebu Hospital, HD Unit
118. Persada Dialysis Centre, HD Unit
119. Port Dickson Hospital, HD Unit
120. Pusat Dialisis Suria (Tampin), HD Unit
121. Pusat Hemodialisis Berkat Seroja, HD Unit
122. Pusat Hemodialisis Mawar N. Sembilan (Bahau), HD Unit
123. Pusat Hemodialisis Mawar N. Sembilan (Lukut), HD Unit
124. Pusat Hemodialisis Mawar N. Sembilan (Rantau), HD Unit
125. Pusat Hemodialisis Mawar N. Sembilan (Seremban), HD Unit
126. Pusat Pakar Dialisis Traktif (Kuala Pilah), HD Unit
127. Pusat Waqaf An-nur (Senawang), HD Unit
128. Seremban Specialist Hospital, HD Unit
129. Tampin Hospital, HD Unit
130. Tuanku Ampuan Najihah Hospital, HD Unit
131. Tuanku Jaafar Hospital (Paed), HD Unit
132. Tuanku Jaafar Hospital, HD Unit

PAHANG

133. Bentong Hospital, HD Unit
134. Jengka Hospital, HD Unit
135. Jerantut Hospital, HD Unit
136. Kuala Lipis Hospital, HD Unit
137. Kuantan Clinical Diagnostic Centre, HD Unit
138. MAA-Medicare Charity (Mentakab), HD Unit
139. Mentakab Haemodialysis Unit, HD Unit
140. Muadzam Shah Hospital, HD Unit
141. Pahang Buddhist Association, HD Unit
142. Pekan Hospital, HD Unit
143. Pusat Hemodialisis Islam Makmur, HD Unit
144. Raub Hospital, HD Unit
145. SJAM-KPS Haemodialysis Centre 9 (Raub), HD Unit
146. Sultan Haji Ahmad Shah Hospital, HD Unit
147. Tengku Ampuan Afzan Hospital (Paed), HD Unit
148. Tengku Ampuan Afzan Hospital, HD Unit

PERAK

149. 96 Hospital Angkatan Tentera (Lumut), HD Unit
150. Batu Gajah Hospital, HD Unit
151. Berchaam Dialysis Centre, HD Unit
152. Changkat Melintang Hospital, HD Unit
153. Emnur Teguh, HD Unit
154. Gerik Hospital, HD Unit
155. Hope Haemodialysis Society Ipoh, HD Unit
156. Ipoh Hospital, HD Unit
157. Ipoh Hospital, Home Unit
158. Kampar Hospital, HD Unit
159. Kuala Kangsar Hospital, HD Unit
160. MAA-Medicare Charity (Teluk Intan), HD Unit
161. Parit Buntar Hospital, HD Unit
162. Perak Community Specialist Hospital, HD Unit
163. Persatuan Amal Chin Malaysia Barat, HD Unit
164. Pertubuhan Perkhidmatan Haemodialisis Ar-Ridzuan, HD Unit
165. Pertubuhan Perkhidmatan Hemodialisis AIXIN Kerian, HD Unit
166. PMA Chan Meng Khor-MAA Medicare Charity Dialysis Centre
167. Pulau Pangkor Hospital, HD Unit
168. Pusat Dialisis Darul Iltizam Taiping, HD Unit
169. Pusat Dialisis Ehsan Perak (Parit Buntar), HD Unit
170. Pusat Dialisis Intan, HD Unit
171. Pusat Dialisis Kuala Kangsar, HD Unit
172. Pusat Dialisis LZS (Kapar), HD Unit
173. Pusat Dialisis Mutiara, HD Unit
174. Pusat Dialisis Penawar Permai, HD Unit
175. Pusat Dialisis Setia (Ipoh)
176. Pusat Dialisis Taiping (Kamunting), HD Unit
177. Pusat Dialisis Taiping (Kuala Kangsar), HD Unit
178. Pusat Dialisis Taiping (Parit Buntar), HD Unit
179. Pusat Dialisis Taiping, HD Unit
180. Pusat Dialysis Setia, HD Unit
181. Pusat Hemodialisis Darul Iltizam (Ipoh), HD Unit
182. Pusat Hemodialisis Darul Iltizam Tapah, HD Unit
183. Pusat Hemodialisis Kampar, Yayasan Nanyang, HD Unit
184. Pusat Hemodialisis Manjung, HD Unit
185. Pusat Rawatan Dialisis Wan Nong, HD Unit
186. Renal Care (Ipoh Specialist), HD Unit
187. Selama Hospital, HD Unit
188. Seri Manjung Hospital, HD Unit
189. Sg Siput Hospital, HD Unit
190. Slim River Hospital (Tanjong Malim), HD Unit
191. Taiping Hospital, HD Unit
192. Tapah Hospital, HD Unit
193. Teluk Intan Hospital, HD Unit
194. Woh Peng Cheang Seah, HD Unit
195. Yayasan Akhlak-NKF Taiping, HD Unit
196. Yayasan Dialysis Pendidikan Akhlak Perak-NKF Ipoh, HD Unit

PARTICIPATING HAEMODIALYSIS CENTRES 2007 (cont.)

PERLIS

197. Tuanku Fauziah Hospital, HD Unit
198. Tuanku Syed Putra Haemodialysis Centre, HD Unit

PENANG

199. AMD Rotary (Penang), HD Unit
200. Asia Renal Care (Penang), HD Unit
201. Balik Pulau Hospital, HD Unit
202. Buddhist Tzu Chi Dialysis Centre (Butterworth), HD Unit
203. Buddhist Tzu Chi HD Centre (Penang), HD Unit
204. Bukit Mertajam Hospital, HD Unit
205. Bukit Mertajam Specialist Hospital, HD Unit
206. Fo Yi NKF Dialysis Centre, HD Unit
207. Fo Yi NKF Dialysis Centre (2)
208. Gleneagles Medical Centre, HD Unit
209. Island Hospital, HD Unit
210. K K Tan Specialist (BM), HD Unit
211. Kepala Batas Hospital, HD Unit
212. Lam Wah Ee Hospital, HD Unit
213. Loh Guan Lye Specialist Centre, HD Unit
214. MAA-Medicare Charity (Butterworth), HD Unit
215. NEPH Sdn Bhd, HD Unit
216. Pantai Mutiara Hospital, HD Unit
217. Penang Adventist Hospital, HD Unit
218. Penang Caring Dialysis Society, HD Unit
219. Pertubuhan Dialisis Rotary-Satu Hati, HD Unit
220. Pertubuhan Hemodialisis SPS, HD Unit
221. Province Wellesley Renal Medifund, HD Unit
222. Pulau Pinang Hospital (Home), HD Unit
223. Pulau Pinang Hospital (Paed), HD Unit
224. Pulau Pinang Hospital, HD Unit
225. Pusat Dialisis Ehsan Perak (Pedar), HD Unit
226. Pusat Haemodialisis Zakat (Jawi), HD Unit
227. Pusat Haemodialysis St Anne BM, HD Unit
228. Pusat Hemodialisis Zakat (Balik Pulau), HD Unit
229. Pusat Hemodialisis Zakat (Bukit Mertajam), HD Unit
230. Pusat Hemodialisis Zakat (Butterworth), HD Unit
231. PWRM (BM) Dialysis Centre, HD Unit
232. Renal Link (Penang), HD Unit
233. Seberang Jaya Hospital (Butterworth), HD Unit
234. Seberang Perai (Bagan), HD Unit
235. SJ Dialysis Centre, HD Unit
236. Sungai Bakap, HD Unit
237. The Penang Community HD Society, HD Unit
238. TSC Renal Care, HD Unit

SABAH

239. Beaufort Hospital, HD Unit
240. Beluran Hospital, HD Unit
241. Duchess of Kent Hospital, HD Unit
242. Keningau Hospital, HD Unit
243. Kota Belud Hospital, HD Unit
244. Kota Kinabatangan Hospital, HD Unit
245. Kota Marudu Hospital, HD Unit
246. Kudat Hospital, HD Unit
247. Labuan Hospital, HD Unit
248. Lahad Datu Hospital, HD Unit
249. Likas Hospital, HD Unit
250. MAA-Medicare Charity (Kota Kinabalu), HD Unit
251. Nobel Dialysis Centre, HD Unit
252. Papar Hospital, HD Unit
253. Persatuan Buah Pinggang Sabah, HD Unit
254. Persatuan Hemodialysis Kinabalu Sabah, HD Unit
255. Queen Elizabeth Hospital, HD Unit
256. Ranau Hospital, HD Unit
257. Rotary Tawau Tanjung, HD Unit
258. Sabah Medical Centre, HD Unit
259. Sandakan Kidney Society, HD Unit
260. Semporna Hospital, HD Unit
261. Sipitang Hospital, HD Unit
262. Tambunan Hospital, HD Unit
263. Tawau Hospital, HD Unit
264. Tenom Hospital, HD Unit

SARAWAK

265. 801 Rumah Sakit Angkatan Tentera (Kuching), HD Unit
266. Bau Hospital, HD Unit
267. Betong Hospital, HD Unit
268. Bintulu Hospital, HD Unit
269. CHKMUS-MAA Medicare Charity, HD Unit
270. Kanowit Hospital, HD Unit
271. Kapit Hospital, HD Unit
272. KAS-Rotary-NKF, HD Unit
273. Kuching Specialist Hospital, HD Unit
274. Lawas Hospital, HD Unit
275. Limbang Hospital, HD Unit
276. Lundu Hospital, HD Unit
277. Marudi Hospital, HD Unit
278. Miri Hospital, HD Unit
279. Miri Red Crescent Dialysis Centre, HD Unit
280. Mukah Hospital, HD Unit
281. Normah Medical Specialist Centre, HD Unit
282. Rejang Medical Centre, HD Unit
283. Saratok Hospital, HD Unit
284. Sarawak General Hospital, HD Unit
285. Sarikei Hospital, HD Unit
286. Serian Hospital, HD Unit
287. Sibu Hospital, HD Unit
288. Sibu Kidney Foundation, HD Unit
289. Simunjan Hospital, HD Unit
290. SJAM-KPS Haemodialysis Centre 8 (Sibu), HD Unit
291. SJAM-KPS Pusat Hemodialisis Centre 10, (Bintulu), HD Unit
292. Sri Aman Hospital, HD Unit
293. Timberland Medical Centre, HD Unit
294. 819 Rumah Sakit Angkatan Tentera, HD Unit

SELANGOR

295. Ampang Hospital, HD Unit
296. Ampang Puteri Specialist Hospital, HD Unit
297. Apex Club of Klang-NKF Charity Dialysis Centre, HD Unit
298. Assunta Hospital, HD Unit
299. Bakti-NKF Dialysis Centre, HD Unit
300. Bangi Dialysis Centre, HD Unit
301. Banting Hospital, HD Unit
302. Berjaya NKF Dialysis Centre, HD Unit
303. Caring Dialysis Centre (Tanjong Karang), HD Unit
304. Damansara Specialist Hospital, HD Unit
305. EAM Dialysis Centre, HD Unit
306. Haemodialysis Association Klang, HD Unit
307. Haemodialysis Edina, HD Unit
308. Healthcare Dialysis Centre, HD Unit
309. Hemodialisis Yayasan Veteran ATM, HD Unit
310. Kajang Dialysis Centre, HD Unit
311. Kajang Hospital, HD Unit
312. Kelana Jaya Medical Centre, HD Unit
313. Kuala Kubu Bharu Hospital, HD Unit
314. MAA-Medicare Charity (Kajang), HD Unit
315. Persatuan Dialisis Kurnia PJ, HD Unit
316. Persatuan Dialisis Touch, HD Unit
317. Ping Rong-NKF, HD Unit
318. PNSB Dialisis Centre, HD Unit
319. Pusat Dialisis Aiman (Shah Alam), HD Unit
320. Pusat Dialisis LZS (Sg. Besar), HD Unit
321. Pusat Dialisis LZS (Shah Alam), HD Unit
322. Pusat Dialisis Pakar Medi-Nefro, HD Unit
323. Pusat Dialisis Sijangkang, HD Unit
324. Pusat Dialysis Mesra (Kapar), HD Unit
325. Pusat Dialysis Mesra (Rahman Putra), HD Unit
326. Pusat Dialysis Mesra (Shah Alam), HD Unit
327. Pusat Dialysis Mesra KKB, HD Unit
328. Pusat Dialysis Putra Jaya (Semenyih), HD Unit
329. Pusat Hemodialisis Fasa, HD Unit
330. Pusat Hemodialisis Kau Ong Yah Ampang, HD Unit
331. Pusat Hemodialisis Majlis Perbandaran Kelang, HD Unit
332. Pusat Hemodialisis Mawar N. Sembilan (Sepang), HD Unit
333. Pusat Hemodialisis Mawar N. Sembilan (Seri Kembangan), HD Unit
334. Pusat Perubatan Primier HUKM, HD Unit
335. Pusat Rawatan Dialisis Islah (Batu Caves), HD Unit
336. Pusat Rawatan Dialisis Nefro Utama (Puchong Jaya), HD Unit
337. Pusat Rawatan Dialisis Traktif (Selayang), HD Unit
338. Pusat Rawatan Hemodialisis Felina, HD Unit
339. Putrajaya Hospital, HD Unit
340. Rawatan Dialysis Bukit Tinggi, HD Unit
341. Reddy Clinic
342. Renal Associates, HD Unit
343. S.P. Menon Dialysis Centre (Klang), HD Unit
344. S.P. Menon Dialysis Centre (Petaling Jaya), HD Unit
345. Selangor Medical Centre, HD Unit
346. Selayang Hospital (Paed), HD Unit
347. Selayang Hospital, HD Unit
348. Serdang Hospital, HD Unit
349. SJAM-KPS Haemodialysis Centre 1 (Raja Muda Musa), HD Unit
350. SJAM-KPS Haemodialysis Centre 11 (Shah Alam), HD Unit
351. SJAM-KPS Haemodialysis Centre 2 (Klang), HD Unit
352. SJAM-KPS Haemodialysis Centre 3 (Banting), HD Unit
353. SJAM-KPS Haemodialysis Centre 5 (Rawang), HD Unit
354. SJAM-KPS Haemodialysis Centre 6 (Kuala Selangor), HD Unit
355. Smartcare Dialysis Centre (Subang Jaya), HD Unit
356. Sri Kota Medical Centre, HD Unit
357. Subang Jaya Medical Centre, HD Unit
358. Sungai Buloh Hospital, HD Unit
359. Sunway Medical Centre (2), HD Unit
360. Sunway Medical Centre, HD Unit
361. Syukur Elit Sdn Bhd, HD Unit
362. Tanjung Karang Hospital, HD Unit
363. Tengku Ampuan Jemaah Hospital, HD Unit
364. Tengku Ampuan Rahimah Hospital, HD Unit
365. Universiti Kebangsaan Malaysia Bangi, HD Unit
366. Yayasan Kebajikan SSL Puchong, HD Unit
367. Yayasan Kebajikan SSL, HD Unit

TERENGGANU

368. Besut Hospital, HD Unit
369. Dungun Hospital, HD Unit
370. Hulu Terengganu Hospital, HD Unit
371. Kemaman Hospital, HD Unit
372. Pusat Dialisis Epic, HD Unit
373. Pusat Dialisis Terengganu/NKF, HD Unit
374. Pusat Hemodialisis Nabilah, HD Unit
375. Pusat Rawatan Dialisis Islah (Kuala Terengganu), HD Unit
376. Sultanah Nur Zahirah Hospital, HD Unit
377. YKN Dialisis (Terengganu), HD Unit

WILAYAH PERSEKUTUAN KUALA LUMPUR

378. Aiman Dialysis Centre, HD Unit
379. Charis-NKF Dialysis Centre, HD Unit
380. Cheras Dialysis Centre, HD Unit
381. Kampong Baru Medical Centre, HD Unit
382. Kuala Lumpur Hospital (Home), HD Unit
383. Kuala Lumpur Hospital (Paed.), HD Unit
384. Kuala Lumpur Hospital (Unit 1), HD Unit
385. Kuala Lumpur Hospital (Unit 3), HD Unit
386. Kuala Lumpur Hospital (Unit 4), HD Unit
387. Kuala Lumpur Lions Renal Centre, HD Unit
388. MAA-Medicare Charity (Cheras), HD Unit
389. MAA-Medicare Charity (Kuala Lumpur), HD Unit
390. MDZ Haemodialysis Centre, HD Unit
391. National Kidney Foundation Dialysis Centre (KL), HD Unit
392. Pantai Indah Hospital, HD Unit
393. Pantai Medical Centre (2), HD Unit
394. Pantai Medical Centre (KL), HD Unit
395. Poliklinik Komuniti Tanglin, HD Unit
396. Pusat Dialisis Falah, HD Unit
397. Pusat Dialisis Pusat Punggutan Zakat (Kuala Lumpur), HD Unit
398. Pusat Hemodialisis Dato' Lee Kok Chee, HD Unit
399. Pusat Hemodialisis Harmoni, HD Unit
400. Pusat Hemodialisis PUSRAWI, HD Unit
401. Pusat Hemodialisis Waz Lian, HD Unit
402. Pusat Hemodialisis Yayasan Felda, HD Unit
403. Pusat Pakar Tawakal, HD Unit
404. Pusat Rawatan Dialisis Nefro Utama (Setapak), HD Unit
405. Renal Dialysis Centre, HD Unit
406. Rotary Damansara-NKF Dialysis, HD Unit
407. S.P. Menon Dialysis Centre (Kuala Lumpur), HD Unit
408. Smartcare Dialysis Clinic, HD Unit
409. The Kidney Dialysis Centre 1, HD Unit
410. The Kidney Dialysis Centre 2, HD Unit
411. The Nayang-NKF Dialysis Centre, HD Unit
412. Traktif Specialist Dialysis Centre (Wangsa Maju), HD Unit
413. Tung Shin Hospital & Yayasan Nanyang Press, HD Unit
414. Tung Shin Hospital, HD Unit
415. UKM Hospital, HD Unit
416. University Malaya Medical Centre, HD Unit
417. University Malaya Specialist Centre, HD Unit
418. YKN Dialisis (Kuala Lumpur), HD Unit

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JOHOR
BP Renal Care, CAPD Unit
BP Renal Care, Segamat, CAPD Unit
Sultan Ismail Hospital (Paed), CAPD Unit
Sultanah Aminah Hospital, CAPD Unit

KEDAH
Sultanah Bahiyah Hospital, CAPD Unit
Raja Perempuan Zainab II Hospital , CAPD Unit
USM Hospital, CAPD Unit

MELAKA
Damai Medical & Heart Clinic, CAPD Unit
Melaka Hospital, CAPD Unit

NEGERI SEMBILAN
Tuanku Jaafar Hospital (Paed), CAPD Unit
Tuanku Jaafar Hospital, CAPD Unit

PAHANG
Tengku Ampuan Afzan Hospital (Paed), CAPD Unit
Tengku Ampuan Afzan Hospital, CAPD Unit

PERAK
96 Hospital Angkatan Tentera (Lumut), CAPD Unit
Ipoh Hospital, CAPD Unit
Renal Care (Ipoh Specialist), CAPD Unit

PENANG
Pulau Pinang Hospital (Paed), CAPD Unit
Pulau Pinang Hospital, CAPD Unit

SABAH
Queen Elizabeth Hospital, CAPD Unit
Sabah Medical Centre, CAPD Unit

SARAWAK
Sarawak General Hospital, CAPD Unit

SELANGOR
Selayang Hospital (Paed), CAPD Unit
Selayang Hospital, CAPD Unit
Serdang Hospital, CAPD Unit
Sri Kota Medical Centre, CAPD Unit
Tengku Ampuan Rahimah Hospital, CAPD Unit

TERENGGANU
Sultanah Nur Zahirah Hospital, CAPD Unit

WILAYAH PERSEKUTUAN KUALA LUMPUR
Kuala Lumpur Hospital (Paed.), CAPD Unit
Kuala Lumpur Hospital, CAPD Unit
UKM Hospital, CAPD Unit
University Malaya Medical Centre, CAPD Unit

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JOHOR
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Hospital Sultan Ismail Pandan (Paed), Tx Unit
Pakar Sultanah Fatimah Muar Hospital, Tx Unit
Pontian Hospital, Tx Unit
Segamat Hospital, Tx Unit
Hospital Sultan Ismail Pandan, Tx Unit
Kluang Hospital, Tx Unit
Sultanah Aminah Hospital, Tx Unit

KEDAH
Alor Setar Hospital, Tx Unit

KELANTAN
Kota Bharu Hospital, Tx Unit
MAA-Medicare Charity Dialysis (KB Rotary), Tx Unit
USM Hospital, Tx Unit

MELAKA
Damai Medical & Heart Clinic, Tx Unit
Mahkota Medical Centre, Tx Unit
Melaka Hospital, Tx Unit

NEGERI SEMBILAN
Hospital Tuanku Ja'afar Seremban, Tx Unit

PAHANG
Tg. Ampuan Afzan Hospital, Tx Unit

PERAK
Ipoh Hospital, Tx Unit
Taiping Hospital, Tx Unit

PENANG
Pulau Pinang Hospital, Tx Unit

SABAH
Duchess of Kent Hospital, Tx Unit
Likas Hospital, Tx Unit
Queen Elizabeth Hospital, Tx Unit
Sabah Medical Centre, Tx Unit
Tawau Hospital, Tx Unit

SARAWAK
Bintulu Hospital Tx Unit
Miri Hospital, Tx Unit
Sarawak General Hospital, Tx Unit
Sibu Hospital, Tx Unit
Timberland Medical Centre, Tx Unit

SELANGOR
Ampang Puteri Specialist Hospital, Tx Unit
Selayang Hospital, Tx Unit
Serdang Hospital, Tx Unit
Sri Kota Medical Centre, Tx Unit
Sunway Medical Centre, Tx Unit
Tan Medical Renal Clinic, Tx Unit
Tg. Ampuan Rahimah Hospital, Tx Unit

TERENGGANU
Kemaman Hospital, Tx Unit
Kuala Terengganu Hospital, Tx Unit

WILAYAH PERSEKUTUAN KUALA LUMPUR
Kuala Lumpur Hospital (Paed), Tx Unit
Kuala Lumpur Hospital, Tx Unit
Renal Dialysis Centre, Tx Unit
Smartcare Dialysis Centre (Cheras), Tx Unit
UKM Hospital, Tx Unit
University Malaya Medical Centre, Tx Unit

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FOREWORD

The planning of facilities for Renal Replacement Therapy (RRT) in a developing country like Malaysia was relatively easy in the last 10-20 years. This was because the demand for RRT was high and resources, particularly financial, were limited. There was no danger of building excess capacity. Every single space in a new facility particularly in the public sector was used.

A figure of 100 per million new cases of End Stage Renal Disease (ESRD) per year was used for planning and management purposes so assiduously that it was frequently quoted in the newspapers, by politicians and by ministry of health officials. All sectors, the government, the non-profit organizations and the private healthcare providers worked towards providing more places for Hemodialysis (HD) treatment.

Quietly, without much fanfare or any display of pride that "we have made it!", the country reached the magic figure of 100 per million in 2003 and moved on to the present rate of 130 per million. Even more impressive was the fact that in 2007, eight of the fourteen states accepted more than 130 new patients per million with four of these states accepting more than 190 per million.

We have indeed come a long way. No other country with our level of national income has come close to these figures. We (all stakeholders in this dialysis provision) deserve to be congratulated. Success, however, calls for evaluation and reevaluation of strategies, if not for anything else, to achieve greater success.

A cursory look at the figures reveals that a state with the highest treatment rate accepted more than three times the number of patients per million population than the one with the lowest. This is continually being addressed and the situation has improved compared to a few years earlier. Another set of data showed that states with high treatment rates do not have optimal HD capacity to patient ratio indicating that there is now excess capacity. There are some dialysis centres running on one shift a day or on alternate days. Should we waste resources just because the public and the government continue to be generous to ESRD patients? Can some of these resources be diverted for other potentially beneficial initiatives like screening for kidney diseases and effective public education?

One other consideration is to use some of the resources to develop Peritoneal Dialysis (PD) treatment in the NGO hemodialysis centres. Presently long-term PD is available almost exclusively in public sector hospitals. Slightly over ten percent of patients on dialysis in 2007 were on PD. Some mechanism can be worked out where NGO centers can collaborate with public sector hospitals in offering patients PD as another choice of dialysis modality. Such collaboration can include having the Tenchkoff Catheter insertion and treatment for peritonitis to be done in public hospitals. The NGO centres can provide day care services like transfer set change and periodic review of patients by nephrologists.

PD should be considered even in states with low treatment rate. The development costs of setting up a Hemodialysis centre is increasing with the rising cost of construction materials and labour. The costs of CAPD (or Automated PD) may come down when the number of patients on this treatment increases.

This basic principle in economics, economy of scale, made us very successful with hemodialysis treatment. We now pay less for dialysers, needles, bloodlines and dialysates than we did 10-15 years ago. The other major reason for affordable hemodialysis was opening up the hemodialysis supplies market to as many players as possible without compromising quality.

Once again our gratitude goes to Ms Lee Day Guat and her team for their commitment and dedication in putting together this 15th report. We also thank the chapter editors, the report editors Drs Lim Yam Ngo and Lim Teck Onn and the staff of all participating centres for sending the data religiously every year. We hope that by studying our centre results, we will be able to further improve the patients' survival and quality of life and reduce the variation across many centres.

Dr. Rozina Ghazalli
Chairperson

Dr. Zaki Morad Mohd Zaher
Co - Chairperson

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REPORT SUMMARY

- Intake of new dialysis patients showed a linear increase from 1253 in 1998 to 3570 in 2006 with corresponding treatment rates of 56 and 134 per million population.
- Prevalent dialysis patients increased from 4570 (205 per million) in 1998 to almost 16000 (615 per million) at year end 2007.
- Transplant rates showed a decreasing trend over 2006 and 2007. Patients with functioning renal transplants increased very slightly from 1112 (50 per million) to 1726 (64 per million) over the same period.
- Pulau Pinang, Melaka, Johor and WP Kuala Lumpur have dialysis treatment rates around 200 per million. Terengganu with treatment rate of 164 per million has joined the developed states in 2007. Pahang and Sarawak have also shown rapid increase in dialysis treatment rates.
- From the centre survey carried out at the end of 2007, there were a total of 17367 dialysis patients, 35.7% in government centres, 30.1% in non-governmental organizations (NGO) centres and 34.8% in private sector. Almost all patients in NGO and private centres were on centre HD. In MOH, 25% were on chronic PD. The private sector had the largest number of dialysis centres, the NGO centres had the largest HD capacity. Private and NGO dialysis centres provided about 80% of the total dialysis provision in states with high dialysis provision rates and less than 50% in states with low centre HD provision rates except for Sarawak and Kedah.
- The treatment gap between men and women has remained consistent over the years.
- Dialysis treatment rates for those >45 years of continued to increase.
- At least 85% of new patients were accepted into centre haemodialysis
- The government continued to fund about 54% of new dialysis treatment, NGO funding was 10% in 2006, and self funding 26%.
- The proportion of new ESRD patients due to diabetes mellitus was 57% in 2007.
- With a developing country level of gross national income (GNI) of USD 5,070 per capita, Malaysia has been able to achieve RRT provision commensurate to many developed countries.
- The proportion of household income to HD cost has declined.
- Inequality of dialysis treatment has declined across all sectors of providers of dialysis as treatment expanded. Public services have switched from favouring the well off to favouring the poor.
- The annual death rate for those on hemodialysis remained relatively unchanged while the annual death rate on CAPD showed a decreasing trend over the last 10 years.
- Cardiovascular disease and death at home remained the commonest causes of death in 2006 at 25 and 18% respectively; death due to sepsis decreased to 10%.
- The overall unadjusted 5 years and 10 years patient survival on dialysis were 57% and 35% respectively.
- 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.
- There was wide variation in odds ratio of death by dialysis centre.
- After adjustment for multiple risk factors, diabetics, older patients, higher diastolic BP, high serum calcium and serum phosphate, and hepatitis B antigenaemia were associated with higher mortality. Higher serum albumin, KT/V, haemoglobin concentration, calcium phosphate product and presence of hepatitis C antibodies were associated with lower mortality.
- Median QoL index scores were satisfactory and HD patients achieved a lower score than CAPD patients. Diabetes mellitus and older age group are factors associated with lower median QoL index scores. Higher employment rate among HD and CAPD patients who started dialysis earlier may be confounded by these healthier individuals who survived longer.

- In 2007, 86% of HD and 74% of CAPD patients were on erythropoietin (EPO). Blood transfusion rate in dialysis patients was 15% in 2007. Use of parenteral iron has increased, with corresponding reduction in oral iron prescription. The median weekly EPO dose remained at 4000 units, in both HD and CAPD patients. Median haemoglobin level increased to 10.8g/L in 2007. Median serum ferritin level was about 500 ng/L and transferrin saturation 32%. Wide variations were seen in the use of EPO, blood transfusion rates, measures of iron stores and hemoglobin levels in HD and CAPD centres

- Serum albumin levels remained at mean and median of about 40g/L for HD and about 34 g/L in CAPD patients in 2007. There were wide variations in the proportion of patients with serum albumin of at least 40g/L in both HD and CAPD centres.

- Body mass index for HD patients has stabilized around 24, but was still increasing for patients on CAPD. There was some variation in proportion of patients with BMI $\geq$ 18.5 in both HD and PD centres.

- In 2007, there was better control of predialysis diastolic than systolic blood pressure in HD patients. Blood pressure (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. Blood pressure control in CAPD was much better than in haemodialysis patients

- Improving cholesterol levels were seen in HD patients 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 remained significant variation in lipid control between dialysis centres.

- In 2007 calcium carbonate remained the major phosphate binder in both HD and CAPD patients. The percentage of patients on calcitriol was increasing. More patients underwent parathyroidectomy. Serum calcium levels were lower in HD patients. Phosphate control was better in CAPD patients. The target of calcium phosphate product of less than 4.5 $mmol^2/L^2$ was achieved more by CAPD patients than HD. Mean iPTH levels was about 246 ng/ml in both HD and CAPD patients in 2007. 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 at about 5%, and was similar between HD and CAPD patients. HCV prevalence in HD although high showed a declining trend to 11% in 2007 from 22% ten years earlier. 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 and diabetics 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, and almost universal use of bicarbonate buffer. Although the prescribed median KT/V was 1.6 in 2007, the delivered median KT/V was only1.4. The percentage of patients with a delivered KT/V $\geq$ 1.2 was 79%. In 2007, the median urea reduction ratio was 71.9% and the percentage of patients with URR $\geq$ 65% was 82%. There was wide variation in the proportion of patients with blood flow rates of >250 ml/min, prescribed KT/V of $\geq$1.3 and delivered KT/V of $\geq$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 2007, 86% of PD patients were on CAPD, 6% on DAPD and 8% on automated PD. For CAPD, 93% were on Baxter disconnect system. 90% were on 4 exchanges a day, 88% used a fill volume of 2 L. The median delivered weekly Kt/V was 2.1, 83% achieved target Kt/V of $\geq$1.7 with a 1.5-fold variation between the highest and the lowest performing centres. Increasing age, diabetes, peritonitis episodes, cardiovascular disease, low serum albumin, low BMI, abnormal lipid profile, blood haemoglobin less than 10g/dL and assisted PD were associated with an increased risk for change of modality. The commonest reason for PD drop-out was peritonitis, followed by membrane failure and patient preference.

- In 2007, median peritonitis rate improved to 40.9 patient-months per episode but varied between 12 and 106 patient-months/episode among centres. Gram positive and Gram negative organisms each accounted for 32% and 27% of peritonitis episodes.

Renal Transplantation

- There were 138 new renal transplant recipients in 2006 and only 86 in 2007. There were 1726 with functioning transplants at the end of 2007. Incident renal transplantation rate was 5-7 per million, and prevalent rates at about 65 per million population.
- Mean age of new transplant patients in 2007 was 37 years; 62% were male, 12% diabetic, 5% HbsAg positive and 11% anti-HCV positive at the time of transplantation.
- Commonest known primary renal disease was chronic glomerulonephritis followed by hypertension and diabetes mellitus.
- In 2007, commercial transplants from China constituted only 33% of all new renal transplantation, live donor transplantation 24% and contribution from local cadaveric transplants increased to 28%.
- 72% of renal transplant recipients were on cyclosporine, and 21% were on tacrolimus. Use of MMF increased to 54% and azathioprine decreased to 29%.
- 14% of the prevalent renal transplant recipients had diabetes mellitus before transplantation, another 7% developed diabetes mellitus post transplantation
- In 2007, 34(2%) of transplant recipients died and 36 (2%) lost their grafts. Infection, cardiovascular disease and cancer were the commonest causes of death. Renal allograft rejection accounted for 50-75% of graft losses for the last 10 years
- The overall transplant patient survival rate from 1994 to 2007 was 95%, 88% and 81% at 1 year, 5 years and 10 years respectively, while the overall graft survival rate was 92%, 79% and 64% respectively. Living donor transplantation had the best patient survival. Living donor and commercial cadaver grafts had the best graft survival rates.

Paediatric Renal Replacement Therapy

- Intake of new paediatric dialysis patients increased from 49 in 1998 to 95 in 2006 giving a dialysis acceptance rate of 4 per million age related population (pmarp) to 8 pmarp respectively.
- At the end of 2007 there were a total of 509 patients under 20 on dialysis giving a dialysis prevalence rate 45 pmarp.
- New renal transplant rate was 2 pmarp from 2005.
- The number of patients with functioning transplants in 2007 was 166 giving a prevalence rate of 15 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 7% were on automated PD.
- About 90% received dialysis in government centres.
- Glomerulonephritis (other than FSGS) accounted for 21% of ESRD, focal segmental glomerulosclerosis 8%, and SLE 7%. 47% of patients had unknown primary renal disease.
- Patient survival for HD was 95% at 1 year, 82% at 5 years. CAPD patient survival was 94% at 1 year and 79% at 5 years.
- In the last 5 years, live related transplantation and cadaveric transplantation each contributed to 38% of renal transplantations done. 23% were from commercial cadaveric transplantation done overseas.
- Transplant patient survival was 98% at 1 year and 94% at 5 years; graft survival was 91% at 1 year and 79% at 5 years.

ABBREVIATIONS

CAPD	Continuous Ambulatory Peritoneal Dialysis
CCPD/APD	Continuous cycling peritoneal dialysis/automated peritoneal dialysis
CRA	Clinical Registry Assistant
CRC	Clinical Research Centre
CRM	Clinical Registry Manager
ESRD	End Stage Renal Disease
GNI	Gross National Income
HD	Haemodialysis
MOH	Ministry of Health
MOSS	Malaysian Organ Sharing System
NRR	National Renal Registry
NGO	Non-governmental organization
PD	Peritoneal dialysis
pmp	per million population
pmarp	per million age related population
RRT	Renal replacement therapy
SDP	Source data producer
TX	Transplant

CHAPTER 1

All Renal Replacement Therapy in Malaysia

Lim Yam Ngo
Lim Teck Onn
Lee Day Guat

SECTION 1.1: STOCK AND FLOW

The intake of new dialysis patients continued to show a linear increase over the years - from 1253 in 1998 to 3570 in 2006. The number of prevalent dialysis patients also increased linearly from 4540 in 1998 to almost more than 16000 at year end 2007. (Data for 2007 however are preliminary since at the time preparation of this report there were still many new cases yet to be notified to registry.)

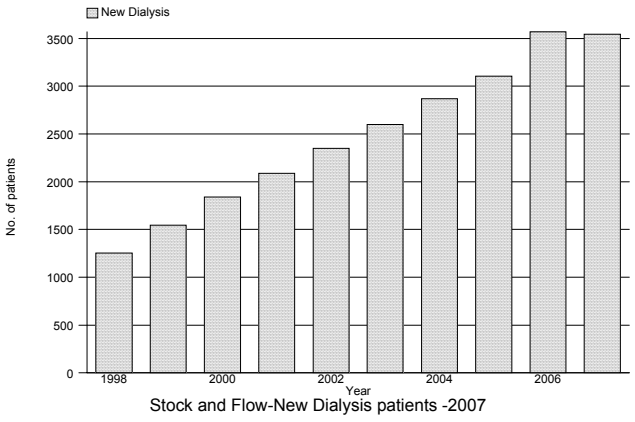
The number of new kidney transplant recipients had been increasing since the late 1990s, but with increasing proscription against commercial transplantation, has started to show a downward trend from 2005. Patients with functioning renal transplants showed a moderate increase - from 1112 to 1726 over the same period. (table and figure 1.1)

Table 1.1: Stock and Flow of RRT, Malaysia 1998-2007

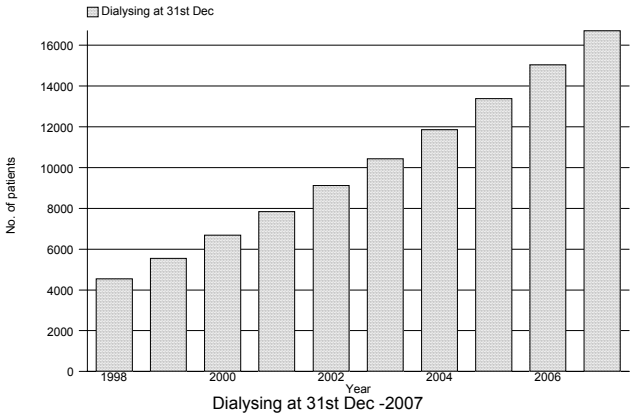
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
New Transplants	104	127	143	162	169	160	190	163	138	86
Dialysis deaths	376	493	594	816	927	1157	1272	1420	1673	1678
Transplant deaths	26	25	30	37	32	37	41	43	50	34
Dialysing at 31st December	4540	5540	6693	7846	9120	10436	11867	13385	15039	16719
Functioning transplant at 31st December	1112	1177	1249	1330	1424	1502	1593	1681	1722	1726

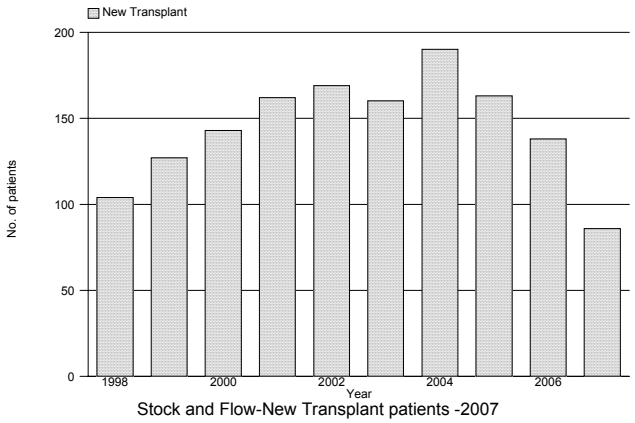
Figure 1.1: Stock and Flow of RRT, Malaysia 1998-2007

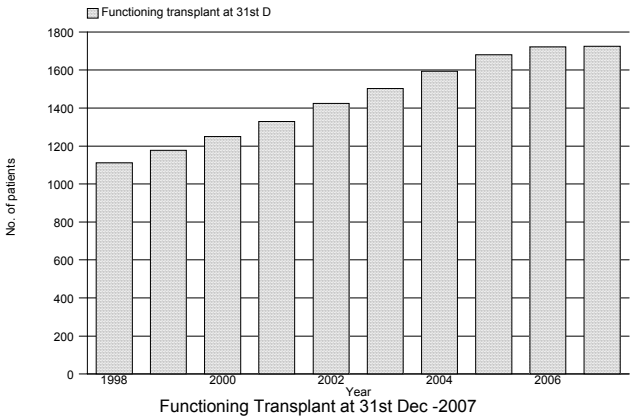
a) New Dialysis and Transplant patients 1998-2007



(b) Patients Dialysing and with Functioning Transplant at 31st December 1998-2007







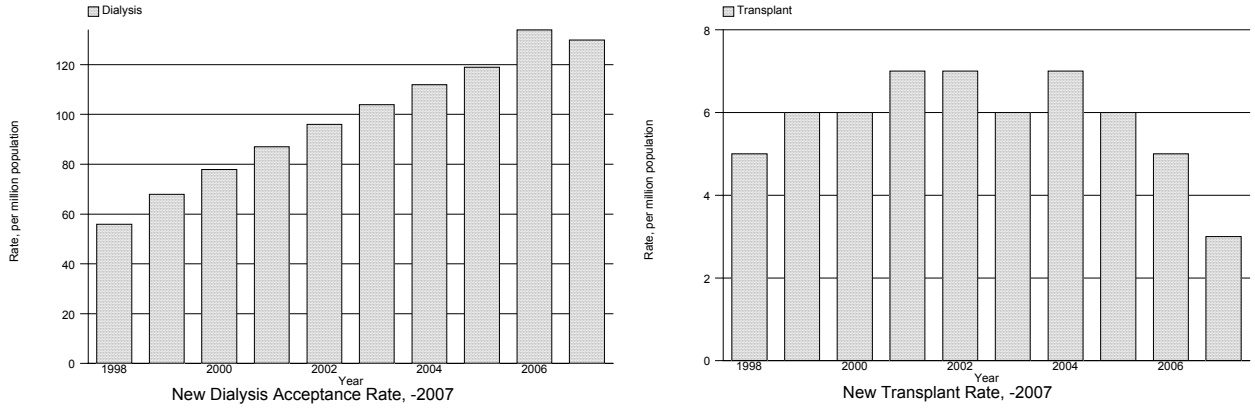
SECTION 1.2: TREATMENT PROVISION RATE

Dialysis acceptance rates also continued to increase linearly from 56 per million population in 1998 to 134 per million in 2006. (table and figure 1.2)
New transplant rates remained dismally low over the years and seemed to be beginning to show a decreasing trend. Since 1990, commercial transplantation carried overseas had contributed more than 50% of all new kidney transplantation each year. With the proscription of commercial transplantation, overseas transplantation contributed only 40% in 2007. (see table 14.3.1)

Table 1.2: New Dialysis Acceptance rate and New Transplant Rate per million population 1998-2007

Acceptance rate	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis	56	68	78	87	96	104	112	119	134	130
New Transplant	5	6	6	7	7	6	7	6	5	3

Figure 1.2: New Dialysis Acceptance and New Transplant Rate 1998-2007

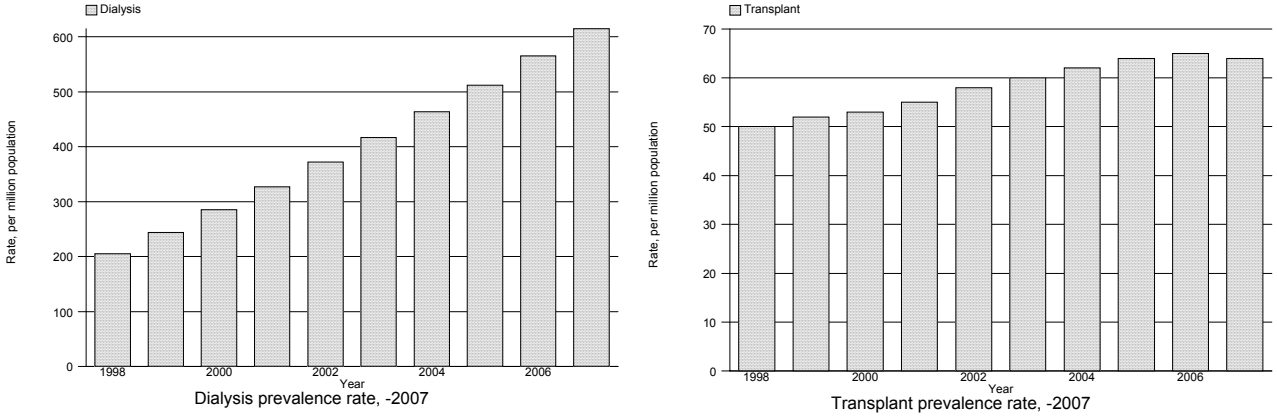


Dialysis prevalence rate continued to increase linearly over the last 10 years, from 205 per million population in 1998 to at least 615 in 2007. The transplant prevalence rate however appears to be static in the last few years. (table and figure 1.3)

Table 1.3: RRT Prevalence Rate per million population 1998-2007

Prevalence rate	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dialysis	205	244	285	327	372	417	464	512	565	615
Transplant	50	52	53	55	58	60	62	64	65	64

Figure 1.3: Dialysis and Transplant Prevalence Rate per million population 1998-2007



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 2006, 3570 patients commenced dialysis, giving a incident rate of 134 per million population. At year end 2006, a total of 15039 patients were reported to the registry as being on dialysis treatment giving a prevalence rate of 565 per million per year. By year end 2007, at least 16719 patients were on dialysis giving a prevalence rate for 2007 of at least 615 per million population. The proportion of dialysis patients lost to follow-up remained at less than 1%.

Table 2.1.1: Stock and flow- Dialysis Patients 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
Died	376	493	594	816	927	1157	1272	1420	1673	1678
Transplanted	61	69	106	130	144	121	153	122	120	83
Lost to Follow-up	8	6	8	8	17	27	33	50	132	105
Dialysing at 31st Dec	4540	5540	6693	7846	9120	10436	11867	13385	15039	16719

Table 2.1.2: Dialysis Treatment Rate per million population 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Acceptance rate	56	68	78	87	96	104	112	119	134	130
Prevalence rate	205	244	285	327	372	417	464	512	565	615

2.1.2. Geographic distribution

Pulau Pinang, Melaka, Johor and Kuala Lumpur – the highest dialysis provision states now have incident rates of 200 or more per million state population. Dialysis provision rates in other states too have increased throughout the years. Pahang, Sarawak and Terengganu particularly have shown rapid increase in dialysis treatment rates. Terengganu demonstrates how advocacy with cash windfall can have dramatic increase in dialysis treatment rates.

Table 2.1.3: Dialysis Treatment Rate by State, per million state population 1998-2007

State	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pulau Pinang	113	124	110	125	158	145	213	199	212	198
Melaka	106	88	150	154	175	185	210	170	199	192
Johor	71	104	131	138	148	146	155	168	205	167
Perak	64	76	105	103	115	129	146	168	181	150
Selangor & WP Putrajaya	77	93	83	94	111	119	123	134	148	141
WP Kuala Lumpur	137	122	157	188	172	193	205	199	215	213
Negeri Sembilan	95	97	116	110	131	147	157	155	147	192
Kedah	47	60	66	63	88	102	97	108	111	92
Perlis	45	49	72	104	103	128	95	102	127	108
Terengganu	34	36	37	75	90	66	80	100	102	164
Pahang	36	48	49	52	52	68	73	88	120	92
Kelantan	15	27	31	61	61	74	66	79	79	80
Sarawak	33	44	50	67	59	62	73	72	86	97
Sabah & WP Labuan	24	31	26	35	37	44	49	46	64	66

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. In addition, enforcement of this Act is still in the preliminary stages.

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 2007. 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 2007, 454 hemodialysis centres and 33 CAPD centres provided dialysis care to 17367 patients. (Data on 16719 inidividual dialysis patients were reported to the Registry giving a dialysis patient ascertainment rate of almost 96%) The Ministry of Health (MOH) provided dialysis to 33.1% of patients, University and Armed forces 2%, non-governmental organizations (NGO) 30.1% and the private sector at 34.8%. Almost all private dialysis patients received centre haemodialysis treatment compared to the MOH sector where patients on chronic peritoneal dialysis (PD) made up 25% of all dialysis patients. There were no PD patients in NGO centres. (table 2.2.1)

Of the 3 main sectors, the private sector again 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 1.49 in 2007. The HD capacity to patient ratio had increased further in the NGO sector from 1.72 in 2006 to 1.98 in 2007. (fig 2.2.1d)

Table 2.2.1: Number of dialysis centres, HD machines and treatment capacity by sector, December 2007

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	132	1278	6390	4302	1.49	20	1444	5746
NGO	123	1836	9180	5228	1.76	0	0	5228
Private (PRV)	186	1787	8935	6026	1.48	9	12	6038
University (UNI)	6	67	335	169	1.98	3	82	251
Armed Force(AF)	7	43	215	99	2.17	1	5	104
TOTAL	454	5011	25055	15824		33	1543	17367

Figure 2.2.1(a): Distribution of dialysis centres by Sector, December 2007

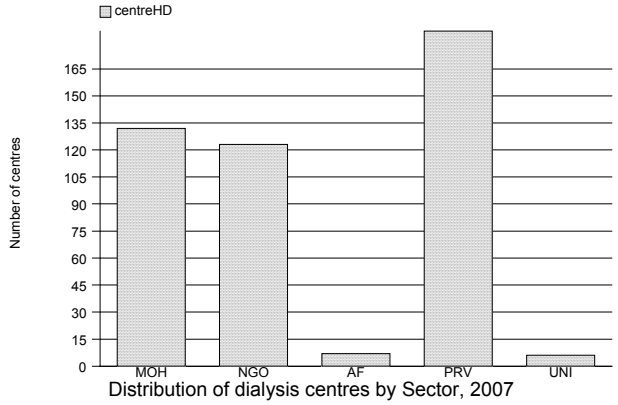


Figure 2.2.1(b): Distribution of HD capacity by Sector, December 2007

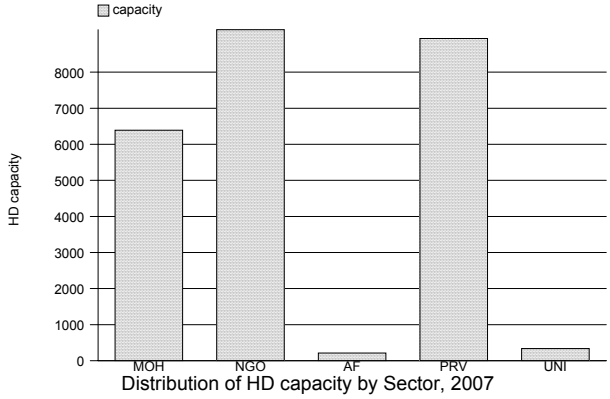


Figure 2.2.1(c): Distribution of dialysis patients by Sector, December 2007

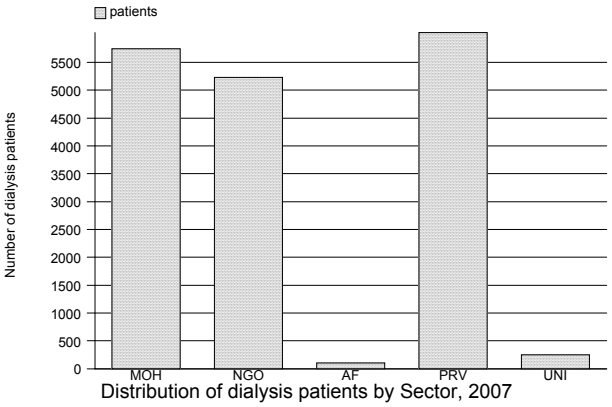
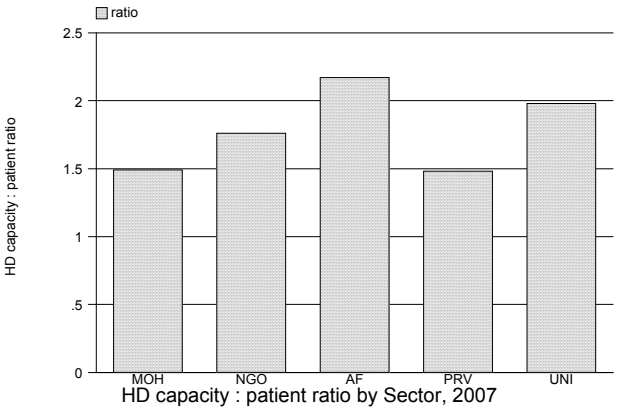


Figure 2.2.1(d): HD capacity: patient ratio by Sector, December 2007



2.2.2. Geographic distribution (centre survey)

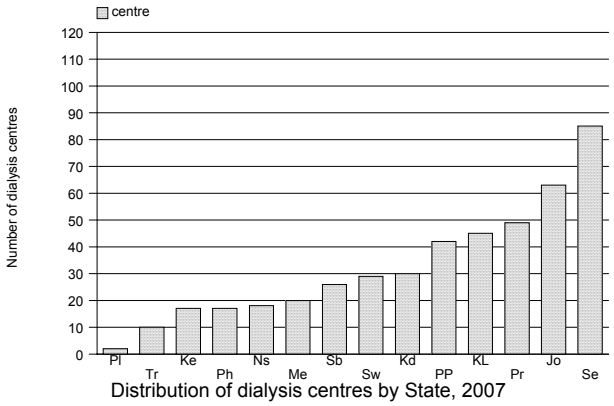
The economically advantaged states of Pulau Pinang, Melaka, Johor, Perak, Selangor, Kuala Lumpur and Negeri Sembilan had centre HD capacity rates and dialysis treatment rates above the national rate. There was a 5-fold difference in treatment rates between the states with the highest provision i.e. Kuala Lumpur and Pulau Pinang, and the state with the lowest treatment rate (Sabah). [table 2.2.2 (a)] Unlike in previous years, the HD capacity to patient ratio did not vary too widely between the different states.

Private sector and NGO dialysis were the main contributors to the large variation in centre HD provision rates between the various states. Private and NGO dialysis centres provided about 80% of the total dialysis provision in states with high dialysis provision rates and less than 50% in states with low dialysis provision rates except for Sarawak and Kedah.

Table 2.2.2(a): 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 2007

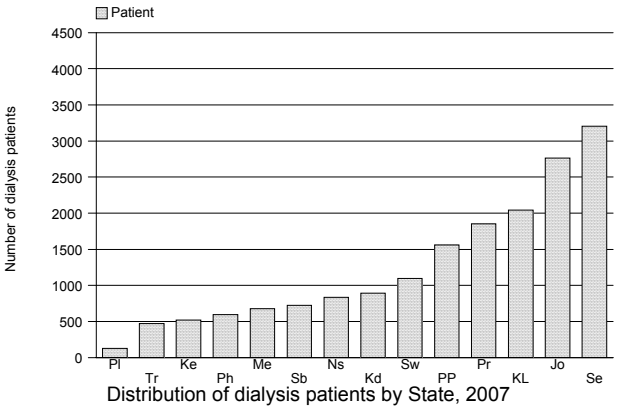
State	Centre HD (No.)	Centre HD machines	Centre HD machines pmp	Centre HD capacity (No.)	Centre HD capacity pmp	Centre HD patients (No.)	Centre HD patients pmp	HD capacity: patient ratio	Centre PD patients (No.)	Centre PD patients pmp	All dialysis patients (No.)	Dialysis treatment rate pmp
Pulau Pinang	42	472	311	2360	1554	1402	923	1.68	158	104	1560	1027
Melaka	20	219	296	1095	1482	644	872	1.7	32	43	676	915
Johor	63	730	225	3650	1126	2557	789	1.43	206	64	2763	853
Perak	49	553	239	2765	1195	1780	769	1.55	71	31	1851	800
Selangor & WP Putrajaya	85	993	200	4965	1001	2954	595	1.68	251	51	3205	646
WP Kuala Lumpur	45	539	336	2695	1680	1735	1081	1.55	309	193	2044	1274
Negeri Sembilan	18	216	221	1080	1104	713	729	1.51	120	123	833	852
Kedah	30	298	155	1490	777	863	450	1.73	30	16	893	465
Perlis	2	39	168	195	841	130	561	1.5	0	0	130	561
Terengganu	10	115	108	575	538	384	360	1.5	88	82	472	442
Pahang	17	182	123	910	613	513	346	1.77	83	56	596	402
Kelantan	17	143	92	715	458	466	299	1.53	54	35	520	333
Sarawak	29	307	128	1535	638	1028	428	1.49	70	29	1098	457
Sabah & WP Labuan	26	202	66	1010	330	654	213	1.54	71	23	725	237
Malaysia	453	5008	184	25040	922	15823	582	1.58	1543	57	17366	639

Figure 2.2.2 (a): Distribution of dialysis centres by State, December 2007



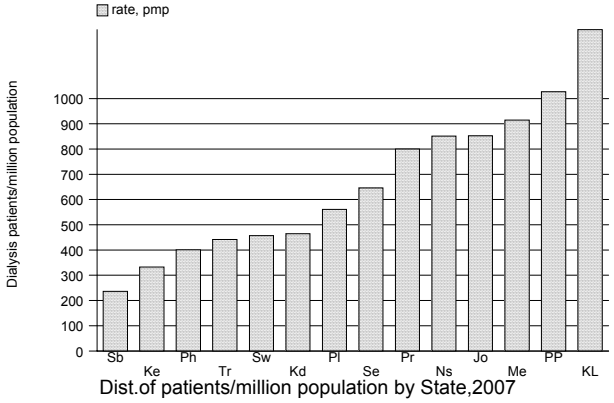
Distribution of dialysis centres by State, 2007

Figure 2.2.2 (b): Distribution of dialysis patients by State, December 2007



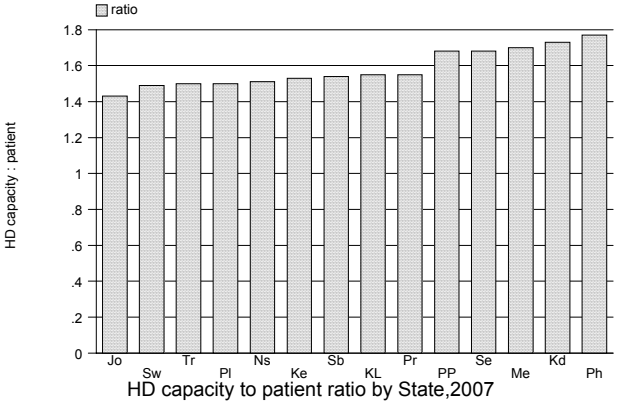
Distribution of dialysis patients by State, 2007

Figure 2.2.2(c): Distribution of dialysis treatment by State, December 2007



Dist.of patients/million population by State,2007

Figure 2.2.2(d): HD capacity to patient ratio by State, December 2007



HD capacity to patient ratio by State,2007

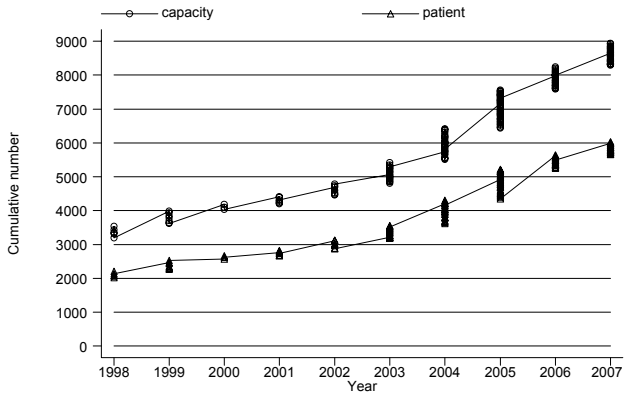
2.2.3 Growth in dialysis provision by sector

The number of patients on HD continued to increase in the private and NGO sector but has remained static over the last 3 years in the public sector. (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)

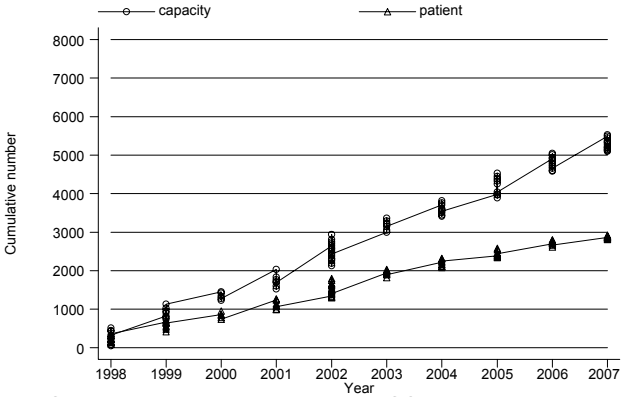
Table 2.2.3: Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1998-2007

Sector	Private		NGO		MOH	
	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients
1998	3540	2212	510	374	780	517
1999	3980	2533	1130	723	965	618
2000	4185	2660	1455	952	1245	815
2001	4410	2818	2040	1273	1640	1077
2002	4780	3135	2940	1796	2025	1379
2003	5420	3560	3365	2038	2260	1533
2004	6415	4303	3815	2325	2960	2059
2005	7555	5217	4525	2582	3800	2578
2006	8240	5644	5045	2801	4150	2677
2007	8935	6026	5525	2921	4170	2698

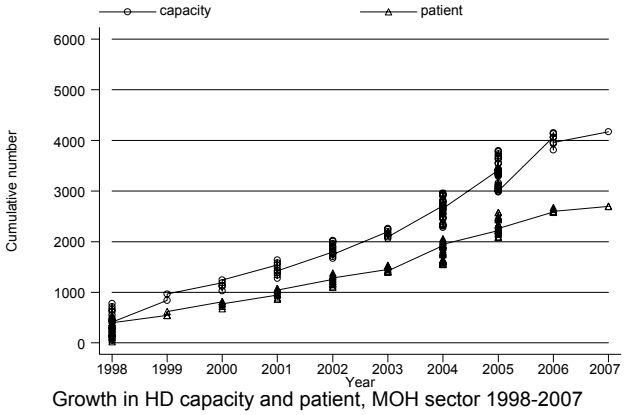
Figure 2.2.3: Growth in HD and HD patients in Private, NGO and MOH sectors, 1998-2007



Growth in HD capacity and patient, private sector 1998-2007



Growth in HD capacity and patient, NGO sector 1998-2007



Growth in HD capacity and patient, MOH sector 1998-2007

SECTION 2.3: DISTRIBUTION OF DIALYSIS TREATMENT

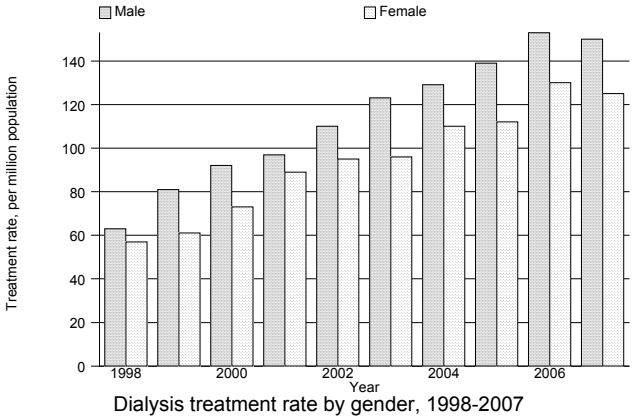
2.3.1 Gender distribution

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 1998-2007

Gender	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Male	63	81	92	97	110	123	129	139	153	150
Female	57	61	73	89	95	96	110	112	130	125

Figure 2.3.1(a): Dialysis Treatment by Gender 1998-



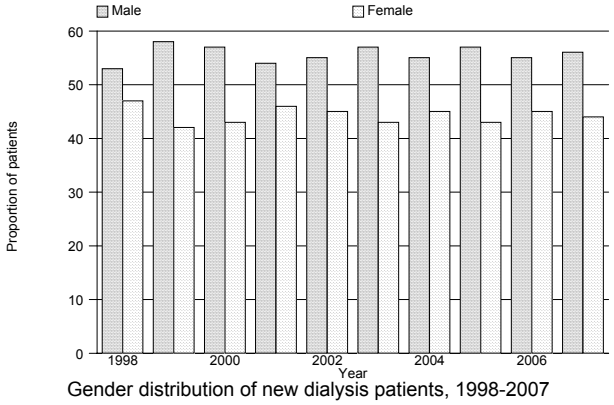
Dialysis treatment rate by gender, 1998-2007

Table 2.3.1(b): Gender distribution of Dialysis Patients 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3541
% Male	53	58	57	54	55	57	55	57	55	56
% Female	47	42	43	46	45	43	45	43	45	44
Dialysing at 31st December	4540	5540	6693	7846	9120	10436	11867	13385	15039	16718
% Male	56	56	56	55	55	55	55	55	55	55
% Female	44	44	44	45	45	45	45	45	45	45

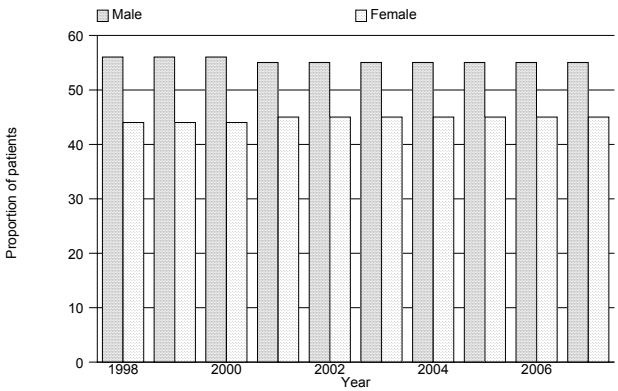
Figure 2.3.1(b): Gender Distribution of Dialysis Patients 1998-2007

(i) New Dialysis patients



Gender distribution of new dialysis patients, 1998-2007

(ii) Dialysing patients at 31st December



Gender distribution of dialysing patients at 31st Dec, 1998-2007

2.3.2 Age distribution

New dialysis treatment rates in the younger age-groups less than 45 years have remained unchanged 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 45 years and older have continued to increase. The most rapid increase in treatment rate is seen in those 65 years and above which showed more than 3-fold increase over the last 10 years.

Table 2.3.2(a): Dialysis Treatment Rate by Age Group, per million age group population 1998-2007

Age groups (years)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
<=14	3	4	4	4	5	4	5	5	5	5
15-24	15	16	18	22	29	26	28	30	30	29
25-34	41	42	46	47	55	52	51	57	59	58
35-44	81	85	98	103	100	102	115	112	123	117
45-54	173	225	249	252	275	279	309	300	356	324
55-64	314	370	432	508	535	586	588	653	667	685
>=65	228	301	347	439	500	584	653	660	793	743

Figure 2.3.2(a): Dialysis Treatment Rate by Age Group 1998-2007

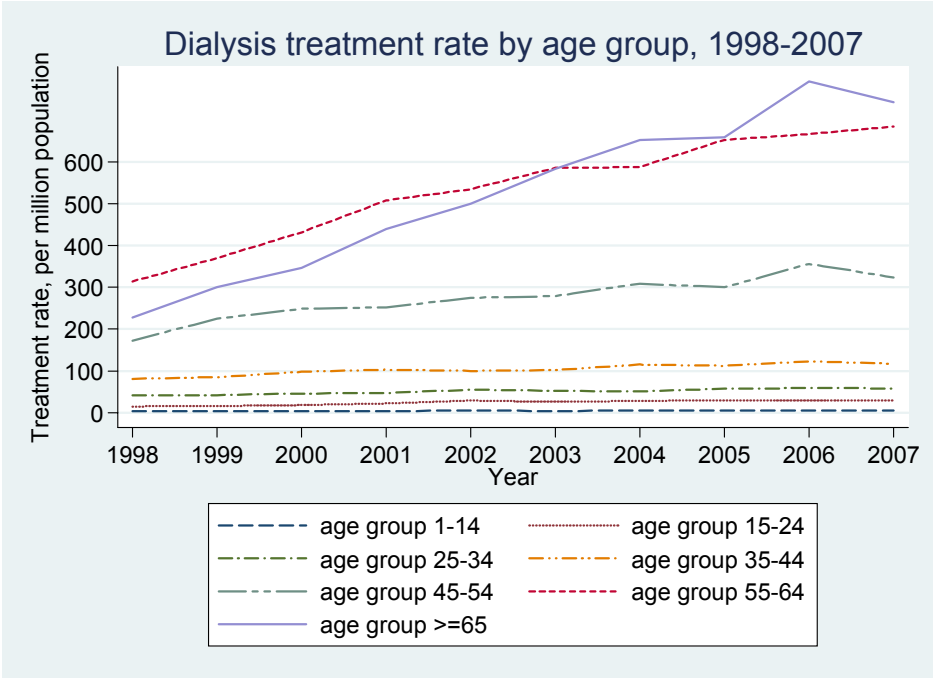
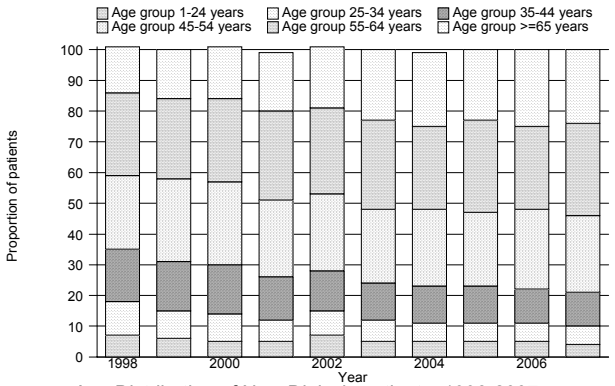


Table 2.3.2(b): Percentage Age Distribution of Dialysis Patients 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
% 1-14 years	2	2	1	1	2	1	1	1	1	1
% 15-24 years	5	4	4	4	5	4	4	4	4	3
% 25-34 years	11	9	9	7	8	7	6	6	6	6
% 35-44 years	17	16	16	14	13	12	12	12	11	11
% 45-54 years	24	27	27	25	25	24	25	24	26	25
% 55-64 years	27	26	27	29	28	29	27	30	27	30
% >=65 years	15	16	17	19	20	23	24	23	25	24
Dialysing at 31st December	4540	5540	6693	7846	9120	10436	11867	13385	15039	16719
% 1-14 years	2	2	1	1	1	1	1	1	1	1
% 15-24 years	5	5	5	5	5	5	5	5	5	5
% 25-34 years	15	14	14	13	12	12	11	10	10	10
% 35-44 years	22	21	20	20	19	18	17	17	16	16
% 45-54 years	24	25	25	25	25	26	26	26	26	26
% 55-64 years	21	22	23	23	24	24	24	25	24	25
% >=65 years	10	11	12	13	14	14	15	16	17	17

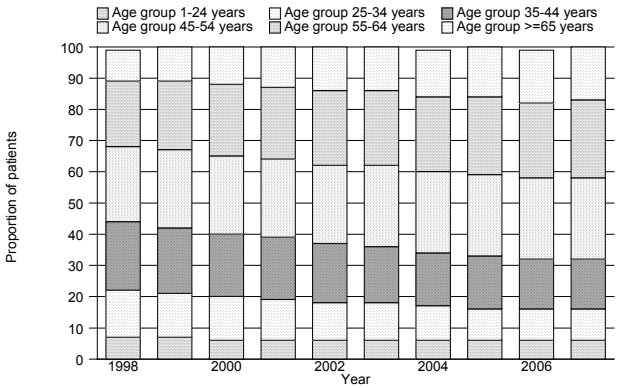
Figure 2.3.2(b): Age Distribution of New Dialysis patients 1998-2007

(i) New Dialysis patients



Age Distribution of New Dialysis patients, 1998-2007

(ii) Dialysing patients at 31st December



Age Distribution of Dialysing Patients at 31st Dec, 1998-2007

2.3.3 Method and Location of dialysis

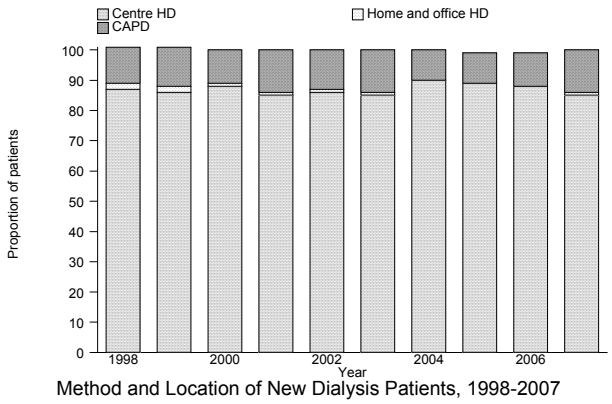
85% of new patients were accepted into centre haemodialysis in 2007. With the conscious effort by the MOH to place PD first, chronic PD accounted for about 14% of new dialysis patients. However, PD only accounted for 8% of prevalent dialysis patients in 2007. (table & fig 2.3.5)

Table 2.3.3: Method and Location of Dialysis 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
% Centre HD	87	86	88	85	86	85	90	89	88	85
% Home and office HD	2	2	1	1	1	1	0	0	0	1
% CAPD	12	13	11	14	13	14	10	10	11	14
Dialysing at 31st December	4195	5152	6247	7311	8501	9768	11143	12739	14456	15924
% Centre HD	87	89	90	90	90	90	91	90	89	89
% Home and office HD	1	1	0	1	0	0	0	1	1	1
% CAPD	12	11	10	9	9	9	9	8	8	8

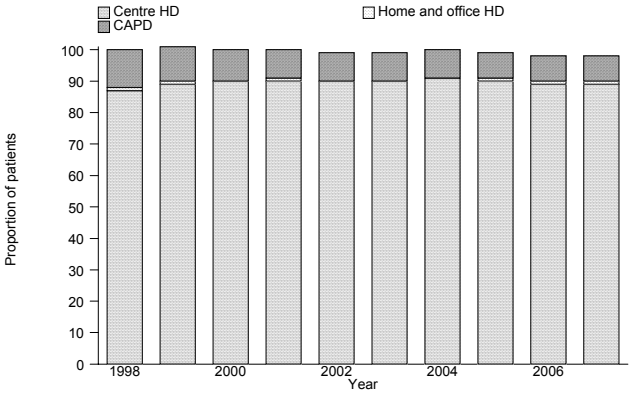
Figure 2.3.3: Method and Location of Dialysis patients 1998-2007

(i) New Dialysis patients



Method and Location of New Dialysis Patients, 1998-2007

(ii) Dialysing patients at 31st December



Method and Location of Dialysing Patients at 31st Dec, 1998-2007

2.3.4 Funding for Dialysis Treatment

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.

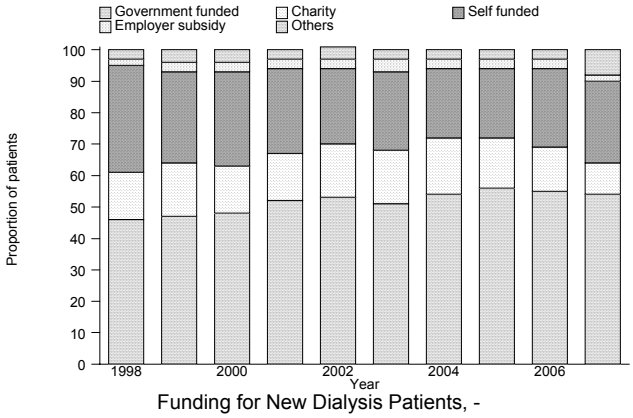
The government continues to be the main payer for dialysis therapy. These funds are channeled not only to the government dialysis centres but also as subsidies to NGO centres and payment of dialysis treatment for civil servants and their dependents in the private centres. A quarter of patients paid for their dialysis treatment. Funding from NGO bodies accounted for between 10-18% over the last 10 years. (table & fig 2.3.4)

Table 2.3.4: Funding for Dialysis Treatment 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
% by Government	46	47	48	52	53	51	54	56	55	54
% by Charity	15	17	15	15	17	17	18	16	14	10
% self funded	34	29	30	27	24	25	22	22	25	26
% subsidized by Employer	2	3	3	3	3	4	3	3	3	2
% Others	3	4	4	3	4	3	3	3	3	8
Dialysing at 31st December	4195	5152	6247	7311	8501	9768	11143	12739	14456	15924
% by Government	51	48	46	46	46	45	45	48	59	59
% by Charity	17	20	24	25	27	26	27	22	13	14
% self funded	26	27	26	25	24	25	24	23	19	17
% subsidized by Employer	3	3	2	2	2	2	2	2	3	3
% Others	2	2	2	2	2	2	2	4	4	6

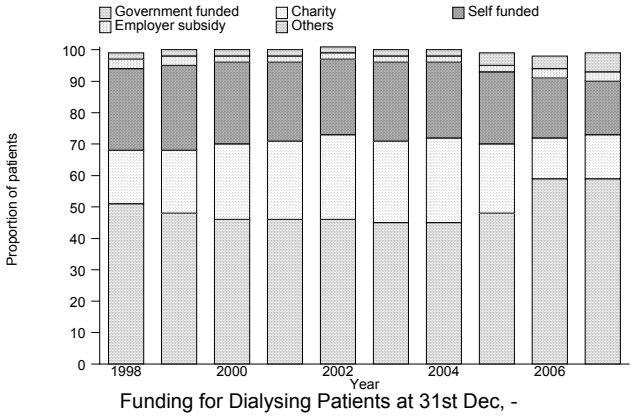
Figure 2.3.4: Funding for Dialysis Treatment 1998-2007

(i) New Dialysis Patients



Funding for New Dialysis Patients, -

(ii) Dialysing patients at 31st December



Funding for Dialysing Patients at 31st Dec, -

2.3.5 Distribution of dialysis patients by sector

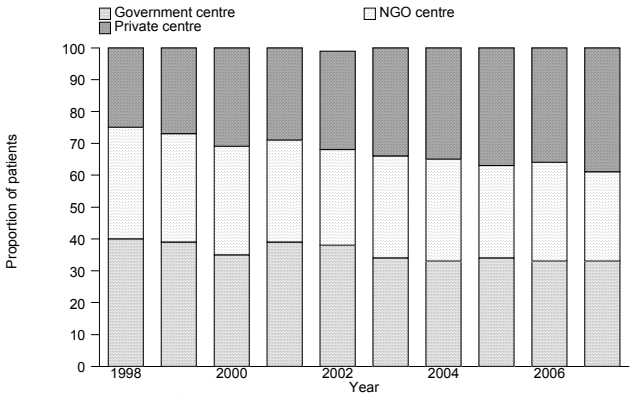
Government centres continued to provide dialysis treatment to one third of new patients, the private sector 39% and the NGO sector 28% in 2007. The proportion of prevalent dialysis patients in government centres continue to decrease with a corresponding increase in proportion of prevalent patients in private centres.

Table 2.3.5: Distribution of Dialysis Patients by Sector 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
% Government centre	40	39	35	39	38	34	33	34	33	33
% NGO centre	35	34	34	32	30	32	32	29	31	28
% Private centre	25	27	31	29	31	34	35	37	36	39
Dialysing at 31st December	4535	5537	6690	7843	9118	10434	11865	13383	15038	16719
% Government centre	51	46	43	42	42	40	39	38	37	36
% NGO centre	29	31	32	33	32	32	32	32	32	31
% Private centre	20	23	25	25	26	28	29	31	31	33

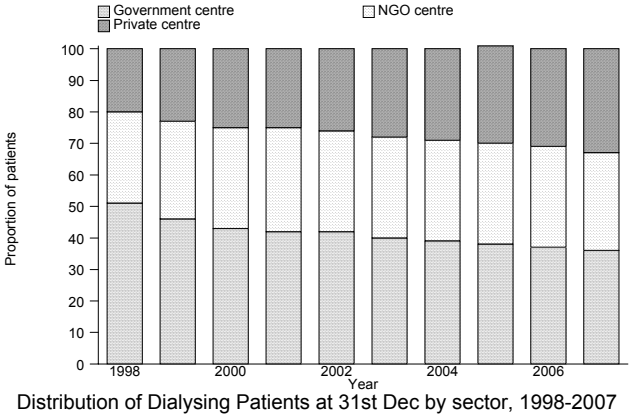
Figure 2.3.5: Distribution of Dialysis Patients by Sector 1998-2007

(i) New Dialysis Patients



Distribution of New Dialysis Patients by sector, 1998-2007

(ii) Dialysing patients at 31st December



Distribution of Dialysing Patients at 31st Dec by sector, 1998-2007

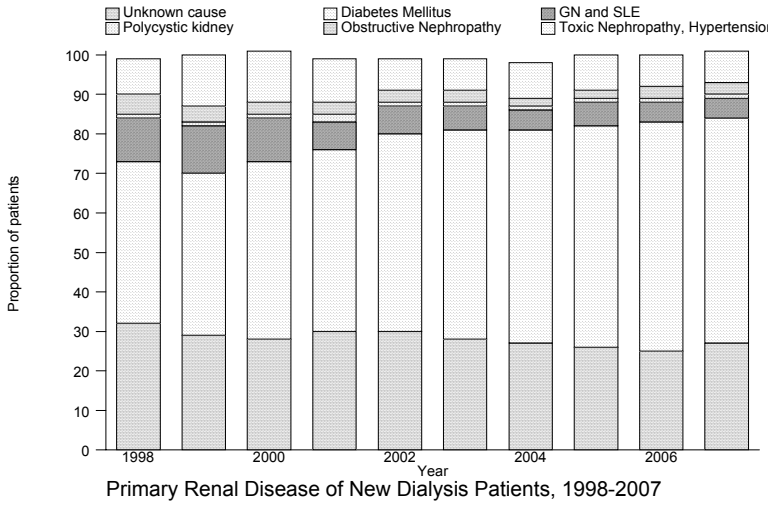
SECTION 2.4: PRIMARY RENAL DISEASE

Diabetes mellitus continues to be the commonest cause of ESRD and has been the cause of at least half of new dialysis patients since 2002. Hypertension was the second commonest known cause of ESRD at about 7%. The proportion of patients with unknown primary renal disease was 27% in 2007. Glomerulonephritis as a cause of ESRD has decreased from 10% in 1997 to only 4% in 2006. Systemic lupus erythematosus (SLE) continue to contribute 1% of new ESRD patients.

Table 2.4.1: Primary Renal Disease 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Dialysis patients	1253	1544	1840	2088	2348	2600	2868	3105	3570	3542
% Unknown cause	32	29	28	30	30	28	27	26	25	27
% Diabetes Mellitus	41	41	45	46	50	53	54	56	58	57
% GN	10	10	9	6	6	5	4	5	4	4
% SLE	1	2	2	1	1	1	1	1	1	1
% Polycystic kidney	1	1	1	2	1	1	1	1	1	1
% Obstructive Nephropathy	5	4	3	3	3	3	2	2	3	3
% Toxic Nephropathy	0	1	0	1	0	0	0	0	0	0
% Hypertension	8	11	12	9	7	7	8	8	7	7
% Others	1	1	1	1	1	1	1	1	1	1

Figure 2.4.1: Primary Renal Disease for New Dialysis Patients 1998-2007



Primary Renal Disease of New Dialysis Patients, 1998-2007

CHAPTER 3

Economics of Dialysis

Lim Teck Onn
Adrian Goh
Lim Yam Ngo
Rozina Ghazalli
Zaki Morad Mohd Zaher
Abu Bakar Suleiman

Introduction

Malaysia has experienced rapid economic development over the past 30 years which have brought higher real incomes, improved population health and greatly expanded provision of chronic dialysis treatment. (Table 3.1)

Table 3.1: Trends in Malaysian GDP, population health and dialysis provision, 1980-2005

	1980	1990	2000	2005
GDP per capita (in 2005RM)	8114	10049	16914	19057
Life expectancy at birth (years)	66.9	70.3	72.6	73.7
Under 5 mortality (per 1,000)	42	22	14	12
Urban population (% of total)	42	49.8	61.8	67.3
Treated RRT incidence	4	20	84	123
Treated RRT prevalence	8	71	338	574

Data: International Monetary Fund, World Economic Outlook Database, World Bank HNP Stats, Malaysian National Renal Registry.

Dialysis and income

Dialysis provision in Malaysia has increased rapidly since the mid-1990s, preceded by rapid economic growth since the late 1980s. Provision growth remained robust through the economic crisis of 1997 (Figure 3.1). Higher income enables a country to fund more dialysis treatment (Figure 3.2). With a developing country level of gross national income (GNI) of USD 5,070 per capita, Malaysia has been able to achieve RRT provision commensurate to many developed countries (Table 3.2).

Figure 3.1(a): Dialysis incidence and GDP per capita, 1980-2005

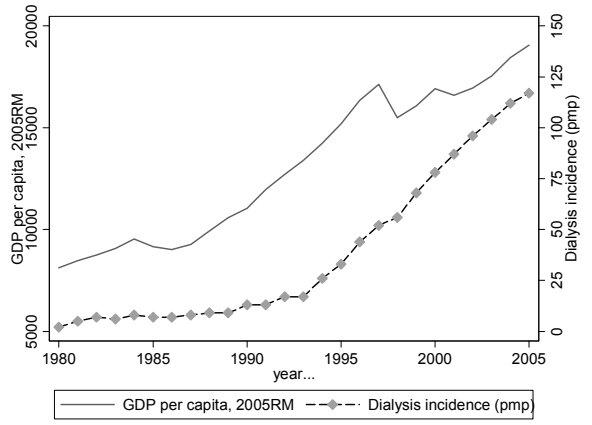
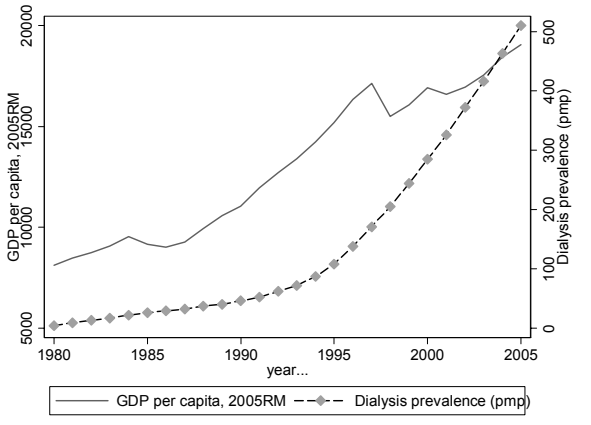
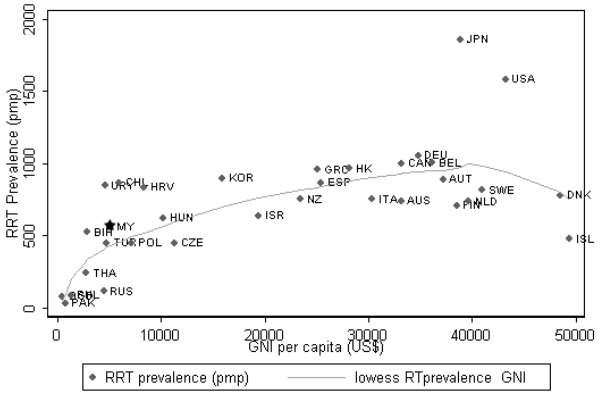


Figure 3.1(b): Dialysis prevalence and GDP per capita, 1980-2005



Data: International Monetary Fund, World Economic Outlook Database, Malaysian National Renal Registry

Figure 3.2: International comparison of income & RRT treatment prevalence, 2005



Data: USRDS Annual Data Report 2007, World Bank World Development Indicators

Table 3.2: Prevalence of renal replacement therapy (RRT) among various regions in the world and by Countries' per capita Gross National Income (GNI) according to World Bank classification

Region/ Country	Prevalence rate in per million population		
	RRT	Dialysis	Transplant
North America	1505	1030	470
Europe	585	400	185
Japan	2045	1945	100
Asia (excluding Japan)	70	60	10
Latin America	380	320	65
Africa	70	65	5
Middle East	190	140	55
Malaysia (GNI USD5070)	574	510	64
High income countries (GNI>USD 9386)	748	-	-
Upper middle income countries (GNI USD3036- 9385)	360	-	-
Lower middle income countries (GNI USD766- 3035)	120	-	-
Low income countries (GNI< USD 766)	37	-	-

Data: Grassmann A, Gioberge S, Moeller S et al. ESRD patients in 2004: global overview of patient numbers, treatment modalities and associated trends. Nephrol Dial Transplant 2005; 20: 2587–2593
White SL, Chadban SJ, Jan S, Chapman JR, Cass A. How can we achieve global equity in provision of renal replacement therapy? Bull World Health Organ. 2008;86:229-37

Dialysis prices and affordability

Affordability of dialysis (measured as proportion of household income to HD cost) has declined due to the combined effects of increasing real incomes and declining price of HD (Table 3.3). The Public sector has been an important provider and funder of dialysis (Figure 3.3a) but Public sector provision has not kept pace with treatment growth. Public sector funding has rebounded following policy changes regarding reimbursement and subsidies for dialysis patients at the government and social welfare organisations in 2001. (Table 3.4).

Table 3.3: Trends in dialysis market prices

	1990	1995	2000	2005
Dialysis prevalence	71	153	338	574
Price per HD (current RM)	170[c]	159[d]	163[e]	168[f]
Price per HD (2005RM)	286[c]	225[d]	191[e]	168[f]
Average Household monthly income (2005RM)	1963	2855	3012a	3356[b]
HD cost to monthly HH income (%)	186	103	83	65

Note: a1999, b2004, c1992-5, d1996-9, e2000-2, f2003-5
Data: Private sector HD prices were from a 2007 survey of 12 private HD centres in Peninsular Malaysia, Malaysia Plan reports.

Figure 3.3(a): Dialysis funding by sector, 1990-2005 (RM million)

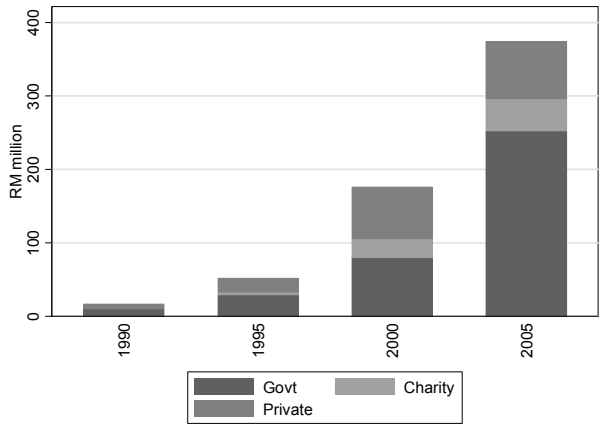


Figure 3.3(b): Dialysis funding by sector, 1990-2005 (%)

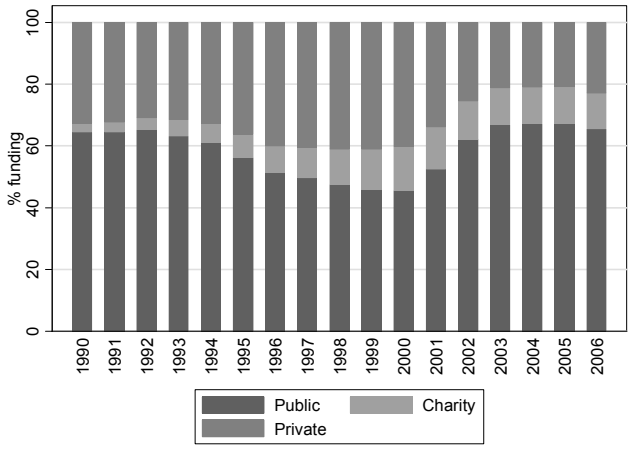


Table 3.4: Trends in dialysis funding & provider mix

	1990	1995	2000	2005
Dialysis incidence	20	38	84	123
Dialysis prevalence	71	153	338	574
Sectoral share of provision (%)				
% Public	88	65	43	37
% NGO	5	20	34	32
% Private	7	15	23	30
Funding for dialysis (2005 RM million)				
Public	15.4	39.4	92.2	255.2
Charity	0.6	5.3	29.2	45.3
Private	7.9	25.5	81.0	78.6
Total	23.9	70.2	202.4	379.1
Funding for dialysis (%)				
% Public	64	56	46	67
% Charity	3	8	14	12
% Private	33	36	41	21

Dialysis access and equality

There is persistent inequality in treatment rates across different states related to the greater ability to pay for services in economically advanced states (Figure 3.4). Inequality of dialysis treatment has declined across all sectors of providers as treatment expanded (Figure 3.5). Public services have switched from favouring the well off to favouring the poor (Figure 3.5.1 and 3.5.2).

Figure 3.4: Dialysis treatment by state, 1997-2004

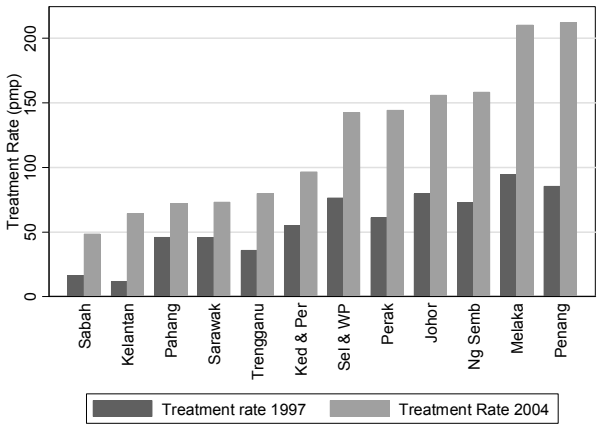


Table 3.5: Dialysis Treatment in Malaysia, 1997-2004

	1997	2004	Change (%)
Dialysis Incidence by state (pmp)			
Malaysia	56.3	119.1	112%
Minimum	11.8	48.3	309%
25th percentile	40.7	72.6	78%
Median	58	119.4	106%
75th percentile	77.8	157	102%
Maximum	94.5	212.1	124%
Concentration Index			
Malaysia	0.111	0.053	
Public sector	0.037	-0.047	
NGO sector	0.294	0.207	
Private sector	0.376	0.23	

Figure 3.5.1: Inequality of dialysis treatment by provider sector, 1997

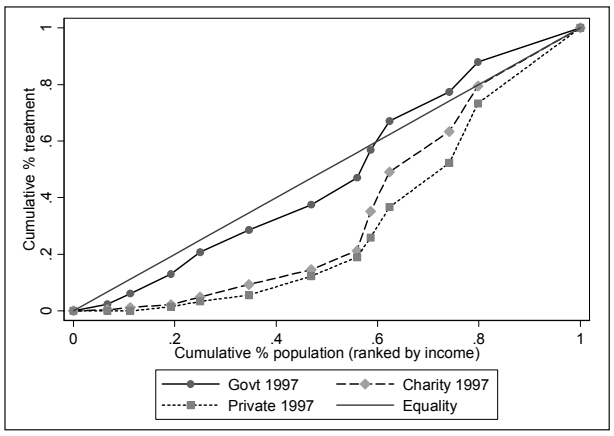
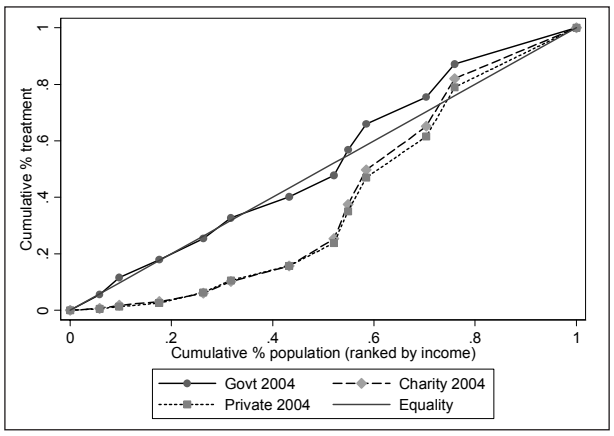


Figure 3.5.2: Inequality of dialysis treatment by provider sector, 2004



Note: Concentration index (CI) measures inequality. It has a range of values from -1 to 1 where zero is equal distribution of health services. A positive (negative) value services are unequally distributed towards the advantaged (disadvantaged). Values of C closer to 1 indicate greater inequality. Concentration curve illustrates inequality by plotting the cumulative proportion of the population ranked from by income against the cumulative proportion of healthcare. Equality in the distribution of health services is represented by a diagonal "Line of Equality".

CHAPTER 4

Death and Survival on Dialysis

Wong Hin Seng
Ong Loke Meng
Wan Shaariah Md Yusuf

SECTION 4.1: DEATH ON DIALYSIS

The number of deaths in dialysis patients for 2007 was 1678 (annual death rate of 10.6%). One thousand four hundred and seventy seven haemodialysis patients died in 2007 (annual rate of 10.2%) while 201 died while on continuous ambulatory peritoneal dialysis (CAPD) (annual death rate of 14.2%).

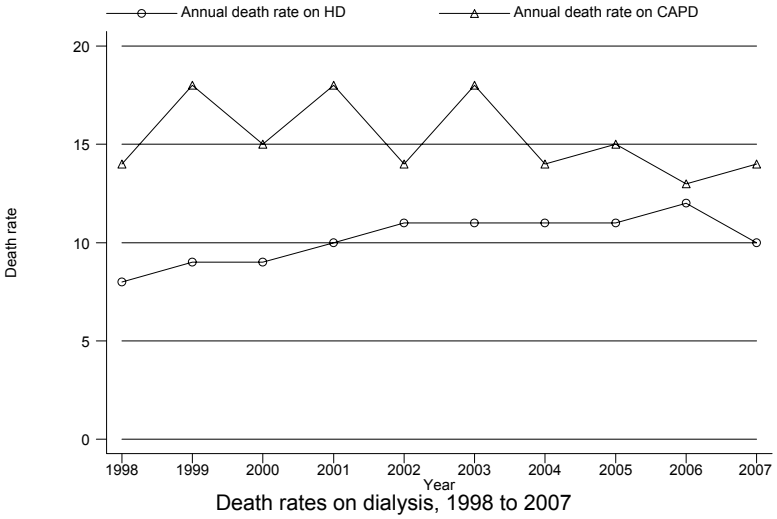
Table 4.1.1: Deaths on Dialysis 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
No. of dialysis patients at risk	4120	5040	6117	7270	8483	9778	11152	12626	14212	15879
Dialysis deaths	376	493	594	816	927	1157	1272	1420	1673	1678
Dialysis death rate %	9	10	10	11	11	12	11	11	12	11
No. of HD patients at risk	3600	4472	5489	6556	7640	8791	10066	11489	12980	14460
HD deaths	302	393	502	686	812	979	1120	1249	1507	1477
HD death rate %	8	9	9	10	11	11	11	11	12	10
No. of CAPD patients at risk	520	568	628	714	843	988	1086	1138	1232	1420
CAPD deaths	74	100	92	130	115	178	152	171	166	201
CAPD death rate %	14	18	15	18	14	18	14	15	13	14

Figure 4.1.1 shows the annual death rate on dialysis from 1998 till 2007. Despite a higher percentage of diabetics (41% in 1998 to 57% in 2007) and elderly patients (in 1998, 31% were aged more than 54 years compared with 42% in 2007) on dialysis in recent years, the overall annual death rate of patients on dialysis remained 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 showed a slight upward trend over the last 10 years. The annual death rate for those on CAPD in 2007 was 14% while the annual death rate for haemodialysis patients in 2007 was 11%; a difference of 3% between the two modalities.

Figure 4.1.1: Death Rates on Dialysis 1998-2007



Death rates on dialysis, 1998 to 2007

The causes of death on dialysis are shown in Table 4.1.2. Cardiovascular disease remained the main cause of death in 2007; accounting for 25%. This has remained unchanged over the last 10 years. Death at home accounted for another 18% and a majority of these deaths were probably secondary to cardiovascular events. Death due to infections has decreased by 42% over the last 10 years and now accounting for only 10% (compared to 18% in 1998).

Table 4.1.2: Causes of Death on Dialysis 1998-2007

Year	1998		1999		2000		2001		2002	
	no	%	no	%	no	%	no	%	no	%
Cardiovascular	110	29	129	26	177	30	210	26	307	33
Died at home	72	19	107	22	135	23	228	28	212	23
Sepsis	66	18	84	17	85	14	128	16	141	15
CAPD peritonitis	2	1	11	2	21	4	29	4	16	2
GIT bleed	7	2	18	4	18	3	18	2	24	3
Cancer	8	2	6	1	8	1	18	2	18	2
Liver disease	5	1	7	1	14	2	11	1	16	2
Withdrawal	1	0	10	2	17	3	20	2	18	2
Others	54	14	65	13	74	12	88	11	104	11
Unknown	51	14	56	11	45	8	66	8	71	8
TOTAL	376	100	493	100	594	100	816	100	927	100

Year	2003		2004		2005		2006		2007	
	no	%	no	%	no	%	no	%	no	%
Cardiovascular	324	28	333	26	357	25	469	28	423	25
Died at home	291	25	304	24	315	22	346	21	307	18
Sepsis	183	16	154	12	161	11	206	12	165	10
CAPD peritonitis	11	1	13	1	18	1	21	1	14	1
GIT bleed	28	2	24	2	28	2	26	2	24	1
Cancer	27	2	20	2	28	2	36	2	26	2
Liver disease	23	2	29	2	25	2	32	2	33	2
Withdrawal	26	2	9	1	11	1	22	1	26	2
Others	160	14	317	25	398	28	383	23	521	31
Unknown	84	7	69	5	79	6	132	8	139	8
TOTAL	1157	100	1272	100	1420	100	1673	100	1678	100

4.2: Patient Survival on Dialysis

4.2.1 Patient survival by type of dialysis modality

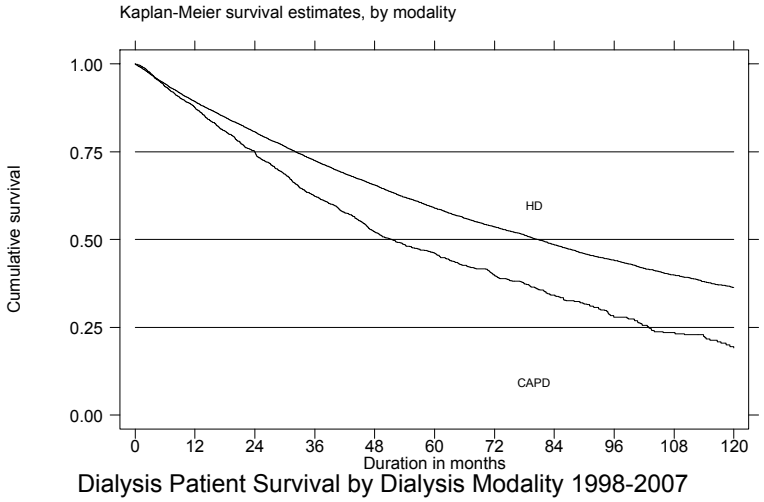
Patient survival by dialysis modalities (censored for change of modalities) is shown in Table 4.2.1(a) and Figure 4.2.1(a). The overall unadjusted 5 years and 10 years patient survival on dialysis were 57% and 35% respectively. The unadjusted patient survival was better for those on haemodialysis compared to those on CAPD and this survival difference progressively widened with time. At 5 years the unadjusted patient survival on haemodialysis was 59% compared 46% in those on CAPD.

However, when patient survival by dialysis modalities was analysed as per ITT (disregarding change of dialysis modality) [Table 4.2.1(b) and Fig 4.2.1(b)], the difference in survival according to dialysis modalities became less evident. The overall unadjusted 5 years and 10 years patient survival on haemodialysis versus CAPD were 61% vs 56% and 41% and 43% respectively.

Table 4.2.1(a): Patient survival by dialysis modality analysis censored for change of modality

Dialysis modality	CAPD			HD			All Dialysis		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	3427	94	0	23081	94	0	26508	94	0
12	2812	88	1	19945	89	0	22757	89	0
24	1866	75	1	15139	81	0	17005	80	0
36	1228	62	1	11553	72	0	12781	71	0
48	804	52	1	8781	66	0	9585	64	0
60	530	46	1	6619	59	0	7149	57	0
72	334	40	1	5011	54	0	5345	52	0
84	207	34	1	3759	49	0	3965	47	0
96	117	28	2	2821	44	0	2937	43	0
108	76	24	2	2070	40	0	2145	38	0
120	42	19	2	1505	36	1	1547	35	1

Figure 4.2.1(a): Patient survival by dialysis modality analysis censored for change of modality

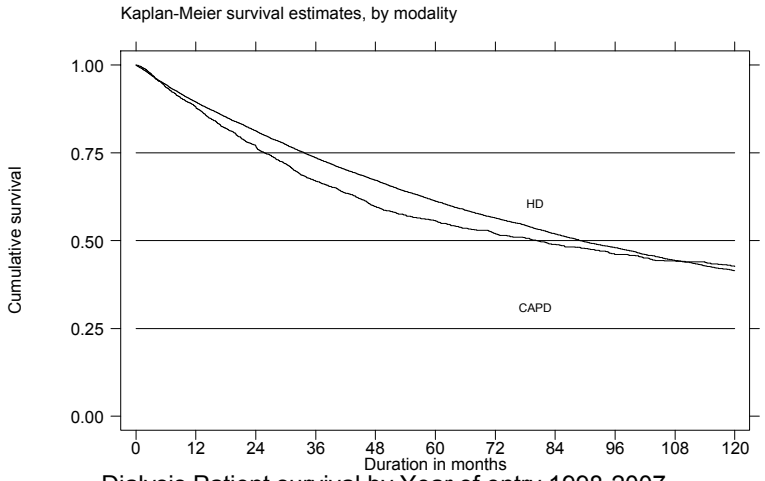


Dialysis Patient Survival by Dialysis Modality 1998-2007

Table 4.2.1(b): Patient survival by dialysis modality analysis as per ITT

Dialysis modality	CAPD			HD			All Dialysis		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	3552	94	0	23531	94	0	27064	94	0
12	3066	88	1	20727	89	0	23793	89	0
24	2304	77	1	16192	81	0	18496	81	0
36	1742	67	1	12634	74	0	14376	73	0
48	1328	60	1	9834	67	0	11162	66	0
60	1021	56	1	7611	61	0	8631	60	0
72	781	52	1	5912	56	0	6693	56	0
84	591	49	1	4567	52	0	5157	52	0
96	452	46	1	3535	48	0	3986	48	0
108	351	44	1	2708	44	0	3057	44	0
120	271	43	1	2068	41	0	2339	42	0

Figure 4.2.1(b): Patient survival by dialysis modality analysis as per ITT



Dialysis Patient survival by Year of entry 1998-2007

4.2.2 Patient survival by year of starting dialysis

Table 4.2.2 and Fig 4.2.2 show the unadjusted patient survival by year of entry. The unadjusted 6 months survival of those starting dialysis in 2007 was 95%. 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 88-91% and 55-61% respectively.

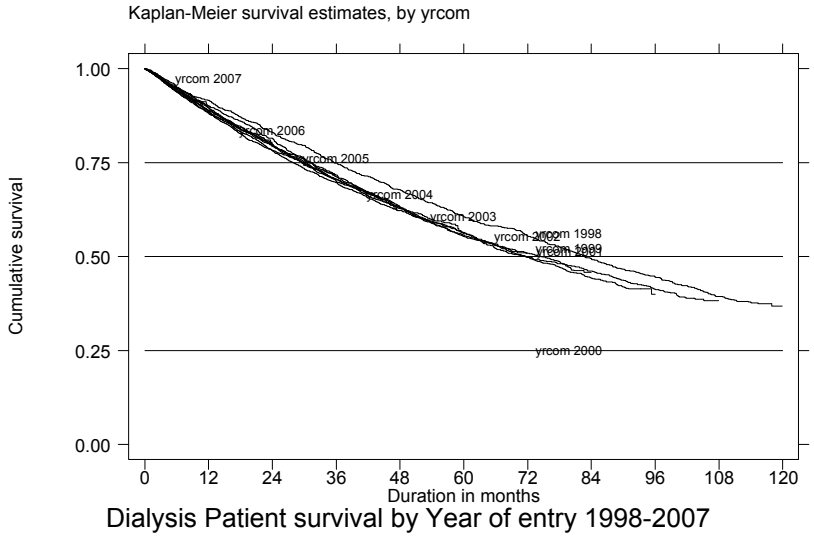
Table 4.2.2: Unadjusted patient survival by year of entry, 1998-2007

Year Interval (months)	1998			1999			2000			2001		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	1245	95	1	1511	95	1	1807	95	1	2071	94	1
12	1179	91	1	1411	90	1	1667	90	1	1888	89	1
24	1039	83	1	1214	81	1	1415	80	1	1604	78	1
36	915	75	1	1038	72	1	1225	71	1	1388	70	1
48	804	68	1	894	63	1	1059	63	1	1207	62	1
60	710	61	1	789	56	1	919	56	1	1044	55	1
72	637	56	1	703	51	1	800	50	1	927	50	1
84	556	49	1	623	46	1	698	44	1	-	.	.
96	496	45	1	548	41	1	-	.	.	-	.	.
108	434	39	1	-	.	.	-	.	.	-	.	.

Year Interval (months)	2002			2003			2004			2005		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	2353	95	0	2530	94	0	2845	95	0	3012	94	0
12	2176	90	1	2334	89	1	2616	89	1	2767	88	1
24	1844	80	1	2020	79	1	2269	80	1	2383	78	1
36	1597	70	1	1745	70	1	1952	71	1	-	.	.
48	1393	63	1	1534	63	1	-	.	.	-	.	.
60	1215	56	1	-	.	.	-	.	.	-	.	.

Year Interval (months)	2006			2007		
	No.	% Survival	SE	No.	% Survival	SE
6	3454	94	0	1886	95	0
12	3194	88	1	-	.	.

Figure 4.2.2: Unadjusted patient survival by year of entry, 1998-2007



Dialysis Patient survival by Year of entry 1998-2007

4.2.3 Patient survival by Age at starting dialysis

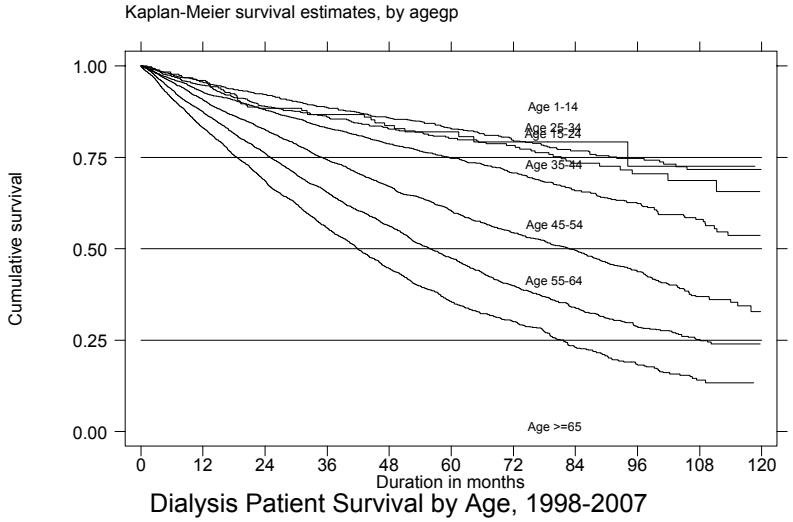
The unadjusted survival for age groups <14 years, 15-24 years and 25-34 years at the start of dialysis were similar, with a 5-year survival of more than 80% as shown in Table 4.2.3.. Beyond the age of 34 years old, the unadjusted survival progressively worsens with increasing age. The 9-year unadjusted survival for those who started dialysis at the age of less than 15 years was 73 % compared with 14% in those more than 64 years of age at the time of initiation of dialysis.

Table 4.2.3: Unadjusted patient survival by age, 1998-2007

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	314	98	1	1021	97	1	1761	98	0	3062	96	0
12	280	96	1	877	95	1	1537	96	0	2651	93	0
24	204	88	2	630	89	1	1170	92	1	2052	88	1
36	141	87	2	481	86	1	924	89	1	1598	83	1
48	104	84	3	350	83	1	723	86	1	1214	79	1
60	71	82	3	249	80	2	537	83	1	916	75	1
72	40	79	3	175	78	2	374	80	1	654	71	1
84	26	79	3	109	73	2	270	77	2	423	66	1
96	11	73	7	62	70	3	169	75	2	243	62	1
108	6	73	7	26	69	3	77	72	2	113	58	2

Age group (years)	45-54			55-64			>=65		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	5767	96	0	6198	93	0	4584	91	0
12	4936	91	0	5207	87	0	3743	83	1
24	3593	83	1	3686	76	1	2454	69	1
36	2635	74	1	2522	65	1	1561	56	1
48	1861	67	1	1696	56	1	941	45	1
60	1309	60	1	1061	47	1	534	35	1
72	865	54	1	640	40	1	318	30	1
84	543	50	1	365	34	1	147	23	1
96	300	44	1	195	29	1	70	18	1
108	113	37	2	77	25	1	28	14	1

Figure 4.2.3: Unadjusted patient survival by age, 1998-2007



Dialysis Patient Survival by Age, 1998-2007

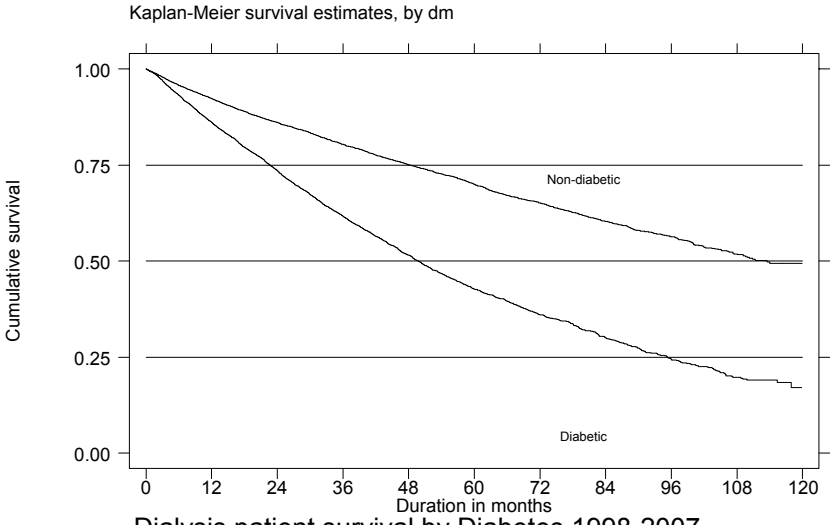
4.2.4 Patient survival by Diabetic status

The unadjusted patient survival among diabetic and non-diabetic patients are shown in Table 4.2.4 and Figure 4.2.4. 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 9 years unadjusted patient survival among diabetics and non-diabetics were 52% and 20% respectively, a two and a half fold difference.

Table 4.2.4: Unadjusted patient survival by Diabetes status, 1998-2007

Diabetes status	Non-diabetic			Diabetic		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE
6	11107	96	0	11599	93	0
12	9631	92	0	9598	86	0
24	7343	86	0	6441	74	0
36	5648	80	0	4209	62	1
48	4223	75	0	2664	52	1
60	3064	70	1	1611	43	1
72	2115	65	1	948	36	1
84	1357	60	1	520	30	1
96	794	56	1	249	24	1
108	333	52	1	102	20	1

Figure 4.2.4: Unadjusted patient survival by Diabetes status, 1998-2007



Dialysis patient survival by Diabetes 1998-2007

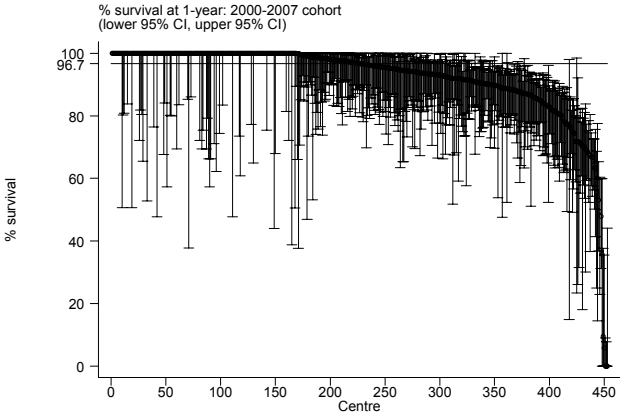
4.3 Survival of incidence patients by centre

4.3.1. Survival of incident haemodialysis patients 2000 – 2007 by centre

Figure 4.3.1(a) and Figure 4.3.1(b) show the patient survival (adjusted for 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 2000-2007 cohort were 96.7% and 69.8% 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 difference)..

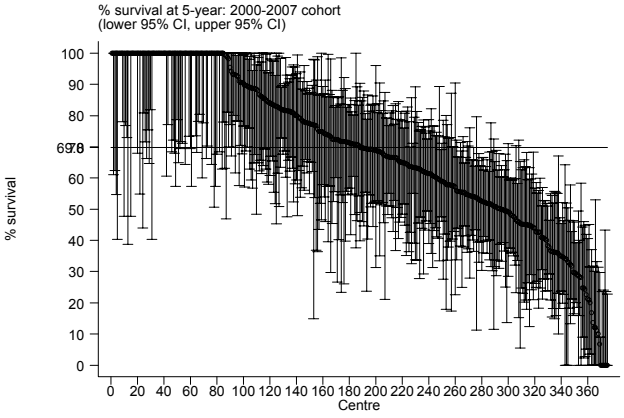
Data on survival at 1 year and 5 years adjusted for age and diabetes are also shown in funnel plots (Figure 4.3.3.1(c) and Figure 4.3.3.1(d) respectively) to identify outliers. For 1 year survival, 63 (14%) centres lie below 3SD while for 5 years survival 113 (30%) centres are more than 3SD below the adjusted median survival.

Figure 4.3.1(a): Variation in % Survival at 1-years adjusted to age and diabetes, 2000-2007



*Horizontal line represents the median % survival among HD centres

Figure 4.3.1(b): Variation in % Survival at 5-years adjusted to age and diabetes, 2000-2007



*Horizontal line represents the median % survival among HD centres

Figure 4.3.1(c): Funnel plot for adjusted age at 60 and diabetes at 1 year after 90 days survival; 2000-2007 cohort (HD centres)

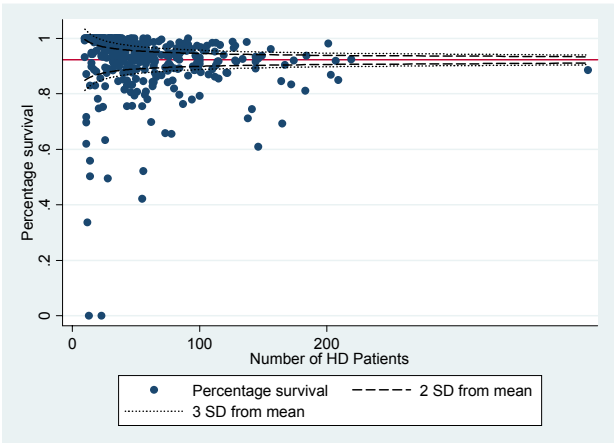
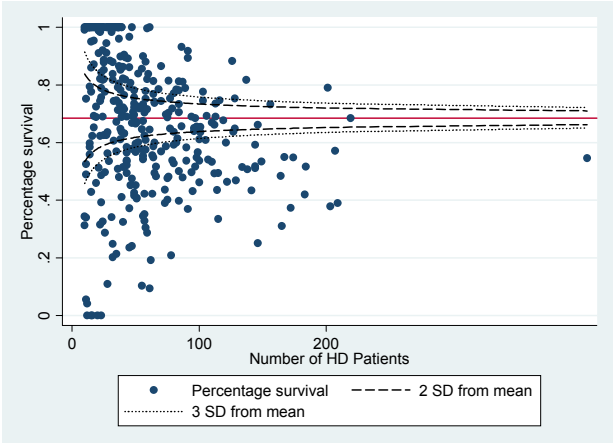


Figure 4.3.1(d): Funnel plot for adjusted age at 60 and diabetes at 5 year after 90 days survival; 2000-2007 cohort (HD centres)

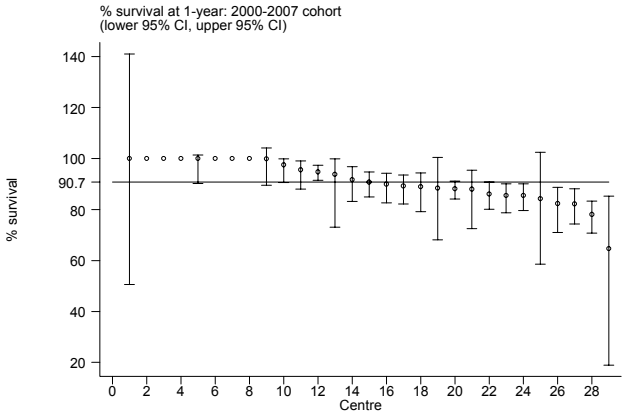


4.3.2. Survival of incidence CAPD patients 2000 – 2007 by centre

The adjusted patient survival (adjusted for age and diabetes) at 1 year and at 5 years by CAPD centres are showed in Figure 4.3.2(a) and Figure 4.3.2.(b). The median adjusted patient survival among CAPD centres at one year and 5 years for the 2000-2007 cohort were 90.7% and 47.9% 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.

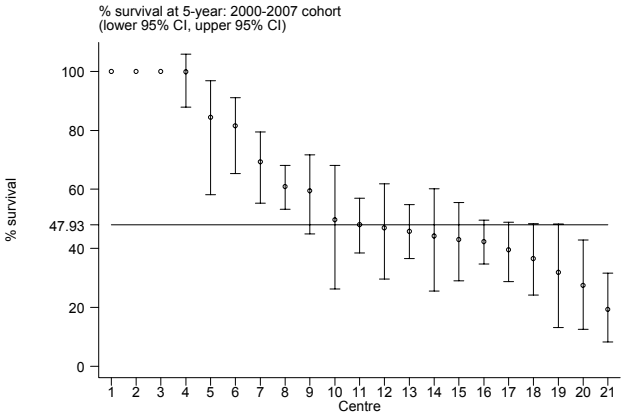
Figure 4.3.2(c) and Figure 4.3.2(d) show the funnel plot for 1 year and 5 years adjusted patient survival among CAPD centres respectively. For 1 year survival, 10 (48%) centres lie below the 3SD while for 5 years survival, 11 (52%) centres are more than 3SD below the adjusted median survival.

Figure 4.3.2(a): Variation in % Survival at 1-year adjusted to age and diabetes, 2000-2007



*Horizontal line represents the median % survival among CAPD centres

Figure 4.3.2(b): Variation in % Survival at 5-years adjusted to age and diabetes, 2000-2007



*Horizontal line represents the median % survival among CAPD centres

Figure 4.3.2(c): Funnel plot for adjusted age at 60 and diabetes at 1 year after 90 days survival; 2000-2007 cohort (CAPD centres)

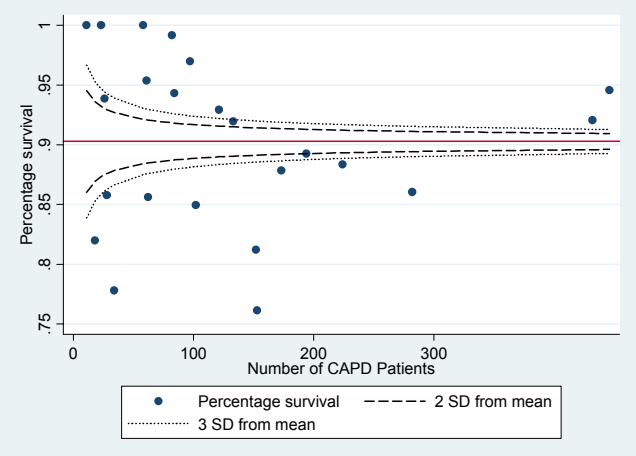
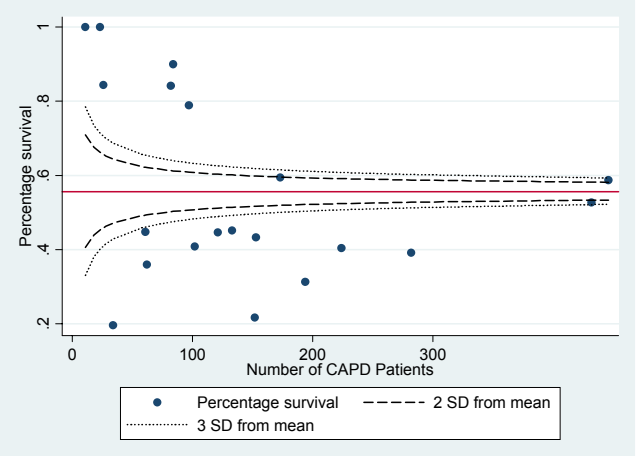


Figure 4.3.2(d): Funnel plot for adjusted age at 60 and diabetes at 5 year after 90 days survival; 2000-2007 cohort (CAPD centres)



4.4 Adjusted Mortality of dialysis patient

4.4.1. Adjusted hazard ratio for mortality of dialysis patients

Table 4.4.1 shows the adjusted hazard ratio for mortality of dialysis patients (1998-2007). The 1998-2007 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, primary renal disease, year commencing dialysis, dialysis modality, BMI, KT/V, diastolic blood pressure and the presence cardiovascular disease. The significant biochemical risk factors for mortality were serum albumin, serum cholesterol, haemoglobin, calcium, calcium phosphate product, phosphate, hepatitis B status and hepatitis C status.

There were positive correlation between age of patient, diabetes mellitus as primary renal disease, diastolic blood pressure [Figure 4.4.1(a)], serum calcium, serum phosphate [Figure 4.4.1(b)] and hepatitis B antigenaemia with mortality while negative correlation was noted between serum albumin, KT/V [Figure 4.4.1(c)], haemoglobin concentration [Figure 4.4.1(d)], calcium phosphate product and presence of hepatitis C antibodies with mortality.

Table 4.4.2 and Fig 4.4.2 show the odd ratio of death according to state. There was variation in the mortality among the dialysis patients in the 14 states in this country. Dialysis patients in Sabah and Labuan has the highest mortality while patients dialysing in Kuala Lumpur has the lowest mortality; a difference in odd ratio of death of 0.62.

Table 4.4.1: Adjusted hazard ratio for mortality of dialysis patients (1998-2007 cohort)

Factors	N	Hazard Ratio	95% CI	P value
Age (years):				
0-14(ref.*)	355	1.00		
15-24	1,154	1.51	(1.08, 2.11)	0.02
25-34	1,987	1.29	(0.93, 1.79)	0.12
35-44	3,443	1.86	(1.35, 2.55)	0.00
45-54	6,553	2.60	(1.90, 3.55)	0.00
55-64	7,235	3.35	(2.45, 4.58)	0.00
>=65	5,528	4.67	(3.41, 6.39)	0.00
Gender:				
Male (ref.*)	14,570	1.00		
Female	11,685	0.87	(0.83, 0.91)	0.00
Primary diagnosis:				
Unknown primary (ref.*)	7,236	1.00		
Diabetes mellitus	13,319	1.49	(1.40, 1.58)	0.00
GN/SLE	2,006	0.89	(0.79, 0.99)	0.04
Polycystic kidney	339	1.10	(0.87, 1.38)	0.43
Obstructive nephropathy	823	1.02	(0.89, 1.18)	0.74
Others	2,532	1.01	(0.92, 1.11)	0.83
Year start dialysis:				
Year 1998-9 (ref.*)	2,949	1.00		
Year 2000-2001	4,180	1.07	(0.99, 1.14)	0.06
Year 2002-3	5,267	1.09	(1.02, 1.17)	0.02
Year 2004-7	13,859	1.10	(1.02, 1.18)	0.01
Modality:				
HD (ref*)	22,793	1.00		
CAPD	3,462	1.30	(1.20, 1.41)	0.00

Table 4.4.1: Adjusted hazard ratio for mortality of dialysis patients (1998-2007 cohort) - continued

Factors	N	Hazard Ratio	95% CI	P value
BMI:				
<18.5	2,432	1.56	(1.41, 1.73)	0.00
18.5-<25	17,597	1.29	(1.21, 1.37)	0.00
>=25 (ref.*)	6,226	1.00		
Serum albumin (g/L):				
<30	1,574	4.29	(3.88, 4.74)	0.00
30-<35	3,426	2.43	(2.25, 2.63)	0.00
35-<40	12,417	1.76	(1.66, 1.87)	0.00
>=40 (ref.*)	8,838	1.00		
Serum cholesterol (mmol/L):				
<3.2	960	1.12	(0.99, 1.27)	0.07
3.2-<5.2	19,202	1.16	(1.10, 1.23)	0.00
>=5.2 (ref.*)	6,093	1.00		
KT/V				
<1	589	1.49	(1.28, 1.73)	0.00
1-<1.2	2,053	1.06	(0.97, 1.17)	0.20
1.2-<1.4 (ref.*)	5,577	1.00		
1.4-<1.6	7,896	0.99	(0.94, 1.06)	0.96
>=1.6	10,140	0.82	(0.77, 0.89)	0.00
Diastolic BP (mmHg):				
<70	3,044	0.92	(0.85, 0.99)	0.03
70-<80	9,732	0.97	(0.92, 1.02)	0.27
80-<90 (ref.*)	10,282	1.00		
90-<100	2,619	1.07	(0.98, 1.17)	0.15
>=100	578	1.96	(1.69, 2.28)	0.00
Hemoglobin:				
<8	2,373	3.42	(3.08, 3.80)	0.00
8-<9	3,819	2.23	(2.02, 2.46)	0.00
9-<10	10,667	2.26	(2.06, 2.47)	0.00
10-<11	5,288	1.26	(1.14, 1.39)	0.00
11-<12 (ref.*)	2,729	1.00		
>=12	1,379	1.01	(0.88, 1.17)	0.87
Serum calcium (mmol/L):				
<2.2	8,160	0.82	(0.77, 0.86)	0.00
2.2-<2.6 (ref.*)	17,463	1.00		
>=2.6	632	1.72	(1.52, 1.95)	0.00
Calcium Phosphate product (mmol2/L2):				
<3.5	8,564	1.01	(0.93, 1.10)	0.84
3.5-<4.5 (ref.*)	12,014	1.00		
4.5-<5.5	3,985	0.67	(0.61, 0.74)	0.00
>=5.5	1,692	0.61	(0.51, 0.73)	0.00
Serum Phosphate (mmol/L):				
<1.6	9,111	0.89	(0.82, 0.97)	0.01
1.6-<2.0 (ref.*)	11,571	1.00		
2.0-<2.2	2,349	1.00	(0.90, 1.12)	0.95
2.2-<2.4	1,454	1.13	(0.98, 1.30)	0.09
2.4-<2.6	875	1.37	(1.13, 1.65)	0.00
>=2.6	895	1.85	(1.50, 2.28)	0.00
HBsAg:				
Negative (ref.*)	25,203	1.00		
Positive	1,052	1.16	(1.05, 1.28)	0.00
Anti-HCV:				
Negative (ref.*)	25,145	1.00		
Positive	1,110	0.86	(0.78, 0.95)	0.00
Cardiovascular disease (CVD):				
No CVD (ref.*)	21,248	1.00		
CVD	5,007	1.31	(1.24, 1.37)	0.00

Figure 4.4.1(a): Adjusted hazard ratio for mortality of dialysis patients by diastolic blood pressure (1998-2007 cohort)

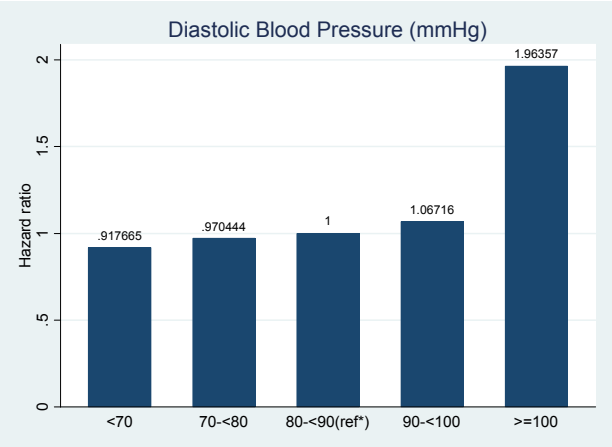


Figure 4.4.1(b): Adjusted hazard ratio for mortality of dialysis patients by serum phosphate (1998-2007 cohort)

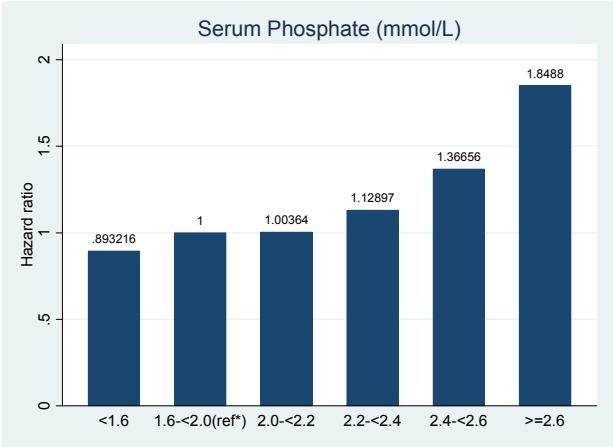


Figure 4.4.1(c): Adjusted hazard ratio for mortality of dialysis patients by KT/V (1998-2007 cohort)

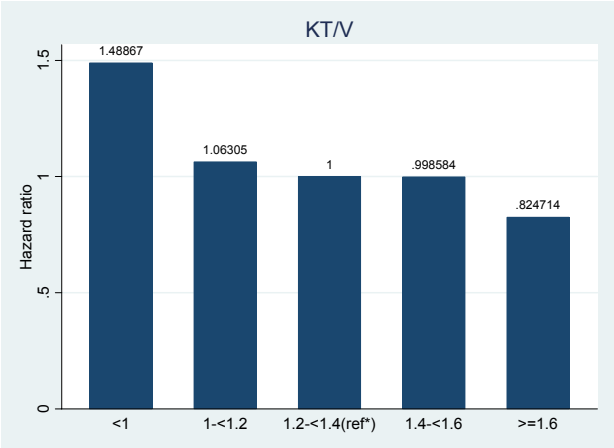
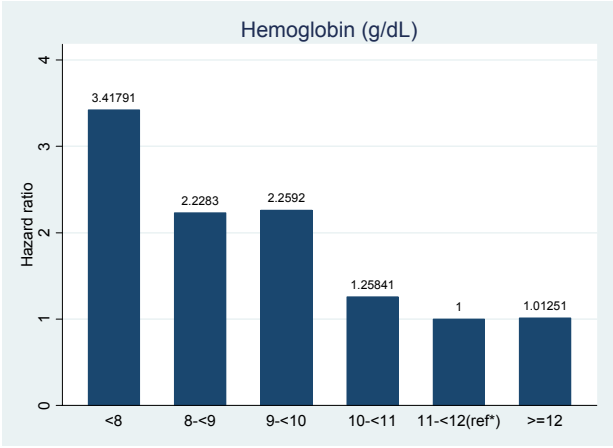


Figure 4.4.1(d): Adjusted hazard ratio for mortality of dialysis patients by hemoglobin (1998-2007 cohort)



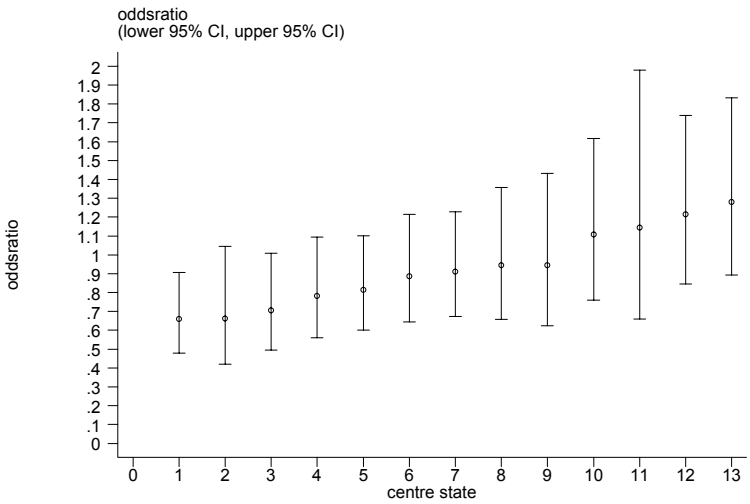
4.4.2. Variation in odds ratio of death by state 2007

Table 4.4.2 and Fig 4.4.2 show the odd ratio of death according to state. There was variation in the mortality among the dialysis patients in the 14 states in this country. Dialysis patients in Sabah and Labuan has the highest mortality while patients dialysing in Kuala Lumpur has the lowest mortality; a difference in odd ratio of death of 0.62.

Table 4.4.2: Variation in odds ratio of death by state, dialysis patients 2007

		Variation in odds ratio of death						
		Min	5th centile	LQ	Median	UQ	95th centile	Max
		0.659	0.659	0.783	0.91	1.108	1.279	1.279
State	Number of centres				Odds ratio			
Pulau Pinang	59				0.783			
Melaka	30				1.214			
Johor	90				0.910			
Perak	71				0.885			
Selangor and WP Putrajaya	123				0.813			
WP Kuala Lumpur	76				0.660			
Negeri Sembilan	26				0.662			
Kedah	36				0.945			
Perlis	3				1.143			
Terengganu	16				0.946			
Pahang	26				1			
Kelantan Darul Naim	26				1.108			
Sarawak	38				0.706			
Sabah and WPLabuan	35				1.279			

Figure 4.4.2: Variation in odds ratio of death by state 2007



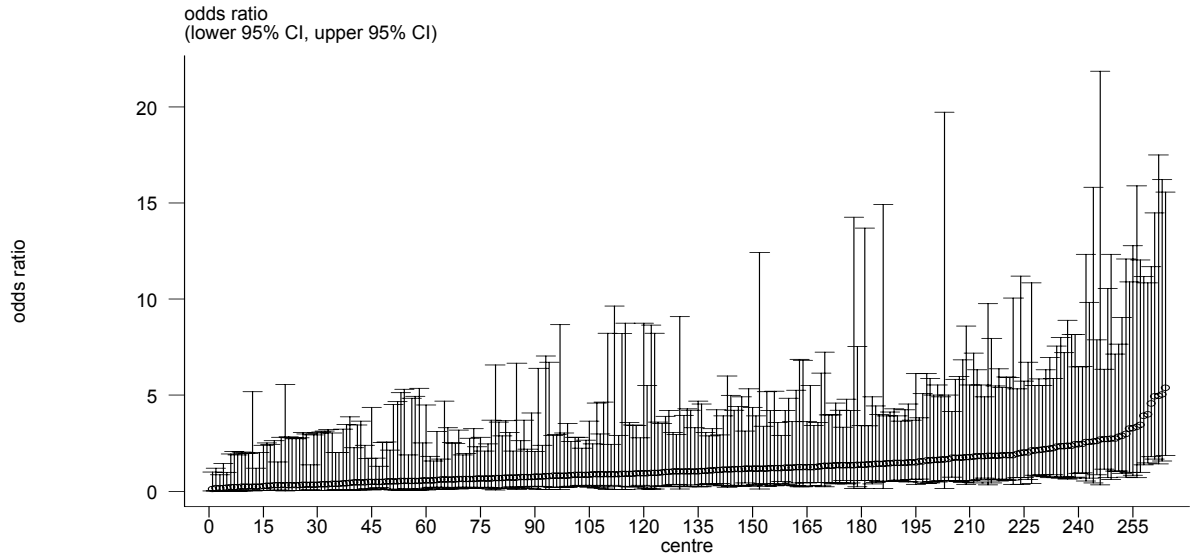
4.4.3. Variation in odds ratio of death by dialysis centre

Table 4.4.3 show the odd ratio of death by all centres in 1998 till 2007. The number of centres has increased from 50 in 1998 to 264 centres in 2007 but centre variations remained wide. In 2007, difference in mortality rate between centres in the lower quartile and centres in the upper quartile was more than two times (Table 4.4.3 and Fig. 4.4.3).

Table 4.4.3 Variation in odds ratio of death by centre, 1998-2007

Year	Number of Centre	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	50	0.075	0.194	0.646	0.927	1.719	2.855	5.190
1999	51	0.017	0.236	0.764	1.916	2.810	5.345	11.666
2000	82	0.024	0.069	0.254	0.518	0.930	1.955	3.888
2001	114	0.071	0.344	0.998	1.446	2.687	4.898	7.257
2002	144	0.125	0.466	1.100	1.710	3.013	5.971	10.684
2003	171	0.044	0.112	0.354	0.656	0.946	2.300	3.860
2004	200	0.000	0.000	0.337	0.610	0.837	1.852	6.820
2005	233	0.054	0.131	0.453	0.806	1.227	2.118	7.476
2006	250	0.065	0.165	0.393	0.751	1.065	1.953	8.789
2007	264	0.116	0.240	0.603	1.025	1.597	2.831	5.390

Figure 4.4.3 Variation in odds ratio of death by centre, 2007



*8 centre were dropped due to very small number of patients

CHAPTER 5

Quality of Life and Rehabilitation Outcomes of Dialysis Patients in Malaysia

Liu Wen Jiun
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Zaki Morad b Mohd Zaher

SECTION A : QUALITY OF LIFE (QoL) INDEX SCORE

18754 patients who entered dialysis between 1998-2007 were analysed. 15801 HD patients and 2953 CAPD patients reported median QoL index score of 9 and 10 respectively (Table 5.1, Figure 5.1) Diabetics have a lower median QoL index score (8 versus 10) than nondiabetics (Table 5.2, Figure 5. 2) whilst there was no difference seen between gender (Table 5.3, Figure 5.3). There is a trend of lower median QoL index score being associated with older dialysis patients (Table 5.4, Figure 5.4). There are no obvious trends in QoL index seen either in the HD or CAPD cohort over the last 10 years. (Table 5.5, Table 5.6, Fig 5.5 and Figure 5.6)

Table 5.1: Cumulative distribution of QoL-Index score in relation to Dialysis modality, All Dialysis patients 1998-2007

Dialysis modality	CAPD	HD
Number of patients	2953	15801
Centile		
0	0	0
0.05	5	4
0.1	6	5
0.25 (LQ)	8	7
0.5 (median)	10	9
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 5.1: Cumulative distribution of QoL-Index score in relation to Dialysis modality, All Dialysis patients 1998-2007

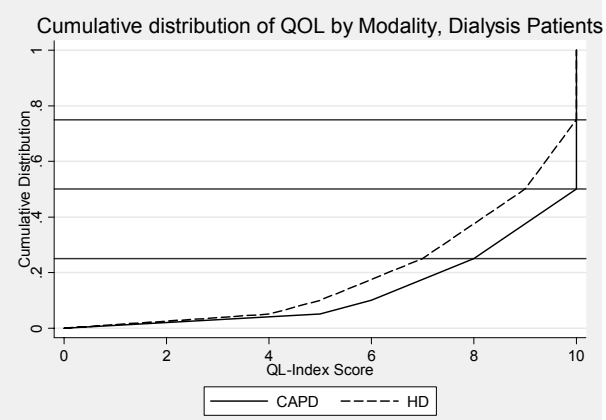

Table 5.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, All Dialysis patients 1998-2007

Diabetes mellitus	No	Yes
Number of patients	9498	9256
Centile		
0	0	0
0.05	5	4
0.1	7	5
0.25 (LQ)	9	6
0.5 (median)	10	8
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 5.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, All Dialysis patients 1998-2007

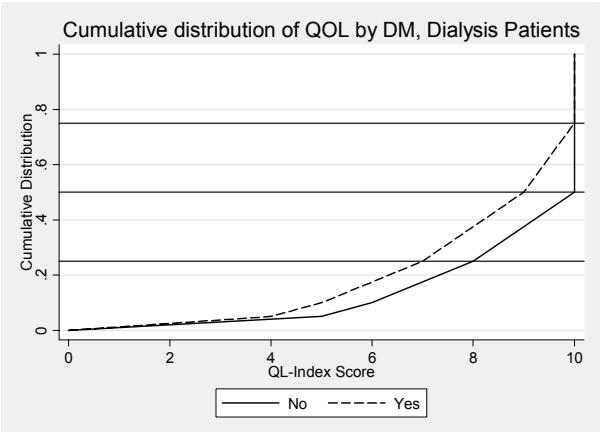

Table 5.3: Cumulative distribution of QoL-Index score in relation to Gender, All Dialysis patients 1998-2007

Gender	Male	Female
Number of patients	10366	8388
Centile		
0	0	0
0.05	5	4
0.1	6	5
0.25 (LQ)	7	7
0.5 (median)	9	9
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 5.3: Cumulative distribution of QoL-Index score in relation to Gender, All Dialysis patients 1998-2007

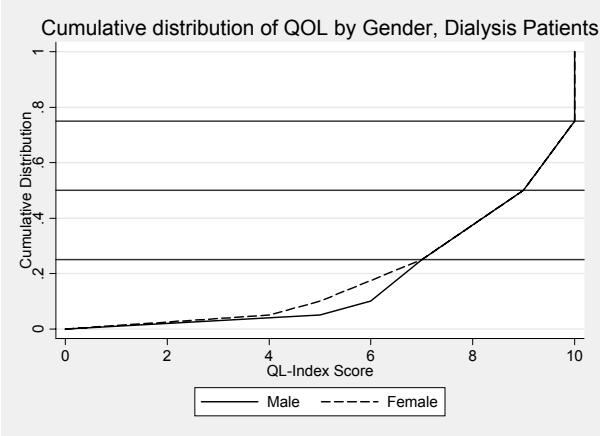

Table 5.4: Cumulative distribution of QoL-Index score in relation to Age, All Dialysis patients 1998-2007

Age group	<20	20-39	40-59	>=60
Number of patients	723	3183	8976	5872
Centile				
0	0	0	0	0
0.05	6	6	5	4
0.1	8	8	6	5
0.25 (LQ)	9	9	8	6
0.5 (median)	10	10	9	8
0.75 (UQ)	10	10	10	9
0.9	10	10	10	10
0.95	10	10	10	10
1	10	10	10	10

Figure 5.4: Cumulative distribution of QoL-Index score in relation to Age, All Dialysis patients 1998-2007

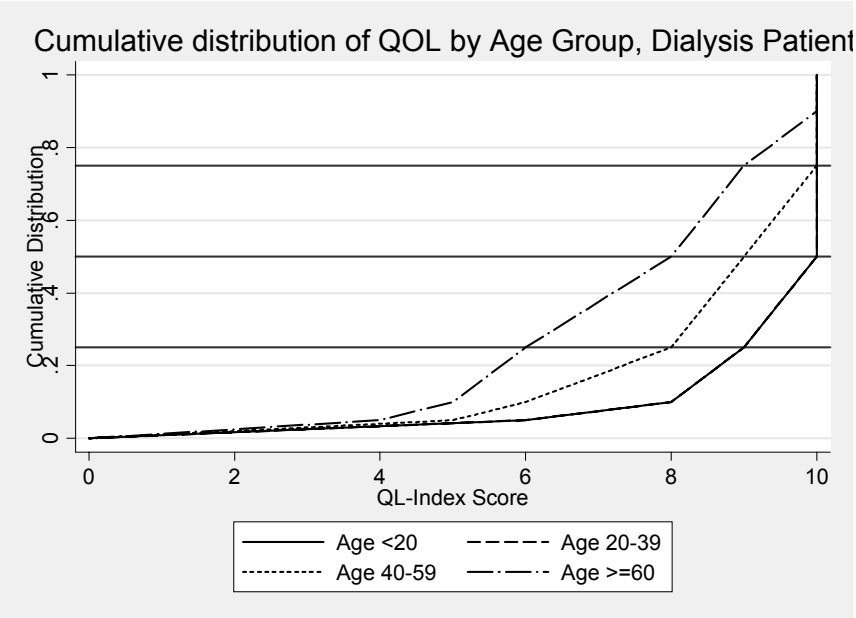

Table 5.5: Cumulative distribution of QoL-Index score in relation to Year of entry, HD patients 1998-2007

Year of Entry	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of patients	834	1033	1262	1419	1619	1673	1968	2046	2272	1675
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	5	5	5	5	4	5	4	4	4	4
0.1	6	6	6	5	5	5	5	5	5	5
0.25 (LQ)	8	7	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
0.9	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 5.5: Cumulative distribution of QoL-Index score in relation to Year of entry, HD patients 1998-2007

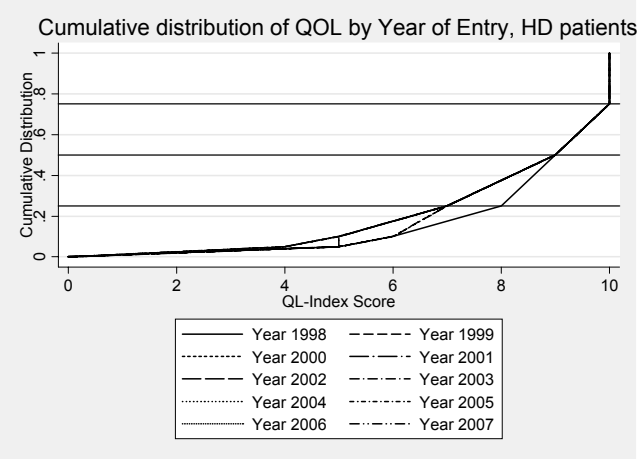

Figure 5.6: Cumulative distribution of QoL-Index score in relation to Year of entry, CAPD patients 1998-2007

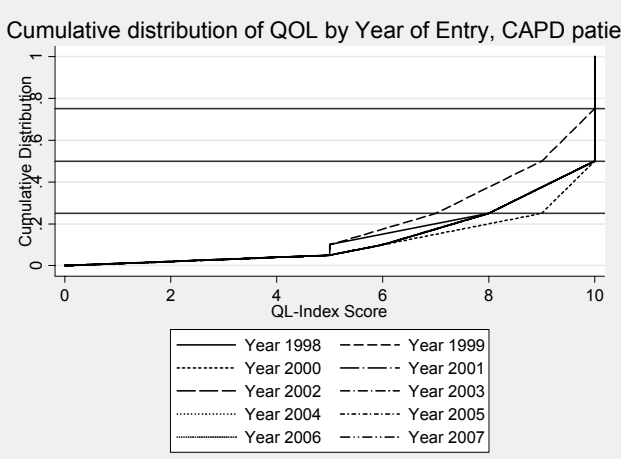

Table 5.6: Cumulative distribution of QoL-Index score in relation to Year of entry, CAPD patients 1998-2007

Year of Entry	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of patients	117	167	188	269	319	368	307	319	423	476
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	5	5	5	5	5	5	5	5	5	5
0.1	5	5	6	6	6	6	6	6	6	6
0.25 (LQ)	8	7	9	8	8	8	8	8	8	8
0.5 (median)	10	9	10	10	10	10	10	10	10	10
0.75 (UQ)	10	10	10	10	10	10	10	10	10	10
0.9	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=6335) and CAPD patients (n=968) who entered dialysis between 1998 –2007, (Table 5.7). 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 = 71% vs CAPD 72%)

Amongst HD as well as CAPD patients, the proportion on employment increases with longer duration on dialysis. (Table 5.8 and Table 5.9) This may be confounded by the healthier individuals who survived longer in the earlier cohort and therefore spuriously increased the proportion on employment.

Table 5.7: Work related rehabilitation in relation to Modality, Dialysis patients 1998-2007

Modality	CAPD		HD	
	N	%	N	%
Number of patients	968		6335	
Able to return for Full or Part time for pay*	693	72	4469	71
Unable to work for pay	275	28	1866	29

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

Table 5.8: Work related rehabilitation in relation to Year of Entry, HD patients 1998-2007

Year		1998	1997	2000	2001	2002	2003	2004	2005	2006	2007
Number of patients		429	525	581	586	666	680	757	736	815	560
Able to return for Full or Part time for pay*	No	345	398	446	423	489	483	515	505	532	333
	%	80	76	77	72	73	71	68	69	65	59
Unable to work for pay	No	84	127	135	163	177	197	242	231	283	227
	%	20	24	23	28	27	29	32	31	35	41

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

Table 5.9: Work related rehabilitation in relation to Year of Entry, CAPD patients 1998-2007

Year		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of patients		39	48	63	84	119	138	101	111	135	130
Able to return for Full or Part time for pay*	No	31	35	42	67	90	106	72	79	90	81
	%	79	73	67	80	76	77	71	71	67	62
Unable to work for pay	No	8	13	21	17	29	32	29	32	45	49
	%	21	27	33	20	24	23	29	29	33	38

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

CHAPTER 6

Paediatric Renal Replacement Therapy

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Lynster Liaw
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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. After the progressive rise in incident dialysis patients during the 80s and 90s; the number of children commencing on dialysis (HD and PD) had begun to plateau over the last 5 years. The dialysis acceptance rate increased gradually from 5 per million age related population (pmarp) in 1998 to 8 pmarp in 2002 and it had stabilized around 8 pmarp over the last 5 years. The number of new transplants had shown an encouraging increase over the last 3 years in terms of numbers although the transplant rate remains at 2 pmarp.

As expected, the number of prevalent dialysis patients continue to rise and by the end of 2007 there was a total of 509 children under 20 on dialysis. The equivalent dialysis prevalence rate increased from 16 pmarp in 1998 to 45 in 2007. There were 166 children with a functioning graft in 2007.

Table 6.1: Stock and Flow of Paediatric Renal Replacement Therapy 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New HD patients	21	23	12	24	28	33	39	34	51	32
New CAPD patients	28	30	37	39	54	38	41	47	44	46
New Transplants	7	15	18	11	13	11	11	18	22	19
HD deaths	3	2	4	1	11	6	10	9	7	10
CAPD deaths	7	2	3	8	8	9	5	9	16	8
Transplant deaths	2	0	1	0	1	2	1	1	3	3
On HD at 31st Dec	90	106	120	144	162	186	218	242	289	312
On CAPD at 31st Dec	73	92	109	123	152	163	176	192	189	197
Functioning transplant at 31st Dec	70	80	93	101	112	118	126	141	156	166

Figure 6.1(a): Incident cases of RRT by modality in children under 20 years old, 1998-2007

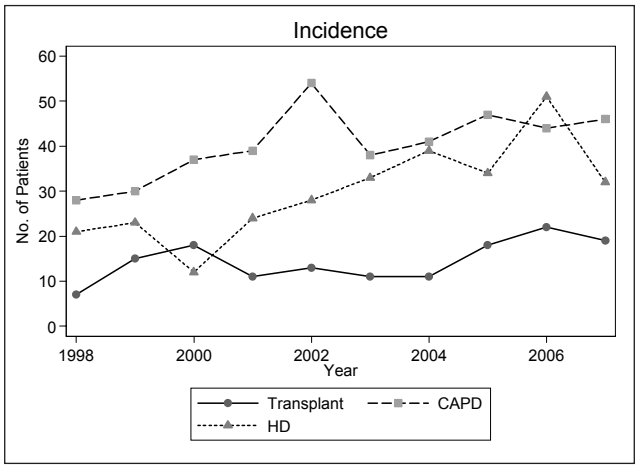


Figure 6.1(b): Prevalent cases of RRT by modality in children under 20 years old, 1998-2007

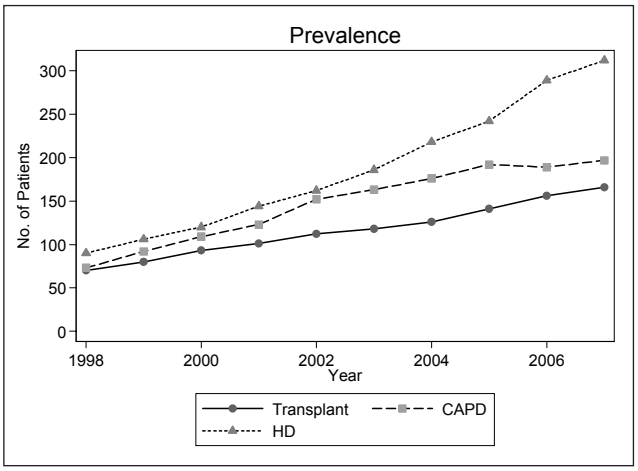
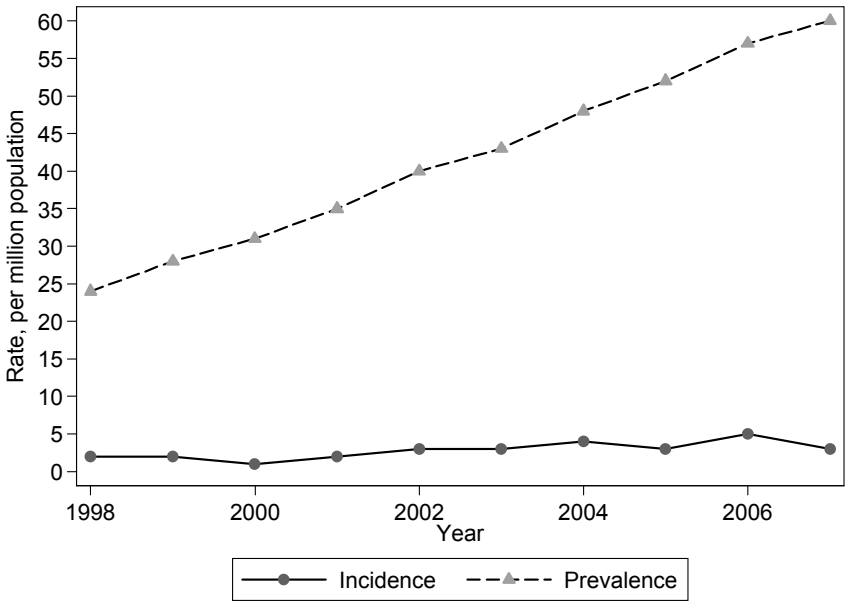


Table 6.2: Paediatric Dialysis and Transplant Rates per million age-group population 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Incidence Rate										
New HD	2	2	1	2	3	3	4	3	5	3
New CAPD	3	3	4	4	5	4	4	4	4	4
New Transplant	1	2	2	1	1	1	1	2	2	2
All RRT	5	6	5	6	8	7	7	8	8	7
Prevalence Rate at 31st December										
On HD	9	11	12	14	15	17	20	22	26	28
On CAPD	7	9	11	12	14	15	16	17	17	17
Functioning Graft	7	8	9	10	11	11	12	13	14	15
All RRT	23	28	32	36	40	43	48	52	57	60

Figure 6.2: Incidence and prevalence rate per million age related population years old on RRT, 1998-2007



SECTION B: DISTRIBUTION OF PAEDIATRIC DIALYSIS PATIENTS

Table 6.3(a) 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. However in terms of numbers; there had been significant increase in new dialysis patients in East Malaysia over the last 5 years most likely due to the availability of nephrology services in that region. (table 6.3b)

Table 6.3(a): Dialysis Treatment Rate by State, per million state age group population; 1998-2007

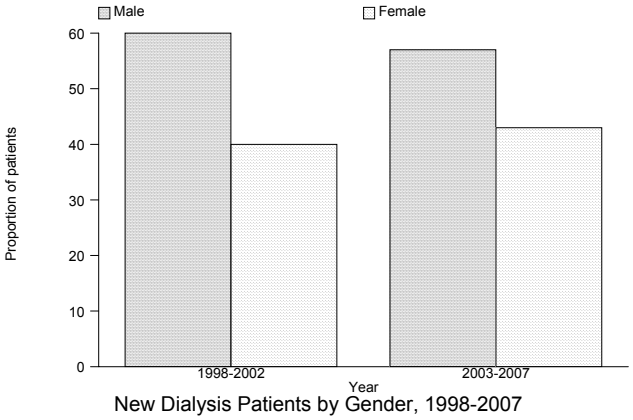
State	1998-2002	2003-2007
Pulau Pinang	9	15
Melaka	8	15
Johor	8	10
Perak	5	10
Selangor &Putrajaya	9	7
Kuala Lumpur	12	11
Negeri Sembilan	10	12
Kedah	8	7
Perlis	14	8
Terengganu	9	9
Pahang	7	8
Kelantan	4	8
Sarawak	5	7
Sabah & WP Labuan	2	6

Table 6.3(b): New Dialysis Patients by State,1998-2007

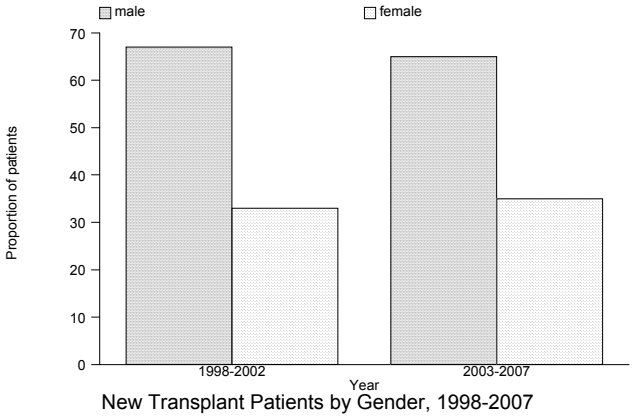
State	1998-2002	2003-2007
Pulau Pinang	21	39
Melaka	11	22
Johor	49	62
Perak	22	47
Selangor & Putrajaya	65	65
Kuala Lumpur	31	33
Negeri Sembilan	18	24
Kedah	31	29
Perlis	7	4
Terengganu	21	23
Pahang	20	26
Kelantan	16	31
Sarawak	22	35
Sabah & WP Labuan	16	40

There had been consistently more males than females among the population of children on dialysis over the last 10 years. This is probably due to higher incidence of ESRD among males. However this gender disparity appears more marked among the transplanted patients.

Figure 6.4: Number of New Dialysis and Transplant Patients by gender 1998-2007



New Dialysis Patients by Gender, 1998-2007



New Transplant Patients by Gender, 1998-2007

Figure 6.5 shows that the treatment rate had begun to level off for all the age groups including the oldest age group of 15-19 years old. The number of 0-4 year olds provided chronic dialysis treatment remained very low at around 1 pmarp.

Figure 6.5: Dialysis and Transplant Treatment Rate by Age group 1998-2007

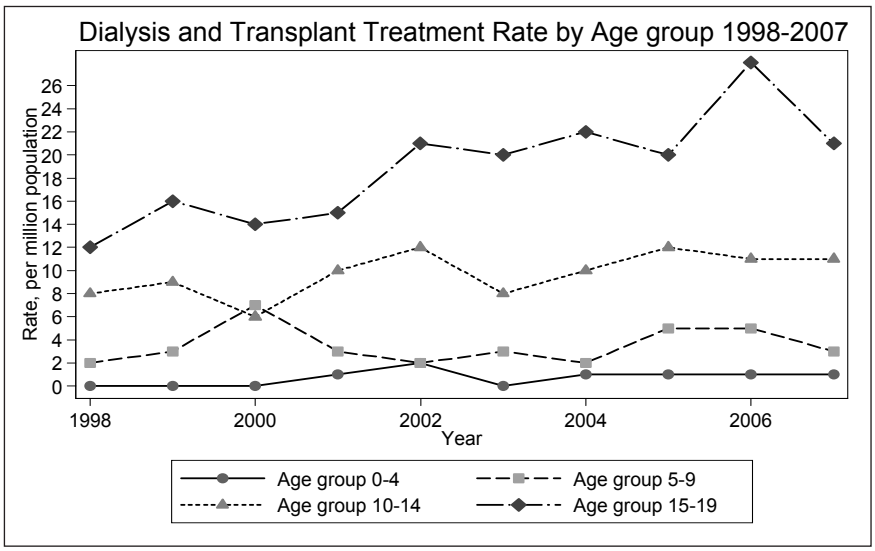


Figure 6.6 shows that CAPD was the preferred mode of initial dialysis modality; however over the last 3 years a significant proportion of children were also started on automated PD (CCPD) as the first modality of dialysis.

Figure 6.6: New Dialysis by treatment modality 1998-2007

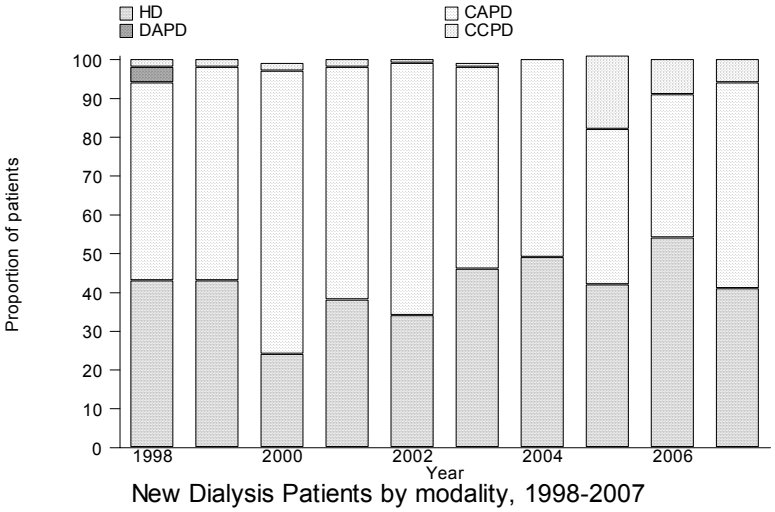
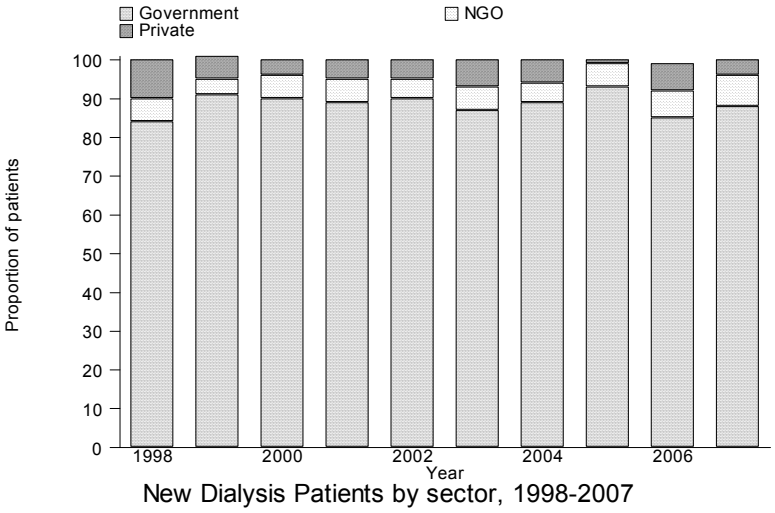


Figure 6.7 shows that up to 90% of children less than 20 years of age received their dialysis treatment from government centres and hence were government funded.

Figure 6.7: New Dialysis by sector 1998-2007



SECTION C: PRIMARY RENAL DISEASE

Glomerulonephritis was the commonest known cause of ESRD accounting for 21% of patients. FSGS on its own accounted for 8% of ESRD. The number of children presenting with ESRD of unknown aetiology was still high at 47%.

Table 6.8: Primary renal disease by sex, 1998-2007

Primary Renal Disease	Male		Female		All	
	N	%	N	%	N	%
Glomerulonephritis	93	22	57	19	150	21
FSGS	33	8	26	9	59	8
Refux nephropathy	20	5	6	2	26	4
SLE	12	3	36	12	48	7
Obstructive uropathy	32	8	8	3	40	6
Renal dysplasia	12	3	6	2	18	3
Others	8	2	10	3	18	3
Hereditary nephritis	10	2	1	0	11	2
Cystic kidney disease	3	1	4	1	7	1
Drug induced nephropathy	0	0	1	0	1	0
Metabolic	3	1	1	0	4	1
Unknown	192	46	142	48	334	47

SECTION D: TYPES OF RENAL TRANSPLANTATION.

Table 6.9 shows that living related transplant is the commonest type of transplantation done among children. However the encouraging trend over the last 5 years showed that cadaveric renal transplantation had increased and accounted for 38% of transplants done. (similar to living related transplants.) About a quarter (23%) of renal transplantation was done overseas under the commercial cadaver donor program.

Table 6.9: Types of Renal Transplant 1998 – 2007

Year	1998-2002		2003-2007	
	No.	%	No.	%
Commercial Cadaver	8	13	19	23
Commercial Living donor	3	5	1	1
Living related donor	34	54	30	38
Cadaver	18	28	30	38
Living emotionally related	0	0	0	0
TOTAL	63	100	80	100

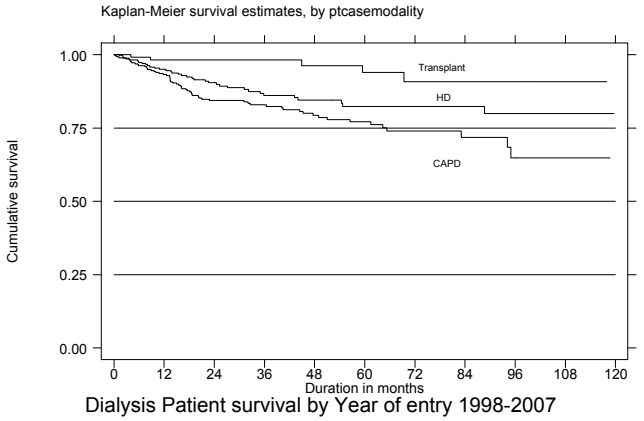
SECTION E: SURVIVAL ANALYSIS

Table and Figure 6.10 show that renal transplantation has the best patient survival; with 94% survival at 5 years. Haemodialysis and CAPD showed comparable survival up till 7 years into dialysis when analyzed without consideration of change of modality of dialysis.(as per ITT) However when censored for change of modality; after 5 years there is progressive separation of the survival curve with CAPD showing a poorer outcome compared to HD (Figure 6.10b)

Table 6.10(a): Patient survival by dialysis modality analysis as per ITT

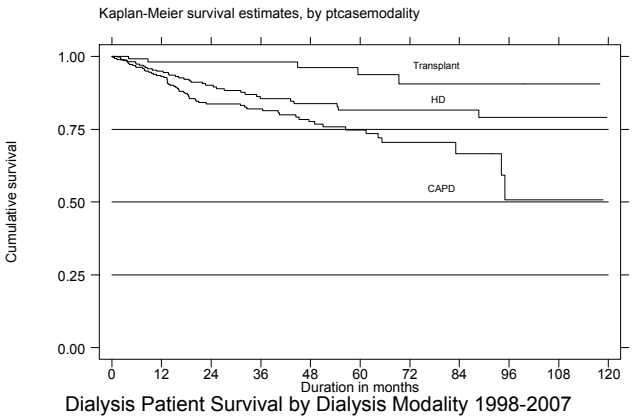
Modality Interval (months)	Transplant			CAPD			HD		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	126	100	-	333	100	-	279	100	-
12	100	98	1	262	93	1	229	95	1
60	41	94	3	88	77	3	66	82	3

Figure 6.10 (a): Patient survival by dialysis modality analysis as per ITT



Dialysis Patient survival by Year of entry 1998-2007

Figure 6.10(b): Patient survival by dialysis modality analysis censored with change of modality



Dialysis Patient Survival by Dialysis Modality 1998-2007

Table 6.10(b): Patient survival by dialysis modality analysis censored with change of modality

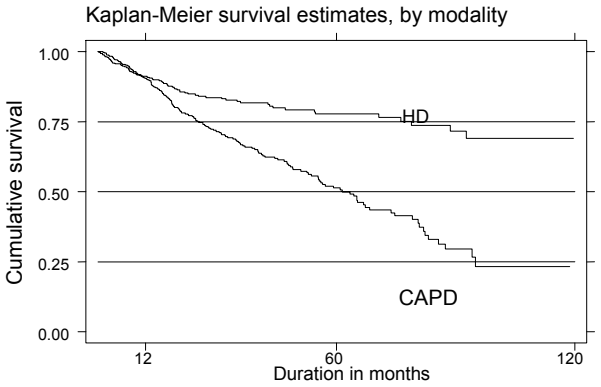
Modality Interval (months)	Transplant			CAPD			HD		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	126	100	-	333	100	-	279	100	-
12	97	98	1	251	93	1	218	95	1
60	40	94	3	66	75	3	63	82	3

Table and Figure 6.11 showed that after the first year; dialysis technique failure rate was much higher amongst CAPD patients with progressive widening of the technique survival curve with increasing years on dialysis. Technique survival at 5- years was only 50% for CAPD compared to 78% for HD.

Table 6.11: Dialysis Technique Survival by Modality, 1998-2007

Modality Interval (years)	CAPD			HD		
	No.	% Survival	SE	No.	% Survival	SE
12	327	90	1	309	91	1
60	80	51	3	86	78	3

Figure 6.11: Dialysis Technique Survival by Modality, 1998-2007



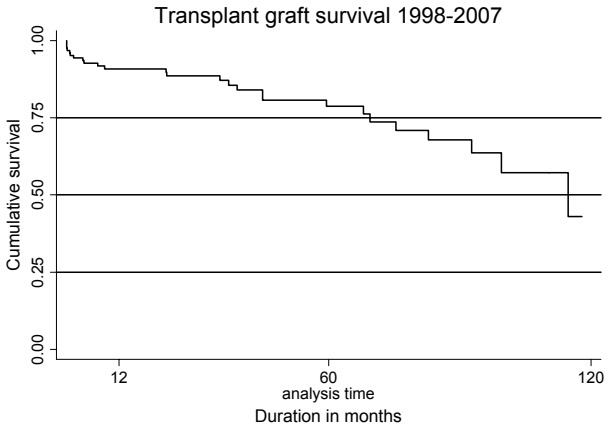
Dialysis technique survival by Modality 1998-

The graft survival for paediatric transplants was 91% at 1 year and 79% at 5 years.

Table 6.12: Transplant Graft Survival, 1998- 2007

interval (year)	No.	% survival	SE
0	126	100	0
12	97	91	3
60	40	79	5

Figure 6.12: Transplant Graft Survival, 1998 – 2007



CHAPTER 7

Management of Anaemia in Dialysis Patients

Philip N.Jeremiah
Bee Boon Cheak

SECTION 7.1: TREATMENT FOR ANAEMIA IN DIALYSIS

Over the last 10 years, 1998 – 2007, the percentage of dialysis patients, both HD and PD on EPO has steadily increased; HD 86% compared with PD 74%. The percentage of patients receiving blood transfusion in both HD and PD were approximately 15%. There is a trend towards a decreasing use of oral iron supplements with the corresponding increase in the use of parenteral iron. (Tables and Figures 7.1.1 to 7.1.2)

Table 7.1.1: Treatment for Anaemia, HD patients 1998 to 2007

Year	No of subjects	% on Erythropoietin	% received blood transfusion	% on oral iron	% received parenteral iron
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	7016	71	12	83	8
2004	8063	74	11	80	10
2005	9344	81	14	74	11
2006	11679	84	18	76	16
2007	12889	86	15	74	17

Table 7.1.2: Treatment for Anaemia, CAPD patients 1998 to 2007

Year	No of subjects	% on Erythropoietin	% received blood transfusion	% on oral iron	% received parenteral iron
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	1552	74	16	83	13
2007	1806	74	16	80	12

In 2007, the percentage of patients on EPO among HD centres varied significantly from the 19% to 100%. The median usage of EPO was 90% compared to 48.5 % 10 years ago. In PD centres, surprisingly the variation in EPO utilization was even more from 0 to 97 %. The median usage of EPO was 78.5%. (Tables and Figures 7.1.3 to 7.1.4)

Table 7.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	50	0	4	35	48.5	57	78	86
1999	75	6	15	42	51	68	82	90
2000	108	0	20	44.5	56	69	83	100
2001	125	0	19	49	61	74	88	100
2002	157	14	25	56	69	79	92	100
2003	181	17	36	60	73	83	95	100
2004	210	8	37	66	76	85	96	100
2005	238	8	55	74	82.5	91	100	100
2006	294	3	59	80	88	93	100	100
2007	308	19	66	83	90	95	100	100

Figure 7.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2007

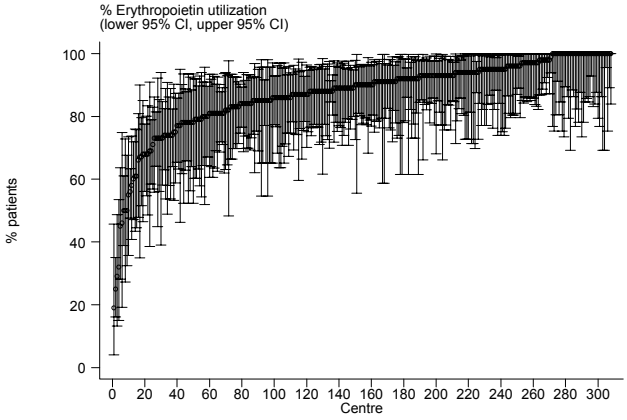


Figure 7.1.4: Variation in Erythropoietin utilization (% patients) among CAPD centres, 2007

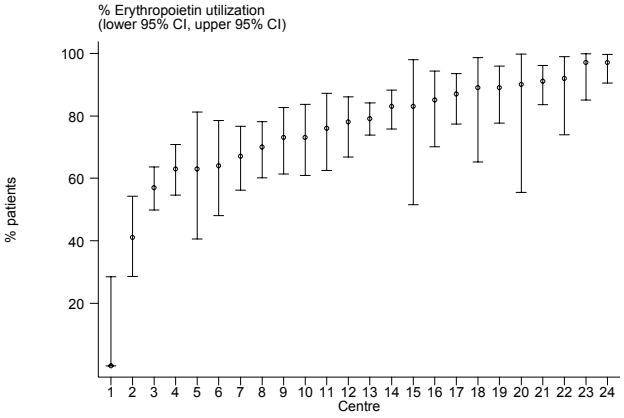


Table 7.1.4: Variation in Erythropoietin utilization (% patients) among CAPD centres, 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	15	15	30	46	57	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	47	57	88	88
2002	15	26	26	43	53	60	68	68
2003	19	25	25	40	51	71	92	92
2004	19	5	5	54	64	76	97	97
2005	20	42	49.5	60.5	68	83.5	97	97
2006	22	38	52	65	73.5	86	97	97
2007	24	0	41	65.5	78.5	89	97	97

The median weekly EPO dose has remained static at 4000 units per week for both HD and PD patients. In HD centres, at the 5th and 95th centiles, 5% of centres have their weekly dose at 2000 units and 6000 units respectively. (Tables and Figures 7.1.5 to 7.1.6)

Table 7.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres, 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	34	2000	2000	4000	4000	4000	4000	4000
1999	52	2000	2000	2000	4000	4000	4000	5000
2000	78	2000	2000	2000	4000	4000	4000	6000
2001	93	2000	2000	2000	4000	4000	4000	8000
2002	117	2000	2000	4000	4000	4000	5000	6000
2003	137	2000	2000	4000	4000	4000	6000	8000
2004	169	2000	2000	4000	4000	4000	6000	8000
2005	195	2000	2000	4000	4000	8000	8000	18000
2006	250	2000	2000	4000	4000	4000	6000	6000
2007	281	4000	2000	4000	4000	4000	6000	6000

Figure 7.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres, 2007

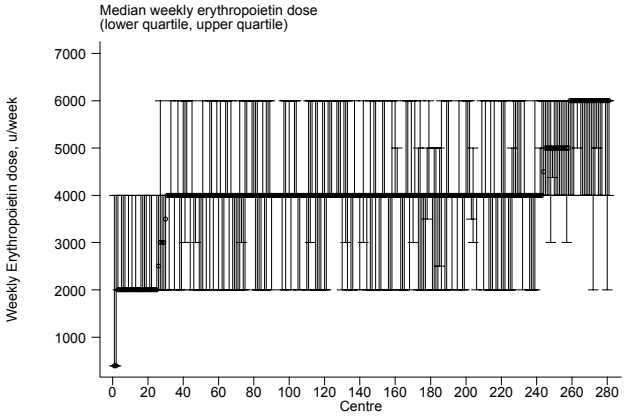


Figure 7.1.6: Variation in median weekly Erythropoietin dose (u/week) among CAPD centres, 2007

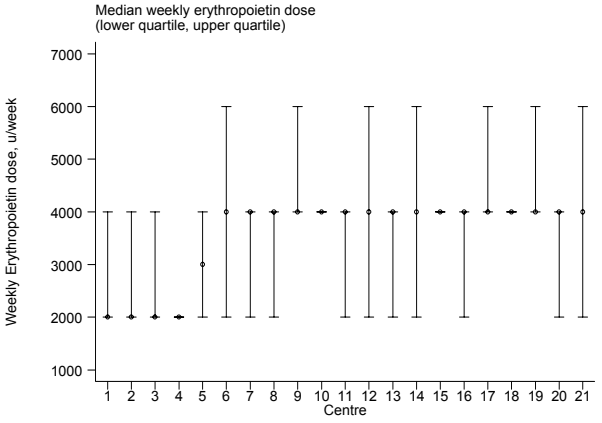


Table 7.1.6: Variation in median weekly Erythropoietin dose (u/week) among CAPD centres 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	6	3000	3000	4000	4000	4000	4000	4000
1999	7	2000	2000	2000	4000	4000	4000	4000
2000	8	2000	2000	3000	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	6000	6000
2004	13	2000	2000	4000	4000	4000	4000	4000
2005	18	2000	2000	4000	4000	4000	8000	8000
2006	21	2000	2000	2000	4000	4000	4000	6000
2007	21	2000	2000	4000	4000	4000	4000	4000

In HD, the median requirement of blood transfusion over the years has been at 10 – 18%, with similar trend in the PD patients. There was a great variation in the use of blood transfusion among centres, ranging from 0 to 100 % in HD centres and 6 to 38% in PD centres. (Tables and Figures 7.1.7 to 7.1.8)

Table 7.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	50	0	0	4	9.5	16	36	48
1999	75	0	0	4	10	21	41	56
2000	108	0	0	4.5	11.5	21.5	49	77
2001	125	0	0	5	12	20	38	50
2002	157	0	0	2	8	14	29	67
2003	181	0	0	3	9	19	36	63
2004	210	0	0	2	8	16	36	50
2005	238	0	0	5	11	20	43	77
2006	294	0	2	10	18	29	48	89
2007	307	0	0	8	15	23	43	100

Figure 7.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2007

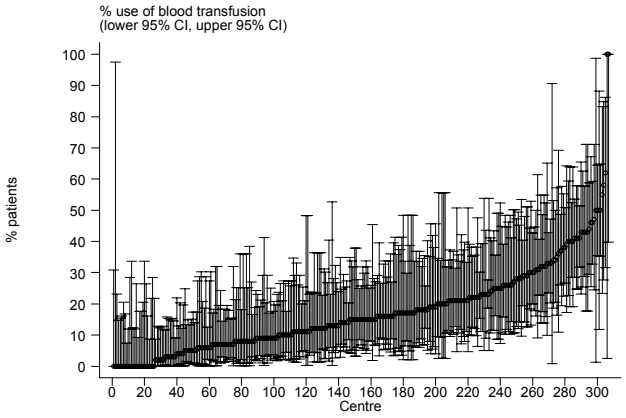


Figure 7.1.8: Variation in use of blood transfusion (% patients) among CAPD centres, 2007

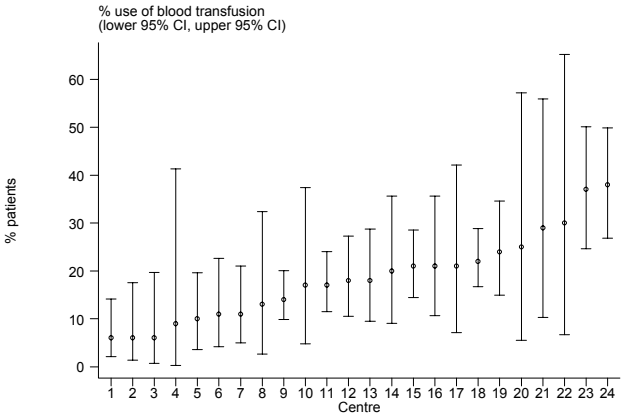


Table 7.1.8: Variation in use of blood transfusion (% patients) among CAPD centres, 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	17	42	42
2001	12	0	0	0	3.5	15.5	37	37
2002	15	0	0	5	8	20	42	42
2003	19	0	0	3	13	21	59	59
2004	19	0	0	5	15	20	37	37
2005	20	0	0	3.5	10.5	17	43	45
2006	22	3	4	9	16	27	36	50
2007	24	6	6	11	18	23	37	38

SECTION 7.2: IRON STATUS ON DIALYSIS

Generally, in HD and PD patients with or without the EPO, the mean and median serum ferritin has steadily increased over the years. Up to 98% of patients had serum ferritin of ≥100 ng/ml. (Table and Figures 7.2.1 to 7.2.4)

Table 7.2.1: Distribution of serum Ferritin without Erythropoietin, HD patients 1998- 2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
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	1134	564.2	488.1	408.5	190	819.9	87
2007	1115	566.5	495.1	414.2	186.1	827	86

Figure 7.2.1: Cumulative distribution of Serum Ferritin without Erythropoietin, HD patients 1998-2007

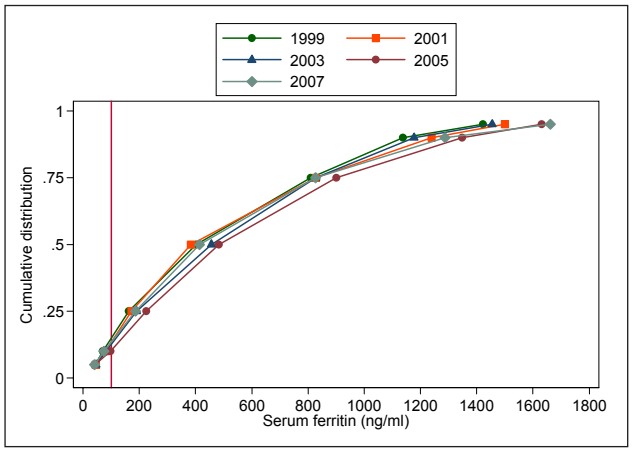


Figure 7.2.2: Distribution of Serum Ferritin without Erythropoietin, CAPD patients 1998–2007

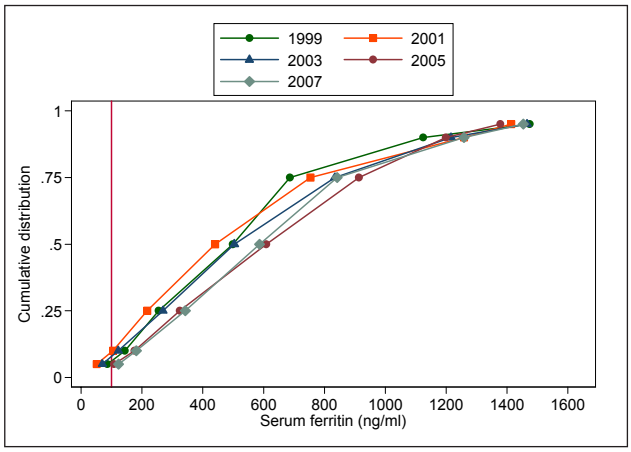


Table 7.2.2: Distribution of serum Ferritin without Erythropoietin, CAPD patients 1998- 2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
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
2007	302	639.5	396.7	586.8	342.8	841.9	96

Table 7.2.3: Distribution of Serum Ferritin on Erythropoietin, HD patients 1998-2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
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	3133	640.7	428.2	562.5	298	931	94
2004	3901	669.9	460.5	571	306	977	94
2005	5114	683.2	471	599.8	316	972.5	93
2006	6800	639.6	458.8	542.7	291	880.8	93
2007	8083	660.7	453.1	566.8	316.5	916.1	94

Figure 7.2.3: Cumulative distribution of Serum Ferritin on Erythropoietin, HD patients 1998-2007

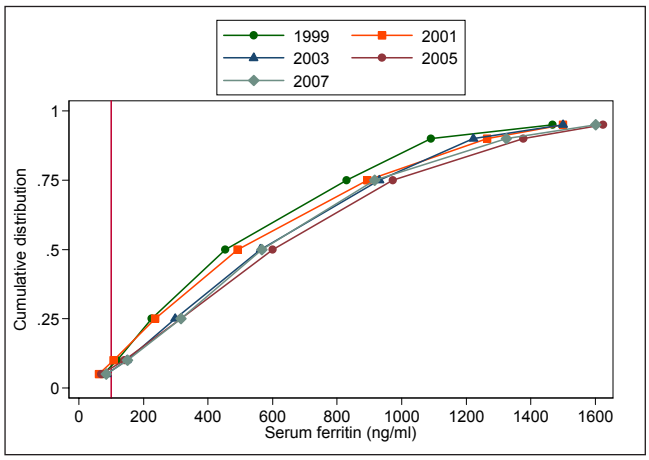


Figure 7.2.4: Cumulative distribution of Serum Ferritin on Erythropoietin, CAPD patients 1998-2007

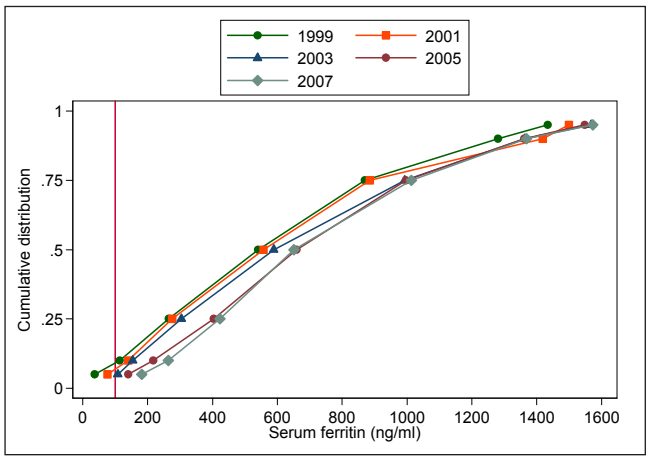


Table 7.2.4: Distribution of Serum Ferritin on Erythropoietin, CAPD patients 1998-2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
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	889	731.9	436.1	639.8	401.7	986.9	98
2007	1094	740.3	426.2	651.1	423	1014	98

The median transferrin saturation has essentially remained the same over the last 10 years, with the mean and median ≥ 30%. Up to 92 % of all patients have transferrin saturation ≥ 20% (Tables and Figures 7.2.5 to 7.2.8)

Table 7.2.5: Distribution of Transferrin saturation without Erythropoietin, HD patients, 1998-2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
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	1117	36.2	16.8	33	24.6	44	87
2007	1156	36.1	16.4	32.5	24.9	43.7	87

Figure 7.2.5: Cumulative distribution of transferrin saturation without Erythropoietin, HD patients 1998-2007

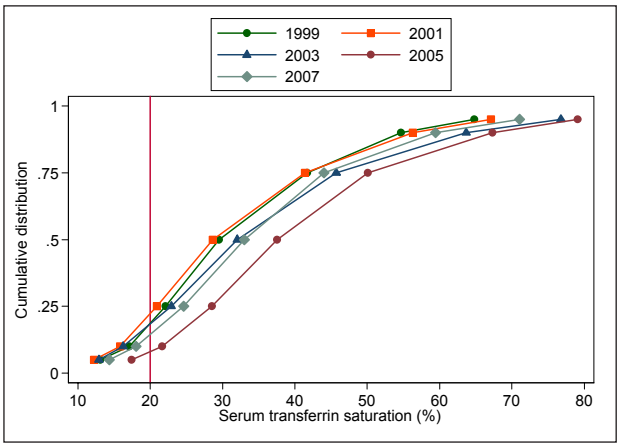


Figure 7.2.6 Cumulative distribution of transferrin saturation without Erythropoietin, CAPD patients 1998-2007

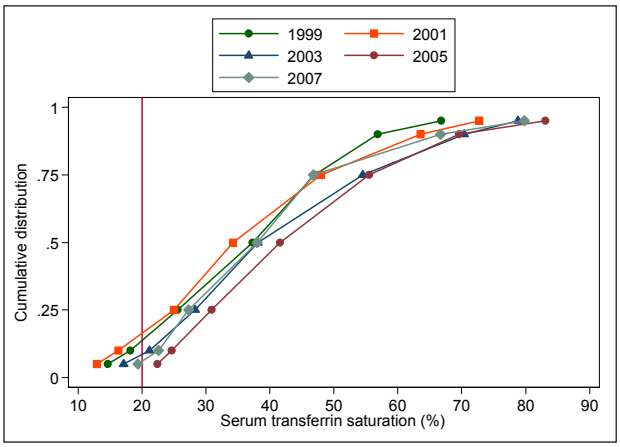


Table 7.2.6: Distribution of Transferrin saturation without Erythropoietin, CAPD patients 1998-2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
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
2007	344	40.2	17.9	36.3	27.5	48.1	92

Table 7.2.7: Distribution of Transferrin saturation on Erythropoietin, HD patients, 1998-2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
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	6416	35.2	16.4	31.6	24.1	42.1	87
2007	7640	34.7	15.5	31.6	24.4	41.6	88

Figure 7.2.7: Cumulative distribution of transferrin saturation on Erythropoietin, HD patients 1998-2007

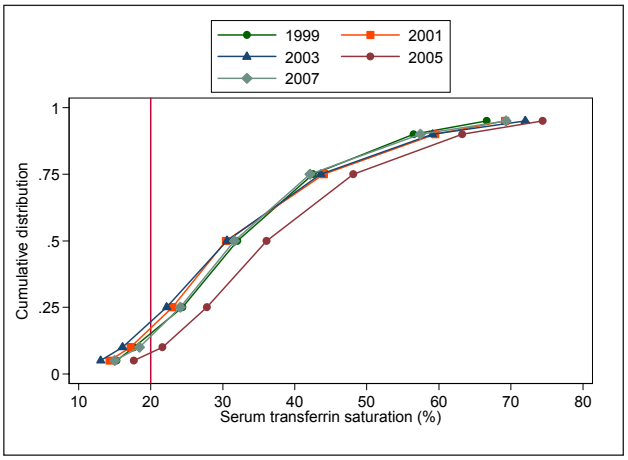


Figure 7.2.8 Cumulative distribution of transferrin saturation on Erythropoietin, CAPD patients 1998-2007

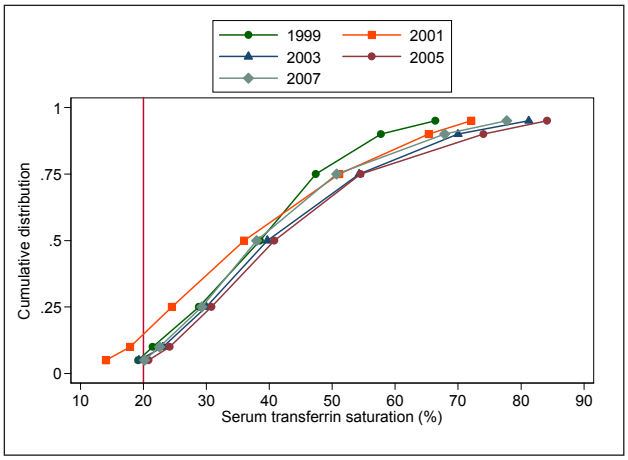


Table 7.2.8: Distribution of Transferrin saturation on Erythropoietin, CAPD patients, 1998-2007

Year	No of subjects	Mean	Std Dev	Median	LQ	UQ	% Patients ≥20%
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	917	41.7	17.5	38	29.3	50.7	95
2007	1084	39.3	17.6	35.3	26.9	47.5	92

Over the last 10 years, the median serum ferritin has increased; the transferrin saturation however has remained the same. There was a wide variation in median ferritin between HD centres in 2007 ranging from 85 to 1400 ng/ml. (Tables and Figures 7.2.9)

A similar trend, but with higher level of Ferritin and transferrin saturation were observed in PD patients (Tables and Figures 7.2.10)

Table 7.2.9: Variation in iron status outcomes among HD centres 2007
a) Median serum ferritin among patients on erythropoietin

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	13	205	205	432	468.5	560.3	722.8	722.8
1999	22	169	189.5	354.5	419	524.5	890.1	949.5
2000	42	143	229	370	537.9	683.8	813.5	1159.8
2001	52	199	238.3	389.7	512.2	678.5	886.5	1191.3
2002	70	106.6	192	364.5	454.9	604	836.5	1070.8
2003	101	152.5	311.5	459.2	543.5	690.3	950.1	1742.8
2004	125	99.5	328.5	465.8	573	722.8	1032	2000
2005	163	126.8	258.5	460.4	616.3	732.5	990.5	2000
2006	211	28	232.7	414.3	550	675.5	897	2000
2007	236	85.5	247	427.3	560.8	681.8	901.9	1457

Figure 7.2.9(a): Variation in median serum ferritin among patients on erythropoietin, HD centres 2007

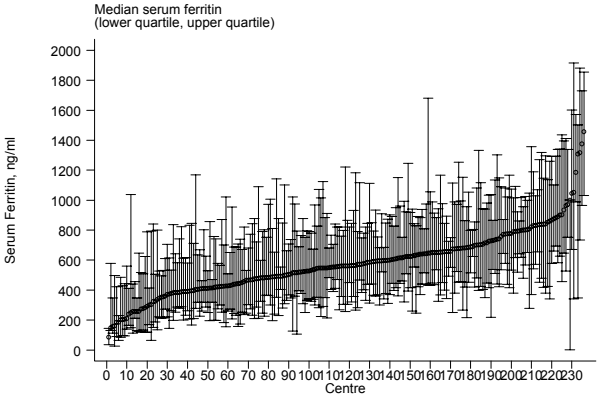
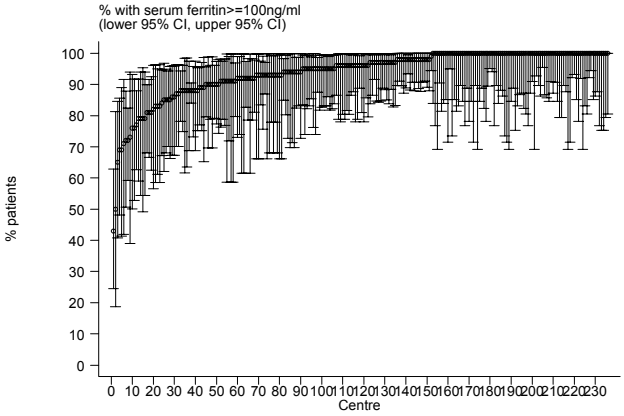


Figure 7.2.9(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml, HD centres 2007



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

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	13	75	75	90	91	95	100	100
1999	22	70	76	92	96	100	100	100
2000	42	68	73	85	93	97	100	100
2001	52	67	73	87	93	97	100	100
2002	70	55	73	88	93	96	100	100
2003	101	57	76	91	96	100	100	100
2004	125	50	84	91	96	100	100	100
2005	164	5	77	90	95	100	100	100
2006	212	0	70	91	94	100	100	100
2007	236	43	77	91.5	96	100	100	100

(c) Median transferrin saturation among patients on erythropoietin, HD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	22	22.8	24.1	27.8	32.3	35.6	44.4	51.9
1999	26	16.4	20.7	26.9	31.7	34	41.8	44.8
2000	42	16	23.2	27.7	31.4	37.2	44.1	57.5
2001	55	21	22.5	27.2	31	37.7	48.1	76.6
2002	61	14.7	21	26	29.7	36.5	50.8	60.2
2003	91	19.2	24.2	30.7	34.2	41	57.3	70.7
2004	112	22.7	26.8	32.6	36.1	40.7	52	67.6
2005	150	15.2	23.3	29.1	32.4	37.9	47.9	69.7
2006	191	14.1	23	27.7	31.3	35.6	46.2	78.7
2007	217	16.3	22	27.6	31.3	35.4	43.3	77.8

Figure 7.2.9(c): Variation in median transferrin saturation among patients on erythropoietin HD centres, 2007

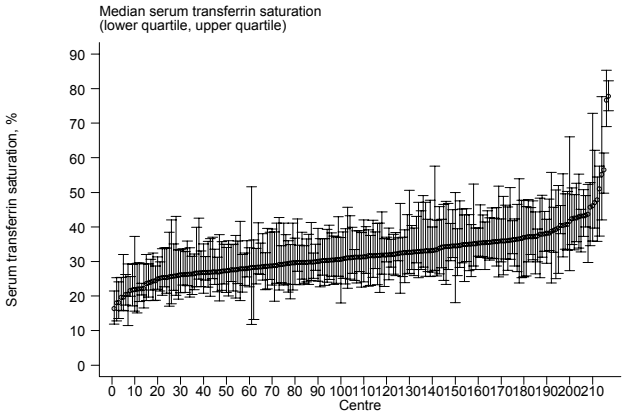
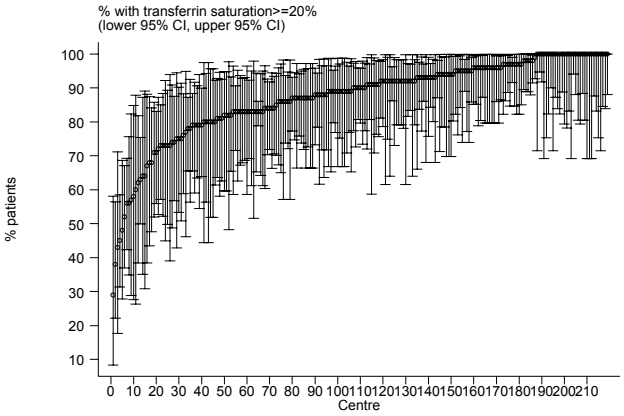


Figure 7.2.9(d): Variation in proportion of patients on erythropoietin with transferrin saturation ≥ 20%, HD centres 2007



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

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	22	57	64	78	88	97	100	100
1999	26	30	57	83	87.5	94	100	100
2000	42	20	60	77	86	94	100	100
2001	55	53	59	74	88	95	100	100
2002	61	33	56	70	82	91	100	100
2003	91	47	69	86	92	100	100	100
2004	112	57	71	91	94	100	100	100
2005	152	29	70	83	91	95	100	100
2006	191	20	61	81	90	95	100	100
2007	219	29	60	83	90	96	100	100

Table 7.2.10: Variation in iron status outcomes among CAPD centres 2007
a) Median serum ferritin among patients on erythropoietin

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	632.6	770	773	773
2001	9	275.7	275.7	532.8	550.7	623	908	908
2002	10	372.2	372.2	437.4	477	606.5	826.5	826.5
2003	13	304	304	455	520.5	716	963.6	963.6
2004	14	317	317	527.8	606.8	701.3	860.3	860.3
2005	17	338.5	338.5	555.5	708	809.9	843	843
2006	19	410	410	535.3	634.6	794.7	925.8	925.8
2007	20	283.3	336	592.6	657.9	737.1	986.6	1048.6

Figure 7.2.10(a): Variation in median serum ferritin among patients on erythropoietin, CAPD centres 2007

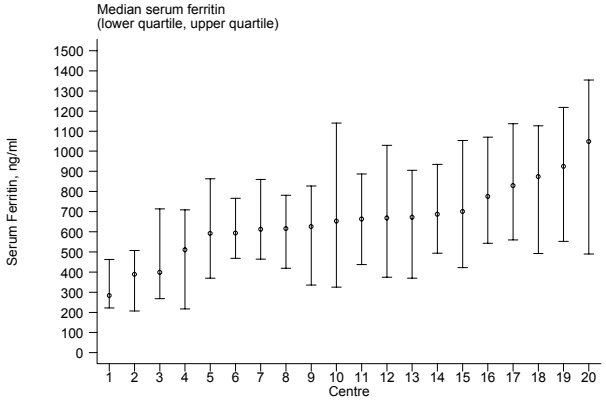
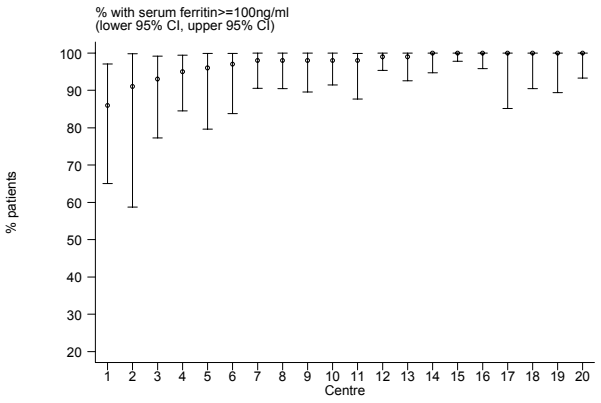


Figure 7.2.10(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml, CAPD centres 2007



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

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	4	83	83	89	97.5	100	100	100
1999	5	84	84	92	95	100	100	100
2000	6	87	87	88	93	100	100	100
2001	9	80	80	85	95	100	100	100
2002	10	91	91	92	94.5	100	100	100
2003	13	85	85	96	96	98	100	100
2004	14	90	90	94	99.5	100	100	100
2005	17	85	85	96	97	100	100	100
2006	19	95	95	97	100	100	100	100
2007	20	86	88.5	96.5	98	100	100	100

(c) Median transferrin saturation among patients on erythropoietin, CAPD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	38.6	40.3	60.4	60.4
2003	13	31.9	31.9	35.8	41.5	47.5	64	64
2004	17	29.1	29.1	36.1	40.9	42.7	82.3	82.3
2005	17	30.3	30.3	35.7	38.5	43	76.4	76.4
2006	18	32.4	32.4	35.2	37.7	40.5	75.8	75.8
2007	19	26.1	26.1	29.6	37.5	46.5	83.2	83.2

Figure 7.2.10(c): Variation in median transferrin saturation among patients on erythropoietin, CAPD centres 2007

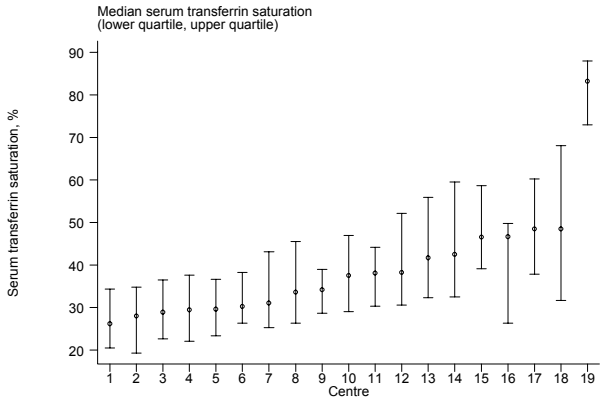
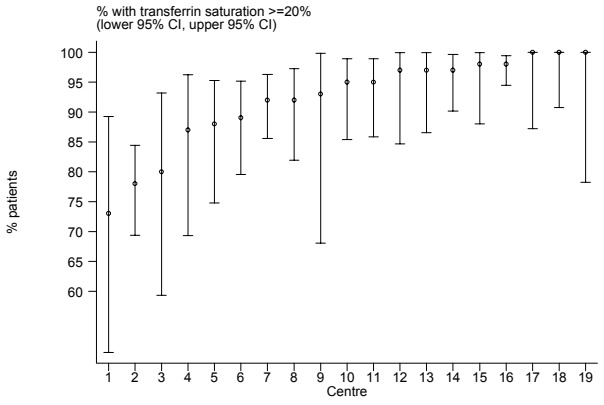


Figure 7.2.10(d): Variation in proportion of patients on erythropoietin with transferrin saturation ≥ 20%, CAPD centres 2007



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

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	93	98	100	100
2003	13	90	90	95	96	100	100	100
2004	17	88	88	95	97	100	100	100
2005	17	89	89	94	97	100	100	100
2006	19	90	90	94	95	98	100	100
2007	19	73	73	88	95	98	100	100

SECTION 7.3: HAEMOGLOBIN OUTCOMES ON DIALYSIS

The mean and median haemoglobin in all dialysis patients, with or without EPO steadily increased over the years. In 2007 the mean and median haemoglobin ranged from 10.2 to 11.1 g/dL. The proportion of patients with haemoglobin ≥ 10 or ≥ 11 g/dL has increased in all dialysis patients irrespective of the use of EPO. (Tables and Figures 7.3.1 to 7.3.4)

Table 7.3.1: Distribution of Haemoglobin Concentration without Erythropoietin, HD patients 1998 – 2007

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
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	1716	10.6	2.2	10.5	9	12.1	42	58	59	41
2007	1664	10.8	2.3	10.8	9.1	12.5	40	60	53	47

Figure 7.3.1: Cumulative distribution of haemoglobin Concentration without Erythropoietin, HD patients 1998-2007

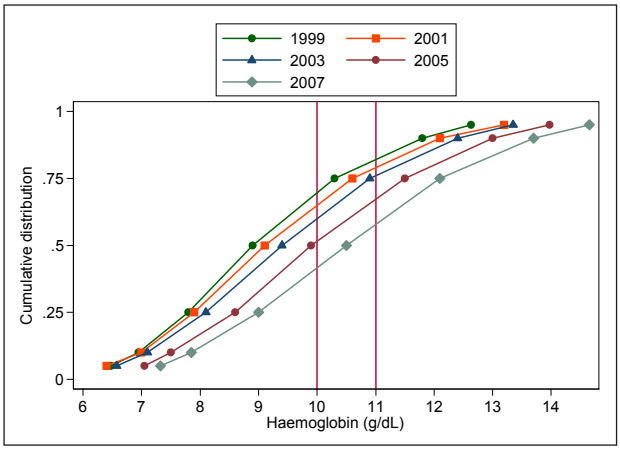


Figure 7.3.2: Cumulative distribution of haemoglobin concentration without Erythropoietin, CAPD patients 1998-2007

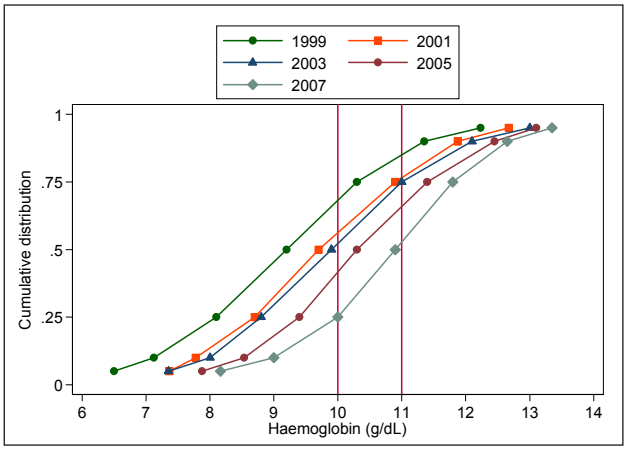


Table 7.3.2: Distribution of Haemoglobin Concentration without Erythropoietin, CAPD patients 1998– 2007

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
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
2007	433	11.1	1.6	11	10.2	12.1	22	78	51	49

Table 7.3.3 Distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1998– 2007

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
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	4781	9.6	1.6	9.6	8.5	10.7	61	39	81	19
2004	5803	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	9459	10.1	1.6	10	9	11.1	50	50	73	27
2007	10771	10.2	1.5	10.3	9.1	11.3	44	56	69	31

Figure 7.3.3 Cumulative distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1998-2007

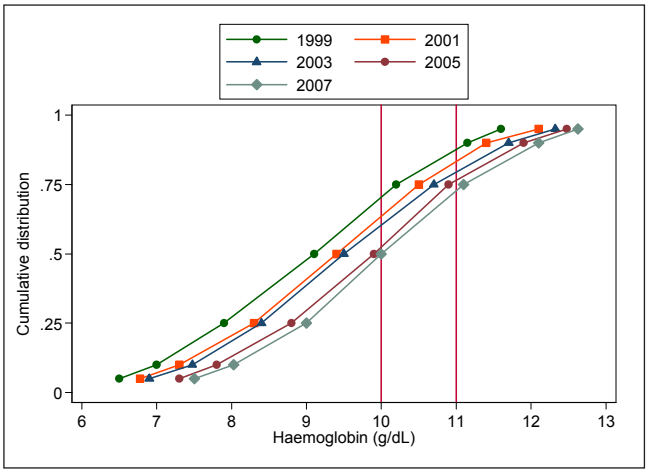


Figure 7.3.4: Cumulative distribution of Haemoglobin Concentration on Erythropoietin, CAPD patients 1998-2007

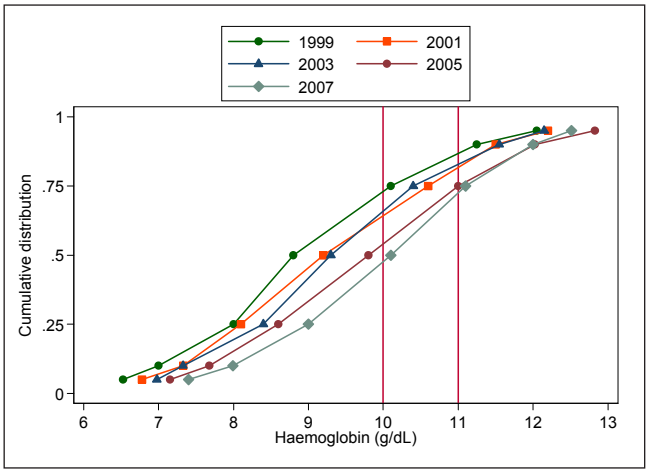


Table 7.3.4: Distribution of Haemoglobin Concentration on Erythropoietin, CAPD patients 1998– 2007

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
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	1120	10	1.6	10.1	9	11.1	50	50	74	26
2007	1322	10.3	1.6	10.4	9.3	11.4	42	58	66	34

In 2007, there was a wide variation in haemoglobin achieved among the HD centres ranging from 8.7 to 12.8 g/dl with the median at 10.2 g/dL. Similar trend was observed in PD centres with a lesser variation. For HD patients on EPO, the proportion of patients with haemoglobin ≥10 g/dL varied between 10 to 100 % with median at 55%. Similarly for haemoglobin ≥11g/dL, the range was from 0 to 85%. Similar trend with a lesser variation was noted in the PD centres. (Tables and Figures 7.3.5 to 7.3.6)

Table 7.3.5: Variation in Haemoglobin outcomes among HD centres 2007
(a) Median haemoglobin level among patients on erythropoietin

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	34	7.6	7.6	8.5	9	9.4	10.2	10.5
1999	53	7.9	8	8.6	9	9.6	10.2	10.4
2000	76	8.1	8.2	8.8	9.3	9.8	10.5	14.6
2001	93	8.1	8.3	8.9	9.5	9.9	10.6	12.2
2002	112	8.2	8.5	9	9.5	10	10.8	11.3
2003	143	7.8	8.5	9	9.6	10	10.7	11.5
2004	174	7.8	8.6	9.2	9.7	10.3	10.9	11.2
2005	212	8.4	8.8	9.5	10	10.5	11.2	12.2
2006	270	8.1	8.9	9.5	10	10.5	11.3	12.9
2007	296	8.7	9	9.7	10.2	10.7	11.3	12.8

Figure 7.3.5(a) Variation in median haemoglobin level among patients on Erythropoietin, HD centres 2007

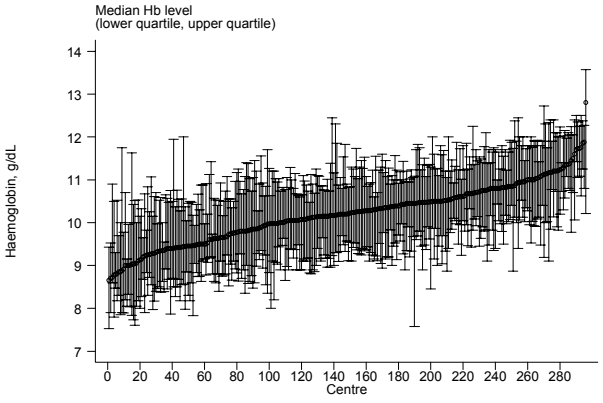
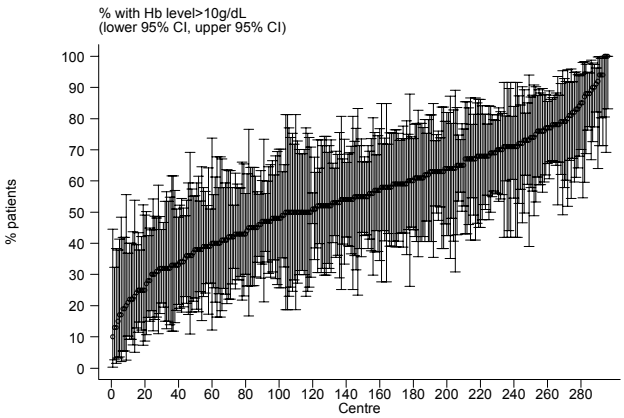


Figure 7.3.5(b) Variation in proportion of patients on erythropoietin with haemoglobin level > 10 g/dL, HD centres 2007



(b) Proportion of patients on erythropoietin with haemoglobin level > 10 g/dl, HD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	34	0	0	14	27.5	38	57	71
1999	53	0	4	15	28	38	58	61
2000	76	0	5	20	31.5	43.5	64	97
2001	93	5	10	22	33	47	68	100
2002	112	8	15	28	36	50.5	68	86
2003	143	0	14	27	36	50	69	100
2004	174	10	17	31	41	57	73	83
2005	212	0	20	34.5	49.5	63	82	100
2006	270	0	19	36	48	63	81	93
2007	296	10	24	43	55	68	87	100

(c) Proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, HD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	34	0	0	0	7	17	27	38
1999	53	0	0	3	8	14	29	39
2000	76	0	0	6.5	12.5	20	31	92
2001	93	0	0	8	13	24	38	60
2002	112	0	5	12	18	27	47	71
2003	143	0	0	7	15	27	42	59
2004	174	0	4	11	19	29	48	58
2005	212	0	4	13	25	36	55	75
2006	270	0	5	16	24.5	37	57	80
2007	296	0	6	19	27.5	40	62	85

Figure 7.3.5(c): Variation in proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, HD centres 2007

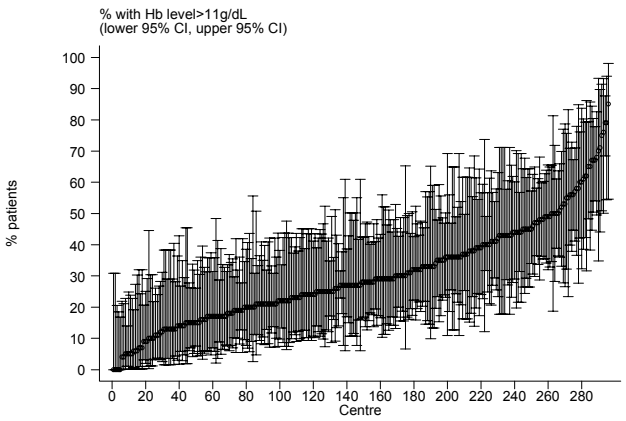


Figure 7.3.6(a): Variation in median haemoglobin level among patients on Erythropoietin, CAPD centres 2007

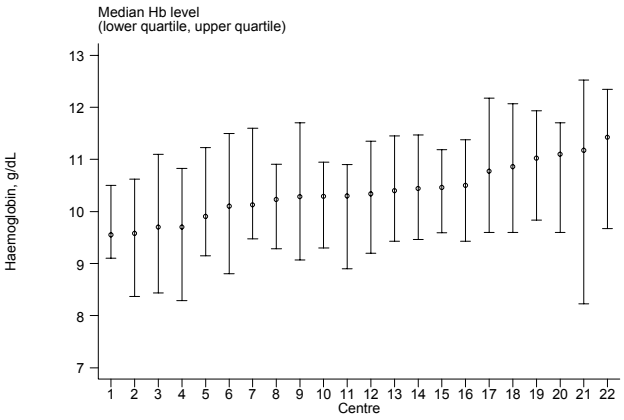


Table 7.3.6: Variation in Haemoglobin outcomes among CAPD centres 2007
(a) Median haemoglobin level among patients on erythropoietin

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	10.1	10.1
2001	11	8.9	8.9	9.2	9.4	9.6	9.7	9.7
2002	12	8.6	8.6	9.1	9.3	9.5	9.9	9.9
2003	16	8.4	8.4	9.2	9.5	10	11.2	11.2
2004	17	8.4	8.4	9.2	9.7	10.1	11.2	11.2
2005	18	8.9	8.9	9.5	9.9	10.4	11	11
2006	22	8.8	8.9	9.6	9.9	10.3	10.6	11
2007	22	9.5	9.6	10.1	10.3	10.8	11.2	11.4

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

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	50	50
2001	11	24	24	31	38	42	47	47
2002	12	11	11	25	32	37.5	48	48
2003	16	0	0	27	36.5	50	75	75
2004	17	10	10	38	43	52	72	72
2005	18	21	21	34	46.5	57	76	76
2006	22	17	18	44	48.5	58	70	79
2007	22	36	38	52	60	64	72	73

Figure 7.3.6(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10 g/dL, CAPD centres , 2007

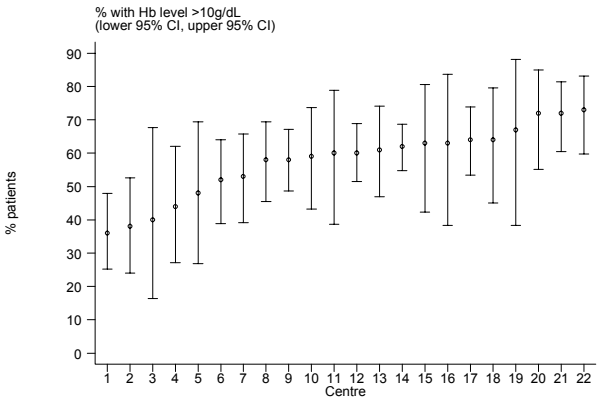
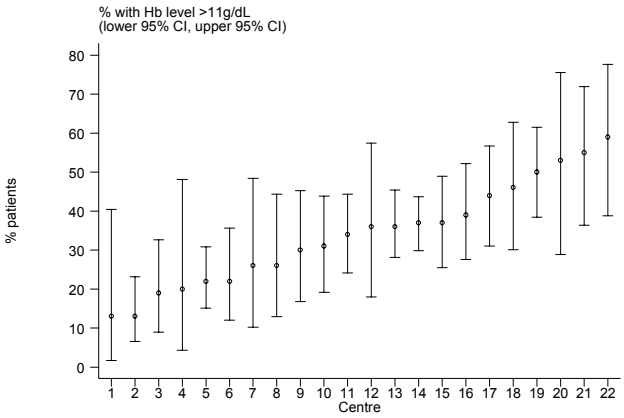


Figure 7.3.6(c): Variation in proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, CAPD centres 2007



(c) Proportion of patients on erythropoietin with haemoglobin level > 11 g/dL, CAPD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	6	8	8	8	11	13	16	16
1999	7	0	0	8	9	13	16	16
2000	9	10	10	16	18	21	24	24
2001	11	8	8	10	16	20	23	23
2002	12	7	7	13	17.5	22	27	27
2003	16	0	0	11	16	22.5	52	52
2004	17	0	0	13	20	29	54	54
2005	18	7	7	20	29.5	34	51	51
2006	22	5	7	16	26	32	39	49
2007	22	13	13	22	35	44	55	59

CHAPTER 8

Nutritional Status on Dialysis

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SECTION 8.1: SERUM ALBUMIN LEVELS ON DIALYSIS

Patient numbers increased by 1372 for HD in 2007. Mean serum albumin levels in 2007 was 39.7 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 remained unchanged since 2003. The percent well-nourished patients (>40g/L) remained above 50% whilst 35% of patients were in the 35-40g/L range. Improving trends were also indicated from the cumulative distribution graph of albumin in HD patients (Figure 8.1.1)

Table 8.1.1: Distribution of serum albumin, HD patients, 1998- 2007

year	no of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30 - ≤35g/L	% patients 35-<40g/L	% patients ≥40g/L
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	6523	39.9	5.4	40	37.3	42.5	3	9	35	52
2004	7580	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	10928	39.8	5.4	40.3	37.3	42.8	3	10	33	54
2007	12300	39.7	5.3	40	37	42.5	3	10	35	52

Figure 8.1.1: Cumulative distribution of Albumin, HD patients 1998-2007

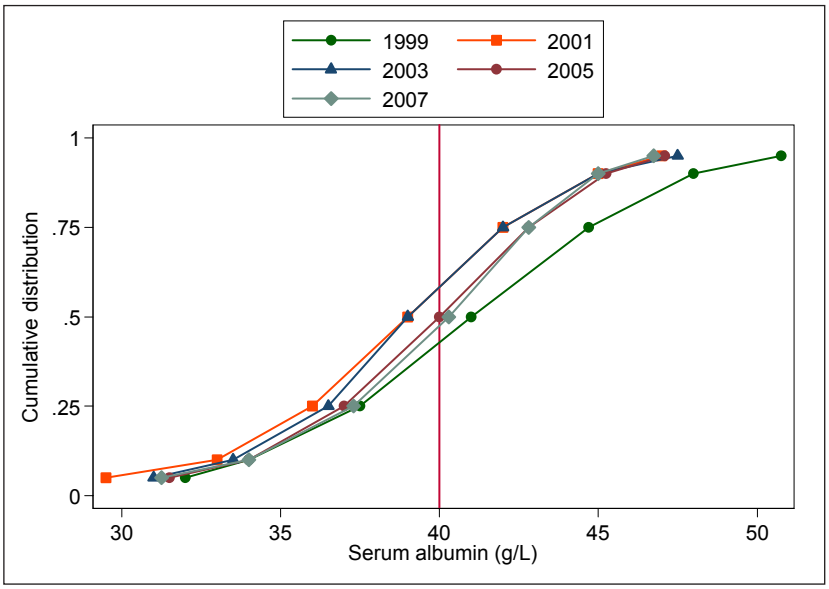
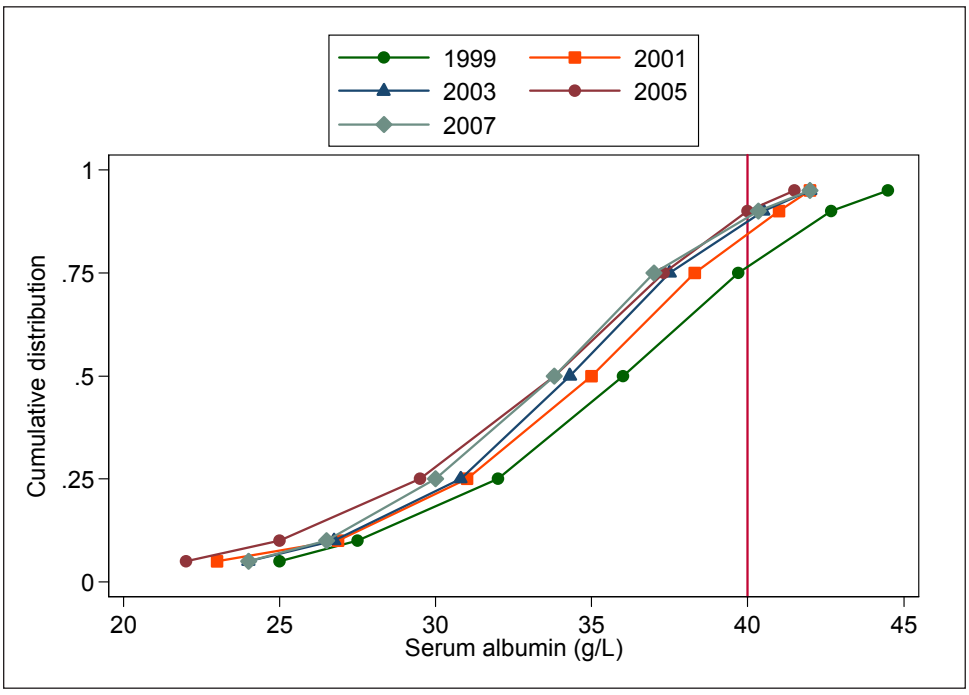


Table 8.1.2: Distribution of serum albumin, CAPD patients, 1998- 2007

year	No of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30 -≤35g/L	% patients 35-<40g/L	% patients ≥40g/L
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	1498	33.5	6.1	33.8	30	37	25	33	30	12
2007	1753	33.6	6.2	34	30	37.8	25	31	30	14

The downward trend in mean serum albumin levels for patients on CAPD decreased from 35.8 g/L in 1998 to 33.6g/L in 2007. Percentage of patients at increased mortality risk (<35 g/L) increased from 41% in 1998 to 56% by 2007. This was despite a 2% improvement in the number of patients with serum albumin >40g/L in 2007 compared to 2006. The cumulative distribution graph in 2007, reflects the trend that CAPD patients with serum albumin <35 g/L is increasing (Figure 8.1.2)

Figure 8.1.2: Cumulative distribution of Albumin, CAPD patients 1998-2007

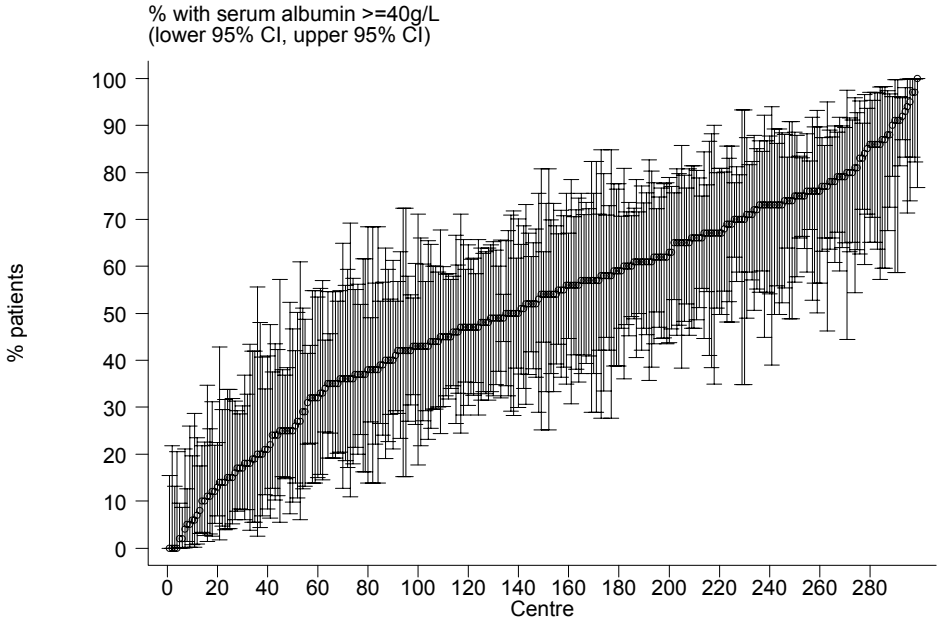


A wide variation between HD centers was observed for those achieving serum albumin ≥40g/L (target albumin) for 2007 as shown in figure 8.1.3. The median was 54% for the year 2007. The trend in the percent of HD centres achieving a median >50% since 2003 is therefore continuing. The best centre had all (100%) patients achieving serum albumin ³ 40g/L (target albumin), whilst the worst center had zero patients achieving this target. For all HD centres, a greater than 8-fold variation in meeting albumin target was observed. (Table 8.1.3).

Table 8.1.3: Variation in Proportion of patients with serum albumin ≥ 40g/L among HD centres 2007

year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	49	7	16	31	54	78	95	96
1999	69	2	8	22	50	65	89	100
2000	94	0	6	25	43	62	83	93
2001	116	0	3	17	39.5	56.5	82	100
2002	141	0	9	26	44	62	83	100
2003	170	0	18	40	55	70	92	100
2004	198	0	10	35	57.5	73	90	100
2005	228	4	13	42	56	70	87	100
2006	279	0	9	36	53	70	87	100
2007	299	0	10	37	54	69	87	100

Figure 8.1.3: Variation in Proportion of patients with serum albumin ≥ 40g/L, HD centres 2007



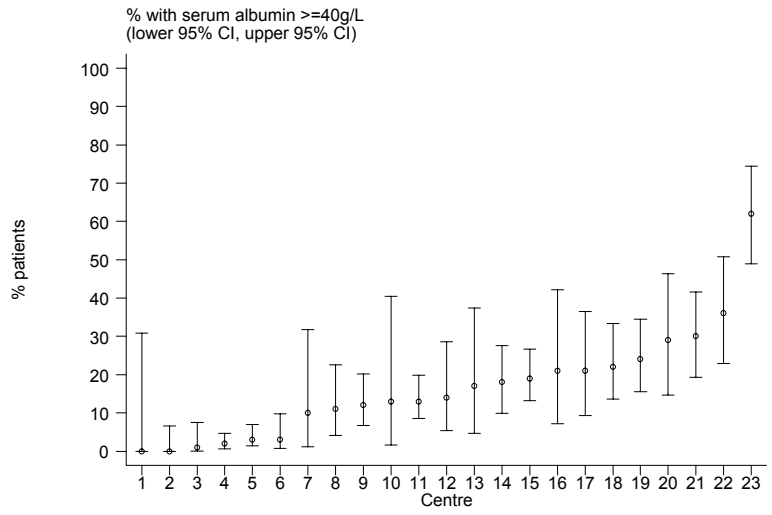
For 23 CAPD centers in 2007, one center reported the maximum proportion of patients achieving the target serum albumin ≥ 40g/L was 62% whilst majority of centers reported less than 40% of patients achieving this target. The maximum proportion of patients achieving the target serum albumin level of ³ 40g/L has dropped by 10%compared to 2006.

Table 8.1.4: Variation in Proportion of patients with serum albumin ≥ 40g/L among CAPD centres 2007

year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	5	5	18	27	34	40	40
1999	10	2	2	8	14.5	18	29	29
2000	11	0	0	5	13	28	42	42
2001	12	1	1	4.5	16	27.5	36	36
2002	15	5	5	6	12	20	36	36
2003	19	1	1	9	14	19	58	58
2004	19	2	2	8	12	21	35	35
2005	20	0	0.5	6	11.5	23.5	28	29
2006	22	1	1	6	13	22	42	72
2007	23	0	0	3	14	22	36	62

There was wide variation amongst 23 CAPD centers reporting the proportion of patients achieving the target serum albumin ≥ 40g/L for the year 2007 as shown in figure 8.1.4.

Figure 8.1.4: Variation in Proportion of patients with serum albumin ≥40g/L, CAPD centres 2007



SECTION 8.2: BODY MASS INDEX (BMI) ON DIALYSIS

Table 8.2.1 indicates the mean BMI for HD patients from 1998 to 2007. For the year 2007 the mean BMI was 23.5 ± 8.5 for a HD population of 10438. This indicates that overall mean BMI trend is stabilizing at 23 [22.9 in 2000 to 23.5 in 2007] despite a 3-fold increase in patient numbers from 2000 onwards. An increasing trend of improved BMI is observed for HD patients, with the percentage of HD patients with BMI ³ 25 increasing from 21% in 1998 to 30% in 2007. This may perhaps reflect an increased number of overweight diabetic patients coming into dialysis, the longer period on dialysis or perhaps an improved dietary intake amongst patients. The percent number of patients with BMI <18.5 remained at 14%.

Table 8.2.1: Distribution of BMI, HD patients, 1998- 2007

year	n	Mean	SD	Median	LQ	UQ	% patients <18.5g/L	% patients 18.5-25g/L	% patients ≥25
1998	1980	24.1	18.3	21.6	19.1	24.3	19	60	21
1999	2710	23.5	15.9	21.4	19.2	24.4	18	61	21
2000	3858	22.9	11.7	21.6	19.3	24.5	18	60	22
2001	4549	23	11	21.9	19.3	24.7	18	59	23
2002	5100	23.2	10.6	22	19.5	24.9	16	59	24
2003	5984	23.1	9.7	22.1	19.5	25.1	16	58	26
2004	6767	23.3	9	22.4	19.8	25.4	14	58	28
2005	7830	23.4	9	22.5	19.8	25.6	14	57	29
2006	9767	23.3	7.9	22.6	19.9	25.7	14	56	29
2007	10438	23.5	8.5	22.7	19.9	25.8	14	56	30

Figure 8.2.1 reflects the increasing BMI trends as curve for 2007 continues in moving right. About 70% of the HD population are at BMI of 25.

Figure 8.2.1: Cumulative distribution of BMI, HD patients 1998-2007

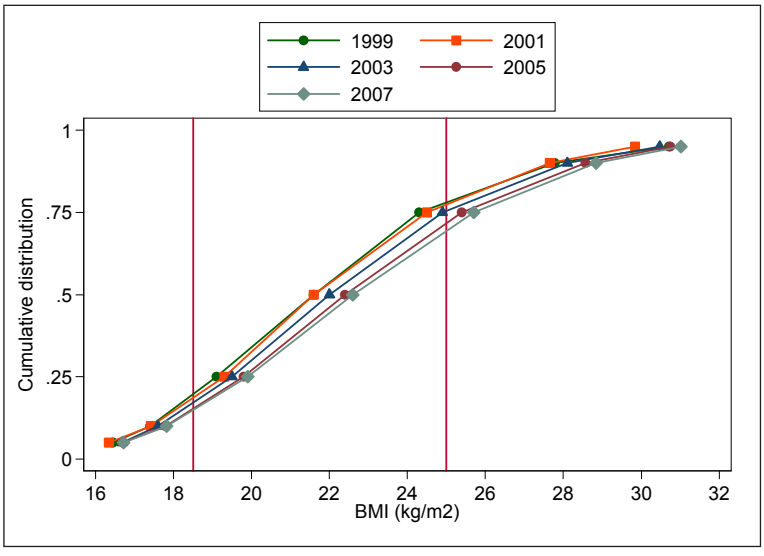
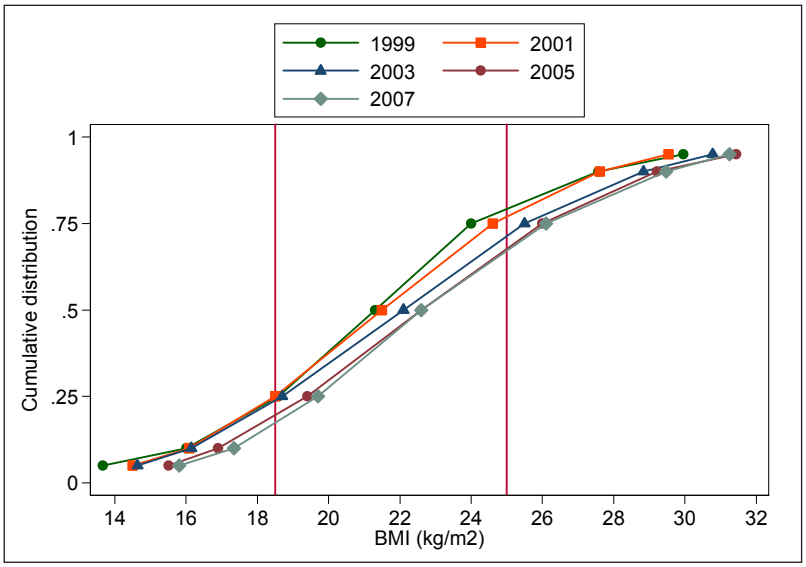


Table 8.2.2. indicates that mean BMI for CAPD patients from 1998 to 2007 is increasing from 22.0 to 23.5 despite a 3-fold increase in patient numbers. The percentage of CAPD patients with BMI ≥ 25 increased from 20% in 1998 to 35% in 2007. This may perhaps reflect an increased number of overweight diabetic patients coming into dialysis.

Table 8.2.2: Distribution of BMI, CAPD patients 1998-2007

year	n	Mean	SD	Median	LQ	UQ	% patients <18.5g/L	% patients 18.5-25g/L	% patients ≥25
1998	491	22	11.1	21.3	18.6	24	23	57	20
1999	552	21.7	4.5	21.5	18.8	24.4	23	56	22
2000	603	21.6	4.5	21.5	18.5	24.6	25	53	22
2001	665	22	5.1	21.7	18.7	25.2	24	50	26
2002	752	22.2	5	22.1	18.7	25.5	24	47	30
2003	1071	22.9	6.8	22.5	19.2	25.8	20	50	30
2004	1175	23.1	7.2	22.6	19.4	26	18	51	31
2005	1223	23	7.2	22.5	19.4	25.8	20	50	30
2006	1419	23.3	8.2	22.6	19.7	26.1	16	51	33
2007	1613	23.5	5.8	22.9	20	26.4	14	51	35

Figure 8.2.2: Cumulative distribution of BMI, CAPD patients 1998-2007



Less variation was observed for BMI measurements amongst 282 HD centers for 2007. The median of participating centres was 87%. The best centre had all (100%) patients achieving BMI ≥ 18.5 (target), while the worst center had 56% of patients achieving this target. For all HD centres, there was 1.4-fold variation in meeting target BMI (≥ 18.5).(Table 8.2.3).

Table 8.2.3: Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2007

year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	47	59	68	76	81	86	93	100
1999	70	57	62	78	82	90	94	100
2000	95	55	65	75	82	89	100	100
2001	111	60	68	77	83	89	94	100
2002	133	55	67	78	85	90	100	100
2003	156	60	70	79	84	91	100	100
2004	187	62	68	81	86	91	100	100
2005	206	64	70	81	88	93	100	100
2006	263	53	71	80	87	92	100	100
2007	282	56	70	82	87	92	100	100

Figure 8.2.3 indicates the variation amongst 282 HD centers reporting the proportion of patients achieving the target BMI ≥ 18.5 for the year 2007. The centre with the least achievement of this target recorded a percentage of 56%.

Figure 8.2.3: Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2007

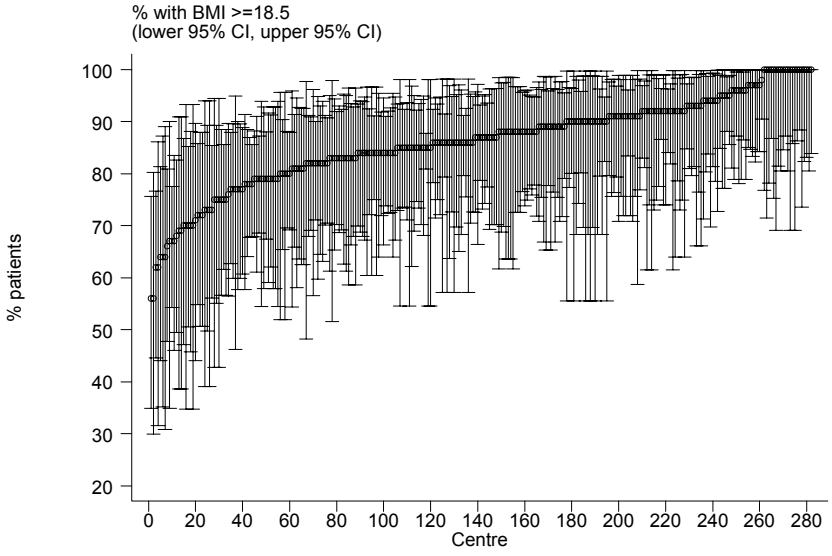


Table 8.2.4: Variation in Proportion of patients with BMI ≥ 18.5 among CAPD centres 2007

year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	0	0	71	80	87	91	91
1999	9	0	0	71	75	83	92	92
2000	11	11	11	63	76	87	90	90
2001	11	15	15	72	77	88	92	92
2002	15	17	17	63	80	84	87	87
2003	19	17	17	63	81	87	96	96
2004	19	27	27	71	82	89	94	94
2005	18	32	32	69	84	87	91	91
2006	22	19	29	78	84.5	91	92	93
2007	22	18	32	76	87.5	92	97	100

For the 22 CAPD centers in 2007, the maximum proportion of patients achieving the target BMI ≥ 18.5 was 100% whilst the worst centres reported 18% of the patients achieving this target. This represented a 5.5-fold difference in variation

Figure 8.2.4 indicates that only one center reported the lowest proportion of patients achieving the target BMI ≥ 18.5 whilst 18 centers reported higher proportions (>75%).

Figure 8.2.4: : Variation in Proportion of patients with BMI ≥ 18.5 among CAPD centres 2007

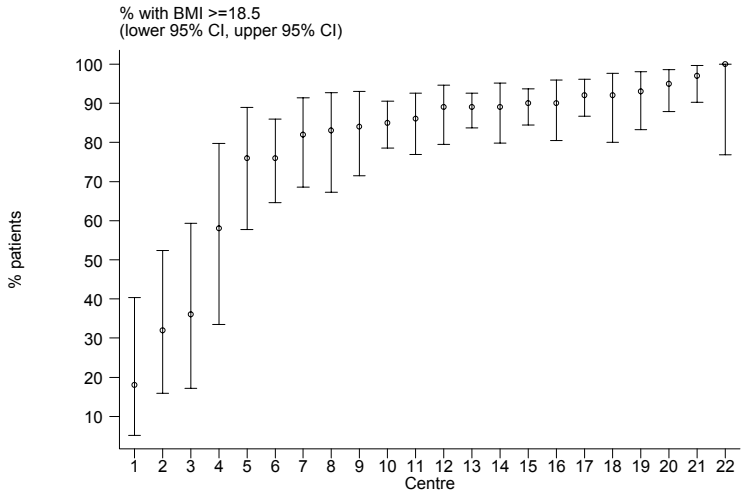


Table 8.2.5: Variation in Proportion of patients with BMI ≤ 18.5 and serum albumin ≤ 30 g/dL among HD centres 2007

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	47	0	0	0	0	1	6	8
1999	63	0	0	0	0	2	5	10
2000	85	0	0	0	0	1	9	28
2001	104	0	0	0	0	0	6	9
2002	123	0	0	0	0	0	5	13
2003	151	0	0	0	0	0	5	10
2004	180	0	0	0	0	0	4	9
2005	199	0	0	0	0	0	5	14
2006	251	0	0	0	0	0	8	36
2007	275	0	0	0	0	0	4	11

Table 8.2.5 & Figure 8.2.5 shows that 15 out of 274 HD centers (5.5%) reported patients with BMI of < 18.5 and serum albumin of <30 g/L with 4 of these centres (1.5%) at the 95th percentile. This shows a marked improvement compared to 2006 which reported 14% of the centers having a high proportion of severely malnourished patients.

Figure 8.2.5: Variation in Proportion of patients with BMI ≤ 18.5 and serum albumin ≤ 30 g/dL among HD centres 2007

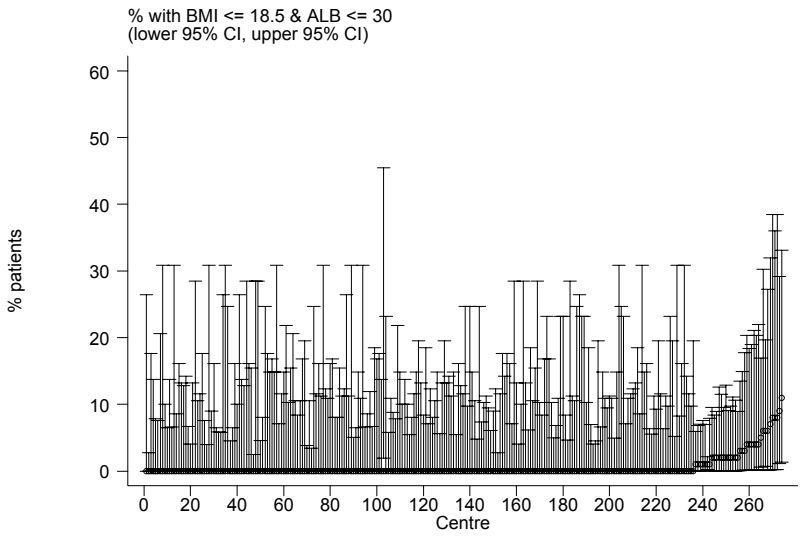
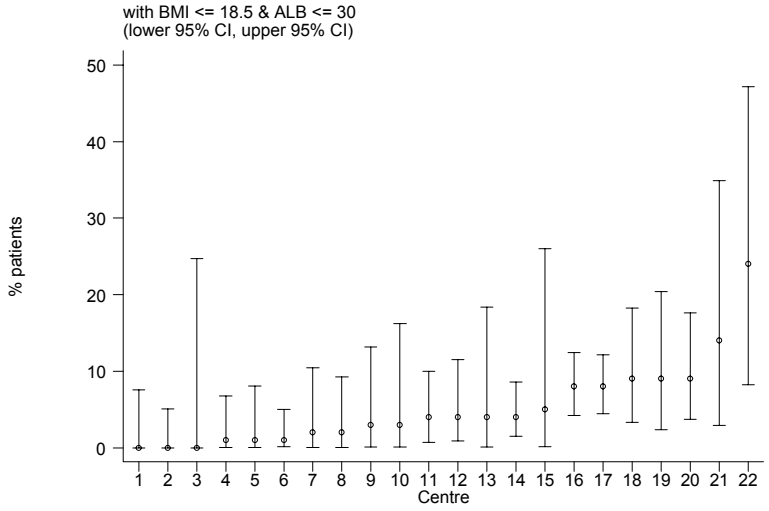


Table 8.2.6: Variation in Proportion of patients with BMI ≤ 18.5 and serum albumin ≤ 30 g/dL among CAPD centres 2007

year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	0	0	0	0	3	5	5
1999	9	0	0	0	3	6	29	29
2000	11	0	0	2	5	8	12	12
2001	11	2	2	4	5	9	15	15
2002	15	0	0	0	3	7	20	20
2003	19	0	0	0	4	9	18	18
2004	19	0	0	0	3	6	10	10
2005	18	0	0	3	5	7	12	12
2006	22	0	0	2	4	6	12	27
2007	22	0	0	1	4	8	14	24

Table 8.2.6 & Figure 8.2.6 shows that 24% of patients in the 22 CAPD centers had low BMI of <18.5 and low serum albumin of <30 g/L with 14% of patients at the 95th percentile. This shows a slight improvement compared to 2006 where 27% of patients in 22 centers were reported to have a high proportion of severely malnourished patients.

Figure 8.2.6: Variation in Proportion of patients with BMI ≦ 18.5 and serum albumin ≦ 30 g/dL among CAPD centres 2007



CHAPTER 9

Blood Pressure Control and Dyslipidaemia in Dialysis Patients

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Lee Wan Tin

SECTION 9.1: BLOOD PRESSURE CONTROL ON DIALYSIS

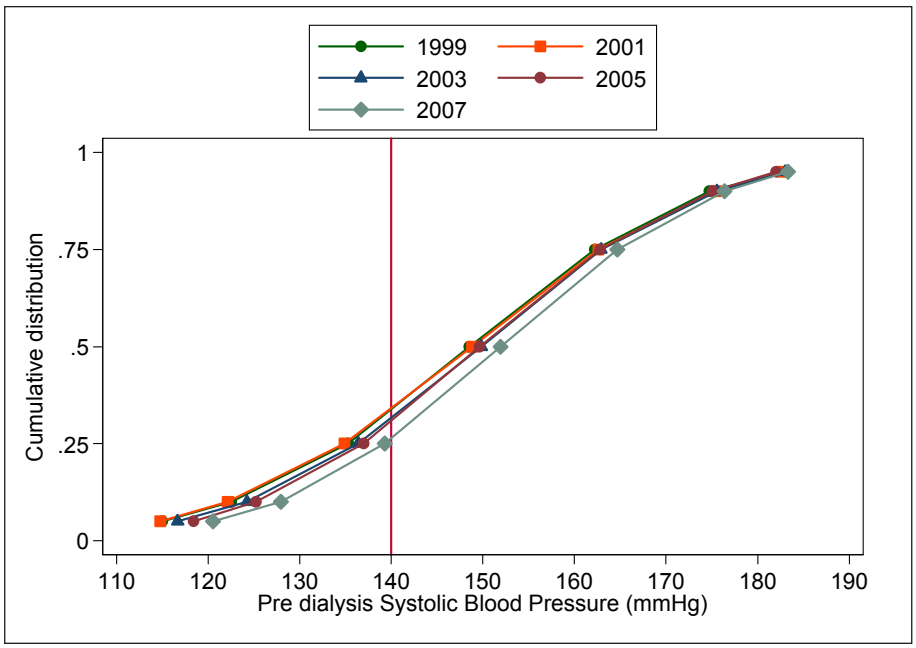
As in previous years, the predialysis systolic blood pressure in 2007 remains poorly controlled with only 26% of the patients achieving a systolic BP of < 140 mmHg. In contrast, the proportion of patients achieving predialysis systolic blood pressure of < 140 mmHg was higher at 37% a decade ago in 1998 (Table 9.1.1). The mean and median predialysis systolic blood pressure in 2007 was 152.1 and 151.9 mmHg respectively.

The increase in the proportion of erderly patients entering the dialysis program in the past few years may be related to this documented poorer control of predialysis systolic blood pressure in 2007.

Table 9.1.1: Distribution of Pre dialysis Systolic Blood Pressure, HD patients 1998-2007

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
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	6833	149.7	20.2	149.8	136.4	162.9	7	24	39	23	7
2004	7936	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	11526	151.4	19.3	151.1	138.8	164	5	22	41	25	7
2007	12812	152.1	19.1	151.9	139.3	164.7	5	21	40	27	7

Figure 9.1.1: Cumulative distribution of Pre dialysis Systolic Blood Pressure, HD patients 1998-2007

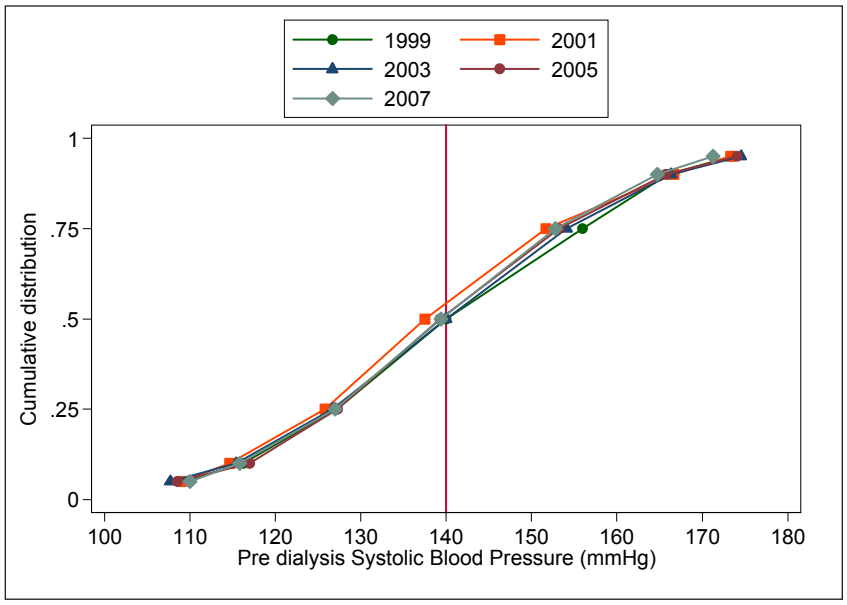


In contrast, predialysis systolic blood pressure was better controlled in CAPD patients in 2007, with 52% of CAPD patients having a predialysis systolic BP < 140 mmHg (Table 9.1.2). this result is similar to 2007 which has 54% of CAPD patients having a predialysis systolic BP < 140 mmHg.

Table 9.1.2: Distribution of Pre dialysis Systolic Blood Pressure, CAPD patients 1998-2007

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
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	1523	139.3	19.3	138.4	126.7	151.6	14	40	32	11	2
2007	1753	139.9	19.2	139.4	127	152.8	15	37	33	13	2

Figure 9.1.2: Distribution of Pre dialysis Systolic Blood Pressure , CAPD patients 1998-2007

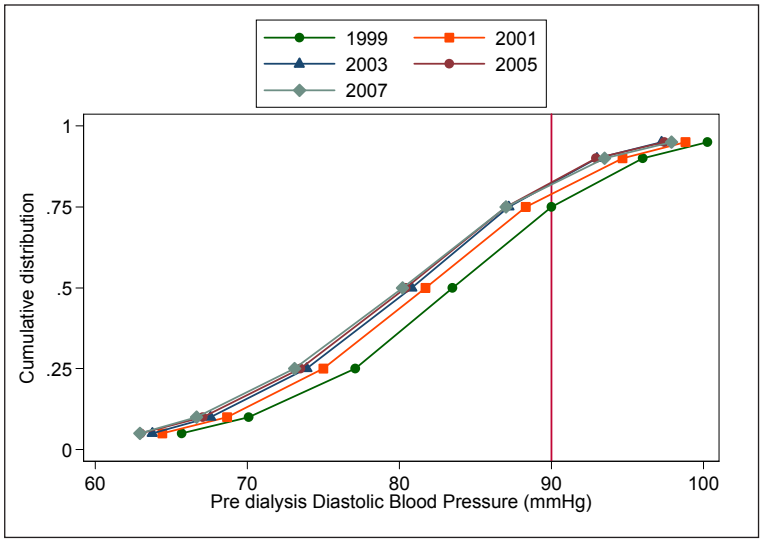


In contrast to predialysis systolic blood pressure, the predialysis diastolic blood pressure was better controlled in haemodialysis patients in 2007, with 82% of haemodialysis patients having predialysis diastolic BP < 90mmHg (Table 9.1.3). This has been the trend over the last few years.

Table 9.1.3: Distribution of Pre dialysis Diastolic Blood Pressure, HD patients 1998-2007

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
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	6831	80.6	10.2	80.8	73.9	87.2	14	32	37	14	3
2004	7934	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	11525	80.4	11.1	80.4	73.3	87.1	16	32	35	14	3
2007	12812	80.4	11.1	80.2	73.1	87	16	32	34	14	4

Figure 9.1.3: Cumulative distribution of Pre dialysis Diastolic Blood Pressure, HD patients 1998-2007

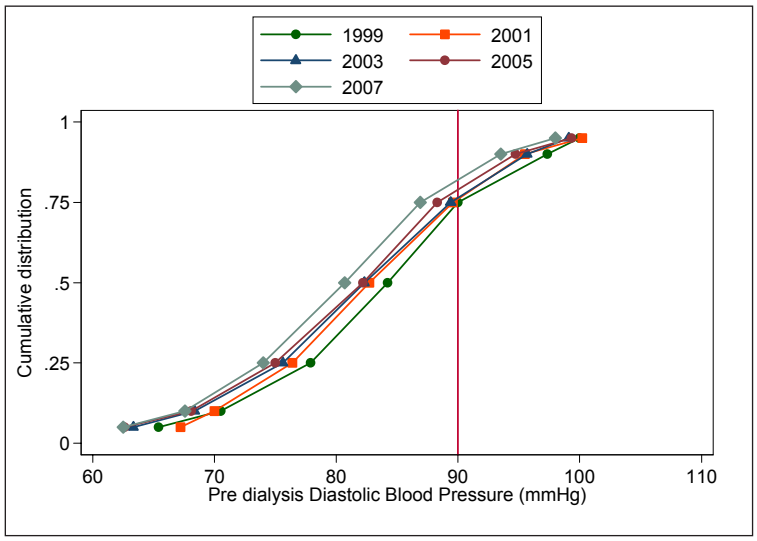


Similarly, predialysis diastolic blood pressure was also well controlled in CAPD patients in 2007 with 84% of CAPD patients have predialysis diastolic BP < 90 mmHg (Table 9.1.4). The mean and median of predialysis diastolic blood pressure in CAPD patients in 2007 were 80.6 mmHg and 80.7 mmHg respectively. These results compared favorably to data obtained 10 years ago when the mean and median predialysis diastolic blood pressure in CAPD patients were 84.3 mmHg and 85 mmHg respectively (in 1998).

Table 9.1.4: Distribution of Pre dialysis Diastolic Blood Pressure, CAPD patients 1998-2007

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
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	1522	81.3	10.6	81.5	74.8	88	13	28	40	15	3
2007	1752	80.6	10.7	80.7	74	86.9	14	32	38	12	3

Figure 9.1.4: Cumulative distribution of Pre dialysis Diastolic Blood Pressure, CAPD patients 1998-2007

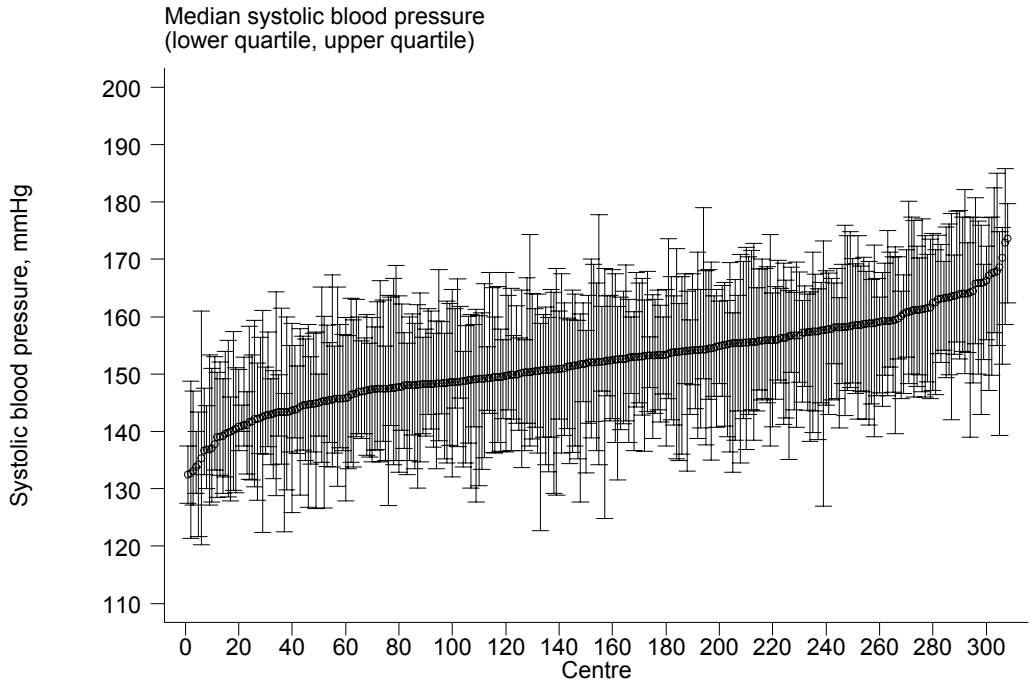


The mild variation in median systolic blood pressure among haemodialysis centres in 2007 was similar to previous years (Table 9.1.5 (a)).

Table 9.1.5: Variation in BP control among HD centers 2007
(a) Median Systolic blood pressure among HD patients, HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	48	131.8	135	141.5	146.3	150.9	158.2	159.9
1999	74	134.2	135.8	144	148.5	154.5	163.4	167.3
2000	107	130.6	136.6	142.5	148	155.1	163.2	181
2001	124	127.5	135.4	143.3	149.3	155	161.9	180.5
2002	152	126.7	137.1	144.2	149.2	154.6	162.5	174.3
2003	176	126.7	135.8	144.9	150.6	155.2	161.8	173.7
2004	207	120	137.7	145.2	150	155	162.4	168.1
2005	236	119.6	136.7	144.1	150.1	155.4	161.3	171.8
2006	290	125.3	137.5	146.4	150.8	156.6	163.6	179
2007	308	132.5	139.8	147.5	152	157.2	164.1	173.7

Figure 9.1.5(a): Variation in median systolic blood pressure among HD patients, HD centers 2007

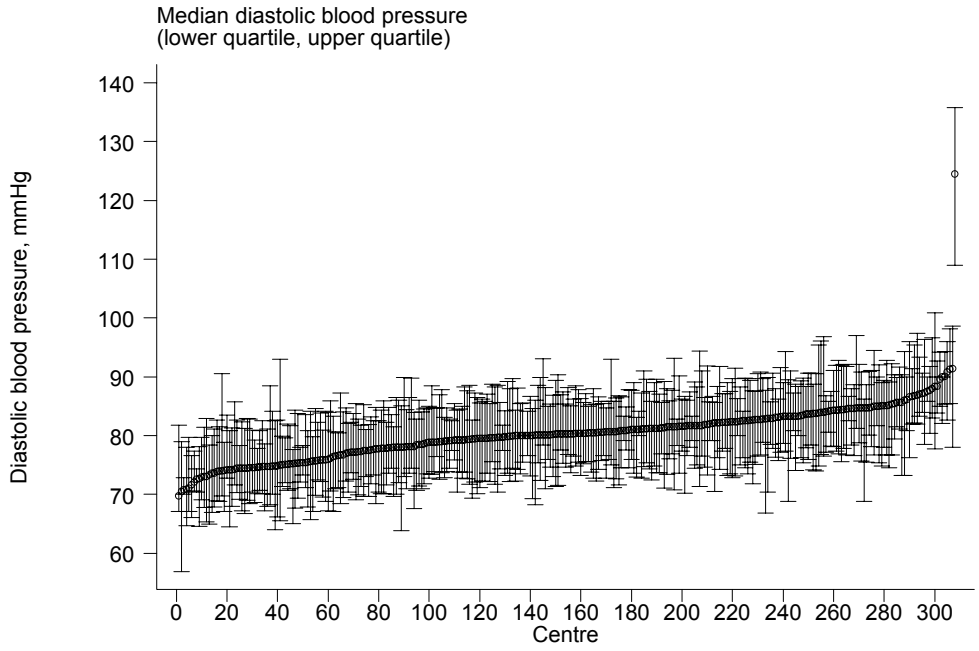


The mild variation in median diastolic blood pressure among haemodialysis centers was also similar to previous years (Table 9.1.5 (b)).

Table 9.1.5(b): Median Diastolic blood pressure among HD patients, HD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	48	77.1	78.6	81.9	83.8	85.9	88.5	90
1999	74	70.9	77.3	81.7	83.6	85.9	89.2	91.8
2000	107	75.2	76.8	80	82.3	85	90	96
2001	124	73.9	75.9	79.8	82	84	87.5	91.3
2002	152	72.3	75.8	79.5	81.3	83.6	87.5	102
2003	176	73.3	75	78.4	80.9	83.6	87	97.5
2004	207	70.4	74	78.2	80.8	82.7	86.5	89.2
2005	236	69.7	73.1	77.9	80.5	82.8	87.1	90.6
2006	290	67.3	74.4	78	80.6	83	87.3	113.5
2007	308	69.8	73.9	77.6	80.3	82.8	86.8	124.5

Figure 9.1.5(b): Variation in median diastolic blood pressure among HD patients, HD centers 2007

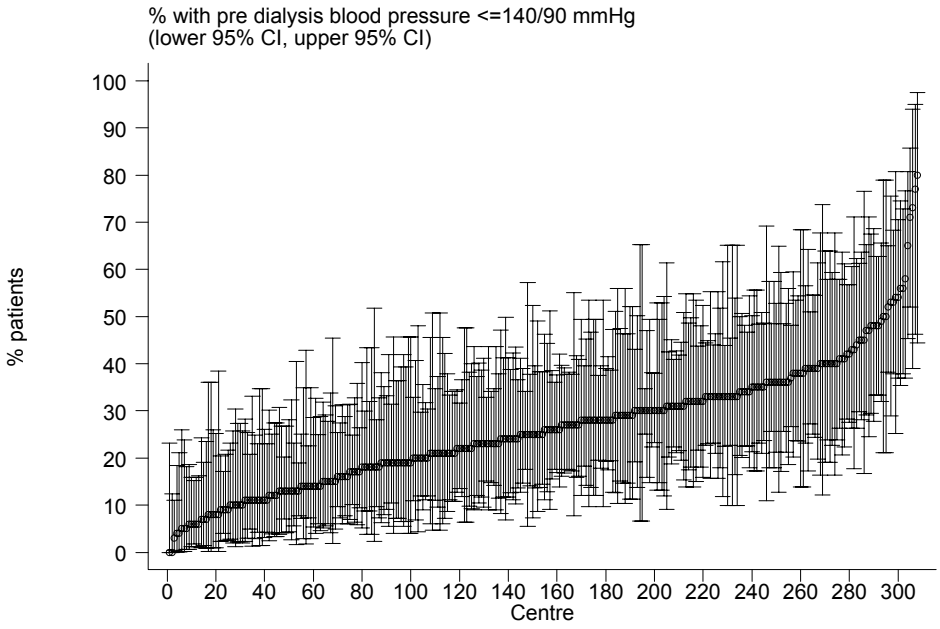


Reflecting the relatively poorer control of predialysis systolic blood pressure in haemodialysis patients, the median of haemodialysis patients predialysis BP < 140/90 mmHg was only 25.5% in 2007 (Table 9.1.5 (c)). This median is lower than the median in 1998 (35%) indicating poorer overall blood pressure control in haemodialysis centres in recent years.

Table 9.1.5(c): Proportion of HD patients with Pre dialysis Blood Pressure < 140/90 mmHg, HD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	48	9	20	27	35	41.5	54	72
1999	74	4	11	23	32	41	56	67
2000	107	0	12	22	32	43	63	83
2001	124	0	11	20.5	30	43	61	69
2002	152	0	10	21	29	39.5	56	71
2003	176	4	8	20	28	39.5	60	80
2004	207	0	10	21	29	38	56	90
2005	236	4	10	21	27	39	57	89
2006	290	0	8	17	25	35	54	70
2007	308	0	7	17	25.5	33	49	80

Figure 9.1.5(c): Variation in proportion of HD patients with pre dialysis blood pressure < 140/90 mmHg, HD centers 2007

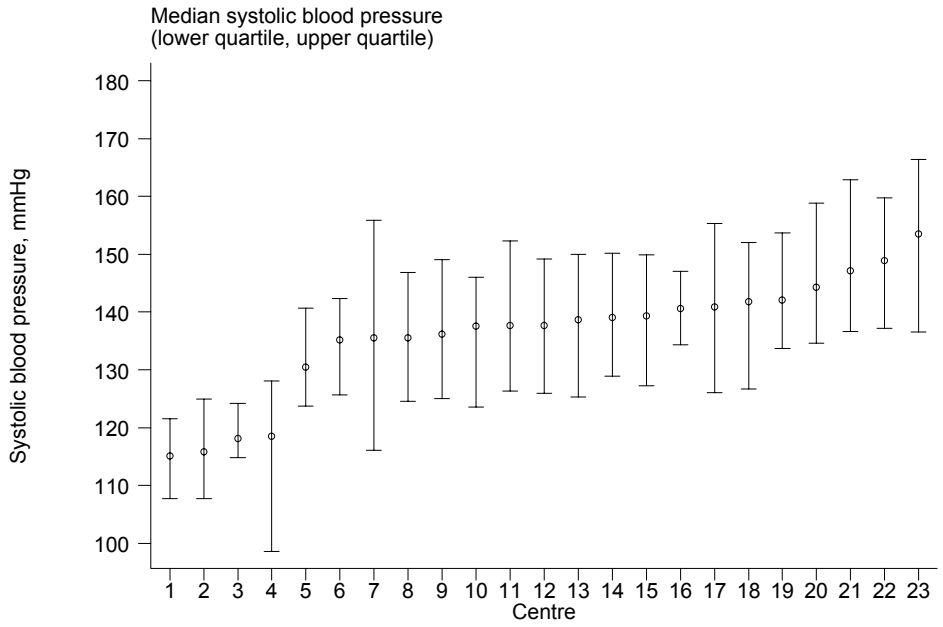


Similar to haemodialysis centers, the variation in median predialysis systolic blood pressure in 2007 was mild and similar to previous years in CAPD centers (Table 9.1.6 (a)).

Table 9.1.6: Variation in BP control among CAPD centers 2007
(a) Median Systolic blood pressure among CAPD patients

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	110.3	110.3	135	138.6	140.8	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	131.3	134.9	137.7	149.1	149.1
2001	11	119.3	119.3	130.7	137.5	138.8	149	149
2002	15	124.1	124.1	134.5	140	144.5	148.2	148.2
2003	19	124.5	124.5	131.9	142	144.3	151.8	151.8
2004	19	117.3	117.3	131.7	139	144.3	149.7	149.7
2005	20	116.9	119.7	134	136.7	140	152.8	158
2006	22	113.3	118.3	131.3	136.4	140.4	146	154.9
2007	23	115.1	115.8	135.2	137.7	141.8	148.9	153.5

Figure 9.1.6(a): Variation in median systolic blood pressure among CAPD patients, CAPD centers 2007

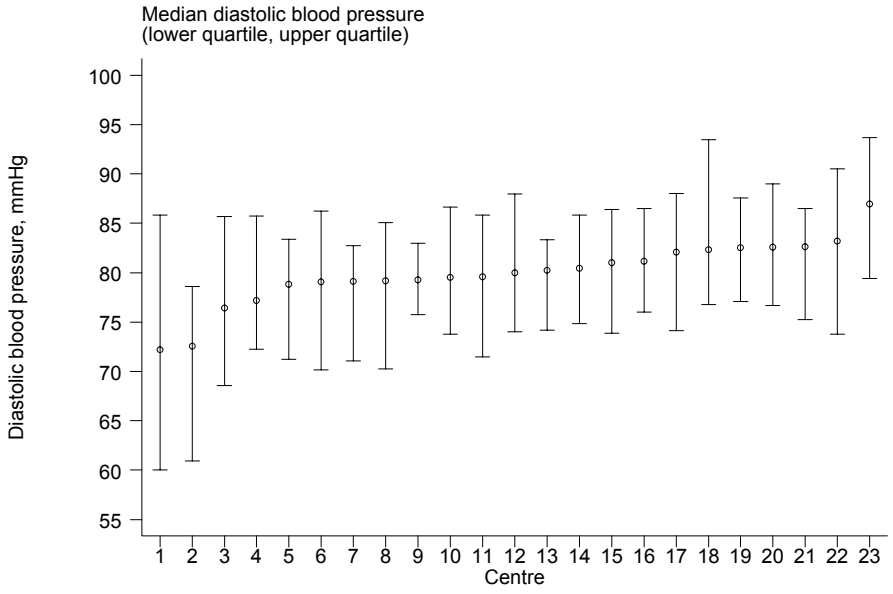


The variation in median predialysis diastolic blood pressure in CAPD centres was also mild and very similar to previous years (Table 9.1.6 (b)).

Table 9.1.6(b): Median Diastolic blood pressure among CAPD patients, CAPD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	75	75	85.2	85.8	86	87	87
1999	9	77.5	77.5	84.1	84.3	85	86.7	86.7
2000	11	73.3	73.3	80	83	84.4	88	88
2001	11	78.7	78.7	80.9	83.4	84.7	88	88
2002	15	78.4	78.4	81.7	83.3	85.7	89.5	89.5
2003	19	77.2	77.2	80.8	82.8	84.4	88	88
2004	19	76.6	76.6	80.5	83.2	84.2	87.5	87.5
2005	20	74.4	75.5	80.3	82.5	84	86.1	86.3
2006	22	71.6	73.2	80.7	81.6	82.5	86.5	88.4
2007	23	72.2	72.5	79.1	80	82.3	83.2	87

Figure 9.1.6(b): Variation in median diastolic blood pressure among CAPD patients, CAPD centers 2007

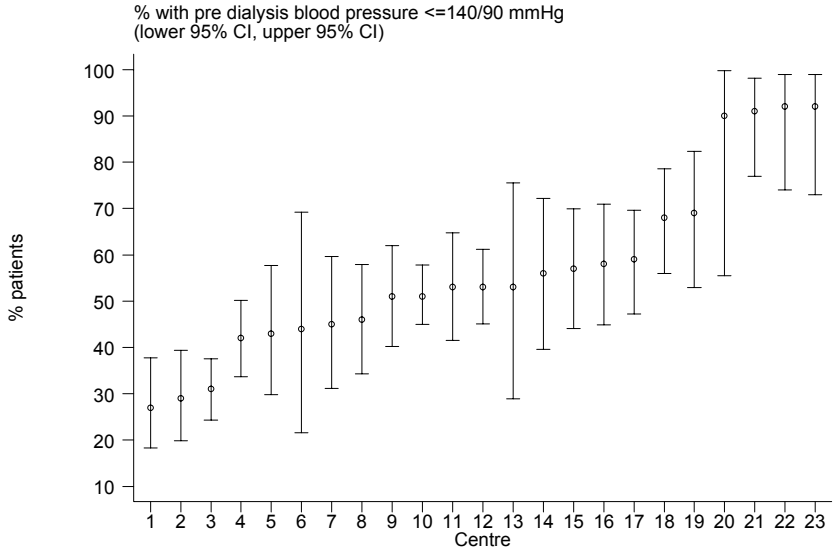


In contrast to haemodialysis centres, CAPD centres in 2007 has better overall blood pressure, with a median of 53% of CAPD centres having BP < 140/90 mmHg in their patients (Table 9.1.6 (c)). This better level of overall blood pressure control in CAPD patients has been stable over the past few years.

Table 9.1.6(c): Proportion of CAPD patients with Pre dialysis Blood Pressure <140/90 mmHg, CAPD centres

Year	No of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	9	36	36	44	47	49	100	100
1999	9	30	30	41	52	60	100	100
2000	11	24	24	53	58	63	91	91
2001	11	36	36	48	52	63	83	83
2002	15	19	19	33	47	56	90	90
2003	19	28	28	39	48	66	90	90
2004	19	29	29	38	49	60	80	80
2005	20	23	26	45.5	55	61	96.5	100
2006	22	18	36	43	58	68	100	100
2007	23	27	29	44	53	68	92	92

Figure 9.1.6(c): Variation in proportion of CAPD patients with pre dialysis blood pressure < 140/90 mmHg, CAPD centers 2006



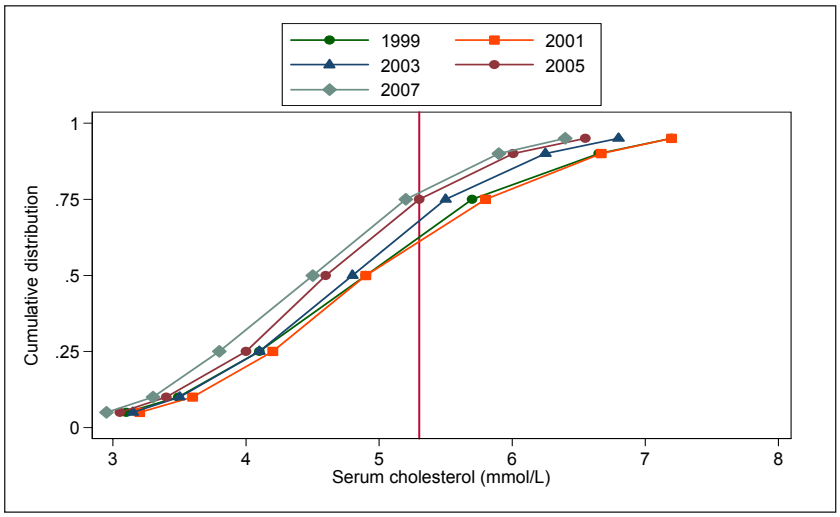
SECTION 9.2: DYSLIPIDEMIA IN DIALYSIS PATIENTS

The recent last few years trend of improving total cholesterol levels in haemodialysis patients continued in 2007, with 77% of haemodialysis patients achieving total cholesterol < 5.3 mmol/l (Table 9.2.1).

Table 9.2.1: Distribution of serum Cholesterol, HD patients 1998-2007

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
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	5805	4.8	1.1	4.8	4.1	5.5	9	59	21	11
2004	6709	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	10139	4.6	1.1	4.6	3.9	5.3	14	62	17	7
2007	11331	4.6	1.1	4.5	3.8	5.2	14	63	17	6

Figure 9.2.1: Cumulative distribution of Cholesterol, HD patients 1998-2007

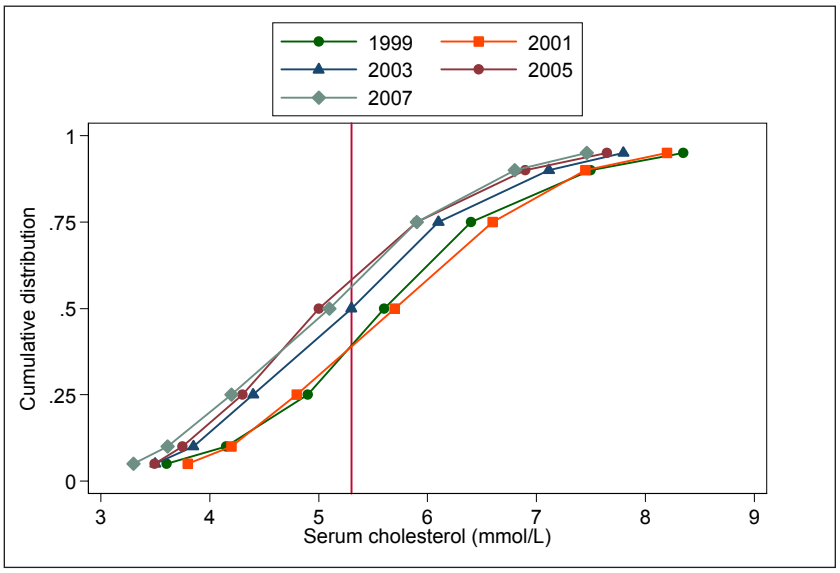


As in previous years, total cholesterol levels in CAPD patients was less optimally controlled in comparison with HD patients in 2007, with 58% of CAPD patients achieving total cholesterol < 5.3 mmol/l (Table 9.2.2).

Table 9.2.2: Distribution of serum Cholesterol, CAPD patients 1998-2007

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
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	1395	5.2	1.4	5.1	4.3	5.9	6	51	25	18
2007	1629	5.1	1.3	5.1	4.2	5.9	8	50	24	18

Figure 9.2.2: Cumulative distribution of Cholesterol (mmol/L), CAPD patients 1998-2007



In 2007, serum triglyceride control was better in HD patients than CAPD patients with 77% of HD patients achieving serum triglyceride levels < 2.3 mmol/l (Table 9.2.3) compared to 69% of CAPD patients achieving serum triglyceride level < 2.3 mmol/l (Table 9.2.4). this trend of better control of triglyceride levels in HD patients has been consistent over the past few years.

Table 9.2.3: Distribution of serum Triglyceride, HD patients 1998-2007

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
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	4709	2	1.3	1.7	1.2	2.5	48	23	18	11
2004	5606	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	9522	2	1.3	1.6	1.2	2.3	54	21	16	9
2007	10866	1.9	1.2	1.6	1.1	2.3	55	21	16	8

Figure 9.2.3: Cumulative distribution of serum triglyceride, HD patients 1998-2007

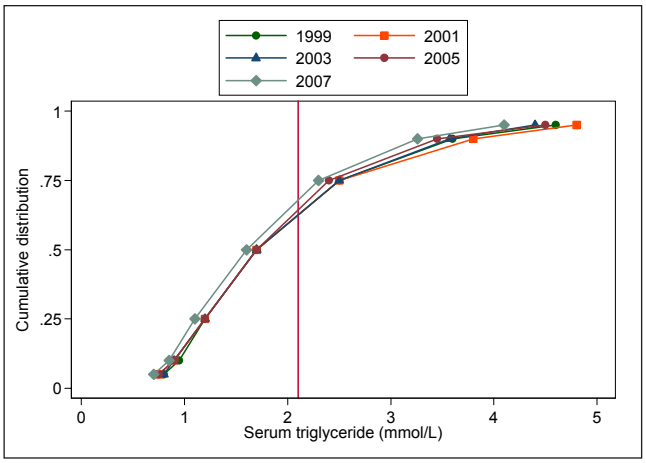


Figure 9.2.4: Cumulative distribution of serum triglyceride, CAPD patients 1998-2007

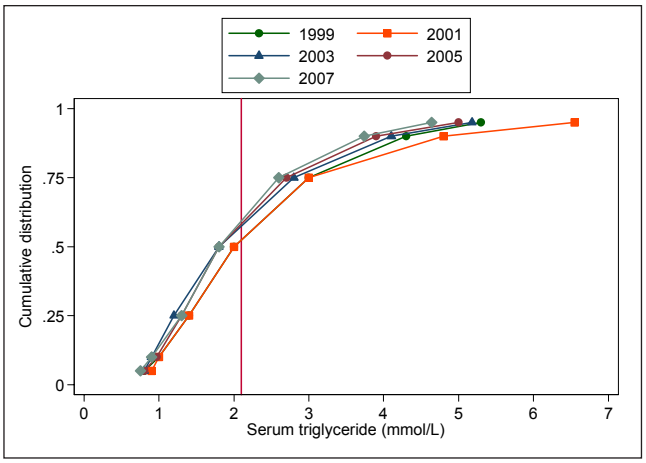


Table 9.2.4: Distribution of serum triglyceride, CAPD patients 1998-2007

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
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	1391	2.2	1.6	1.7	1.2	2.6	47	21	18	13
2007	1625	2.1	1.4	1.8	1.3	2.6	45	24	19	12

The median variation in median serum cholesterol levels and median serum triglyceride levels among HD centers were similar to previous years (Table 9.2.5 (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 63% in 1998 to 77% in 2006 (Table 9.2.5 (b)). In addition, the median of the proportion of patients with serum triglyceride level < 2.1 mmol/l in HD centers has also gradually increased from 65% in 1998 to 71% in 2007 (Table 9.2.5 (d)).

Table 9.2.5: Variation in dyslipidaemia among HD centers 2007
(a) Median serum cholesterol level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	31	4.2	4.4	4.7	5	5.3	5.5	5.5
1999	47	3.5	4.2	4.6	4.8	5.1	5.6	5.7
2000	76	4.1	4.3	4.7	4.9	5.2	5.6	5.9
2001	95	4.1	4.4	4.7	5	5.2	5.6	6.3
2002	121	4.3	4.6	4.7	4.9	5.1	5.4	6
2003	152	4.1	4.3	4.6	4.8	5	5.3	5.6
2004	182	3.7	4.1	4.5	4.7	4.9	5.3	6.2
2005	210	3.8	4.1	4.4	4.6	4.8	5.2	5.7
2006	264	3.4	3.9	4.3	4.6	4.8	5.2	5.7
2007	280	3.6	4	4.3	4.6	4.8	5	5.6

Figure 9.2.5(a): Variation in median serum cholesterol level among HD patients, HD centers 2007

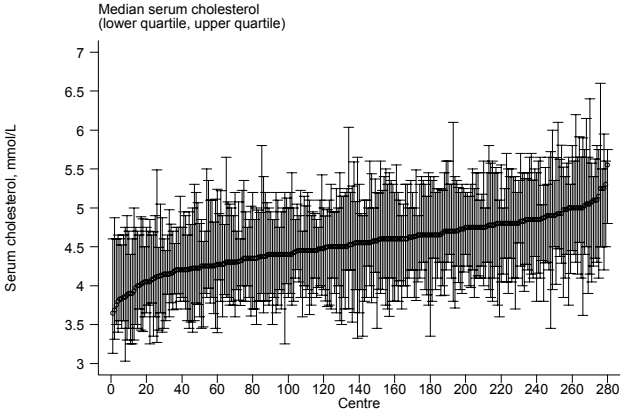
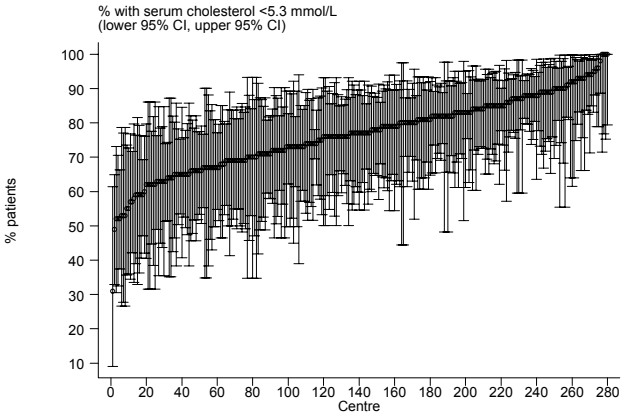


Figure 9.2.5(b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, HD centers 2007



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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	31	30	30	51	63	72	90	100
1999	47	38	38	58	64	78	86	89
2000	76	27	36	51.5	61	68	86	94
2001	95	14	36	53	60	68	79	85
2002	121	28	45	57	64	71	79	93
2003	152	36	50	59	67.5	76	83	92
2004	182	31	50	62	70	79	90	94
2005	210	25	53	66	74	81	91	94
2006	264	40	53	69	75	83	93	100
2007	280	31	59	69	77	84.5	93	100

(c) Median serum triglyceride level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	29	1.4	1.5	1.6	1.8	2	2.1	2.3
1999	41	1.2	1.4	1.5	1.7	1.9	2.2	2.5
2000	59	1.2	1.4	1.5	1.8	2	2.6	3
2001	81	1.1	1.3	1.5	1.7	1.9	2.3	2.5
2002	98	1.1	1.4	1.6	1.8	2	2.5	3.2
2003	130	1.2	1.3	1.5	1.7	1.9	2.2	2.5
2004	158	1	1.3	1.5	1.7	1.8	2.3	2.8
2005	191	0.8	1.3	1.5	1.7	1.9	2.2	2.6
2006	252	0.9	1.2	1.5	1.6	1.8	2.2	4.5
2007	267	0.8	1.2	1.4	1.6	1.8	2.2	2.6

Figure 9.2.5(c): Variation in median serum triglyceride level among HD patients, HD centers 2007

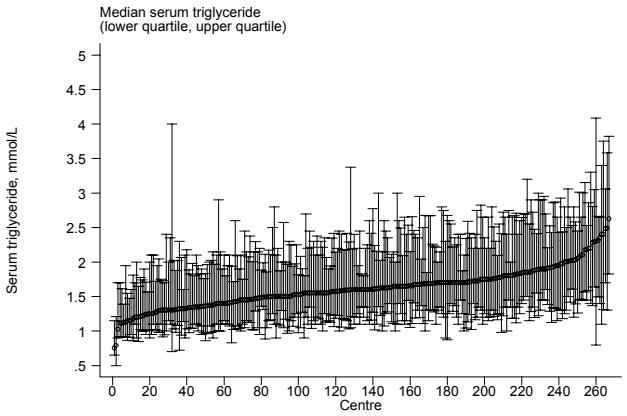
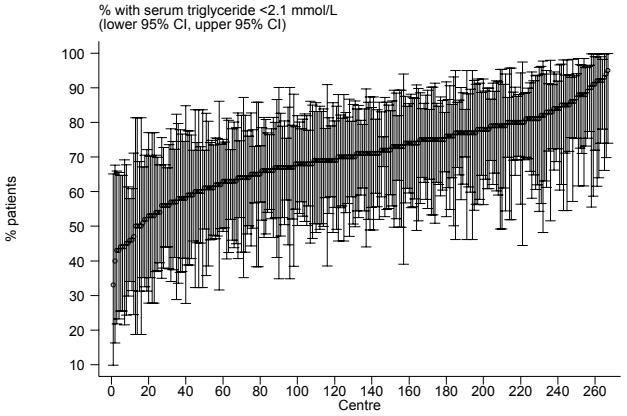


Figure 9.2.5(d): Variation in proportion of patients with serum triglyceride < 2.1 mmol/L, HD centers 2007



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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	29	44	50	58	63	70	82	83
1999	41	36	47	59	67	73	88	92
2000	59	23	27	56	65	73	83	86
2001	81	38	45	57	65	76	85	90
2002	98	0	43	54	64.5	72	80	94
2003	130	27	43	57	67	75	90	100
2004	158	21	47	60	69	78	85	94
2005	191	33	44	59	67	73	83	100
2006	252	0	49	63.5	70	76	90	100
2007	267	33	50	63	71	78	88	95

In 2007 the variation in median serum cholesterol levels and median serum triglyceride levels among CAPD centers were similar to previous years (Table 9.2.6 (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 from 32% in 1998 to 54% in 2007 (Table 9.2.6 (b)). The median of the proportion of patients with serum triglyceride level < 2.1 mmol/l in CAPD centers has only increased slightly from 61% in 1998 to 64% in 2007 (Table 9.2.6 (d)).

Table 9.2.6: Variation in dyslipidaemia among CAPD centers 2007
(a) Median serum cholesterol level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	5.7	6.2	6.2
2003	18	4.5	4.5	5	5.3	5.7	5.9	5.9
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	5.4	5.9	5.9
2006	21	4.4	4.6	4.8	5.1	5.4	6.1	6.2
2007	23	4.4	4.5	4.8	5.2	5.4	6.1	6.2

Figure 9.2.6(a): Variation in median serum cholesterol level among CAPD patients, CAPD centers 2007

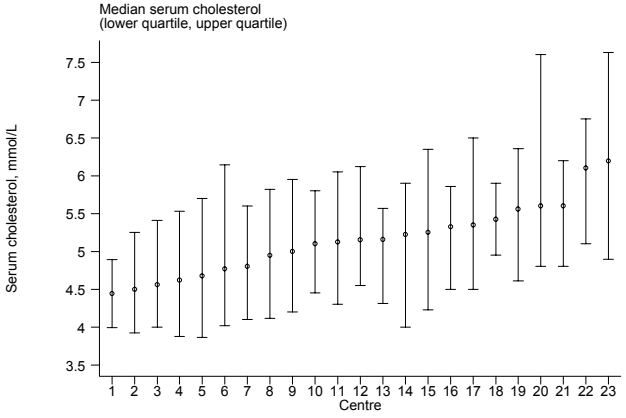
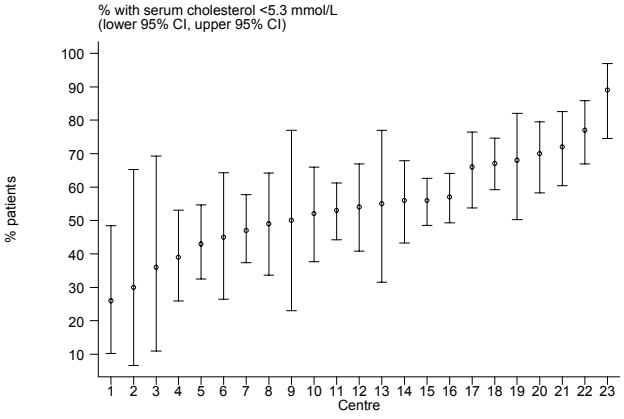


Figure 9.2.6(b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, CAPD centers 2007



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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	19	19	33	42	45	80	80
2003	18	20	20	39	48.5	59	83	83
2004	19	10	10	40	49	60	71	71
2005	19	28	28	49	60	70	77	77
2006	21	18	29	48	59	66	75	80
2007	23	26	30	45	54	67	77	89

Table 9.2.6: Variation in dyslipidaemia among CAPD centers 2007
(c) Median serum triglyceride level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	1.2	1.2	1.7	1.8	2	2.3	2.3
2004	19	1.3	1.3	1.6	1.8	1.8	2.2	2.2
2005	19	1.3	1.3	1.6	1.9	2	2.2	2.2
2006	21	1.1	1.4	1.6	1.8	1.9	2	2.6
2007	23	1.2	1.5	1.7	1.8	1.9	2.1	2.7

Figure 9.2.6(c): Variation in median serum triglyceride level among CAPD patients, CAPD centers 2007

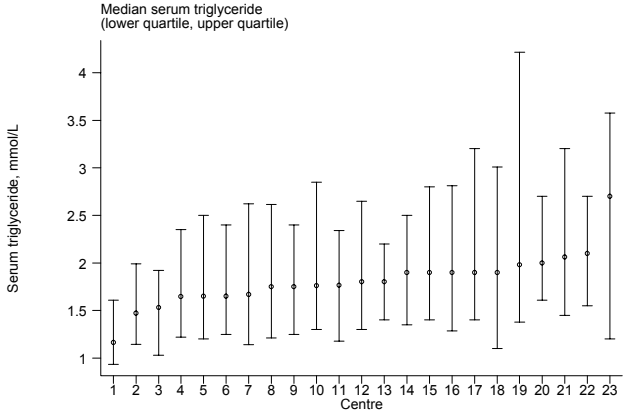
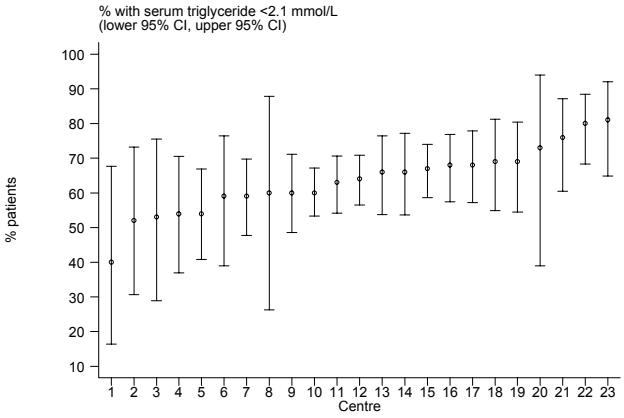


Figure 9.2.6(d): Variation in proportion of patients with serum triglyceride < 2.1 mmol/L, CAPD centers 2007



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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	38	38	52	56	57	76	76
2003	18	48	48	55	59	62	92	92
2004	19	47	47	60	62	67	90	90
2005	19	42	42	55	60	69	89	89
2006	21	29	52	56	61	63	78	83
2007	23	40	52	59	64	69	80	81

CHAPTER 10

Management of Renal Bone Disease in Dialysis Patients

Fan Kin Sing
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SECTION 10.1: TREATMENT OF RENAL BONE DISEASE

From 1998 to 2007, calcium carbonate remained as the main phosphate binder used. Majority of HD patients (92%) and CAPD patients (88%) received calcium carbonate as phosphate binder. The number of patients on aluminium based phosphate binders continued to decrease in both HD and CAPD patients. An increasing number of patients received lanthanum as phosphate binders although the number remains small. (Tables 10.1.1 & 10.1.2)

Calcitriol remained the main Vitamin D used in treatment of renal bone disease in both HD and CAPD patients. The percentage of patients on calcitriol therapy has increased in both HD and CAPD patients since 2001. However, an increasing number of patients is using paracalcitol since 2006. (Tables 10.1.1 & 10.1.2)

The number of parathyroidectomies done in HD patients had increased from 152 to 181 in year 2007 but the number had decreased from 15 to 11 in CAPD patients. (Tables 10.1.1 & 10.1.2)

Table 10.1.1 Treatment for renal bone disease, HD patients, 1998- 2007

Year	No. of subjects	No. of subjects on $CaCO_3$	% on $CaCO_3$	No. of subjects on $Al(OH)_3$	No. of subjects on lanthanum	No. of subjects on calcitriol	% on Calcitriol	No. of subjects on paracalcitol	No. of subjects had Para-thyroidectomy
1998	2141	1956	91	343	0	652	30	0	0
1999	2996	2693	90	244	0	770	26	0	0
2000	4392	3977	91	239	0	1084	25	0	0
2001	5194	4810	93	145	0	1145	22	0	0
2002	6108	5536	91	171	0	1375	23	0	0
2003	7017	6424	92	118	0	1690	24	0	0
2004	8163	7407	91	106	0	2028	25	0	0
2005	9351	8568	92	98	0	2555	27	0	43
2006	11682	10776	92	71	14	3783	32	15	152
2007	12891	11853	92	57	37	4893	38	32	181

Table 10.1.2 Treatment for renal bone disease, CAPD patients, 1998- 2007

Year	No. of subjects	No. of subjects on $CaCO_3$	% on $CaCO_3$	No. of subjects on $Al(OH)_3$	No. of subjects on lanthanum	No. of subjects on calcitriol	% on calcitriol	No. of subjects on paracalcitol	No. of subjects had Para-thyroidectomy
1998	541	425	79	46	0	110	20	0	0
1999	610	450	74	36	0	75	12	0	0
2000	662	522	79	15	0	96	15	0	0
2001	781	588	75	5	0	84	11	0	0
2002	891	713	80	6	0	130	15	0	0
2003	1231	1039	84	10	0	238	19	0	0
2004	1327	1124	85	18	0	304	23	0	0
2005	1398	1186	85	13	0	314	22	0	4
2006	1552	1323	85	7	3	375	24	3	15
2007	1806	1585	88	4	11	514	28	3	11

SECTION 10.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level decreased to 2.2 mmol/l in HD patients (Table 10.2.1 and Fig 10.2.1) but remained at 2.4 mmol/l in CAPD patients (Table 10.2.2 and Fig 10.2.2). In 2007, the percentage of patients who achieved target serum calcium level of 2.1 to 2.37 mmol/l had increased in both HD and CAPD patients.

Table 10.2.1: Distribution of corrected serum calcium, HD patients, 1998- 2007

Year	No of subject	Mean	SD	Median	LQ	UQ	%patients ≥2.1&≤2.37 mmol/L
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	6465	2.3	0.2	2.3	2.2	2.4	46
2004	7535	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	10881	2.3	0.2	2.3	2.1	2.4	50
2007	12260	2.2	0.2	2.2	2.1	2.4	52

Figure 10.2.1 Cumulative distribution of corrected serum calcium, HD patients, 1998-2007

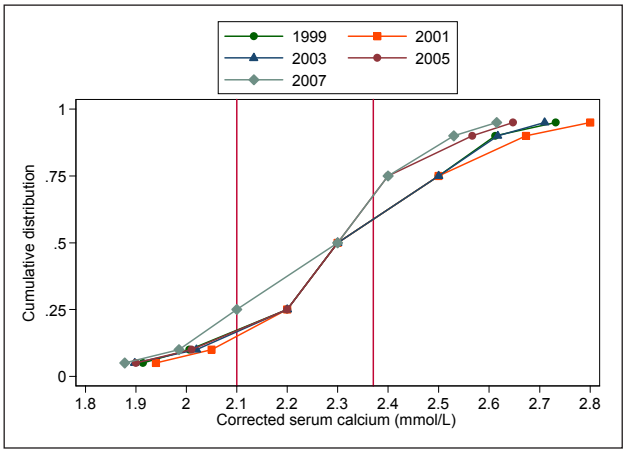


Figure 10.2.2: Cumulative distribution of corrected serum calcium, CAPD patients, 1998-2007

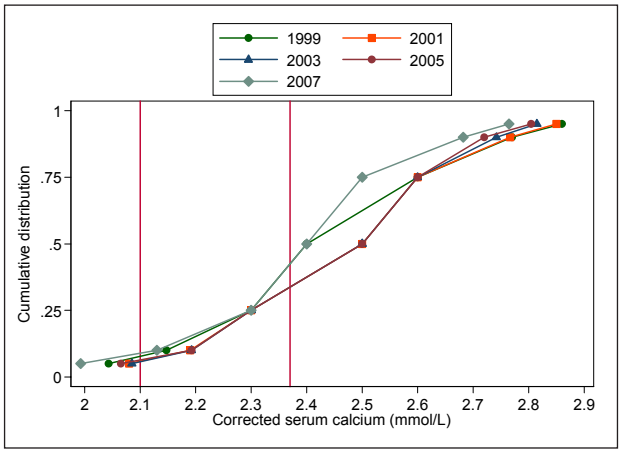


Table 10.2.2: Distribution of corrected serum calcium, CAPD patients, 1998- 2007

Year	No of subject	Mean	SD	Median	LQ	UQ	%patients ≥2.1&≤2.37 mmol/L
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	1495	2.4	0.2	2.4	2.3	2.5	38
2007	1748	2.4	0.2	2.4	2.2	2.5	42

The median serum phosphate level was higher among HD patients (1.7 mmol/l) compared to CAPD patients (1.6 mmol/l). (Tables and Fig 10.2.3 and 10.2.4) In 2007, the percentage of patients who achieved target serum phosphate level of 1.13 to 1.78 mmol/l had increased to 47% among HD patients and 55% among CAPD patients.

Table 10.2.3: Distribution of serum phosphate, HD patients, 1998- 2007

Year	No of subjects	mean	SD	Median	LQ	UQ	%patients with phosphate <1.13 mmol/L	%patients with phosphate ≥1.13&<1.78 mmol/L	%patients with phosphate ≥1.78&≤2.6 mmol/L	%patients with phosphate >2.6 mmol/L
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	6587	1.8	0.5	1.8	1.5	2.2	7	41	43	9
2004	7619	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	11129	1.8	0.5	1.7	1.4	2.1	9	46	39	6
2007	12407	1.8	0.5	1.7	1.4	2.1	9	47	39	5

Figure 10.2.3: Cumulative distribution of serum phosphate, HD patients, 1998-2007

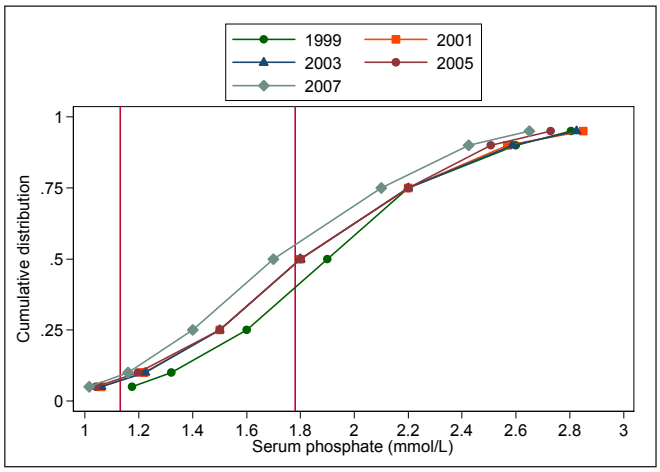


Figure 10.2.4: Cumulative distribution of serum phosphate, CAPD patients, 1998-2007

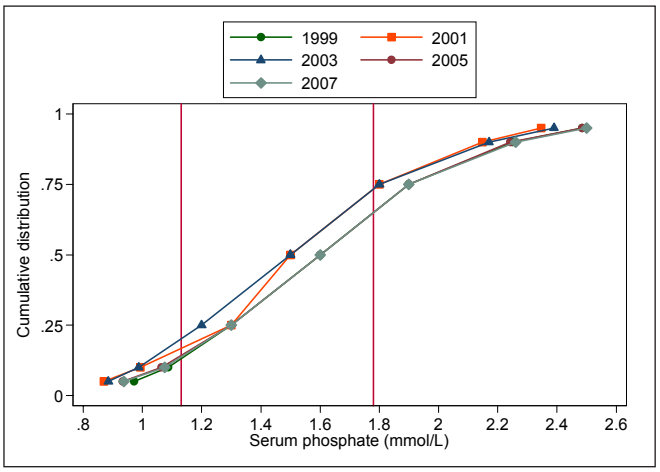


Table 10.2.4: Distribution of serum phosphate, CAPD patients, 1998- 2007

Year	No of subjects	mean	SD	Median	LQ	UQ	%patients with phosphate <1.13 mmol/L	%patients with phosphate ≥1.13&<1.78 mmol/L	%patients with phosphate ≥1.78&≤2.6 mmol/L	%patients with phosphate >2.6 mmol/L
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	1511	1.6	0.5	1.6	1.3	1.9	13	54	29	4
2007	1757	1.6	0.5	1.6	1.3	1.9	13	55	27	5

In year 2007, the median corrected calcium phosphate product had remained at 3.8 $mmol^2/L^2$ among HD patients and declined to 3.6 $mmol^2/L^2$ among CAPD patients (Tables and Figs 10.2.5 and 10.2.6)

Table 10.2.5: Distribution of corrected calcium x phosphate product, HD patients 1998-2007

Year	No of subjects	mean	SD	Median	LQ	UQ	Percent patients with calcium phosphate product: <3.5 $mmol^2/L^2$	≥3.5 to <4.5 $mmol^2/L^2$	≥4.5 to<5.5 $mmol^2/L^2$	≥5.5 $mmol^2/L^2$
1998	2020	4.5	1.2	4.4	3.7	5.2	21	32	28	19
1999	2698	4.4	1.3	4.3	3.4	5.2	27	29	26	18
2000	3650	4.4	1.3	4.3	3.5	5.2	25	31	25	19
2001	4555	4.3	1.3	4.2	3.4	5.2	27	31	24	18
2002	5403	4.4	1.3	4.3	3.4	5.2	27	31	24	19
2003	6382	4.2	1.3	4.1	3.3	5.1	30	31	23	16
2004	7413	4.2	1.3	4.1	3.3	5	32	32	22	15
2005	8496	4	1.3	3.9	3.2	4.8	36	32	20	12
2006	10758	4	1.2	3.8	3.1	4.7	38	32	19	11
2007	12157	3.9	1.2	3.8	3.1	4.6	38	33	19	10

Figure 10.2.5: Cumulative distribution of corrected calcium x phosphate product, HD patients 1998- 2007

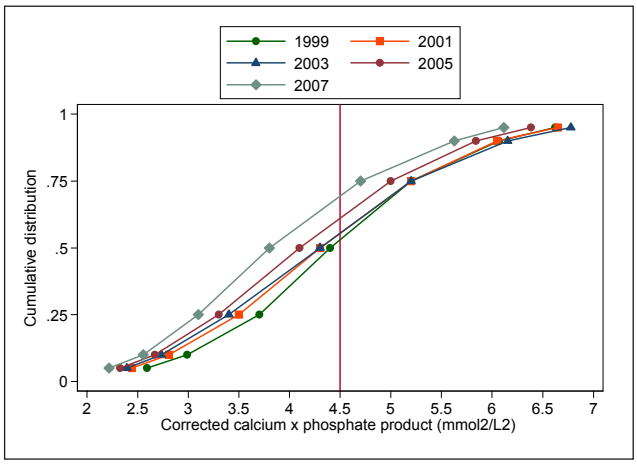


Figure 10.2.6: Cumulative distribution of corrected calcium x phosphate product, CAPD patients 1998- 2007

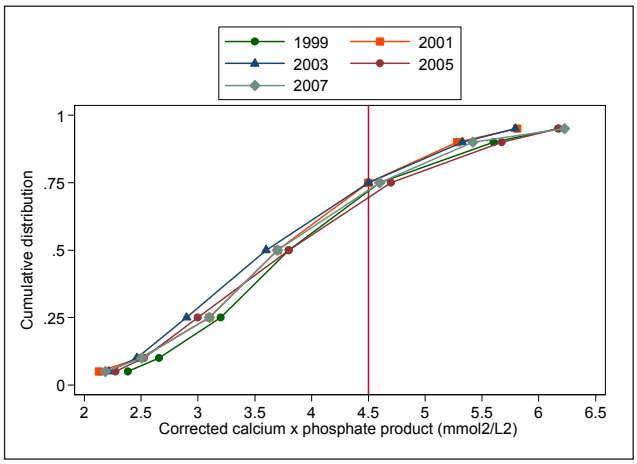


Table 10.2.6: Distribution of corrected calcium x phosphate product, CAPD patients 1998-2007

Year	No of subjects	mean	SD	Median	LQ	UQ	Percent patients with calcium phosphate product: <3.5 $mmol^2/L^2$	≥3.5 to <4.5 $mmol^2/L^2$	≥4.5 to <5.5 $mmol^2/L^2$	≥5.5 $mmol^2/L^2$
1998	533	4	1.1	3.8	3.2	4.6	38	35	16	11
1999	580	4	1.2	3.8	3.2	4.8	36	33	22	10
2000	621	3.8	1.1	3.7	3.1	4.5	44	31	17	8
2001	723	3.8	1.1	3.6	2.9	4.5	46	30	18	7
2002	856	3.8	1.2	3.6	2.9	4.5	45	29	18	8
2003	1162	3.9	1.2	3.7	3	4.6	43	29	17	10
2004	1274	4	1.2	3.8	3	4.7	41	30	18	12
2005	1333	3.9	1.3	3.7	3	4.6	43	29	17	11
2006	1494	3.9	1.2	3.7	3.1	4.6	43	31	17	9
2007	1745	3.8	1.2	3.6	3	4.5	46	29	15	10

In 2007, the median corrected serum calcium level among HD patients from 299 centres ranged from 1.8 to 2.4 mmol/l. (Tables 10.2.7 and Fig 10.2.7a) The median corrected serum calcium level among CAPD patients from 23 centres ranged from 2.2 to 2.4 mmol/l. (Tables 10.2.8 and Fig 10.2.8a)

Table 10.2.7: Variation in corrected serum calcium level among HD centres, 2007
a) median serum calcium level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	49	2	2.1	2.3	2.3	2.4	2.4	2.5
1999	68	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	138	1.9	2.1	2.2	2.3	2.4	2.5	2.6
2003	169	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	227	1.8	2	2.2	2.3	2.3	2.4	2.5
2006	278	1.9	2.1	2.2	2.3	2.3	2.4	2.5
2007	299	1.8	2	2.2	2.2	2.3	2.4	2.6

Figure 10.2.7(a): Variation in median serum calcium among HD patients, HD centres, 2007

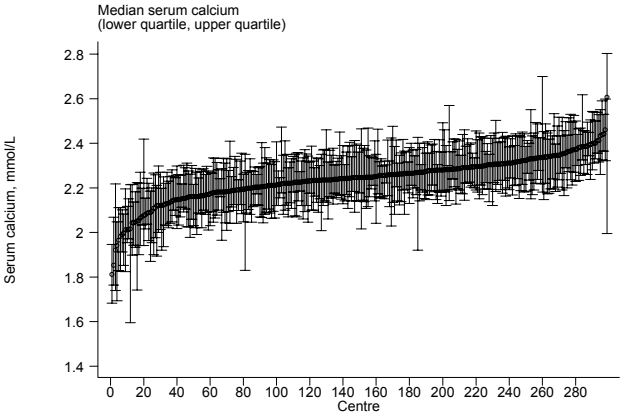


Figure 10.2.8(a): Variation in median serum calcium level among CAPD patients, CAPD centres, 2007

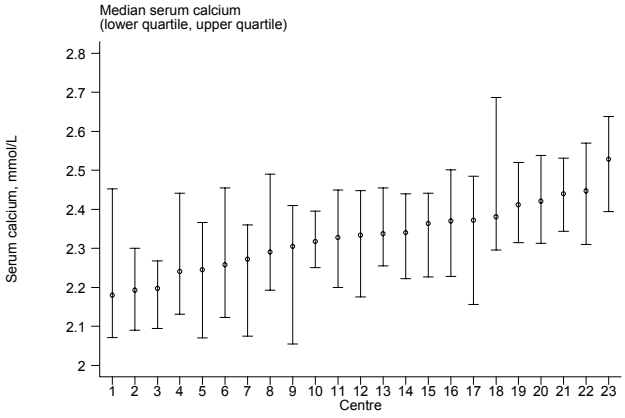


Table 10.2.8: Variation in corrected serum calcium level among CAPD centres, 2007
a). median serum calcium level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	2.6	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	2.2	2.2	2.4	2.4	2.5	2.6	2.6
2004	19	2.2	2.2	2.4	2.4	2.5	2.5	2.5
2005	20	2.2	2.2	2.3	2.4	2.4	2.5	2.6
2006	22	2.2	2.2	2.3	2.4	2.4	2.5	2.6
2007	23	2.2	2.2	2.3	2.3	2.4	2.4	2.5

We reviewed the proportion of patients with serum calcium level achieving target of 2.1 to 2.37 mmol/l. The median was 52% for HD centres (Table & Fig 10.2.7b) and 43% for CAPD centres (Table & Fig 10.2.8b). There is a great variation between the HD centres with regards to the proportion of patients with serum calcium 2.1 to 2.37 mmol/l, ranging from 8 to 95%. There is also a great variation between the CAPD centres with regards to the proportion of patients with serum calcium 2.1 to 2.37 mmol/l, ranging from 19 to 63%.

Table 10.2.7(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	49	12	21	36	43	53	70	78
1999	68	0	10	25	38.5	46	59	79
2000	93	0	15	31	42	50	65	96
2001	116	7	12	29	40	50	64	85
2002	138	5	15	33	44	53	64	73
2003	169	13	24	36	46	54	68	91
2004	198	8	22	38	47	58	70	82
2005	227	0	18	38	50	58	70	81
2006	278	12	29	41	50	60	71	88
2007	299	8	27	45	52	61	74	95

Figure 10.2.7(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2007

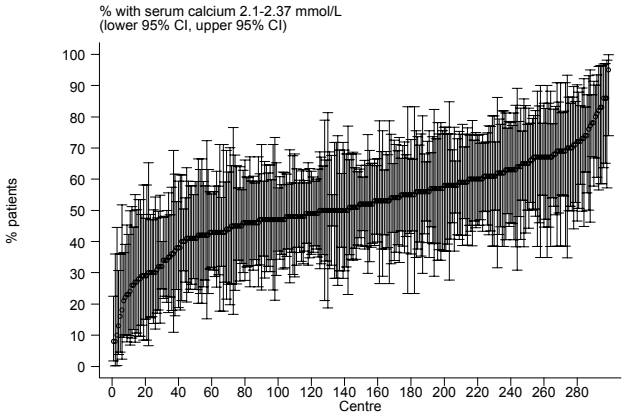


Figure 10.2.8(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, CAPD centres, 2007

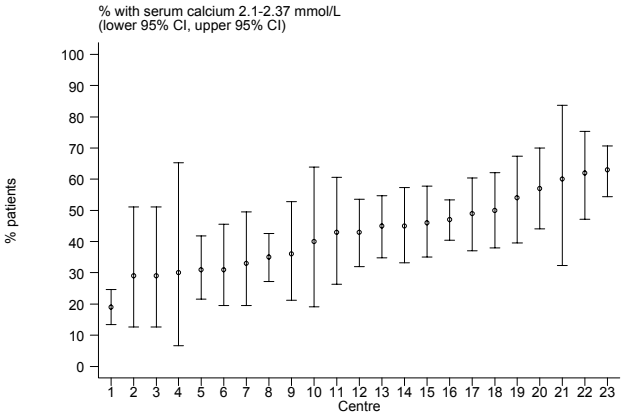


Table 10.2.8(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, CAPD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	9	13	13	23	38	40	64	64
1999	10	5	5	21	28	32	42	42
2000	11	14	14	18	25	33	48	48
2001	12	11	11	18	24	34.5	38	38
2002	15	12	12	20	25	34	41	41
2003	19	9	9	19	33	40	58	58
2004	19	11	11	18	26	31	53	53
2005	20	16	17	24.5	34	40	48	51
2006	22	16	23	35	43.5	49	61	76
2007	23	19	29	31	43	50	62	63

With regards to the proportion of patients with serum phosphate level 1.13 – 1.78 mmol/l. the median was 46% for HD centres (Table & Fig 10.2.9b) and 53% for CAPD centres (Table & Fig 10.2.10 b). There is a great variation between the HD centres with regards to the proportion of patients with serum phosphate 1.13 – 1.78 mmol/l, ranging from 15 to 92%.(Table 10.2.9b) Among the CAPD centres, the proportion of patients with serum phosphate 1.13 – 1.78 mmol/l, ranged from 39 to 79%. (Table 10.2.10 b)

Table 10.2.9: Variation in serum phosphate level among HD centres, 2007
(a) Median serum phosphate level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	49	1.5	1.5	1.8	1.9	2	2.2	2.6
1999	68	1.1	1.6	1.8	1.9	2	2.1	2.1
2000	101	1.4	1.6	1.7	1.9	2	2.2	3.7
2001	117	1.3	1.5	1.7	1.8	1.9	2.1	2.4
2002	145	1.3	1.5	1.8	1.9	2	2.2	2.4
2003	176	0.8	1.5	1.7	1.8	1.9	2.2	2.4
2004	199	1.3	1.5	1.7	1.8	1.9	2.1	2.3
2005	229	0.8	1.4	1.6	1.8	1.9	2	2.2
2006	282	0.9	1.5	1.6	1.7	1.8	2.1	2.5
2007	304	0.9	1.4	1.6	1.7	1.8	2	2.6

Figure 10.2.9(a): Variation in median serum phosphate level among HD patients, HD centres, 2007

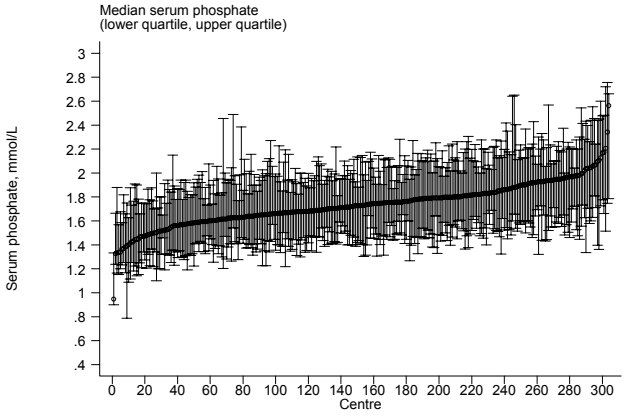
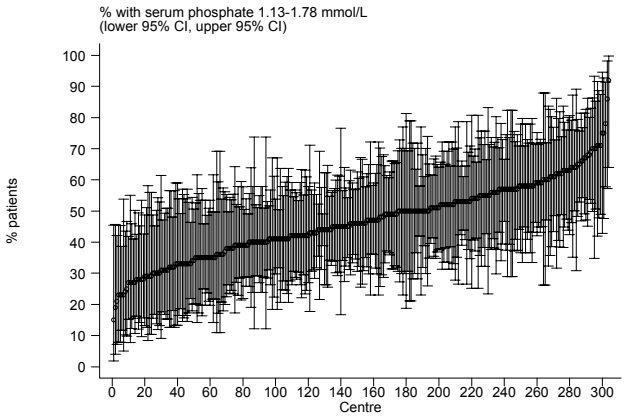


Figure 10.2.9(b): Variation in proportion of patients with serum phosphate 1.13 to 1.78 mmol/L, HD centres,



(b) Proportion of patients with serum phosphate 1.13 to 1.78 mmol/L, HD centres, 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	49	9	18	29	34	44	63	70
1999	68	8	17	26.5	36	44.5	59	63
2000	101	9	18	29	36	44	57	73
2001	117	0	21	33	38	47	61	67
2002	145	6	14	29	36	45	63	91
2003	176	9	19	31.5	40	49	66	93
2004	199	0	18	31	40	52	67	92
2005	229	9	23	35	42	53	68	90
2006	282	12	26	39	45	54	68	92
2007	304	15	28	39	46	55	67	92

Table 10.2.10: Variation in serum phosphate levels among CAPD centres, to 2007
(a) Median serum phosphate level among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	9	1.4	1.4	1.5	1.6	1.6	1.8	1.8
1999	9	1.5	1.5	1.5	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	2
2003	19	1.2	1.2	1.4	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	20	1.4	1.4	1.5	1.5	1.7	1.9	1.9
2006	22	1.3	1.4	1.5	1.6	1.7	1.8	1.9
2007	23	1.3	1.4	1.5	1.6	1.7	1.9	2.4

Figure 10.2.10(a): Variation in median serum phosphate level among CAPD patients, CAPD centres 2007

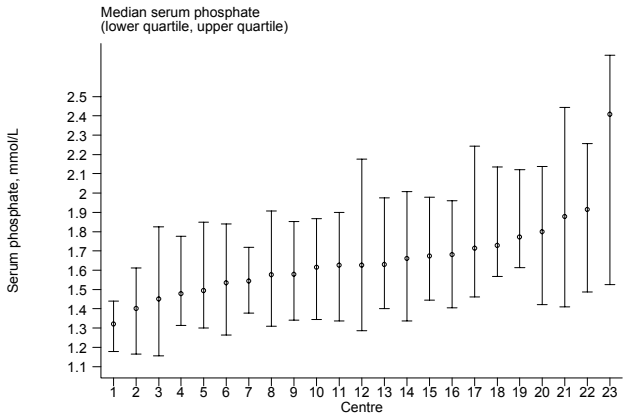
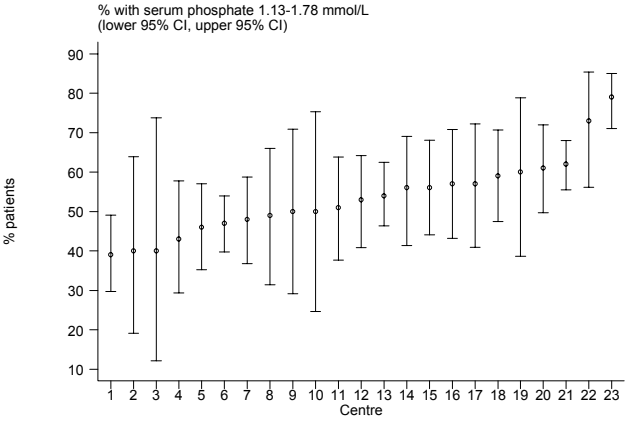


Figure 10.2.10(b): Variation in proportion of patients with serum phosphate 1.13 to 1.78 mmol/L, CAPD centres



(b) Proportion of patients with serum phosphate 1.13 to 1.78 mmol/L, CAPD centres 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	9	43	43	54	60	61	80	80
1999	9	45	45	51	58	63	68	68
2000	11	43	43	48	53	61	65	65
2001	12	42	42	48.5	54	58	78	78
2002	15	40	40	47	53	60	84	84
2003	19	40	40	47	54	61	76	76
2004	19	37	37	49	52	63	76	76
2005	20	40	41	45.5	52.5	59	73	76
2006	22	38	43	48	52.5	58	66	68
2007	23	39	40	47	53	59	73	79

In 2007, the median corrected serum calcium phosphate product among HD patients from 298 centres ranged from 2.2 to 5.4 (Tables 10.2.11 and Fig 10.2.11a). The median corrected serum calcium phosphate product among CAPD patients from 23 centres ranged from 3.1 to 4.6 mmol/l. (Tables 10.2.12 and Fig 10.2.12a)

Table 10.2.11: Variation in corrected calcium x phosphate product among HD centres, 2007
(a) median corrected calcium x phosphate product among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	49	3.2	3.4	4.1	4.5	4.7	5.2	5.3
1999	66	2.3	3.2	4	4.3	4.7	5.2	5.3
2000	91	3.1	3.5	4	4.3	4.6	5.2	6.2
2001	113	2.9	3.5	3.9	4.2	4.6	5.1	6
2002	138	2.9	3.6	4	4.3	4.5	5.3	6.2
2003	169	2.1	3.3	3.9	4.1	4.5	4.9	5.5
2004	196	2.9	3.4	3.8	4.1	4.4	5	5.6
2005	221	2.1	3.2	3.6	3.9	4.3	4.7	5.6
2006	275	1.8	3.2	3.6	3.9	4.2	4.7	5.2
2007	298	2.2	3.1	3.6	3.9	4.1	4.6	5.4

Figure 10.2.11(a): Variation in median corrected calcium x phosphate product among HD patients, HD centres, 2007

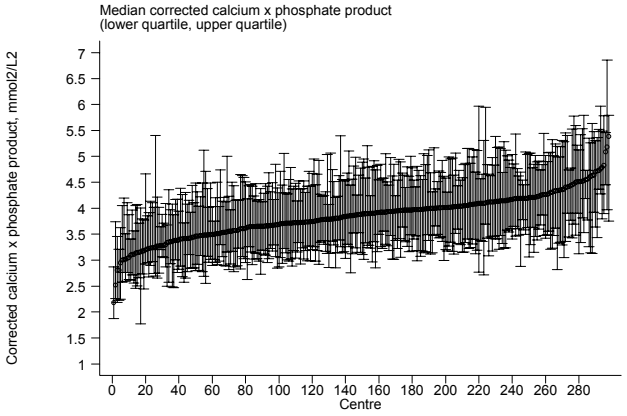


Figure 10.2.12(a): Variation in median corrected calcium x phosphate product among CAPD centres, to 2007

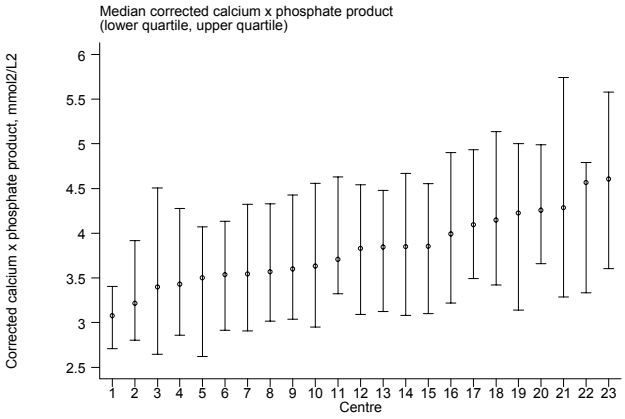


Table 10.2.12: Variation in corrected calcium x phosphate product among CAPD centres, 2007
(a) median corrected calcium x phosphate product among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	9	3.5	3.5	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	3.9	4.3	4.3
2002	15	3.3	3.3	3.4	3.6	4	4.6	4.6
2003	19	2.9	2.9	3.4	3.6	4	4.1	4.1
2004	19	3.2	3.2	3.5	3.8	4	4.4	4.4
2005	20	3.3	3.4	3.6	3.7	4	4.2	4.3
2006	22	3	3.3	3.6	3.7	4	4.3	4.5
2007	23	3.1	3.2	3.5	3.8	4.1	4.6	4.6

With regards to the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$, the median was 72% for HD centres (Table & Fig 10.2.11b) and 73% for CAPD centres (Table & Fig 10.2.12 b). There is again a great variation between the HD centres with regards to the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$, ranging from 30% to 100%.(Table 10.2.11b) Among the CAPD centres, the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$, ranged from 45% to 98%. (Table 10.2.12 b)

Table 10.2.11(b): Proportion of patients with corrected calcium x phosphate < 4.5 $mmol^2/L^2$, HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	49	27	31	41	52	64	83	91
1999	66	19	30	47	55	63	91	95
2000	91	12	27	47	57	67	80	88
2001	113	18	37	47	57	70	82	91
2002	138	11	33	49	57	69	89	100
2003	169	22	33	52	62	72	88	100
2004	196	17	38	54	63.5	73	90	100
2005	221	23	44	58	69	76	91	100
2006	275	30	44	61	70	79	91	100
2007	298	30	47	62	72	80	93	100

Figure 10.2.11(b): Variation in propotion of patients with corrected calcium x phosphate product < 4.5 4.5 $mmol^2/L^2$, HD centres 2007

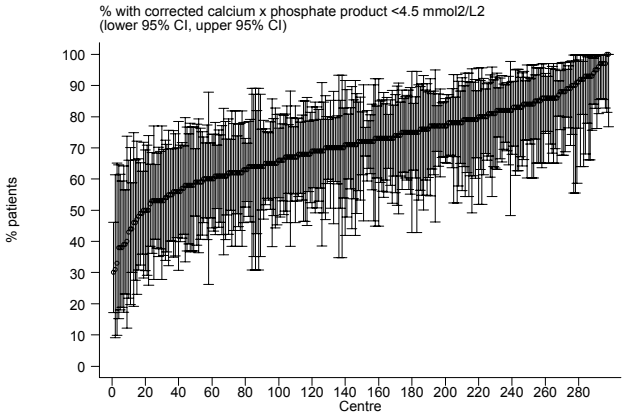


Figure 10.2.12(b): Variation in proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$ CAPD centres, 2007

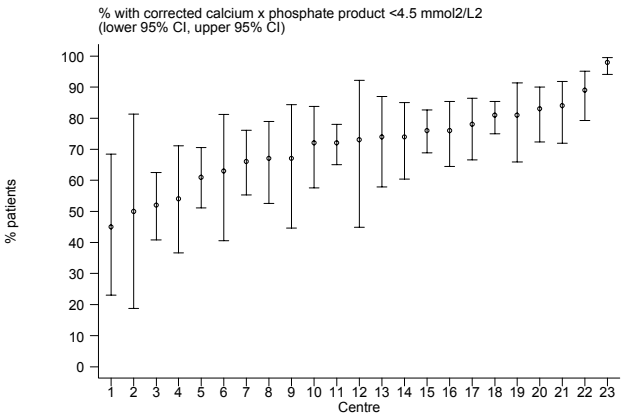


Table 10.2.12(b): Proportion of patients with corrected calcium x phosphate < 4.5 $mmol^2/L^2$, CAPD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	9	66	66	71	73	79	91	91
1999	9	59	59	65	72	74	79	79
2000	11	64	64	70	73	81	85	85
2001	12	50	50	71.5	75	81.5	84	84
2002	15	47	47	65	78	82	88	88
2003	19	61	61	64	75	86	100	100
2004	19	57	57	66	72	79	90	90
2005	20	55	55	65.5	73.5	78	84.5	85
2006	22	50	57	67	72	80	88	96
2007	23	45	50	63	73	81	89	98

SECTION 10.3: SERUM PARATHYROID HORMONE CONTROL

Among the HD patients, the mean intact parathyroid hormone (iPTH) level was 246.1 ng/ml while the median was 105 ng/ml. (Table and Fig 10.3.1a) Among the CAPD patients, the mean iPTH level was 248.4 ng/ml while the median was 152.5 ng/ml. (Table and Fig 10.3.2a). The percentage of patients with iPTH less than 150 ng/ml among HD patients had decreased to 58% in 2007 compared to 61% in 2006. The percentage of patients with iPTH less than 150 ng/ml among CAPD patients had also decreased to 52% in 2007 compared to 54% in 2006.

In 2007, the diabetic HD patients had a mean iPTH level of 184.4 ng/ml while the median was 71,2 ng/ml. (Table and Fig 10.3.1b). In the non-diabetic HD patients, both the mean and median iPTH levels (289.8 ng/ml and 136 ng/ml respectively) were higher than a diabetic HD patient. (Table and Fig 10.3.1c)

The same trend was also noted in CAPD patients. In 2007, the diabetic CAPD patients had a mean iPTH level of 176.1 ng/ml while the median was 113 ng/ml. (Table and Fig 10.3.2b). In the non-diabetic CAPD patients, both the mean and median iPTH levels (295.9 ng/ml and 197 ng/ml respectively) were higher than diabetic CAPD patients. (Table and Fig 10.3.2c)

Table 10.3.1(a): Distribution of iPTH, HD patients, 2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH: <150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
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	4067	219.1	328.8	79	24.3	263.5	64	14	9	14
2004	4747	212.1	325.6	74.3	22.6	257.5	65	13	10	13
2005	5826	221.6	312.5	83.8	26.5	297	61	14	11	14
2006	7744	219.1	307.2	88	29	292	61	14	11	13
2007	9135	246.1	332.8	105	30.5	336	58	15	12	16

Figure 10.3.1(a): Cumulative distribution of iPTH, HD, 1998- 2007

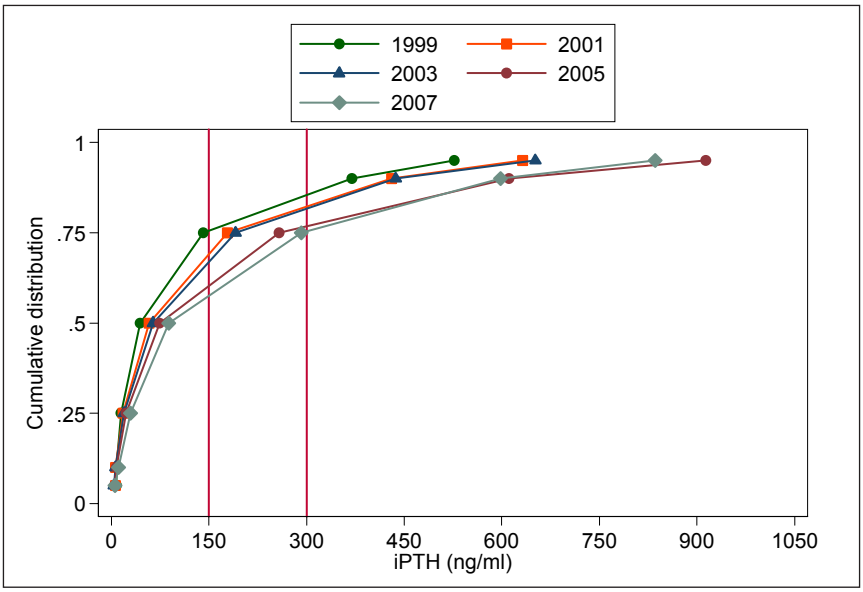


Table 10.3.1(b): Distribution of iPTH, diabetic HD patients, 1998- 2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH: <150 ng/ml	≥150 & ≤300 ng/ml	≥300 & ≤500 ng/ml	>500 ng/ml
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	531	87.4	137.1	35.6	10.6	101	83	9	6	2
2001	720	82.5	139.6	32	10.9	89.5	83	11	3	2
2002	967	92.5	161.5	35	11	99	83	10	4	3
2003	1249	122.1	210.8	40.5	13.5	124.5	78	10	6	6
2004	1580	113.5	196.4	38	14	118	80	10	5	5
2005	2160	150.7	248	47.5	16.4	171	72	12	8	8
2006	3141	154.8	252.3	54.4	20.8	173	72	12	8	7
2007	3789	184.4	269.5	71.2	23	237.8	65	14	10	10

Figure 10.3.1(b): Cumulative distribution of iPTH, diabetic HD patients, 1998- 2007

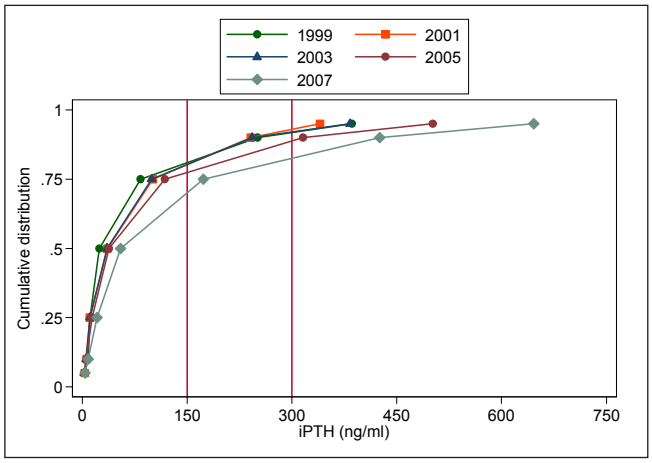


Figure 10.3.1(c): Cumulative distribution of iPTH, non diabetic HD patients, 1998- 2007

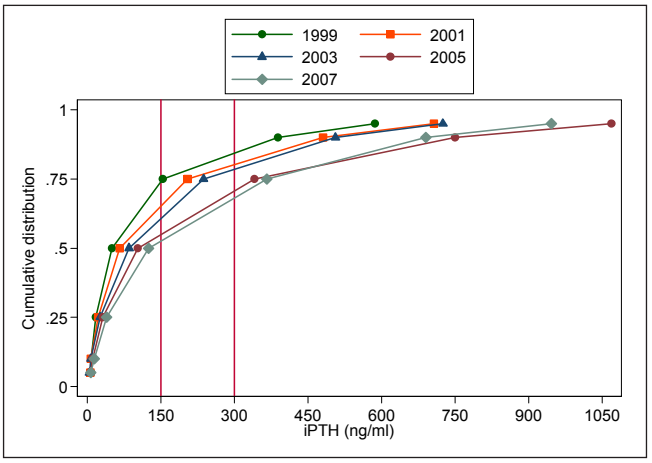


Table 10.3.1(c): Distribution of iPTH, non diabetic HD patients, 1997- 2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH: <150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
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	1713	168.5	248.8	65.7	21.8	204	69	14	9	9
2001	2040	162	238.1	71	23.5	198	69	16	7	8
2002	2424	189.2	270.2	85	26	236.8	65	15	10	10
2003	2818	262.1	361	108.8	33.7	331	57	16	10	17
2004	3167	261.4	363.9	102.8	31.1	341	58	14	12	17
2005	3666	263.4	338.1	115	36	365	55	15	13	17
2006	4603	263.1	332.6	124.9	39.6	365.8	54	16	13	17
2007	5346	289.8	365	136	39.1	406	52	15	13	20

Table 10.3.2(a): Distribution of iPTH, CAPD patients, 1998- 2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH: <150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
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	1265	224.6	271.9	128	41.5	318	54	20	14	12
2007	1436	248.4	297.1	152.5	51	332.8	50	22	15	14

Figure 10.3.2(a): Cumulative distribution of iPTH, CAPD patients, 1998- 2007

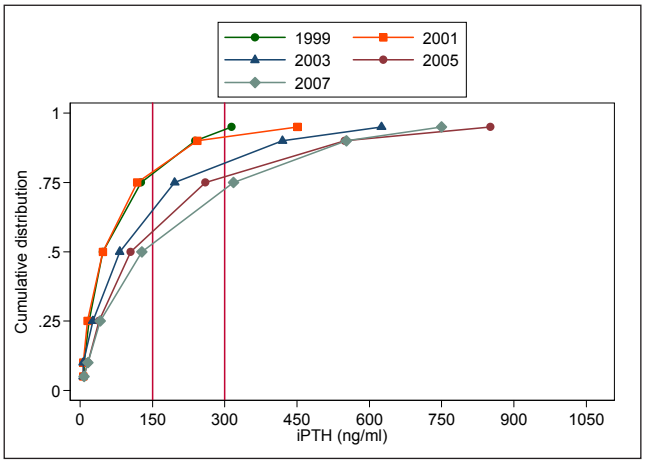


Figure 10.3.2(b): Cumulative distribution of iPTH, diabetic CAPD patients, 1998- 2007

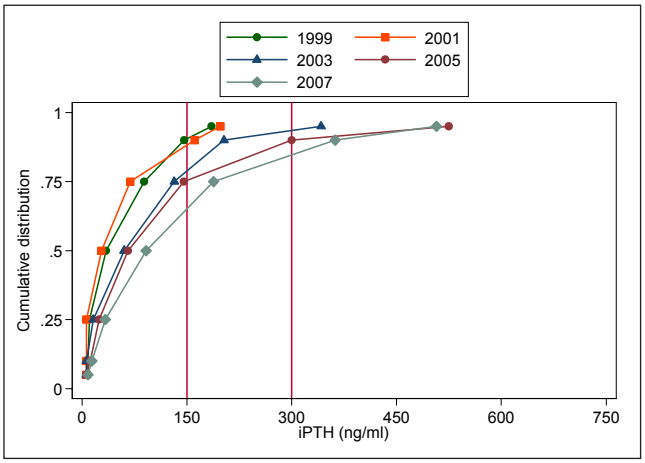


Table 10.3.2(b): Distribution of iPTH, diabetic CAPD patients, 1998-2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH: <150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
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	325	121.7	173.9	68	29	154	74	16	6	3
2004	379	130.6	191.5	65.5	24.2	145.5	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
2007	569	176.1	202.6	113	42	238	58	25	11	6

Table 10.3.2(c): Distribution of iPTH, non diabetic CAPD patients, 1998- 2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	Percent patients with iPTH: <150 ng/ml	≥150 & ≤300 ng/ml	>300 & ≤500 ng/ml	>500 ng/ml
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	613	287.9	389.4	128	50	339	54	18	10	17
2004	736	260.6	338.3	140.3	50	327.8	52	21	12	14
2005	704	292.8	328.4	175	48.2	420	46	19	16	19
2006	803	266.5	298.6	167	50	390	47	21	16	16
2007	867	295.9	337.1	197	57.5	409	44	20	18	18

Figure 10.3.2(c): Cumulative distribution of iPTH, non diabetic CAPD patients, 1998- 2007

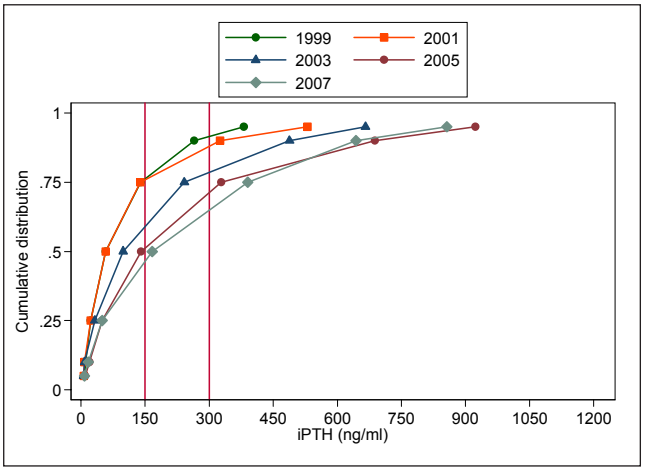


Figure 10.3.3(a): Variation in median iPTH among HD patients, HD centres 2007

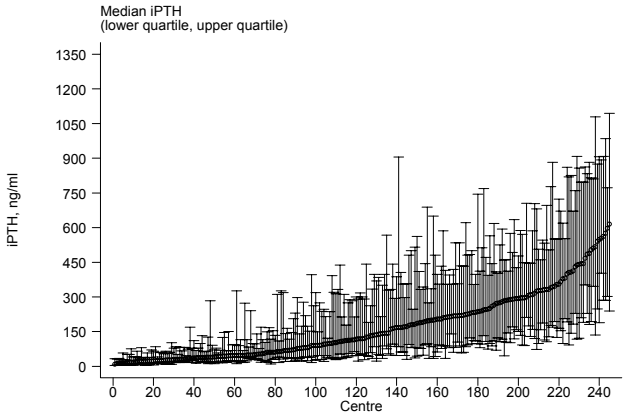


Table 10.3.3: Variation in iPTH among HD centres 2007
(a) Median iPTH among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	31	8	13.1	24	45	107	196.6	221
1999	39	10	17	40.3	77	151	302	396
2000	59	5.6	15.4	30	48.5	94.1	349.8	493
2001	69	7.3	10.4	27.6	56	93	240	550
2002	90	2.9	11.6	27.9	49.7	131	309	660.3
2003	114	4	9.6	37.2	93	210	427	1106
2004	134	3.6	12.4	30.5	77.3	203.5	393.5	702
2005	165	5.8	15.7	37	95	231	366.4	612.3
2006	219	7.7	16.6	41.1	88.8	208.7	377	704.8
2007	245	8.7	20	46.3	119.1	244.7	467.5	615

With regards to the proportion of patients with serum iPTH level 150-300 ng/ml, the median was only 15% for HD centres (Table & Fig 10.3.3b) and 20.5% for CAPD centres (Table & Fig 10.3.4b). There was again a great variation between the HD centres with regards to the proportion of patients with serum iPTH level 150-300 ng/ml,, ranging from 0% to 53%.(Table 10.3.3b) Among the CAPD centres, the proportion of patients with serum iPTH level 150-300 ng/ml, ranged from 0% to 45%. (Table 10.3.4 b)

Table 10.3.3(b): Variation in proportion of patients with iPTH 150-300ng/ml, HD centres, 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	31	0	0	5	8	18	26	31
1999	39	0	0	9	16	23	37	38
2000	59	0	0	5	10	15	33	45
2001	69	0	0	6	10	20	31	40
2002	90	0	0	2	10	22	33	45
2003	114	0	0	7	14	22	38	43
2004	134	0	0	5	11	20	36	50
2005	165	0	0	7	13	19	34	50
2006	219	0	0	7	14	20	31	47
2007	245	0	0	8	15	21	31	53

Figure 10.3.3(b): Variation in proportion of patients with iPTH 150-300ng/ml, HD centres, 2007

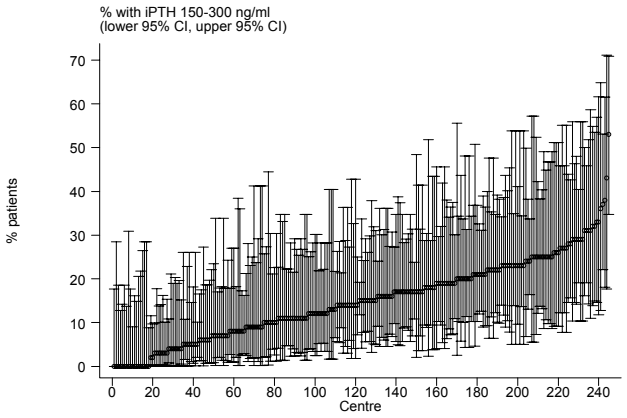


Figure 10.3.4(a): Variation in median iPTH among CAPD patients, CAPD centres, 2007

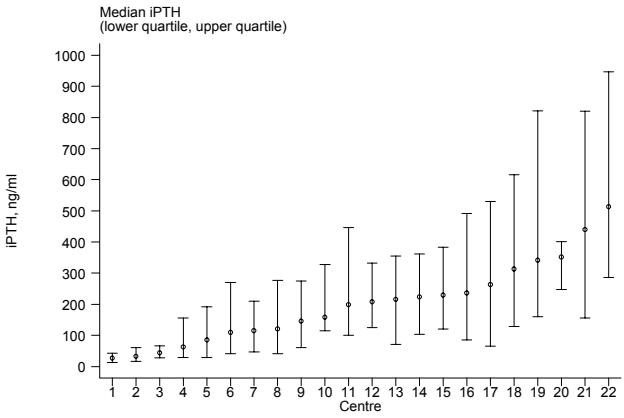


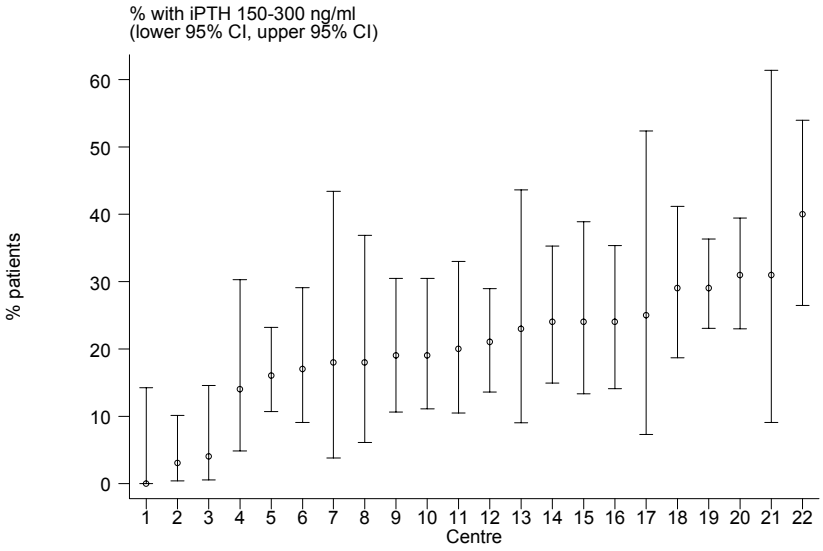
Table 10.3.4: Variation in iPTH among CAPD centres, 2007
(a) Median iPTH among CAPD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	5	16	16	57.5	59.5	66.3	74	74
1999	8	16.5	16.5	49.9	75.1	87.5	263.9	263.9
2000	9	16	16	33	46.5	60.8	122	122
2001	11	15.4	15.4	42.5	59.5	91	274	274
2002	14	27.3	27.3	50	82.9	107	280.5	280.5
2003	17	22.3	22.3	70	134	175	393	393
2004	18	41.5	41.5	74.5	138.8	169.3	303.8	303.8
2005	19	25	25	88	179.1	321.5	496.9	496.9
2006	21	34.5	36.9	101	177.5	233	386	411
2007	22	26.3	32	108.8	203.3	263.3	440	513.9

Table 10.3.4(b): Proportion of patients with iPTH 150-300ng/ml, CAPD centres, 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	5	0	0	9	15	17	27	27
1999	8	6	6	7	12	21.5	26	26
2000	9	0	0	5	12	17	18	18
2001	11	0	0	9	14	18	30	30
2002	14	0	0	10	15.5	21	24	24
2003	17	2	2	11	18	22	33	33
2004	18	7	7	14	20	25	32	32
2005	19	0	0	11	18	23	31	31
2006	21	5	6	14	20	25	32	42
2007	22	0	3	17	20.5	25	31	40

Figure 10.3.4(b): Variation in proportion of patients with iPTH 150-300ng/ml, CAPD centres 2007



Conclusion

In 2007, there was no major change in the type of phosphate binders used in both HD and CAPD patients. The majority of patients still received calcium carbonate as phosphate binders. Although the numbers were still small, there was a gradual increase in the number of patients receiving lanthanum as phosphate binders. The number of patients on aluminium hydroxide is still on a decreasing trend.

The percentage of HD and CAPD patients on calcitriol was also increasing. The number of patients on newer Vitamin D analogues was still small but showed an increasing trend.

There was an increasing trend in the number of patients who underwent parathyroidectomy for the past three years. This may be due to the availability of the service of endocrine surgeons in more hospitals in Malaysia and also a better awareness and understanding of the morbidity of second hyperparathyroidism.

The mean corrected serum calcium remained lower in the HD patients (2.2 mmol/l) compared to CAPD patients. (2.4 mmol/l). Phosphate control continued to be better in CAPD patients. The proportion of CAPD patients achieving target serum phosphate 1.13-1.78 mmol/l was 55% compared to 47% of HD patients. However, the phosphate control in HD patients shows improving trend since 1998. More CAPD patients (76%) achieved the target serum calcium product of less than 4.5 mmol2/L2 compared with HD patients (71%).

The mean iPTH level among HD patients had increased from 219.1 ng/ml in year 2006 to 246.1 ng/ml in year 2007. The mean iPTH level among CAPD patients had also increased from 224.6 ng/ml in year 2006 to 248.4 ng/ml in year 2007. The percentage of patients achieving target iPTH of 150-300 ng/ml remained low. Diabetic patients consistently had lower mean and median iPTH level compared with non-diabetic patients in both HD and CAPD patients.

There was consistently wide variation among HD and CAPD centres achieving targets reflecting the differences in management of renal bone disease in different centres.

CHAPTER 11

Hepatitis on Dialysis

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The prevalence of Hepatitis B infection has remained low and was similar comparing HD and CAPD patients. Due to the higher risk of nosocomial transmission with HD, HCV prevalence remains higher in HD as compared to CAPD patients. However an annual decline in HCV prevalence is observed and this implies that the current infection control measures to curb the epidemic of HCV within our dialysis facility has been successful.

Table 11.1: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, HD patients 1998-2007

Year	No. of subjects	Prevalence of $HBsAg^+$ (%)	Prevalence of Anti-HCV^+ (%)
1998	2139	6	22
1999	2991	6	23
2000	4386	6	25
2001	5187	6	23
2002	6106	5	20
2003	6976	5	19
2004	7617	5	17
2005	8957	4	14
2006	11295	5	12
2007	12479	5	11

Table 11.2: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, CAPD patients 1998-2007

Year	No. of subjects	Prevalence of $HBsAg^+$ (%)	Prevalence of Anti-HCV^+ (%)
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	1491	5	4
2007	1727	5	4

Table 11.3: Variation in Proportion of patients with positive HBsAg at annual survey among HD centres, 2007

Year	No. of centres	Min	5^{th} Centile	LQ	Median	UQ	95^{th} Centile	Max
1998	50	0	0	0	5	9	18	23
1999	75	0	0	0	5	10	19	30
2000	108	0	0	0	4	9	15	73
2001	125	0	0	0	5	9	15	82
2002	157	0	0	0	3	8	14	80
2003	180	0	0	0	3.5	7	15	69
2004	203	0	0	0	3	8	14	93
2005	233	0	0	0	1	6	15	100
2006	291	0	0	0	0	6	15	94
2007	305	0	0	0	0	6	16	100

Figure 11.3: Variation in Proportion of patients with positive HBsAg among HD centres, 2007

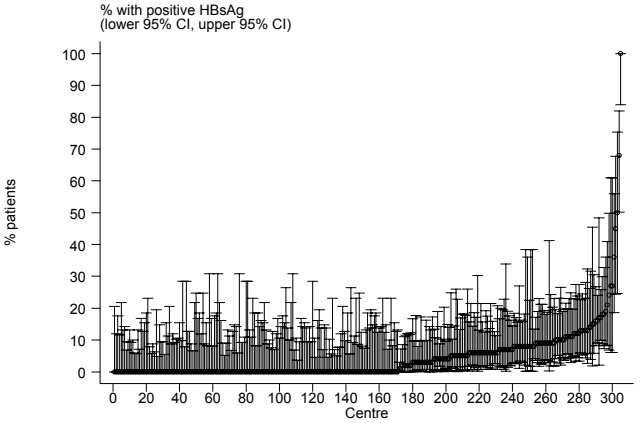
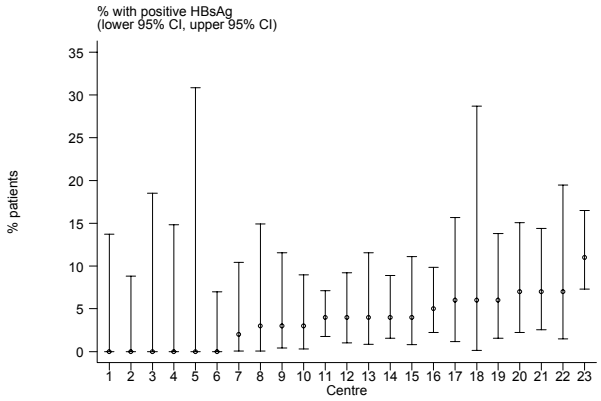


Table 11.4: Variation in Proportion of patients with positive HBsAg at annual survey among CAPD centres, 2007

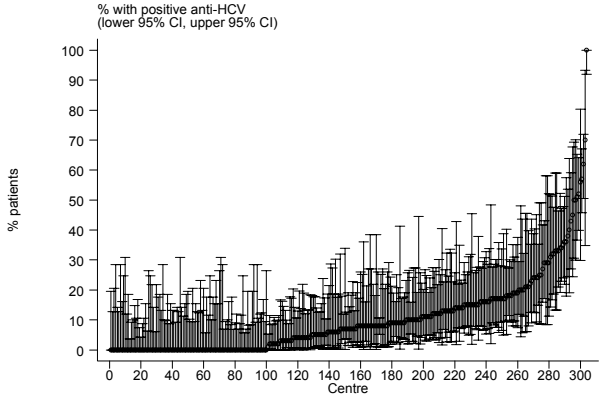
Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	9	0	0	0	1	3	6	6
1999	10	0	0	0	2	2	4	4
2000	11	0	0	0	1	4	5	5
2001	12	0	0	0	2	3	9	9
2002	15	0	0	1	3	6	18	18
2003	19	0	0	1	3	6	8	8
2004	19	0	0	1	3	5	11	11
2005	20	0	0	0.5	3	5	7.5	10
2006	22	0	0	2	4	6	9	13
2007	23	0	0	0	4	6	7	11

Figure 11.4: Variation in Proportion of patients with positive HBsAg among CAPD centres, 2007



There is only small center to center variation in the proportion of Hepatitis B patients for both HD and CAPD.

Figure 11.5: Variation in Proportion of patients with positive anti-HCV among HD centres, 2007



The median proportion of HCV infected HD patients continue to decline annually even though there remains a wide center to center variation in the prevalence of HCV infection. There should be continuing measures to implement and standardize strict infection control measures in the HD facility in order to reduce this center to center variation.

Table 11.5: Variation in Proportion of patients with positive anti-HCV at annual survey among HD centres, 2007

Year	No. of centre	Min	5th centile	LQ	Median	UQ	95th centile	Max
1998	50	0	0	9	20.5	30	61	78
1999	75	0	0	7	20	33	62	79
2000	108	0	0	8.5	18.5	30.5	70	91
2001	125	0	0	7	17	30	64	91
2002	157	0	0	5	14	25	58	96
2003	180	0	0	5.5	14	25.5	49.5	96
2004	205	0	0	4	11	25	49	100
2005	234	0	0	2	10	21	40	98
2006	291	0	0	0	8	18	45	98
2007	304	0	0	0	7	15	35	100

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

Table 11.6: Variation in Proportion of patients with positive anti-HCV at annual survey among CAPD centres, 2007

Year	No. of centre	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	7	7
2002	15	0	0	0	3	8	11	11
2003	19	0	0	1	4	8	9	9
2004	19	0	0	0	4	7	10	10
2005	20	0	0	2	4	7.5	9.5	10
2006	22	0	0	2	4	6	8	9
2007	23	0	0	1	3	6	8	9

Figure 11.6: Variation in Proportion of patients with positive anti-HCV among CAPD centres, 2007

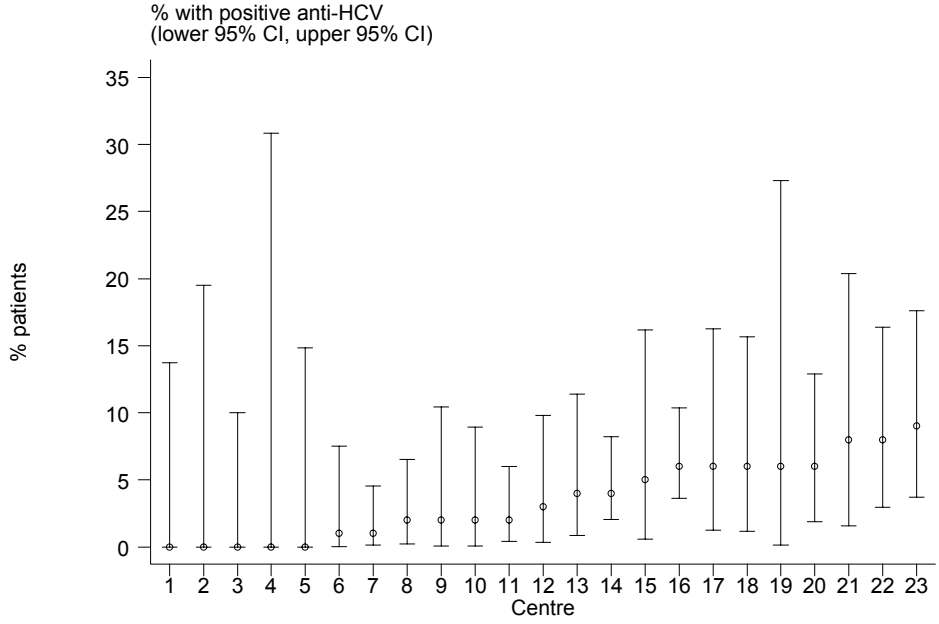


Table 11.7(a): Risk factors in relation to HD practices for seroconversion to anti-HCV positive among sero-negative patients

Risk factor	Number of patients	Risk Ratio	95% CI	p-value
Assistance to Perform HD				
(1) Self care [ref]	158	1.00		
(2) Partial self care	128	0.66	(0.52, 0.84)	0.001
(3) Completely assisted	311	0.43	(0.36, 0.53)	0.000
Dialyzer Reuse				
(1) less than 10 [ref]	260	1.00		
(2) more than 10	350	0.96	(0.82, 1.13)	0.654
Dialyzer Reprosessing System				
(1) Fully Auto [ref]	306	1.00		
(2) Semi Auto	25	1.29	(0.85, 1.95)	0.235
(3) Manual	45	1.01	(0.74, 1.39)	0.938
(4) No Reuse	1	2.91	(0.38, 22.45)	0.305
Age				
(1) <=20 [ref]	26	1.00		
(2) 21-40	200	1.06	(0.70, 1.61)	0.780
(3) 41-60	278	0.57	(0.38, 0.86)	0.008
(4) >60	106	0.32	(0.21, 0.49)	0.000
Gender				
(1) Female [ref]	239	1.00		
(2) Male	371	1.19	(1.01, 1.41)	0.035
Diabetes				
(1) No [ref]	444	1.00		
(2) Yes	166	0.41	(0.34,0.49)	0.000
Previous Renal Transplant				
(1) No [ref]	515	1.00		
(2) Yes	95	3.93	(3.13, 4.94)	0.000
History of Blood Transfusion				
(1) No [ref]	371	1.00		
(2) Yes	239	1.24	(1.05,1.46)	0.011

Risk factors for HCV seroconversion were previous renal transplant and a history of blood transfusion. There was also a trend of increasing risk with men and younger patients. Completely assisted HD patients and diabetics had a lower risk of acquiring HCV infection. This was not surprising as these patients are fully assisted by trained staffs who may be more stringent with infection control measures. Completely assisted patients also tend to have more co morbidities such as diabetes. This may explain why diabetics have a lower tendency to acquire HCV infection in the dialysis facility.

Table 11.7(b): 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]	26	1.00		
(2) 21-40	200	2.79	(0.93, 8.33)	0.067
(3) 41-60	278	1.66	(0.57, 4.86)	0.354
(4) >60	106	0.39	(0.09, 1.74)	0.216
Gender				
(1) Female [ref]	239	1.00		
(2) Male	371	1.26	(0.70, 2.30)	0.441
Diabetes				
(1) No [ref]	444	1.00		
(2) Yes	166	0.32	(0.15, 0.66)	0.002
Switch from HD to CAPD				
(1) No [ref]	3,443	1.00		
(2) Yes	283	8.59	(4.67, 15.81)	0.000
Previous Renal Transplant				
(1) No [ref]	515	1.00		
(2) Yes	95	1.95	(0.76, 4.98)	0.164
History of Blood Transfusion				
(1) No [ref]	371	1.00		
(2) Yes	239	1.79	(0.99, 3.23)	0.052

CAPD patients who were switched from HD, had previous renal transplant and blood transfusion had a tendency for increased risk of seroconversion.

Conclusion:

Nosocomial transmission in HD has been implicated for the higher HCV prevalence in HD compared to CAPD. Even though our efforts to reduce the overall prevalence of HCV in HD has been successful, a wide center to center variation still remains.

Areas of future research would include aspects of our current HD practices which may account for the wide center variation in HCV prevalence. These include dialyzer reuse practices, isolation and infection control protocols and staffing level.

CHAPTER 12

Haemodialysis Practices

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SECTION 12.1: VASCULAR ACCESS AND ITS COMPLICATIONS

Table 12.1.1: Vascular Access on Haemodialysis, 1998-2007

Access types	1998		1999		2000		2001		2002	
	No	%	No	%	No	%	No	%	No	%
Wrist AVF	1763	84	2406	81	3561	82	4049	79	4680	78
BCF*	273	13	431	14	655	15	897	17	1068	18
Venous graft	6	0	8	0	11	0	19	0	14	0
Artificial graft	20	1	34	1	31	1	64	1	78	1
Permanent CVC	8	0	17	1	19	0	25	0	43	1
Temporary CVC*	37	2	77	3	77	2	90	2	138	2
Temporary FVC*	0	0	0	0	0	0	0	0	0	0
TOTAL	2107	100	2973	100	4354	100	5144	100	6021	100

Access types	2003		2004		2005		2006		2007	
	No	%	No	%	No	%	No	%	No	%
Wrist AVF	5249	75	5891	73	6405	69	7798	68	8297	65
BCF*	1358	19	1692	21	2169	23	2856	25	3418	27
Venous graft	23	0	41	1	30	0	22	0	38	0
Artificial graft	114	2	150	2	221	2	284	2	304	2
Permanent CVC	62	1	99	1	180	2	235	2	261	2
Temporary CVC*	180	3	233	3	269	3	302	3	430	3
Temporary FVC*	0	0	0	0	7	0	24	0	30	0
TOTAL	6986	100	8106	100	9281	100	11521	100	12778	100

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

There proportion of patients with native vascular access remains at 92% in 2007. The ratio of brachiocephalic fistula (BCF) to arteriovascular fistula (AVF) has increased. In 2007, 27% of native vascular access was BCF. The proportion of patients with artificial graft remains at 2 % and permanent or temporary catheter remained at 5% in total.

Table 12.1.2: Difficulties reported with Vascular Access, 1998-2007

Access difficulty	1998		1999		2000		2001		2002	
	No	%	No	%	No	%	No	%	No	%
Difficulty with needle placement	82	4	133	5	146	4	217	5	215	4
Difficulty in obtaining desired blood flow rate	60	3	112	5	136	4	239	5	235	4
Other difficulties	30	2	55	2	32	1	39	1	57	1
No difficulties	1778	91	2155	88	3402	92	4276	90	5073	91
TOTAL	1950	100	2455	100	3716	100	4771	100	5580	100

Access difficulty	2003		2004		2005		2006		2007	
	No	%	No	%	No	%	No	%	No	%
Difficulty with needle placement	217	3	255	3	319	4	394	3	478	4
Difficulty in obtaining desired blood flow rate	243	4	301	4	354	4	356	3	368	3
Other difficulties	60	1	67	1	58	1	45	0	57	0
No difficulties	5969	92	6956	92	8339	92	10592	93	11559	93
TOTAL	6489	100	7579	100	9070	100	11387	100	12462	100

Complication rates have remained similar despite an increase in intake of elderly and diabetic patients on dialysis in recent years.

Table 12.1.3: Complications reported with Vascular Access, 1998-2007

Complication	1998		1999		2000		2001		2002	
	No	%	No	%	No	%	No	%	No	%
Thrombosis	69	3	129	5	148	4	209	4	202	3
Bleed	37	2	23	1	30	1	62	1	66	1
Aneurysmal dilatation	134	6	159	6	208	5	212	4	211	4
Swollen limb	36	2	51	2	44	1	67	1	56	1
Access related infection, local/ systemic	21	1	34	1	52	1	49	1	52	1
Distal limb ischaemia	12	1	9	0	26	1	22	0	17	0
Venous outflow obstruction	50	2	71	3	78	2	123	2	101	2
Carpal tunnel	19	1	35	1	42	1	41	1	44	1
Others	48	2	64	2	37	1	74	1	118	2
No complications	1636	79	2119	79	3237	83	4204	83	4988	85
TOTAL	2062	100	2694	100	3902	100	5063	100	5855	100

Complication	2003		2004		2005		2006		2007	
	No	%	No	%	No	%	No	%	No	%
Thrombosis	220	3	284	4	289	3	317	3	405	3
Bleed	54	1	67	1	73	1	69	1	58	0
Aneurysmal dilatation	199	3	193	2	179	2	246	2	385	3
Swollen limb	55	1	77	1	84	1	89	1	101	1
Access related infection, local/ systemic	43	1	70	1	63	1	78	1	97	1
Distal limb ischaemia	13	0	37	0	35	0	30	0	27	0
Venous outflow obstruction	119	2	151	2	170	2	202	2	196	2
Carpal tunnel	63	1	49	1	55	1	48	0	46	0
Others	118	2	133	2	109	1	116	1	152	1
No complications	5962	87	6895	87	8113	88	10154	89	11034	88
TOTAL	6846	100	7956	100	9170	100	11349	100	12501	100

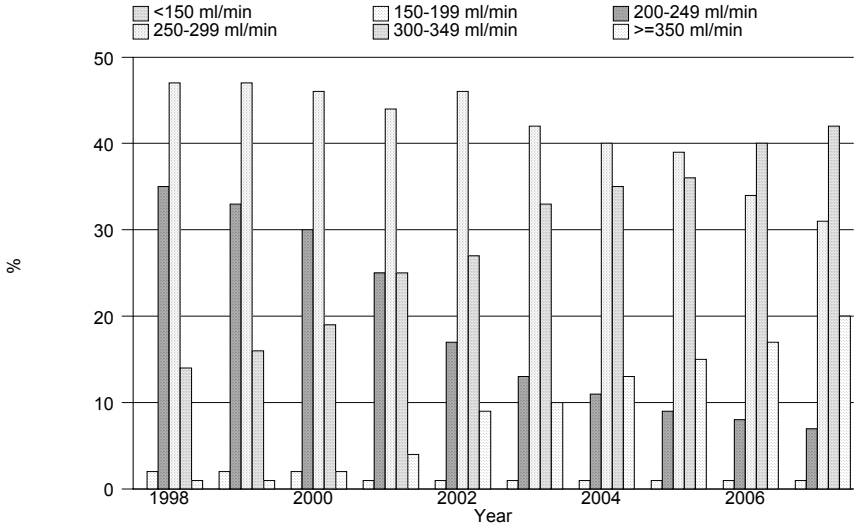
SECTION 12.2: HD PRESCRIPTION

Table 12.2.1: Blood Flow Rates in HD centres, 1998-2007

Blood flow rates	1998		1999		2000		2001		2002	
	No	%	No	%	No	%	No	%	No	%
<150 ml/min	4	0	6	0	9	0	7	0	9	0
150-199 ml/min	36	2	65	2	85	2	69	1	69	1
200-249 ml/min	735	35	962	33	1282	30	1233	25	973	17
250-299 ml/min	968	47	1367	47	1938	46	2229	44	2692	46
300-349 ml/min	298	14	455	16	814	19	1276	25	1590	27
>=350 ml/min	30	1	31	1	94	2	216	4	505	9
TOTAL	2071	100	2886	100	4222	100	5030	100	5838	100

Blood flow rates	2003		2004		2005		2006		2007	
	No	%	No	%	No	%	No	%	No	%
<150 ml/min	4	0	11	0	7	0	5	0	10	0
150-199 ml/min	84	1	86	1	94	1	103	1	87	1
200-249 ml/min	882	13	879	11	814	9	923	8	928	7
250-299 ml/min	2865	42	3112	40	3523	39	3818	34	3817	31
300-349 ml/min	2240	33	2711	35	3226	36	4529	40	5201	42
>=350 ml/min	690	10	1019	13	1328	15	1920	17	2451	20
TOTAL	6765	100	7818	100	8992	100	11298	100	12494	100

Figure 12.2.1: Blood Flow Rates in HD centres, 1998-2007



There was an increasing trend toward the use of higher blood flow rates from 1998 to 2007. The proportion of patients with blood flow rates > 350mls/min increased from 1% in 1998 to 20% in 2007. Sixty two percent of patients had blood flow rates of > 300mls/min in 2007.

Ninety eight 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 are dialyzing in private centres and unable to afford 3 HD sessions / week.

Majority of patients (99%) are on 4 hours HD session.

Table 12.2.2: Number of HD Sessions per week, 1998-2007

HD sessions	1998		1999		2000		2001		2002	
per week	No	%	No	%	No	%	No	%	No	%
1	1	0	4	0	8	0	8	0	10	0
2	5	0	153	5	341	8	337	7	369	6
3	2110	100	2811	95	3982	92	4761	92	5603	93
4	2	0	3	0	10	0	50	1	18	0
TOTAL	2118	100	2971	100	4341	100	5156	100	6000	100

HD sessions	2003		2004		2005		2006		2007	
per week	No	%	No	%	No	%	No	%	No	%
1	15	0	11	0	7	0	25	0	14	0
2	343	5	281	3	265	3	273	2	256	2
3	6557	95	7708	96	9010	97	11326	97	12584	98
4	9	0	30	0	31	0	34	0	31	0
TOTAL	6924	100	8030	100	9313	100	11658	100	12885	100

Table 12.2.3: Duration of HD, 1998-2007

Duration of HD	1999		1999		2000		2001		2002	
per session	No	%	No	%	No	%	No	%	No	%
<=3 hours	3	0	4	0	8	0	6	0	18	0
-3.5 hours	18	1	9	0	12	0	33	1	15	0
-4 hours	1993	94	2735	92	4053	93	4956	96	5845	98
-4.5 hours	91	4	160	5	189	4	106	2	68	1
-5 hours	8	0	61	2	77	2	59	1	48	1
>5 hours	3	0	0	0	13	0	0	0	0	0
TOTAL	2116	100	2969	100	4352	100	5160	100	5994	100

Duration of HD	2003		2004		2005		2006		2007	
per session	No	%	No	%	No	%	No	%	No	%
<=3 hours	11	0	23	0	22	0	28	0	36	0
-3.5 hours	7	0	17	0	17	0	7	0	12	0
-4 hours	6760	98	7829	97	9152	98	11504	99	12754	99
-4.5 hours	76	1	119	1	67	1	68	1	42	0
-5 hours	66	1	47	1	54	1	42	0	32	0
>5 hours	0	0	3	0	0	0	1	0	1	0
TOTAL	6920	100	8038	100	9312	100	11650	100	12877	100

Table 12.2.4: Dialyser membrane types in HD centres, 1998-2007

Dialyser	1998		1999		2000		2001		2002	
membrane	No	%	No	%	No	%	No	%	No	%
Modified Cellulose	395	19	1224	41	1605	37	1666	37	1376	24
Regenerated Cellulose	1195	56	1012	34	1183	27	890	20	1473	26
Hydrophobic/Hydrophilic	524	25	754	25	1589	36	1944	43	2828	50
Hydrophilized copolymers	2	0	1	0	0	0	0	0	1	0
TOTAL	2116	100	2991	100	4377	100	4500	100	5678	100

Dialyser	2003		2004		2005		2006		2007	
membrane	No	%	No	%	No	%	No	%	No	%
Modified Cellulose	1114	17	1717	22	1919	21	2351	21	2803	23
Regenerated Cellulose	1502	23	1150	15	901	10	951	8	688	6
Hydrophobic/Hydrophilic	3782	59	4843	62	5976	67	7789	69	8813	71
Hydrophilized copolymers	35	1	74	1	139	2	132	1	134	1
TOTAL	6433	100	7784	100	8935	100	11223	100	12438	100

The use of synthetic membrane (hydrophobic/ hydrophilic and hydrophilised copolymer) has increased from 25% in 1998 to 72% in 2007. Regenerated cellulose membrane usage has progressively declined from 56% in 1998 to 6% in 2007. The use of modified cellulose membrane has increased over the same period to 23% in 2008.

Figure 12.2.4: Dialyser membrane types in HD centres, 1998-2007

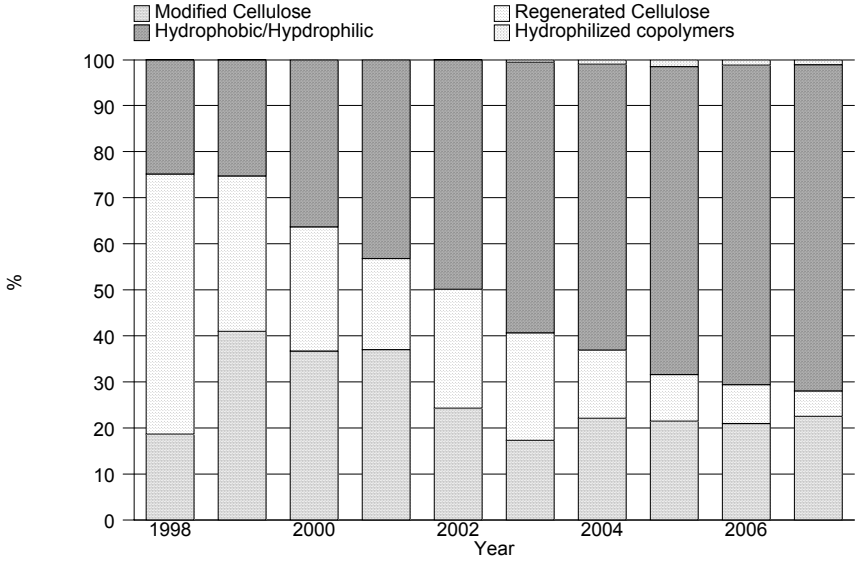


Table 12.2.5: Dialyser Reuse Frequency in HD centres, 1998-2007

Dialyser reuse	1998		1999		2000		2001		2002	
frequency	No	%	No	%	No	%	No	%	No	%
1*	16	1	65	2	116	3	152	3	197	4
2	5	0	13	0	17	0	15	0	41	1
3	215	11	191	7	205	5	232	5	316	6
4	113	6	250	9	477	12	416	9	337	6
5	137	7	264	10	312	8	357	7	318	6
6	1072	55	1414	51	1730	43	1413	29	1216	22
7	37	2	46	2	69	2	85	2	124	2
8	66	3	122	4	357	9	793	16	866	16
9	109	6	179	6	101	2	132	3	59	1
10	84	4	96	3	246	6	400	8	538	10
11	23	1	6	0	4	0	43	1	36	1
12	64	3	118	4	333	8	470	10	879	16
>=13	0	0	0	0	91	2	331	7	644	12
TOTAL	1941	100	2764	100	4058	100	4839	100	5571	100

Dialyser reuse	2003		2004		2005		2006		2007	
frequency	No	%	No	%	No	%	No	%	No	%
1*	251	4	319	4	196	4	400	5	568	5
2	19	0	42	1	1	0	5	0	24	0
3	349	5	194	3	81	2	36	0	117	1
4	339	5	192	3	85	2	75	1	151	1
5	266	4	191	3	137	3	190	3	128	1
6	915	14	806	11	555	10	593	8	809	7
7	71	1	89	1	44	1	63	1	138	1
8	852	13	809	11	477	9	422	6	797	7
9	87	1	50	1	46	1	115	2	107	1
10	880	14	1160	16	770	15	959	13	1530	13
11	25	0	42	1	12	0	100	1	94	1
12	1511	24	1916	26	1353	26	2243	30	4074	36
>=13	819	13	1644	22	1548	29	2191	30	2817	25
TOTAL	6384	100	7454	100	5305	100	7392	100	11354	100

Reuse of 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.

Table 12.2.6: Dialysate Buffer used in HD centres, 1998-2007

Dialysate buffer	1998		1999		2000		2001		2002	
	No	%	No	%	No	%	No	%	No	%
Acetate	627	30	552	19	393	9	240	5	138	2
Bicarbonate	1492	70	2429	81	3969	91	4920	95	5880	98
TOTAL	2119	100	2981	100	4362	100	5160	100	6018	100

Dialysate buffer	2003		2004		2005		2006		2007	
	No	%	No	%	No	%	No	%	No	%
Acetate	76	1	33	0	58	1	147	1	176	1
Bicarbonate	6814	99	7956	100	9268	99	11640	99	12836	99
TOTAL	6890	100	7989	100	9326	100	11787	100	13012	100

Ninety nine percent of patients were on bicarbonate dialysate buffer in 2007 compared to 70% in 1998. One percent of patients were still reported to use acetate as buffer.

Table 12.2.7(a): Distribution of prescribed KT/V, HD patients 1998-2007

Year	No.of subjects	Mean	SD	Median	LQ	UQ	% patients ≥ 1.3
1998	2022	1.4	0.3	1.4	1.2	1.6	65
1999	2831	1.5	0.4	1.5	1.3	1.7	72
2000	4087	1.5	0.4	1.5	1.3	1.7	73
2001	4908	1.5	0.4	1.5	1.3	1.7	73
2002	5496	1.5	0.4	1.5	1.3	1.7	73
2003	6515	1.6	0.4	1.6	1.3	1.8	79
2004	7452	1.6	0.4	1.6	1.4	1.8	81
2005	8749	1.6	0.4	1.6	1.4	1.9	81
2006	11092	1.6	0.4	1.6	1.3	1.8	77
2007	12336	1.6	0.4	1.6	1.3	1.8	78

The median prescribed KT/V was 1.6. The percentage of patients with KT/V > 1.3 has increased from 65% in 1998 to 78% in 2007. There is a slight decrease when compared to 2005 when 81% had KT/V > 1.3.

Figure 12.2.7(a): Cumulative distribution of prescribed KT/V, HD patients 1998-2007

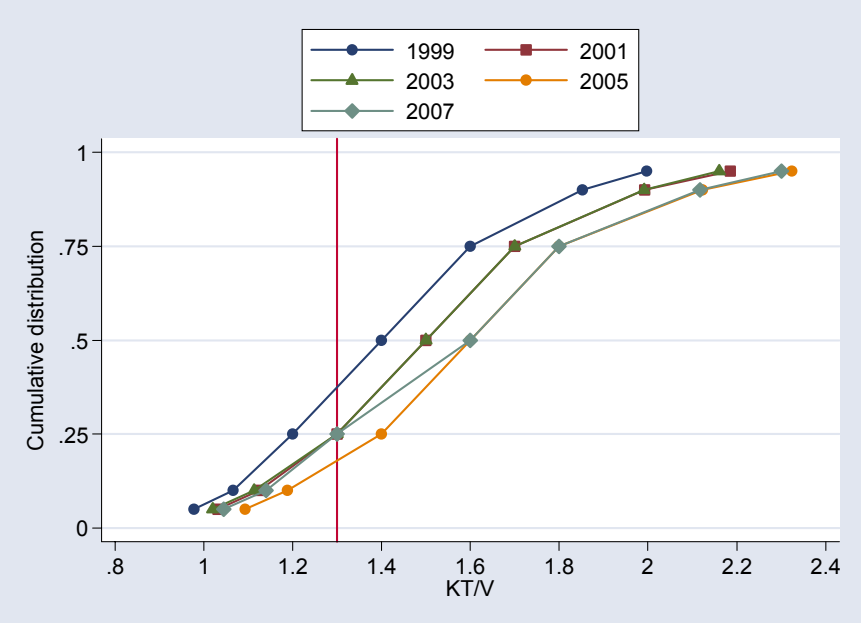
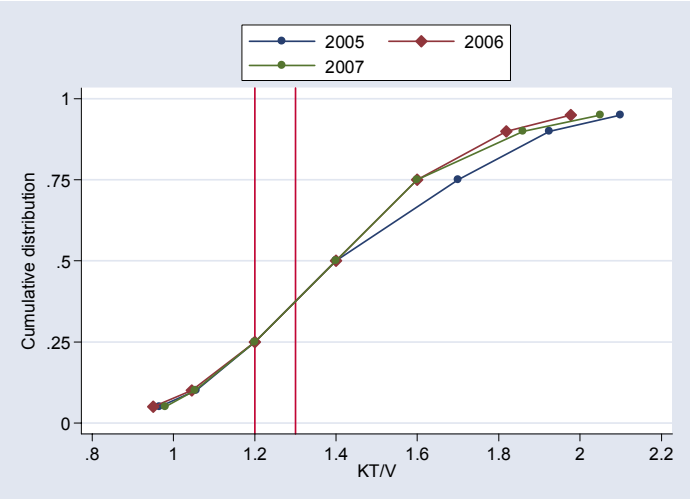


Table 12.2.7(b): Distribution of delivered KT/V, HD patients 2005-2007

Year	No.of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥1.2	% Patients ≥1.3	Variance*
2005	1760	1.6	2.7	1.4	1.2	1.7	80	63	0
2006	5555	1.4	1.3	1.4	1.2	1.6	76	59	0
2007	6346	1.5	0.6	1.4	1.2	1.6	78	62	0

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

Figure 12.2.7(b): Cumulative distribution of delivered KT/V, HD patients 2005-2007

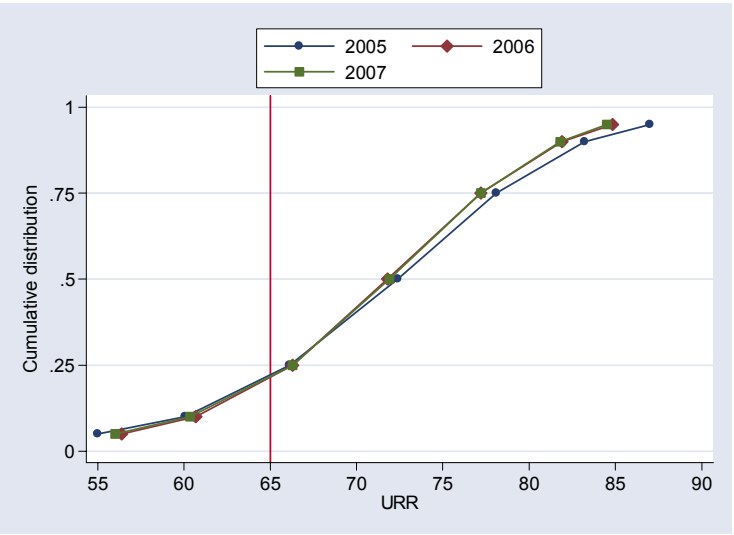


Although the prescribed median KT/V was 1.6, the delivered median KT/V was only 1.4. The percentage of patients with a delivered KT/V > 1.3 had increased from 59% in 2006 to 62% in 2007.

Table 12.2.7(c): Distribution of URR, HD patients 2005-2007

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patient ≥65
2005	2510	71.8	10.2	72.4	66.1	78.1	79
2006	8170	71.4	9.2	71.8	66.3	77.2	79
2007	9838	71.3	9.2	71.9	66.3	77.2	80

Figure 12.2.7(c): Cumulative distribution of URR, HD patients 2005-2007



The percentage of patients with URR > 65 was 80% in 2007 compared to 79% in 2006.

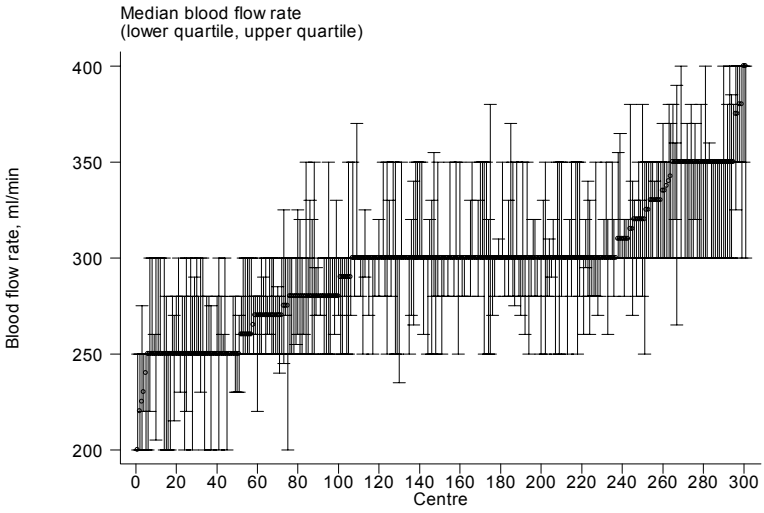
Table 12.2.8: Variation in HD prescription among HD centres 2007.

(a) Median blood flow rates in HD patients, HD centres

Year	No.of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	283	200	250	270	300	300	350	400
2007	301	200	250	280	300	300	350	400

The median blood flow rates among centres had increased from 250 mls/min in 1998 to 300mls/min in 2007. There was still a wide variation in practices among centres. The median blood flow rates among centres ranged from 200mls/min to 400mls/min.

Figure 12.2.8(a): Variation in medical blood flow rates in HD patients among centres 2007



(b) Proportion of patients with blood flow rates > 250 ml/min, HD centres

Year	No.of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	283	0	19	56	81	92	100	100
2007	301	0	22	65	83	93	100	100

There was an increase in the proportion of patients with blood flow rates from >250mls/min. In 2007, 50% of centres had 83% of their patients with blood flow rates of > 250mls/min compared to only 20.5% in 1998.

There was still a wide variation in the proportion of patients with blood flow rate > 250mls/min among centres. Three centres that had no patients with blood flow rates of > 250mls/min.

Figure 12.2.8(b): Variation in Proportion of patients with blood flow rates > 250 ml/min among HD centres 2007

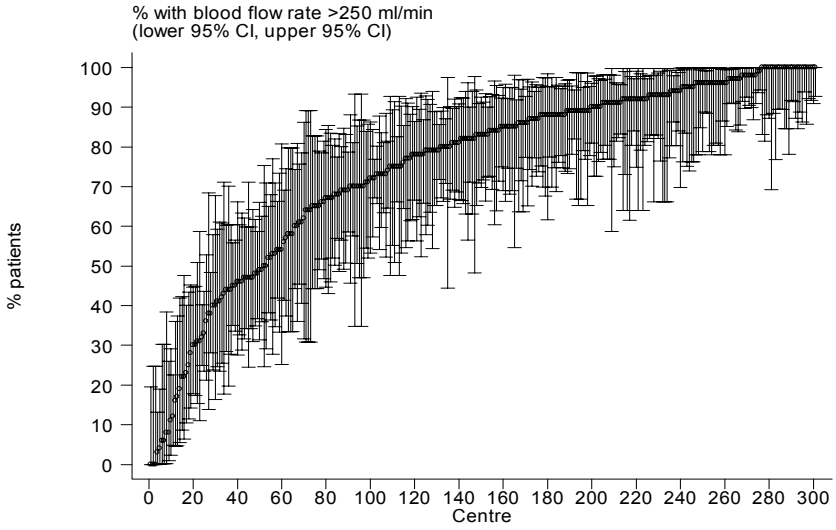


Table 12.2.8(c): Proportion of patients with 3 HD sessions per week, HD centres

Year	No.of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	287	52	83	98	100	100	100	100
2007	308	51	87	98	100	100	100	100

The majority of centres had 100% of their patients with 3 HD sessions/ week. Three centres had less than 60% of their patients on less than 3 HD session/ week.

Figure 12.2.8(c): Variation in proportion of patients with 3 HD sessions per week among HD centres 2007

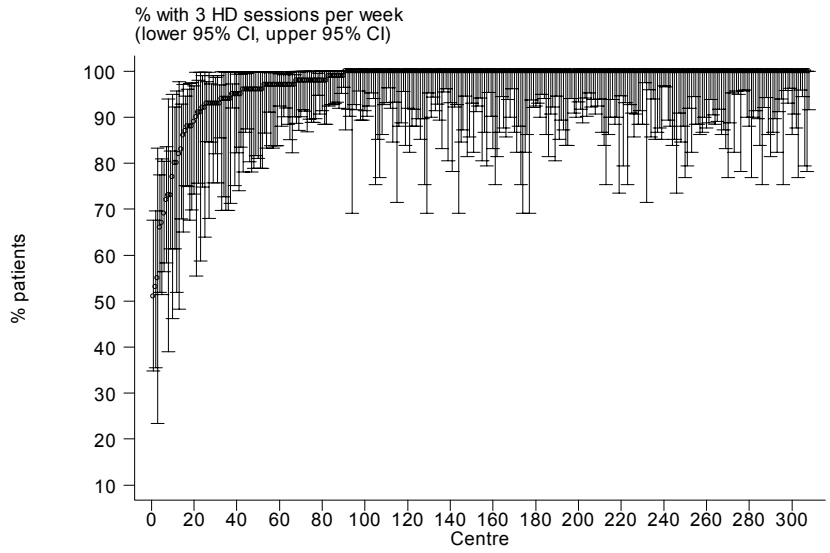
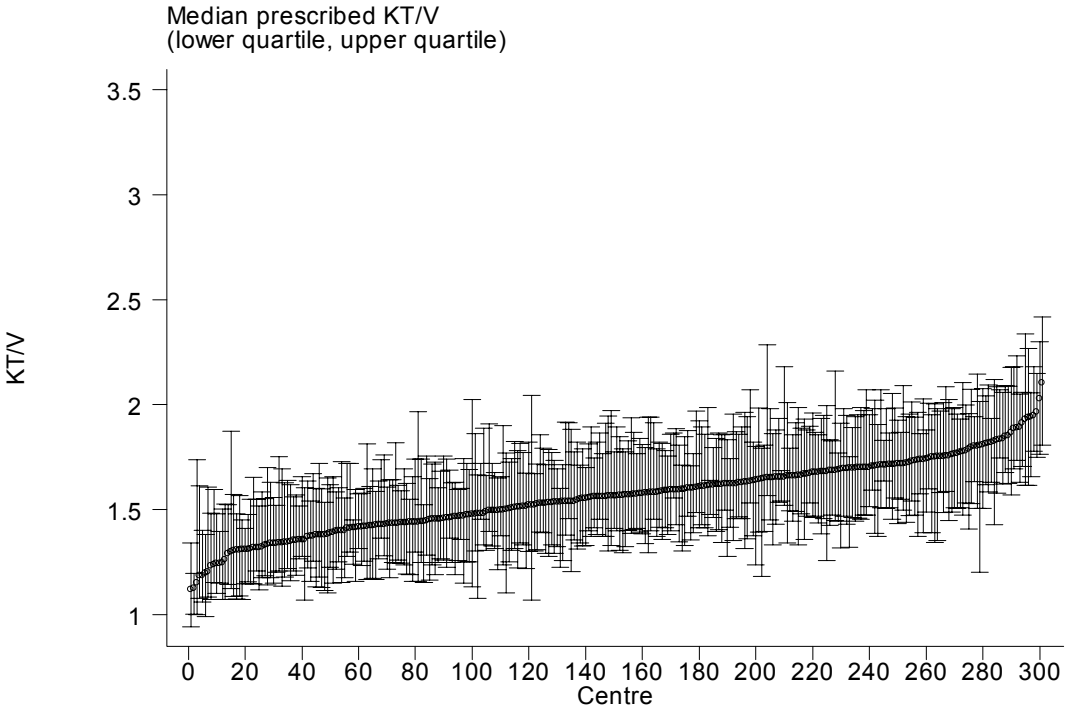


Table 12.2.8(d): Median prescribed KT/V in HD patients, HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	45	1.1	1.3	1.3	1.4	1.5	1.5	1.6
1999	67	1.1	1.3	1.4	1.5	1.6	1.8	1.8
2000	99	1	1.3	1.4	1.5	1.6	1.8	2.8
2001	114	1.2	1.3	1.4	1.5	1.6	1.7	1.9
2002	132	1.2	1.3	1.4	1.5	1.6	1.7	1.8
2003	150	1.1	1.3	1.5	1.6	1.7	1.9	2
2004	181	1.2	1.4	1.5	1.6	1.7	1.8	2.2
2005	224	1.2	1.3	1.5	1.6	1.7	1.8	2
2006	281	1	1.3	1.4	1.6	1.7	1.8	2.1
2007	301	1.1	1.3	1.4	1.6	1.7	1.8	2.1

Figure 12.2.8(d): Variation in median prescribed KT/V in HD patients among HD centres 2007

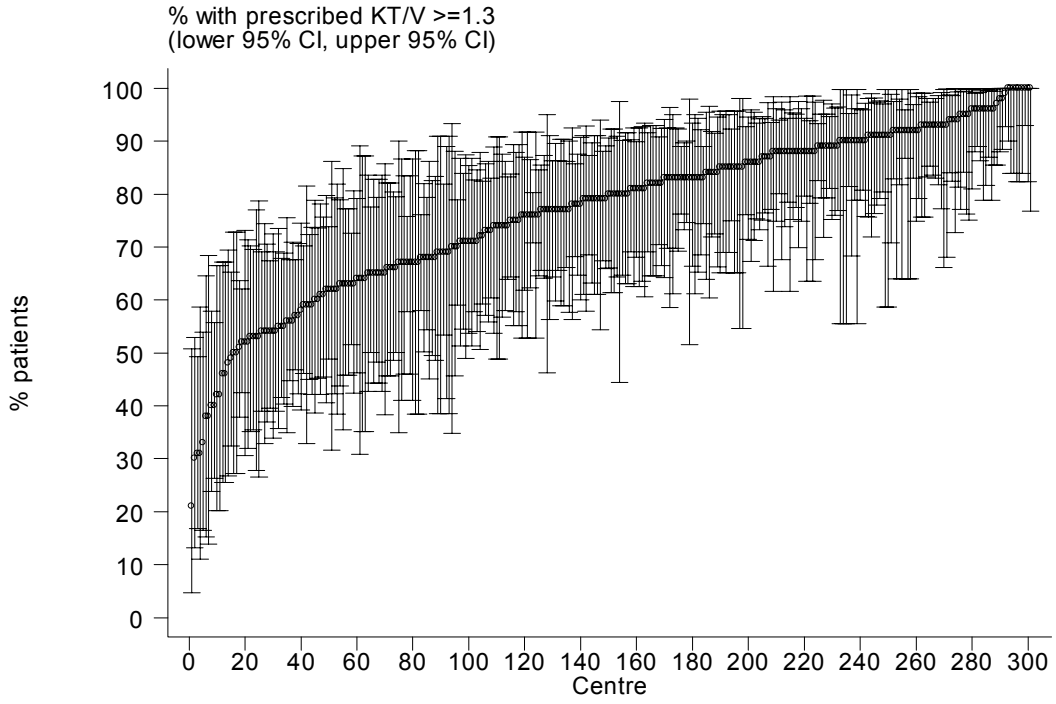


The median prescribed KT/V in HD patients was 1.6 in 2007. The minimum prescribed KT/V was 1.1 and maximum KT/V was 2.1.

Table 12.2.8(e): Proportion of patients with prescribed KT/V ≥ 1.3

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1998	45	0	46	57	67	73	83	88
1999	67	29	45	64	73	84	94	100
2000	99	26	43	64	78	85	94	100
2001	114	33	42	66	74.5	83	93	100
2002	132	26	43	65	74.5	83	92	98
2003	150	30	48	72	81	89	95	100
2004	181	28	58	74	83	91	98	100
2005	224	32	56	73	82	90	98	100
2006	281	0	46	67	79	87	96	100
2007	301	21	50	67	80	89	96	100

Figure 12.2.8(e): Variation in proportion of patients with prescribed KT/V ≥ 1.3 among HD centres 2007



In 2007, half the centres had 80% of their patients with a prescribed KT/V > 1.3. However there was still a wide variation in proportion of patients with KT/V > 1.3 among the centres.

Table 12.2.8(f): Median delivered KT/V in HD patients, HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	52	1.1	1.2	1.3	1.4	1.5	1.7	1.7
2006	142	1	1.2	1.3	1.4	1.5	1.6	1.7
2007	156	1.1	1.2	1.3	1.4	1.5	1.7	1.8

In 2007, 156 centres reported delivered KT/V compared to only 52 centres in 2005.
The median delivered KT/V was 1.4.
The variation of median delivered KT/V ranged from1.1 to 1.8 in 2007.

Figure 12.2.8(f): Variation in median delivered KT/V in HD patients among HD centres 2007

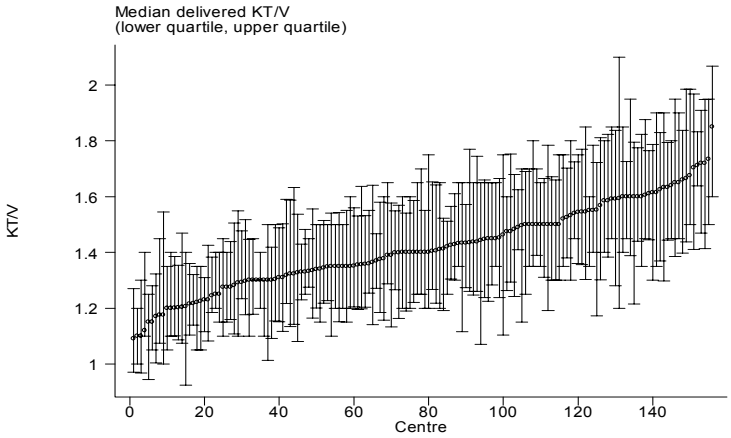


Table 12.2.8(g): Proportion of patients with delivered KT/V ≥ 1.2

Year	No.of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	52	36	40	69	81.5	90	100	100
2006	142	0	43	65	76.5	86	94	100
2007	156	34	46	69.5	79	89	97	100

In 2007, 50% of centres had 79% of their patients with a delivered KT/V > 1.2. There were 3 centres with < 40% of their patients with a delivered KT/V > 1.2.

Figure 12.2.8(g): Variation in proportion of patients with delivered KT/V ≥ 1.2

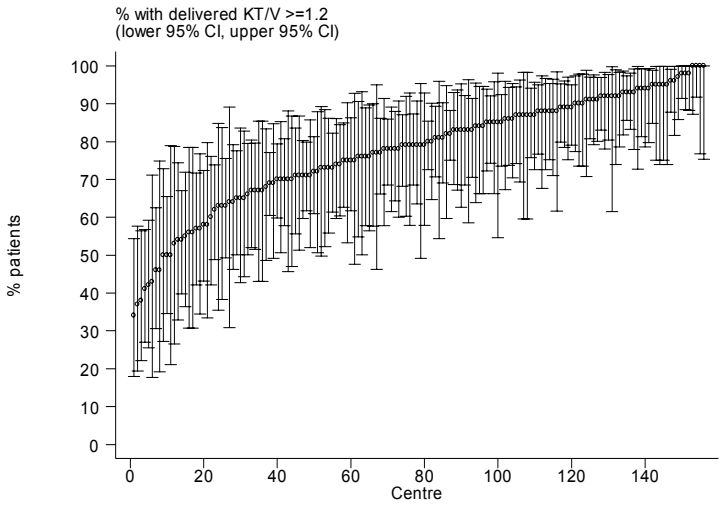


Table 12.2.8(h): Median URR among HD patients, HD centres

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	214	55.4	64.2	69	71.4	74.2	78.2	94.4
2007	244	56.1	65.4	69.5	71.8	74.7	78.1	95.5

Figure 12.2.8(h): Variation in median URR among HD patients, HD centres 2007

The median URR for 2007 was 71.8%. The number of centres reporting URR has increased from 73 in 2005 to 244 in 2007.

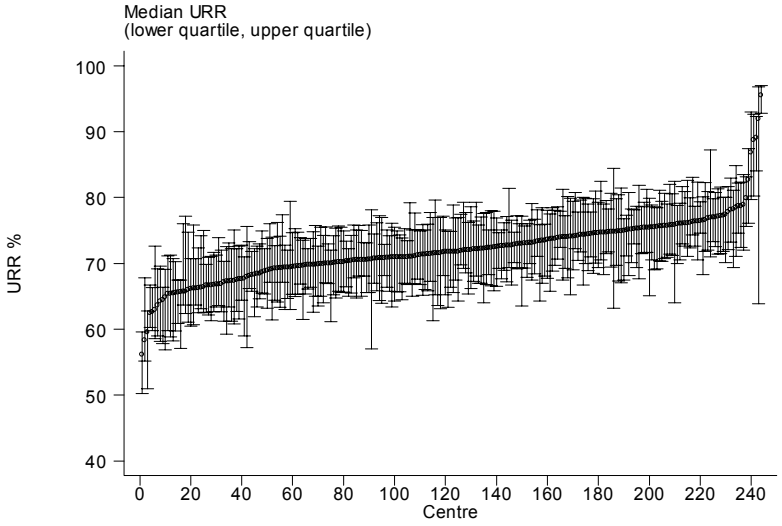
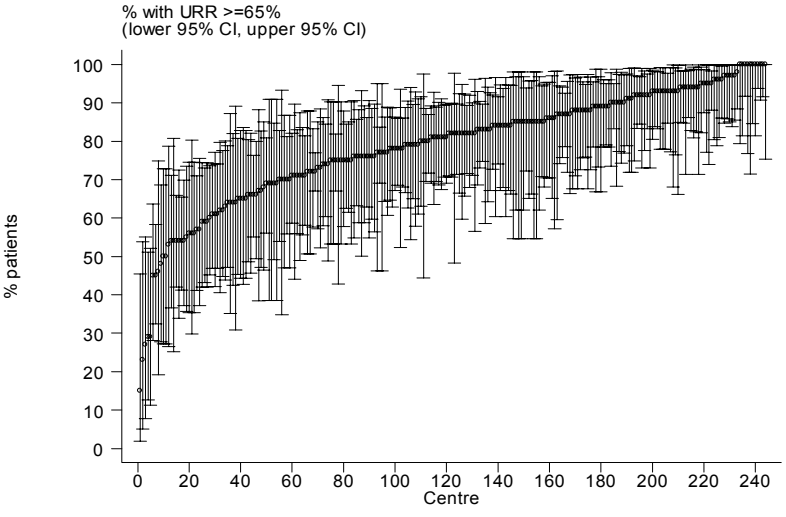


Table 12.2.8 (i): Proportion of HD patients with URR ≥ 65%, HD centres

Year	No.of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	73	40	53	70	81	88	100	100
2006	214	0	50	69	80	88	97	100
2007	244	15	54	71	82	89.5	97	100

Figure 12.2.8(i): Variation in proportion of patients with URR ≥ 65% among HD centres 2007

In 2007, 50% of centres had 82% of their patients with a URR >65%. There were 4 centres with less than 40% of their patients with URR > 65%



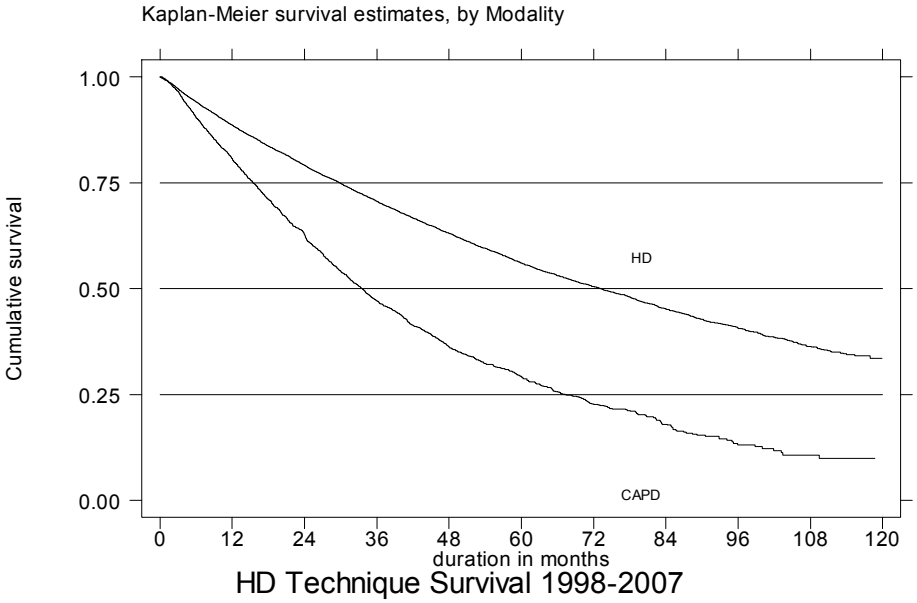
SECTION 12.3: TECHNIQUE SURVIVAL ON DIALYSIS

Table 12.3.1: Unadjusted technique survival by Dialysis modality, 1998-2007

Dialysis modality Interval (month)	CAPD			HD			All Dialysis		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
6	2865	90	1	19841	94	0	22706	94	0
12	2289	81	1	16940	89	0	19229	88	0
24	1456	63	1	12328	79	0	13784	77	0
36	910	47	1	8947	71	0	9857	68	0
48	565	36	1	6322	63	0	6887	6	0
60	332	29	1	4343	56	0	4675	53	0
72	178	23	1	2885	50	0	3063	47	0
84	91	18	1	1785	45	1	1875	42	1
96	36	13	1	1008	41	1	1043	37	1
108	16	11	1	419	36	1	434	33	1

* No.=Number at risk SE = standard error

Figure 12.3.1: Unadjusted technique survival by Dialysis modality, 1998 – 2007



The unadjusted HD technique survival at 1 year, 5 years and 9 years was 89%, 56% and 36% respectively. The unadjusted CAPD technique survival was 81% at 1 year, 29% at 5 years and 11% at 8 years.

Table 12.3.2: Unadjusted technique survival by year of entry, 1998-2007

Year	1998			1999			2000		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	1102	95	1	1322	95	1	1602	94	1
12	1052	92	1	1237	90	1	1482	89	1
24	944	84	1	1098	82	1	1278	79	1
36	841	76	1	961	73	1	1125	71	1
48	746	68	1	838	64	1	982	63	1
60	666	61	1	740	57	1	853	55	1
72	604	56	1	667	52	1	754	49	1
84	527	49	2	597	47	1	663	44	1
96	477	45	2	532	42	1	.	.	.
108	419	40	1	.	.	.	.	.	.

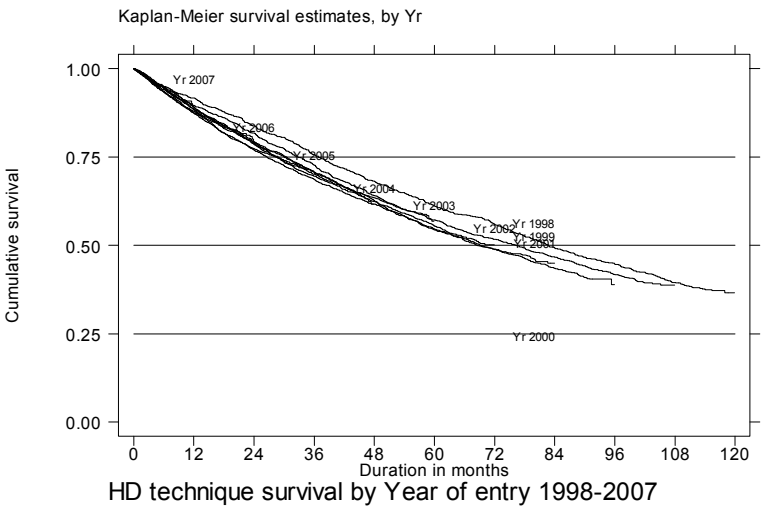
Year	2001			2002			2003			2004		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	1769	93	1	2011	94	1	2162	94	0	2543	94	0
12	1623	87	1	1883	89	1	2003	88	1	2351	88	1
24	1407	77	1	1617	79	1	1768	7	1	2056	79	1
36	1238	69	1	1433	70	1	1563	71	1	1790	70	1
48	1101	62	1	1268	62	1	1392	63	1	.	.	.
60	967	54	1	1120	55	1	.	.	.	.	.	.
72	864	49	1	.	.	.	.	.	.	.	.	.

Year	2005			2006			2007		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	2691	93	0	3028	93	0	1617	95	0
12	2488	87	1	2824	88	1	.	.	.
24	2164	77	1	.	.	.	.	.	.

No.=Number at risk SE = standard error

There was no apparent difference in the unadjusted HD technique survival by year of starting dialysis for the years 1998 to 2007.

Figure 12.3.2: Unadjusted technique survival by year of entry, 1998-2007



HD technique survival by Year of entry 1998-2007

Table 12.3.3: Unadjusted technique survival by age, 1998 – 2007

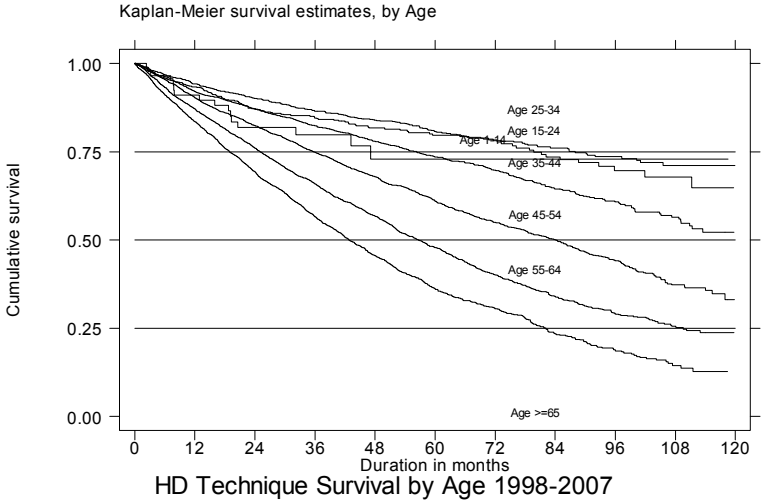
Age group (years) Interval (month)	<= 14			15-24			25-34			35-44		
	No.	% Survival	SE	No	% Survival	SE	No.	% Survival	SE	No	% Survival	SE
6	74	96	2	738	96	1	1503	97	0	2677	96	0
12	66	91	3	644	93	1	1326	94	1	2331	92	1
24	49	82	5	475	87	1	1024	90	1	1837	87	1
36	36	80	5	373	85	1	817	86	1	1452	82	1
48	21	73	6	278	82	2	655	84	1	1113	78	1
60	16	73	6	210	80	2	495	81	1	850	74	1
72	11	73	6	152	78	2	350	78	1	622	70	1
84	9	73	6	100	74	2	258	76	2	403	64	1
96	6	73	6	59	70	3	161	74		235	61	2
108	3	73	6	25	68	3	72	71	2	111	56	2

Age group (years) Interval (month)	45-54			55-64			>=65		
	No.	% Survival	SE	No	% Survival	SE	No	% Survival	SE
6	5102	95	0	5544	93	0	4204	91	0
12	4384	90	0	4728	87	0	3480	84	1
24	3244	82	1	3389	76	1	2314	69	1
36	2423	7	1	2354	66	1	1497	57	1
48	1749	68	1	1598	57	1	915	46	1
60	1238	61	1	1014	48	1	522	36	1
72	826	5	1	617	40	1	312	31	1
84	525	50	1	354	34	1	144	24	1
96	292	44	1	193	29	1	68	18	1
108	111	37	2	76	26	1	27	15	2

* No.=Number at risk SE = standard error

The unadjusted HD technique survival was better in the younger age groups than the older age group, 9-years unadjusted HD technique survival in the age group of 25-34, 35-44, 44-54, 55-64 and > 65 years old was 71%, 56 %, 37%, 26% and 15% respectively.

Figure 12.3.3: Unadjusted technique survival by age, 1998 – 2007



HD Technique Survival by Age 1998-2007

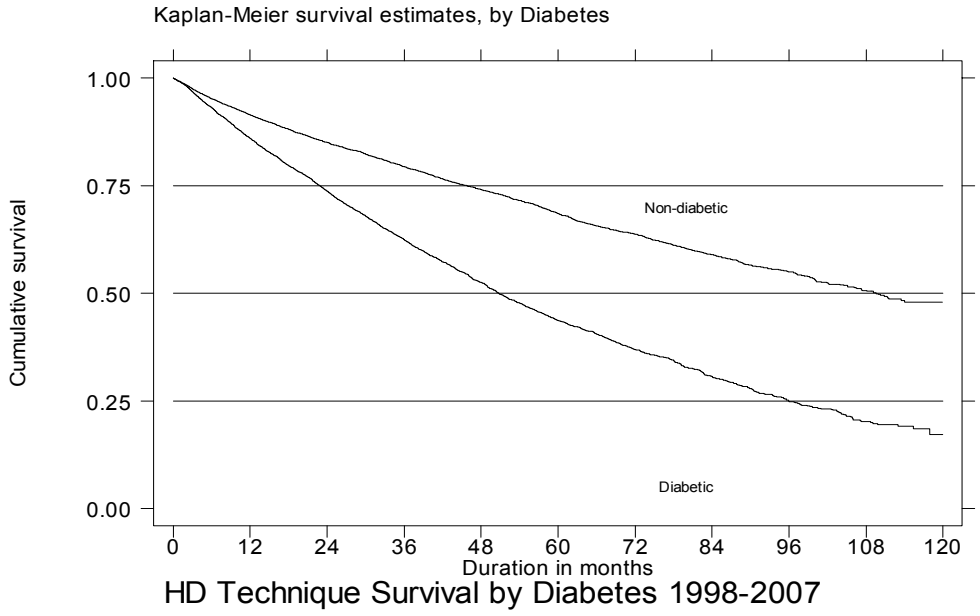
Unadjusted HD technique survival in non diabetics at 1 year, 5 years and 9 years was 91%, 69% and 51% respectively. Unadjusted HD technique survival for diabetics was worse than non diabetics with 86% at 1 year, 44% at 5 years and only 21% at 9 years.

Table 12.3.4: Unadjusted technique survival by Diabetes status, 1998-2007

Diabetes status	Non-Diabetic			Diabetic		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE
6	9468	95	0	10373	93	0
12	8253	91	0	8687	78	0
24	6398	85	0	5930	74	0
36	4990	79	0	3957	62	1
48	3785	74	1	2537	52	1
60	2794	69	1	1549	44	1
72	1968	64	1	917	37	1
84	1284	59	1	503	31	1
96	764	55	1	244	25	1
108	319	51	1	101	20	1

* No.=Number at risk SE = standard error

Figure 12.3.4: Unadjusted technique survival by Diabetes status, 1998 – 2007



CHAPTER 13

Chronic Peritoneal Dialysis Practices

Sunita Bavanandan
Lily Mushahar

SECTION 13.1: PD PRACTICES

13.1 : Mode of PD (Tables 13.1.1 to 13.1.4)

In 2007, there were a total of 1801 patients on peritoneal dialysis (PD), of which 92% were on CAPD and 8% on automated PD (APD). Compared with 2 years ago, the percentage of APD penetration has doubled but the number is still small. This could be explained by the fact that APD is largely only available for government pensioners or paediatric patients who receive funding from the National Kidney Foundation and the PD industry. Daytime ambulatory PD (DAPD) is still prescribed in up to 6% of patients to minimize fluid absorption during overnight dwell. This PD regime is utilised mainly as an alternative to Icodextrin use or APD which would be more costly.

Most patients were on the Baxter disconnect system (92%) and the majority (90%) do 4 exchanges per day. Five percent of patients required 5 exchanges per day but this figure may not truly reflect the dwell volumes required for PD adequacy as some patients may be converted to haemodialysis rather than increase the number of daily exchanges. Most patients (88%) used a fill volume of 2L but up to 10% were using larger fill volumes.

Table 13.1.1: Chronic Peritoneal Dialysis Regimes, 1998-2007

PD regime	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	492	93	577	96	633	97	755	98	837	97
DAPD	32	6	16	3	16	2	17	2	24	3
Automated PD/ CCPD	6	1	6	1	5	1	2	0	3	0
TOTAL	530	100	599	100	654	100	774	100	864	100

PD regime	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	1153	97	1211	96	1297	93	1393	90	1542	86
DAPD	33	3	39	3	45	3	67	4	115	6
Automated PD/ CCPD	5	0	12	1	50	4	88	6	144	8
TOTAL	1191	100	1262	100	1392	100	1548	100	1801	100

Table 13.1.2: CAPD Connectology, 1998-2007

CAPD Connectology	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
UVXD	10	2	3	1	0	0	0	0	0	0
Baxter disconnect	511	95	347	58	235	39	436	57	719	87
B Braun disconnect	18	3	248	41	370	61	324	43	93	11
Fresenius disconnect	0	0	0	0	0	0	0	0	11	1
Others	0	0	0	0	0	0	0	0	0	0
TOTAL	539	100	598	100	605	100	760	100	823	100

CAPD Connectology	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
UVXD	0	0	0	0	0	0	0	0	0	0
Baxter disconnect	1038	87	1142	88	1260	90	1425	92	1674	93
B Braun disconnect	7	1	14	1	1	0	0	0	1	0
Fresenius disconnect	154	13	145	11	111	8	119	8	116	6
Others	1	0	0	0	25	2	6	0	2	0
TOTAL	1200	100	1301	100	1397	100	1550	100	1793	100

Table 13.1.3: CAPD Number of Exchanges per day, 1998-2007

No. of Exchanges/ day	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	2	0	0	0	2	0	1	0	0	0
3	4	1	4	1	1	0	5	1	11	1
4	508	96	579	97	624	96	735	95	834	96
5	16	3	13	2	23	4	31	4	28	3
TOTAL	530	100	596	100	650	100	772	100	873	100

No. of Exchanges/ day	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	4	0	6	0	3	0	4	0	2	0
3	14	1	12	1	25	2	55	4	40	2
4	1136	96	1225	95	1280	94	1359	91	1566	90
5	32	3	52	4	48	4	76	5	123	7
TOTAL	1186	100	1295	100	1356	100	1494	100	1731	100

Table 13.1.4: CAPD Volume per Exchange, 1998– 2007

Volume per Exchange (L)	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	25	5	19	3	25	4	32	4	37	4
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	496	95	557	96	595	95	711	95	793	94
>2.0	0	0	2	0	5	1	9	1	14	2
TOTAL	521	100	578	100	625	100	752	100	844	100

Volume per Exchange (L)	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	41	4	42	3	55	4	50	3	46	3
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	1088	94	1154	92	1195	89	1315	88	1508	88
>2.0	31	3	60	5	92	7	135	9	167	10
TOTAL	1160	100	1256	100	1342	100	1500	100	1721	100

SECTION 13.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT

The median delivered weekly Kt/V remained at 2.1 since year 2003, with 83% of patients achieving K/DOQI recommendation in 2006 of a Kt/V of ≥ 1.7 per week. Comparison between PD centres according to the percentage of patients in each centre achieveing this target Kt/V has shown a 1.5-fold variation between the highest- and lowest-performing centres (93% vs 69%). Half of the centres were

Table 13.2.1: Distribution of delivered KT/V, CAPD patients 2003-2007

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥ 1.7 per week
2003	789	3.7	19.9	2.1	1.8	2.5	83
2004	1068	2.8	9.9	2.1	1.8	2.5	85
2005	1124	3.3	13.7	2.1	1.8	2.5	84
2006	1290	2.4	3.6	2.1	1.8	2.4	84
2007	1435	2.2	0.7	2.1	1.8	2.4	83

Figure 13.2.1: Cumulative distribution of delivered KT/V, CAPD patients 2003-2007

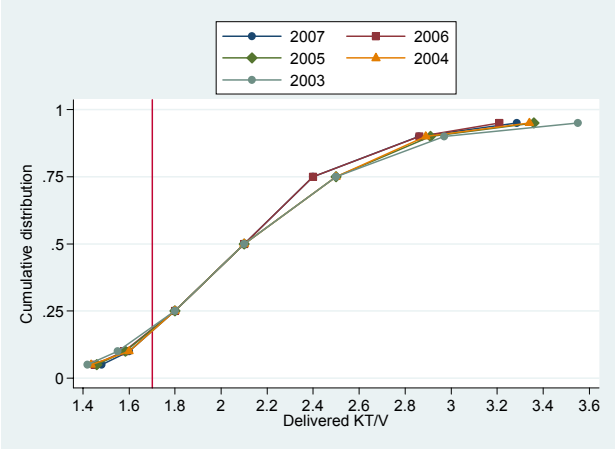


Figure 13.2.2: Variation in proportion of patients with KT/V ≥1.7 per week among CAPD centres 2007

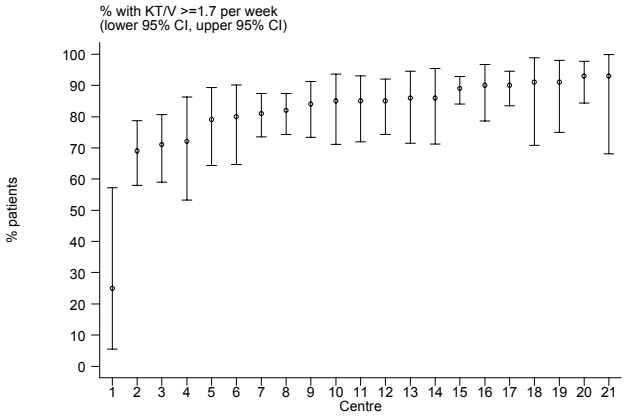


Table 13.2.2: Variation in proportion of patients with KT/V ≥ 1.7 per week among CAPD centres 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2003	14	0	0	75	82.5	88	91	91
2004	17	75	75	79	85	88	100	100
2005	18	56	56	75	85	90	97	97
2006	21	66	67	77	83	92	100	100
2007	21	25	69	80	85	90	93	93

Among incident PD patients low average transport status was commonest (42%) followed by high average transport status (38%). Over time a proportion of patients will develop changes in their peritoneal membrane characteristics such that there was high PET status in 15% vs 9% in prevalent as compared to incident PD patients (Tables 13.2.3 and 13.2.4). There is no apparent association between comorbidities such as cardiovascular disease and diabetes with PET status.

Table 13.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2007

Year	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	6	67	15	69	12	105	12	106	10
Low average	85	51	187	41	246	41	359	42	429	42
High average	62	37	176	38	223	37	315	37	392	38
High	11	7	29	6	62	10	75	9	95	9
TOTAL	168	100	459	100	600	100	854	100	1022	100

Table 13.2.4: Peritoneal transport status by PET D/P creatinine at 4 hours, prevalent PD patients 2003-2007

Year	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	3	39	9	44	13	23	8	19	10
Low average	174	44	180	42	130	39	106	38	65	34
High average	171	43	168	39	118	35	106	38	78	41
High	39	10	41	10	42	13	41	15	28	15
TOTAL	394	100	428	100	334	100	276	100	190	100

Table 13.2.5: Association among PET and comorbidity, 2003 – 2007

Co morbidity	Low		Low Average		High Average		High	
	No.	%	No.	%	No.	%	No.	%
No CVD	306	12.3	1030	41.2	219	8.8	942	37.7
CVD	51	8.4	276	45.5	53	8.7	226	37.3
No DM	239	13	777	42.4	153	8.4	663	36.2
DM	118	9.3	529	41.6	119	9.4	505	39.7

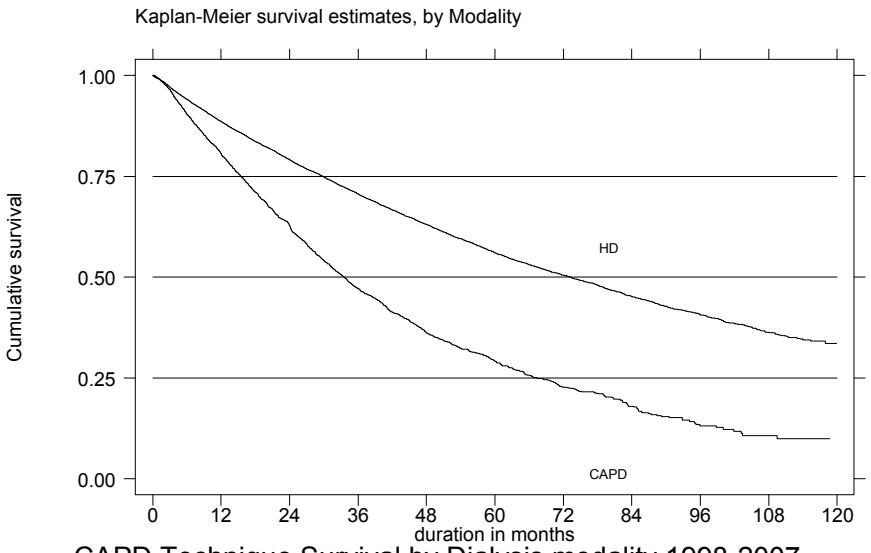
SECTION 13.3: TECHNIQUE SURVIVAL ON PD

CAPD fared worse compared with haemodialysis in terms of technique survival. The Kaplan-Meir cumulative survival curves diverge as early as 6 months. One-, three-and five-year technique survival for CAPD was 81%,41% and 29% respectively as compared to 89%,71% and 56% for HD. Median technique survival time was less than 36 months. Overall these trends in technique survival are unchanged by year of entry (Tables and figures 13.3.1 and 13.3.2). The best technique survival rate was seen in the age group 25-34 years while the oldest age group (>65 years) consistently had the worst technique survival (Table and figure 13.3.3). There was no gender difference (Table and figure 13.3.4). Diabetics have a poorer technique survival than non-diabetics (Table and figure 13.3.5). After 36 months there was a clear separation in survival curves according to solute clearance. As expected, those with Kt/V >2.0 fared the best as compared to those with Kt/V < 1.7 (Table and figure 13.3.6).

Table 13.3.1: Unadjusted technique survival by Dialysis modality, 1998-2007

Year Interval (month)	CAPD			HD			All dialysis		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	2865	90	1	19841	94	0	22706	94	0
12	2289	81	1	16940	89	0	19229	88	0
24	1456	63	1	12328	79	0	13784	77	0
36	910	47	1	8947	71	0	9857	68	0
48	565	36	1	6322	63	0	6887	60	0
60	332	29	1	4343	56	0	4675	53	0
72	178	23	1	2885	50	0	3063	47	0
84	91	18	1	1785	45	1	1875	42	1
96	36	13	1	1008	41	1	1043	37	1
108	16	11	1	419	36	1	434	33	1
120	-	-	-	-	-	-	-	-	-

Figure 13.3.1: Unadjusted technique survival by Dialysis modality, 1998-2007



CAPD Technique Survival by Dialysis modality 1998-2007

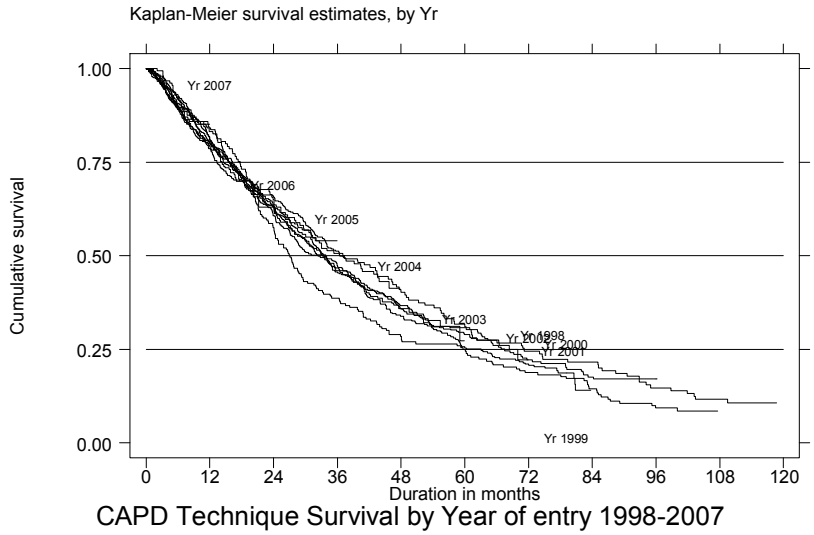
Table 13.3.2: Unadjusted technique survival by year of entry, 1998-2007

Year Interval (month)	1998			1999			2000			2001		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
6	144	92	2	189	90	2	206	91	2	303	90	2
12	128	83	3	175	84	3	185	81	3	266	80	2
24	96	65	4	117	58	3	138	63	3	198	61	3
36	75	51	4	78	39	3	101	46	3	151	47	3
48	59	40	4	57	29	3	78	36	3	107	34	3
60	45	32	4	50	25	3	67	31	3	78	25	2
72	34	25	4	37	19	3	47	22	3	63	21	2
84	30	22	3	27	15	3	36	18	3	-	-	-
96	20	15	3	17	9	2	-	-	-	-	-	-
108	16	12	3	-	-	-	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2002			2003			2004			2005		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
6	342	92	1	369	89	2	302	89	2	322	89	2
12	293	80	2	332	80	2	266	79	2	280	79	2
24	228	64	3	254	63	2	213	66	3	219	63	3
36	165	47	3	183	46	2	163	51	3	-	-	-
48	126	37	3	142	36	2	-	-	-	-	-	-
60	96	29	2	-	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2006			2007		
	No	% Survival	SE	No	% Survival	SE
6	427	93	1	269	90	1
12	370	81	2	3	-	-
24	-	-	-	-	-	-

Figure 13.3.2: Unadjusted technique survival by year of entry, 1998-2007



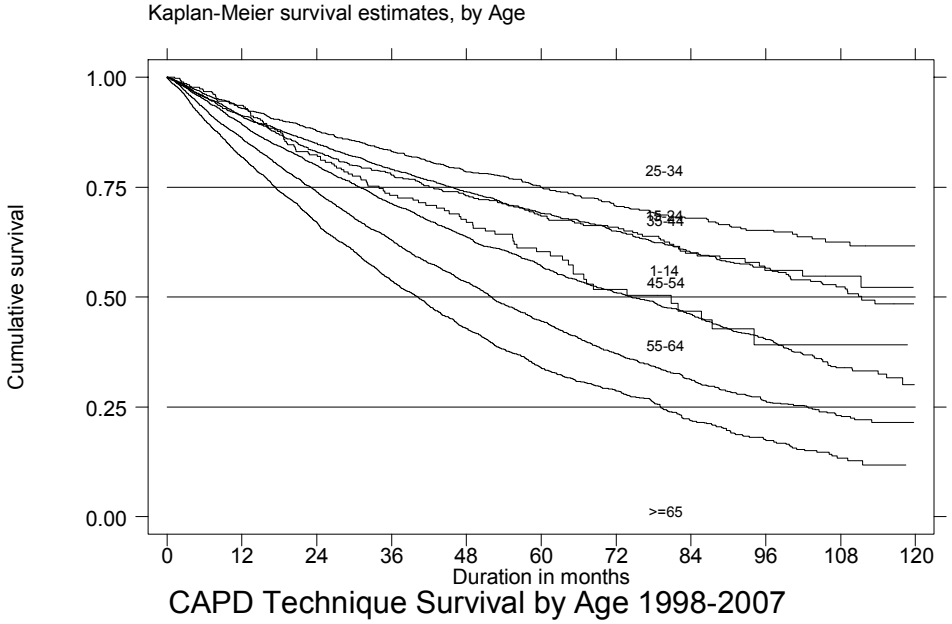
CAPD Technique Survival by Year of entry 1998-2007

Table 13.3.3: Unadjusted technique survival by age, 1998-2007

Age group (years) Interval (month)	<=14			15-24			25-34			35-44		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
6	314	97	1	1021	96	1	1761	96	0	3062	96	0
12	280	94	1	877	91	1	1537	93	1	2651	91	0
24	204	82	2	630	83	1	1170	88	1	2052	85	1
36	141	73	3	481	78	1	924	83	1	1598	79	1
48	104	67	3	350	73	2	723	79	1	1214	74	1
60	71	60	4	249	68	2	537	75	1	916	69	1
72	40	52	4	175	66	2	374	71	1	654	65	1
84	26	47	5	109	60	2	270	68	2	423	60	1
96	11	39	6	62	56	3	169	65	2	243	57	1
108	6	39	6	26	55	3	77	63	2	113	52	1
120	-	-	-	-	-	-	-	-	-	-	-	-

Age group (years) Interval (month)	45-54			55-64			>=65		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
6	5767	95	0	6198	93	0	4584	90	0
12	4936	89	0	5207	86	0	3743	82	1
24	3593	80	1	3686	74	1	2454	67	1
36	2635	71	1	2522	63	1	1561	54	1
48	1861	64	1	1696	53	1	941	43	1
60	1309	57	1	1061	44	1	534	34	1
72	865	51	1	640	37	1	318	29	1
84	543	46	1	365	31	1	147	22	1
96	300	40	1	195	26	1	70	17	1
108	113	34	1	77	23	1	28	13	1
120	-	-	-	-	-	-	-	-	-

Figure 13.3.3: Unadjusted technique survival by age, 1998-2007

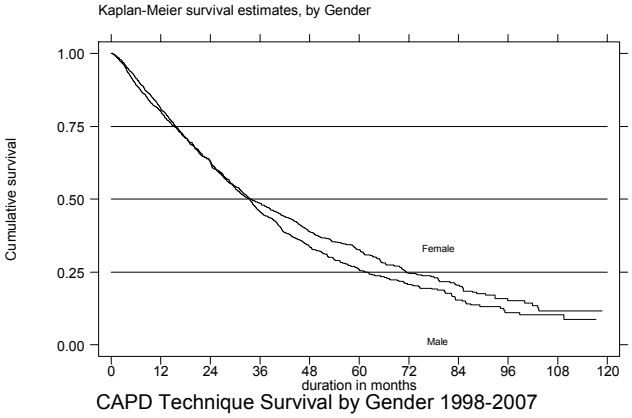


CAPD Technique Survival by Age 1998-2007

Table 13.3.4: Unadjusted technique survival by Gender, 1998-2007

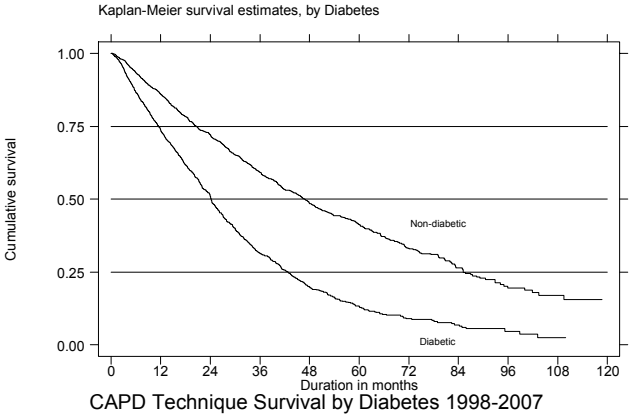
Gender Interval (months)	Male			Female		
	No	% survival	SE	No	% survival	SE
6	1448	91	1	1417	89	1
12	1138	81	1	1152	80	1
24	723	63	1	735	63	1
36	441	46	1	471	49	1
48	269	34	1	297	39	1
60	150	26	1	184	33	2
72	80	21	2	99	25	2
84	39	15	2	53	21	2
96	16	11	2	21	15	2
108	9	10	2	8	12	2
120	-	-	-	-	-	-

Figure 13.3.4: Unadjusted technique survival by Gender, 1998-2007



CAPD Technique Survival by Gender 1998-2007

Figure 13.3.5: Unadjusted technique survival by Diabetes status, 1998-2007



CAPD Technique Survival by Diabetes 1998-2007

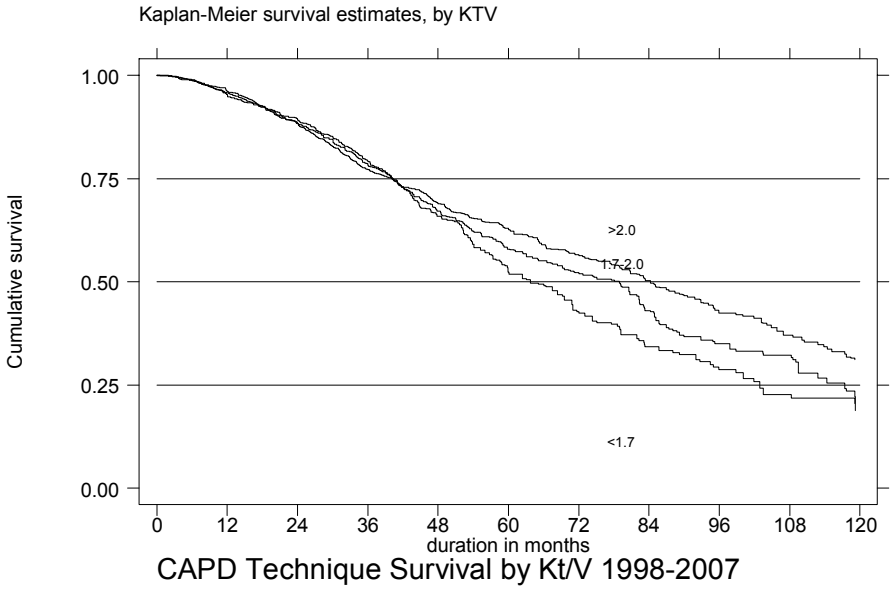
Table 13.3.5: Unadjusted technique survival by Diabetes status, 1998-2007

Diabetes status Interval (month)	Non-Diabetic			Diabetic		
	No	% survival	SE	No	% survival	SE
6	1639	93	1	1226	87	1
12	1378	86	1	911	74	1
24	945	72	1	511	51	1
36	658	59	1	253	31	1
48	438	48	1	128	20	1
60	270	41	2	63	13	1
72	147	33	2	32	9	1
84	74	26	2	18	7	1
96	31	20	2	6	5	1
108	15	17	2	2	2	1
120	-	-	-	-	-	-

Table 13.3.6: Unadjusted technique survival by Kt/V, 1998-2007

KT/V	<1.7			1.7-2.0			>2.0		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
6	898	99	0	1381	99	0	3217	99	0
12	823	95	1	1301	96	1	2964	96	0
24	709	89	1	1065	88	1	2392	88	1
36	556	79	1	857	79	1	1773	77	1
48	391	66	2	625	67	1	1289	69	1
60	232	52	2	392	58	2	883	63	1
72	117	43	2	260	52	2	595	57	1
84	72	34	3	144	43	2	391	50	1
96	45	28	3	80	35	2	245	42	1
108	31	23	3	61	32	2	166	37	2
120	16	20	3	33	19	3	94	31	2

Figure 13.3.6 Unadjusted technique survival by Kt/V, 1998 -2007



Increasing age, diabetes, peritonitis episodes, cardiovascular disease, low serum albumin, low BMI, abnormal lipid profile, serum Hb less than 10g/dL and assisted PD were associated with an increased risk for change of modality. The commonest reason for PD drop-out was peritonitis (40%), followed by membrane failure (18%) and patient preference(16%).

Table 13.3.7: Adjusted hazard ratio for change of modality, 1998-2007

Factors	N	Hazard Ratio	95% CI		p value
Age (years):					
Age 1-14 (ref)	257	1.00			
Age 15-24	311	1.85	(1.37	2.48)	0.000
Age 25-34	286	1.96	(1.42	2.70)	0.000
Age 35-44	437	2.21	(1.62	3.01)	0.000
Age 45-54	737	2.55	(1.85	3.50)	0.000
Age 55-64	767	2.94	(2.17	4.00)	0.000
Age >=65	482	4.09	(2.96	5.66)	0.000
Peritonitis					
No (ref)	3,049	1.00			
Yes	228	2.28	(1.96	2.65)	0.000
Diabetes Mellitus					
Non-diabetic (ref)	1,810	1.00			
Diabetic	1,467	1.55	(1.34	1.78)	0.000
Gender					
Male (ref)	1,639	1.00			
Female	1,638	0.92	(0.82	1.04)	0.175
Year start dialysis:					
Year 1998-1999 (ref)	325	1.00			
Year 2000-2001	516	1.10	(0.94	1.30)	0.239
Year 2002-2003	756	1.16	(0.99	1.36)	0.073
Year 2004-2007	1,680	1.05	(0.89	1.25)	0.549
Cardiovascular Disease:					
No CVD (ref)	2,520	1.00			
CVD	757	1.31	(1.16	1.48)	0.000
BMI:					
<18.5	530	1.31	(1.11	1.54)	0.001
18.5-<25 (ref)	1,775	1.00			
>=25	972	0.83	(0.74	0.94)	0.002
Serum Albumin:					
<30	866	1.81	(1.58	2.09)	0.000
30-<35	1,124	1.31	(1.15	1.49)	0.000
35-<45 (ref)	964	1.00			
>=45	323	1.10	(0.87	1.40)	0.418
Serum Cholesterol:					
<3.2	63	1.77	(1.22	2.55)	0.002
3.2-<5.2 (ref)	1,557	1.00			
>=5.2	1,657	1.13	(1.01	1.25)	0.026
Diastolic BP:					
<70	373	1.17	(0.99	1.40)	0.073
70-<80	1,018	0.93	(0.82	1.05)	0.226
80-<90 (ref)	1,375	1.00			
90-<100	428	1.40	(1.19	1.64)	0.000
>=100	83	1.88	(1.38	2.57)	0.000
Hemoglobin:					
<8	218	2.04	(1.63	2.57)	0.000
8-<9	456	1.63	(1.35	1.98)	0.000
9-<10	848	1.35	(1.15	1.60)	0.000
10-<11	910	1.01	(0.86	1.19)	0.898
11-<12 (ref)	537	1.00			
>=12	308	0.96	(0.77	1.20)	0.749

Table 13.3.7: Adjusted hazard ratio for change of modality, 1998-2007 (cont'd)

Factors	N	Hazard Ratio	95% CI	95% CI	p value
Serum Calcium:					
<2.2	1,118	1.14	(1.01	1.29)	0.038
2.2-<2.6 (ref)	2,030	1.00			
>=2.6	129	1.81	(1.43	2.28)	0.000
Calcium Phosphate product:					
<3.5	1,750	1.17	(0.99	1.39)	0.070
3.5-<4.5 (ref)	984	1.00			
4.5-<5.5	413	0.91	(0.72	1.15)	0.415
>=5.5	130	0.72	(0.45	1.14)	0.156
Serum Phosphate:					
<1.6 (ref)	1,903	1.00			
1.6-<2.0	888	0.83	(0.69	1.00)	0.044
2.0-<2.2	233	1.04	(0.76	1.42)	0.802
2.2-<2.4	115	1.16	(0.78	1.72)	0.472
2.4-<2.6	70	1.45	(0.87	2.41)	0.157
>=2.6	68	1.59	(0.87	2.94)	0.135
KT/V					
<=1.7 (ref)	2,176	1.00			
>1.7	1,101	0.97	(0.79	1.17)	0.722
Assisted PD					
Self-care (ref)	1,934	1.00			
Assisted	1,277	1.33	(1.18	1.50)	0.000

Table 13.3.8: Reasons for change of dialysis modality to HD, 1998-2007

Cause	No.	Percentage
Peritonitis	302	40
Catheter related infection	24	3
Membrane failure	135	18
Technical problem	60	8
Patient preference	120	16
Others	71	9
Unknown	38	5
Total	750	100

SECTION 13.4: Patient Survival on PD

Increasing age ,diabetes, cardiovascular disease, low BMI, low serum albumin, diastolic BP<70 or >90 mmHg, haemoglobin <10 g/dL, hypercalcaemia, peritonitis episodes and assisted PD are associated with an increased mortality risk (Table 13.4.1).

Table 13.4.1: Adjusted Hazard Ratio for patient mortality

Factors	N	Hazard Ratio	95% CI		p value
Age (years):					
Age 1-14 (ref)	257	1.00			
Age 15-24	311	2.09	(1. 03	3.36)	0.002
Age 25-34	286	1.88	(1.11	3.17)	0.018
Age 35-44	437	2.92	(1.82	4.69)	0.000
Age 45-54	737	4.64	(2.89	7.44)	0.000
Age 55-64	767	5.42	(3.42	8.57)	0.000
Age >=65	482	7.73	(4.81	12.43)	0.000
Diabetes Mellitus					
Non-diabetic (ref)	1,810	1.00			
Diabetic	1,467	1.95	(1.62	2.34)	0.000
Gender					
Male (ref)	1,639	1.00			
Female	1,638	0.89	(0.77	1.03)	0.118
Year start dialysis:					
Year 1998-1999 (ref)	325	1.00			
Year 2000-2001	516	0.92	(0.75	1.13)	0.427
Year 2002-2003	756	1.05	(0.86	1.29)	0.613
Year 2004-2007	1,680	0.92	(0.74	1.13)	0.417
Cardiovascular Disease:					
No CVD (ref)	2,520	1.00			
CVD	757	1.51	(1.31	1.75)	0.000
BMI:					
<18.5	530	1.43	(1.15	1.78)	0.001
18.5-<25 (ref)	1,775	1.00			
>=25	972	0.76	(0.66	0.89)	0.000
Serum Albumin:					
<30	866	2.04	(1.71	2.45)	0.000
30-<35	1,124	1.34	(1.13	1.60)	0.001
35-<45 (ref)	964	1.00			
>=45	323	1.06	(0.77	1.48)	0.711
Diastolic BP:					
<70	373	1.27	(1.03	1.56)	0.025
70-<80	1,018	0.92	(0.79	1.08)	0.321
80-<90 (ref)	1,375	1.00			
90-<100	428	1.30	(1.03	1.65)	0.028
>=100	83	2.24	(1.46	3.44)	0.000
Hemoglobin:					
<8	218	2.02	(1.49	2.74)	0.000
8-<9	456	1.64	(1.28	2.09)	0.000
9-<10	848	1.49	(1.21	1.82)	0.000
10-<11	910	0.99	(0.81	1.22)	0.989
11-<12 (ref)	537	1.00			
>=12	308	0.99	(0.76	1.31)	0.991
Serum Calcium:					
<2.2	1,118	1.03	(0.87	1.21)	0.742
2.2-<2.6 (ref)	2,030	1.00			
>=2.6	129	1.96	(1.47	2.61)	0.000

Table 13.4.1: Adjusted Hazard Ratio for patient mortality—(cont'd)

Factors	N	Hazard Ratio	95% CI	95% CI	p value
Calcium Phosphate product:					
<3.5	1,750	1.11	(0.89	1.39)	0.359
3.5-<4.5 (ref)	984	1.00			
4.5-<5.5	413	1.06	(0.78	1.45)	0.704
>=5.5	130	1.06	(0.57	1.98)	0.856
Serum Phosphate:					
<1.6 (ref)	1,903	1.00			
1.6-<2.0	888	0.78	(0.61	0.99)	0.041
2.0-<2.2	233	1.13	(0.75	1.71)	0.548
2.2-<2.4	115	1.31	(0.76	2.26)	0.324
2.4-<2.6	70	1.11	(0.55	2.26)	0.764
>=2.6	68	0.75	(0.27	2.08)	0.582
KT/V					
<=1.7	2,176	1.00			
>1.7 (ref)	1,101	1.06	(0.81	1.38)	0.680
Peritonitis episode					
No (ref)	2,979				
Yes	298	0.72	(0.58	0.88)	0.002
Assisted PD					
No (ref)	1,934	1.00			
Yes	1,277	1.58	(1.36	1.84)	0.000

SECTION 13.5: PD PERITONITIS

The median peritonitis rate has improved to 40.9 patient-months per episode (pt-month/epi) as shown in Table 13.5.1. There was a wide inter-centre variation with the highest and lowest peritonitis rates of 12 and 106.7 patient-months per episode. Gram-positive organisms accounted for 27% of peritonitis episodes while 32% were due to gram negative organisms. The commonest organism for gram positive peritonitis was staphylococcus coagulase negative (12%), followed by *Staphylococcus aureus* (8%). Meanwhile, for the gram negative peritonitis *E.coli* was the commonest organism (9%) followed by *Pseudomonas aeruginosa* (8%). Fungal organisms accounted for 5% of cases. The culture negative rate reduced to 33% compared to 39% in 2006 (Table 13.5.2).

Catheter removal rate was highest in fungal infection (40%), followed by *Pseudomonas aeruginosa* (21%).

Table 13.5.1: Variation in peritonitis rate (pt-month/epi) among CAPD centres, 2000- 2007

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	12	11.7	11.7	18.7	24.1	32.5	1145.1	1145.1
2001	11	10.8	10.8	19.9	22.8	39.6	60.3	60.3
2002	14	12.6	12.6	20.1	30.5	42.6	219.2	219.2
2003	13	18.3	18.3	21	32.9	40.7	312.1	312.1
2004	15	0	0	23.5	32.7	36.3	41.5	41.5
2005	15	18	18	25.4	35.3	43	56.8	56.8
2006	21	14.8	18.5	26.6	36.8	49.7	62.2	97.7
2007	24	12	13	30.6	40.9	55.8	75.1	106.7

Figure 13.5.1: Variation in peritonitis rate among CAPD centres, 2007

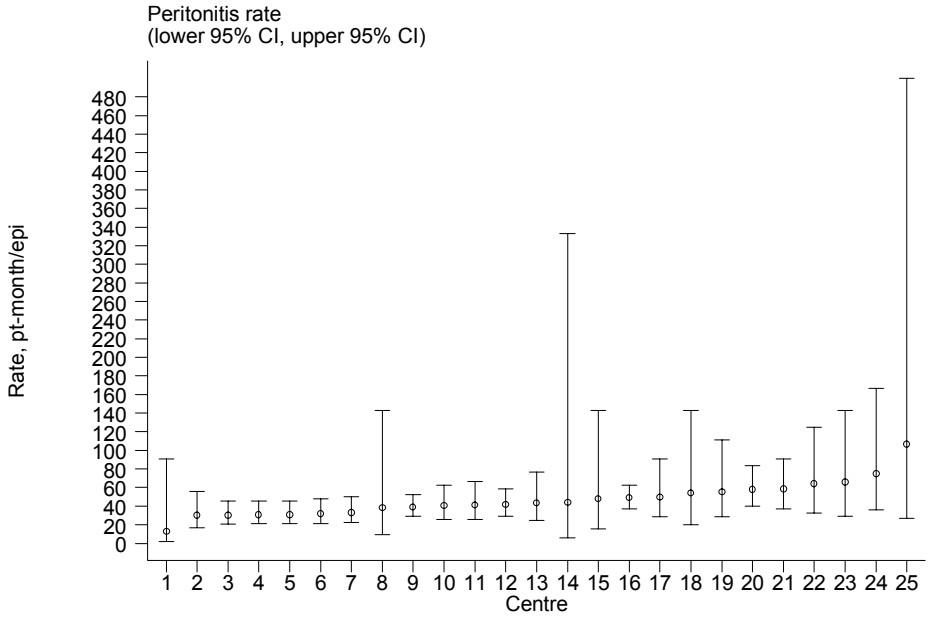


Table 13.5.2: Causative organism in PD peritonitis, 2000-2007

Microorganism	2000		2001		2002		2003		2004		2005		2006		2007	
	No.	%	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	43	12
Staph Coagulase Neg.	34	11	30	10	39	11	47	13	41	11	43	13	32	9	30	8
Strep	17	6	17	5	11	3	16	4	13	3	10	3	16	4	14	4
Others	4	1	6	2	7	2	15	4	4	1	8	2	13	4	10	3
(B) Gram Negatives																
Pseudomonas	19	6	14	4	23	6	20	5	28	8	27	8	23	6	30	8
Acinetobacter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Klebsiella	10	3	7	2	18	5	27	7	25	7	20	6	8	2	21	6
Enterobacter	11	4	16	5	11	3	13	4	19	5	19	6	20	5	17	5
E.Coli	15	5	16	5	23	6	20	5	23	6	30	9	15	4	32	9
Others	9	3	17	5	15	4	15	4	16	4	17	5	14	4	14	4
(C) Polymicrobial	9	3	10	3	8	2	3	1	2	1	0	0	1	0	0	0
(D) Others																
Fungal	19	6	21	7	12	3	12	3	15	4	7	2	16	4	20	5
Mycobacterium	6	2	4	1	1	0	3	1	4	1	2	1	4	1	1	0
Others	2	1	14	4	14	4	13	4	8	2	3	1	11	3	15	4
(E) No growth	119	39	99	32	118	33	115	32	123	33	96	30	142	39	124	33
TOTAL	309	100	312	100	362	100	364	100	372	100	322	100	365	100	371	100

Table 13.5.3: Outcome of peritonitis by Causative organism, 2000-2007

Causative Organism	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives								
Staph. Aureus	130	36	39	11	108	30	277	100
Staph Coagulase Neg.	112	38	14	5	104	35	230	100
Strep	39	34	6	5	47	41	92	100
Others	15	22	2	3	32	48	49	100
(B) Gram Negatives								
Pseudomonas	50	27	38	21	61	33	149	100
Acinetobacter	0		0		0		0	100
Klebsiella	47	35	20	15	41	30	108	100
Enterobacter	35	28	23	18	45	36	103	100
E.Coli	51	29	28	16	53	30	132	100
Others	35	30	23	20	32	27	90	100
(C) Polymicrobial	3	9	0	0	22	65	25	100
(D) Others								
Fungal	2	2	49	40	32	26	83	100
Mycobacterium	0	0	9	36	13	52	22	100
Others	17	21	9	11	29	36	55	100
(E) No growth	340	36	71	8	289	31	700	100

Table 13.5.4: Factors influencing peritonitis rate, 2000 -2007

Factors	N (no at risk)	Annualised rate Epi/pt-year	(95% CI)	
Age (years):				
<=14	70	0.393	(0.321	0.482)
15-24	38	0.453	(0.344	0.596)
25-34 (ref)	82	0.398	(0.335	0.473)
35-44	93	0.436	(0.367	0.518)
45-54	143	0.515	(0.448	0.591)
55-64	121	0.567	(0.486	0.662)
>=65	51	0.668	(0.526	0.849)
Gender:				
Male (ref)	282	0.483	(0.436	0.535)
Female	316	0.471	(0.43	0.516)
Diabetes:				
No (ref)	414	0.442	(0.408	0.479)
Yes	184	0.598	(0.526	0.681)
Income:				
RM 0-999 (ref)	210	0.531	(0.475	0.593)
RM 1000-1999	181	0.437	(0.386	0.496)
RM 2000-2999	83	0.4	(0.332	0.482)
>=RM 3000	45	0.585	(0.457	0.749)
Education:				
Nil	50	0.513	(0.404	0.652)
Primary	214	0.544	(0.487	0.607)
Secondary (ref)	267	0.404	(0.363	0.448)
Tertiary	38	0.537	(0.42	0.686)
Assistance to perform CAPD:				
Self care (ref)	415	0.449	(0.415	0.487)
Partially assisted	72	0.553	(0.456	0.672)
Completely assisted	99	0.578	(0.483	0.693)
Year vintage				
1 to < 2 (ref)	128	1.387	(1.19	1.617)
>2 to < 4	161	0.816	(0.707	0.941)
> 4	309	0.344	(0.315	0.376)

CHAPTER 14

Renal Transplantation

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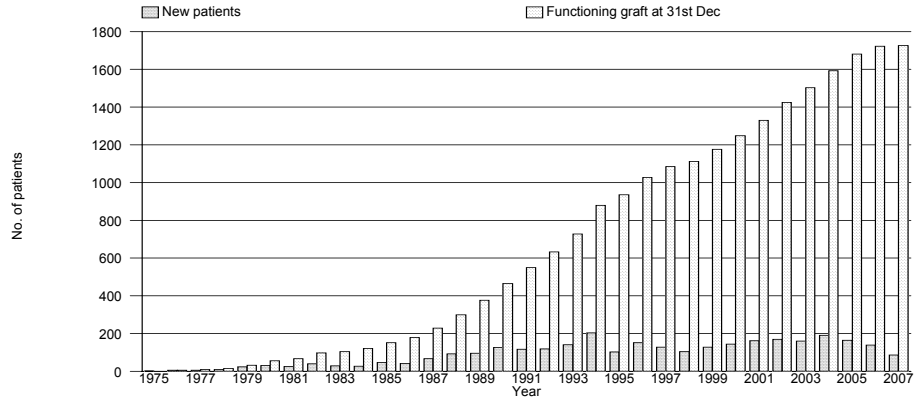
SECTION 14.1: STOCK AND FLOW

The number of new renal transplant patients shows an initial rise from 104 transplants per year in 1998 to a peak of 190 transplants in 2004. This is a rise of >80% but the number declined subsequently to only 86 in 2007 (Table 14.1.1). This is due to reduction in the number of transplantations done in China. As renal transplantation in the country is still dependant on the availability of commercial cadaveric transplantation done abroad this drop was foreseeable. The number of functioning renal transplants reported to the National Transplant Registry (NTR) had increased from 1112 in 1998 to 1726 in 2007 (Table 14.1.1).

Table 14.1.1: Stock and Flow of Renal Transplantation, 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New transplant patients	104	127	143	162	169	160	190	163	138	86
Died	26	25	30	37	32	37	41	43	50	34
Graft failure	49	36	32	40	38	41	44	21	36	36
Lost to Follow up	1	1	9	4	5	4	14	11	11	12
Functioning graft at 31st December	1112	1177	1249	1330	1424	1502	1593	1681	1722	1726

Figure 14.1.1: Stock and Flow of Renal Transplantation, 1975-2007



The incidence of renal transplantation stabilised at a modest rate of 5-7 per million population (Table 14.1.2) while transplant prevalence rate has grown slowly from 50 per million in 1998 to 64 per million population in 2007, an increase of 30% over the 1998 figures. However compared to growth in the prevalence rate of dialysis patients (which has increased by 300% from 205 in 1998 to 615 in 2007) our transplant prevalence rate has not kept up. (refer table 2.1.2, chapter 2)

Table 14.1.2: New transplant rate per million population (pmp), 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New transplant patients	104	127	143	162	169	160	190	163	138	86
New transplant rate, pmp	5	6	6	7	7	6	7	6	5	3

Figure 14.1.2: New transplant rate, 1975-2007

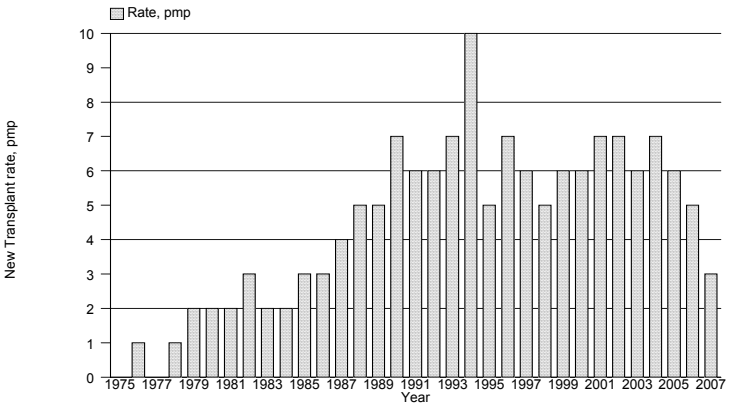
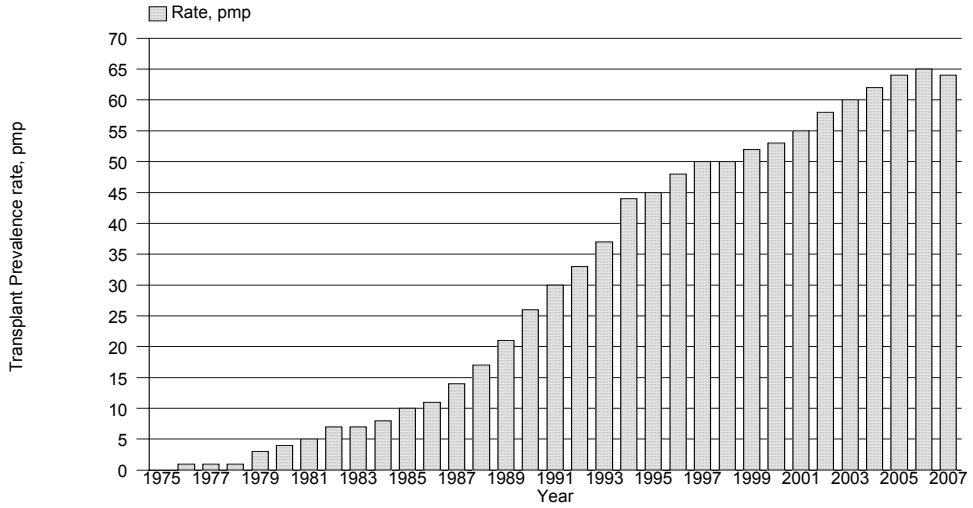


Table 14.1.3: Transplant prevalence rate per million population (pmp), 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Functioning graft at 31st Dec	1112	1177	1249	1330	1424	1502	1593	1681	1722	1726
Transplant prevalence rate, pmp	50	52	53	55	58	60	62	64	65	64

Figure 14.1.3: Transplant prevalence rate, 1975-2007



In terms of place of transplantation, transplantation within local centres has grown slightly from 40 cases (39% of renal transplants) in 1998 to 52 cases (60% of renal transplants) in 2007. This translates to a net increase of 1 case per year over the 10 year period. This is disturbing data as it underscores our failure to improve transplantation rates within the country which is mainly due to the lack of both living as well as cadaver donors. Transplantation in China in 2007 only comprised 34% of all of renal transplant recipients with 29 patients. In fact this is the first time local transplantation out-perform China transplantation over the last decade.

Table 14.1.4: Place of transplantation, 1998-2007

	1998		1999		2000		2001		2002	
Year	No.	%	No.	%	No.	%	No.	%	No.	%
HKL	33	32	36	28	28	20	33	20	28	17
UMMC	7	7	16	13	19	13	23	14	14	8
Selayang Hospital	0	0	0	0	4	3	11	7	11	7
Other local	0	0	1	1	3	2	4	2	1	1
China	50	48	62	49	80	56	83	51	103	61
India	7	7	5	4	9	6	7	4	12	7
Other overseas	3	3	2	2	0	0	1	1	0	0
Unknown	4	4	5	4	0	0	0	0	0	0
TOTAL	104	100	127	100	143	100	162	100	169	100

	2003		2004		2005		2006		2007		TOTAL	
Year	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
HKL	26	16	20	11	32	20	35	25	35	41	306	21
UMMC	6	4	7	4	7	4	5	4	0	0	104	7
Selayang Hospital	11	7	11	6	5	3	8	6	14	16	75	5
Other local	1	1	2	1	5	3	2	1	3	3	22	2
China	111	69	137	72	108	66	79	57	29	34	842	58
India	4	3	11	6	5	3	7	5	1	1	68	5
Other overseas	1	1	2	1	1	1	2	1	4	5	16	1
Unknown	0	0	0	0	0	0	0	0	0	0	9	1
TOTAL	160	100	190	100	163	100	138	100	86	100	1442	100

SECTION 14.2: RECIPIENTS' CHARACTERISTICS

In terms of renal transplant recipients' characteristics, age at transplant has been stable at 35 to 42 years and between 57% and 67% of recipients are males over the last 10 years. There has been an increase in the population of diabetic patients undergoing transplantation from 10% in 1998 to 20% in 2006 (Table 14.2.1). However, there is a drastic drop in number of diabetic patients who underwent transplantation in 2007 (12%). This coincided with the drop in China transplants where the majority of the diabetic patients underwent their transplantation. Patients with hepatitis B and hepatitis C remained static at around 7%. In terms of cause of end stage renal failure (Table 14.2.2), the primary cause was still glomerulonephritis, followed by hypertension and diabetes as the third cause. Up to 40% of transplant recipients had end stage renal disease due to unknown causes, belying the fact that we often diagnose these patients too late.

Table 14.2.1: Renal Transplant Recipients' Characteristics, 1998-2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
New Transplant Patients	104	127	143	162	169	160	190	163	138	86
Age at transplant (years), Mean	37	37	39	41	41	42	41	38	37	35
Age at transplant (years), SD	11	13	14	13	12	13	13	14	15	15
% Male	58	62	64	62	57	66	62	70	67	62
% Diabetic (co-morbid/ primary renal disease)	10	11	15	19	15	22	22	20	20	12
% HBsAg positive	6	4	5	5	7	8	5	4	7	5
% Anti-HCV positive	18	11	8	15	9	10	8	2	7	11

Table 14.2.2: Primary causes of end stage renal failure, 1998-2007

Year	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	104	100	127	100	143	100	162	100	169	100
Glomerulonephritis	28	27	41	32	49	34	43	27	53	31
Diabetes Mellitus	5	5	10	8	16	11	23	14	16	9
Hypertension	5	5	7	6	20	14	17	10	24	14
Obstructive uropathy	4	4	4	3	3	2	3	2	2	1
ADPKD	1	1	1	1	3	2	1	1	3	2
Drugs/ toxic nephropathy	0	0	0	0	0	0	0	0	0	0
Hereditary nephritis	0	0	0	0	0	0	0	0	0	0
Unknown	54	52	62	49	54	38	61	38	68	40
Others	11	11	6	5	12	8	23	14	16	9

Year	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	160	100	190	100	163	100	138	100	86	100
Glomerulonephritis	54	34	62	33	45	28	51	37	26	30
Diabetes Mellitus	26	16	32	17	29	18	21	15	6	7
Hypertension	25	16	51	27	38	23	29	21	20	23
Obstructive uropathy	2	1	4	2	3	2	4	3	1	1
ADPKD	5	3	5	3	3	2	1	1	0	0
Drugs/ toxic nephropathy	2	1	2	1	0	0	1	1	0	0
Hereditary nephritis	0	0	1	1	0	0	0	0	0	0
Unknown	58	36	83	44	50	31	42	30	32	37
Others	12	8	27	14	17	10	16	12	12	14

SECTION 14.3: TRANSPLANT PRACTICES

In 2006, 62% of the renal transplant recipients received their grafts from commercial sources. Fifty-eight percent of these were from commercial cadavers. Live donor transplantation made up 21% of transplants (28 recipients) in the same year which was down from 29 cases (29%) in 1998 and 41 cases (25%) in 2005. Local cadaveric donation made up 18% of transplants (24 recipients) in 2006 although it had shown an initial promising rise to 37 recipients in 2001. 2007 marked the first time in 10 years there were more local transplantations (37%) compared to commercial transplantations in China (34%).

Table 14.3.1: Type of Renal Transplantation, 1998-2007

Year	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	51	51	62	51	80	56	83	51	103	61
Commercial live donor	4	4	4	3	9	6	6	4	11	7
Live donor (genetically related)	28	28	40	33	21	15	32	20	30	18
Live donor (emotionally related)	2	2	5	4	6	4	4	2	3	2
Cadaver	15	15	10	8	27	19	37	23	22	13
Total	100	100	121	100	143	100	162	100	169	100

Year	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	112	70	143	76	105	64	80	58	28	33
Commercial live donor	3	2	6	3	8	5	5	4	2	2
Live donor (genetically related)	25	16	21	11	38	23	24	17	20	24
Live donor (emotionally related)	5	3	2	1	3	2	4	3	11	13
Cadaver	15	9	17	9	9	6	25	18	24	28
Total	160	100	189	100	163	100	138	100	85	100

*Commercial Cadaver (China, India, other oversea) *Commercial live donor (living unrelated) *Cadaver (local)

Table 14.3.2: Biochemical data, 2005-2007

Biochemical parameters	Summary	2005	2006	2007
Creatinine, umol/L	N	1635	1592	1685
	Mean	133.6	135.7	131.9
	SD	65.4	81.3	77.6
	Median	120	120	116
	Minimum	35	21.7	36
	Maximum	763	1152	1186
Hb, g/dL	N	1635	1592	1685
	Mean	12.8	12.7	12.8
	SD	1.9	1.9	1.9
	Median	12.9	12.8	12.8
	Minimum	5.5	3.3	4.4
	Maximum	19	19.8	18.7
Albumin, g/L	N	1635	1592	1685
	Mean	39.9	39.9	39.9
	SD	0.5	0.7	0.8
	Median	39.9	39.9	39.9
	Minimum	34	29	29
	Maximum	46	48	48

Table 14.3.2: Biochemical data, 2005-2007 (cont'd)

Biochemical parameters	Summary	2005	2006	2007
Calcium, mmol/L	N	1635	1592	1685
	Mean	2.3	2.3	2.3
	SD	0.2	0.2	0.2
	Median	2.3	2.3	2.3
	Minimum	1.2	1.1	1.4
	Maximum	3.3	3.1	3.2
Phosphate, mmol/L	N	1635	1592	1685
	Mean	1.1	1.1	1.1
	SD	0.2	0.2	0.3
	Median	1.1	1.1	1.1
	Minimum	0.5	0.5	0.5
	Maximum	3.3	3.5	3.9
Alkaline Phosphate (ALP), U/L	N	1635	1592	1685
	Mean	79	79.1	79.1
	SD	46.5	43.2	38.4
	Median	73	71	72
	Minimum	20	24	22
	Maximum	831	700	439
ALT, U/L	N	1635	1592	1685
	Mean	30.8	29.9	29.9
	SD	30.9	30.4	25.7
	Median	24	22	23
	Minimum	4	4	4
	Maximum	613	433	356
Total cholesterol, mmol/L	N	1635	1592	1685
	Mean	5.3	5.3	5.2
	SD	1	1	1
	Median	5.3	5.3	5.3
	Minimum	1.7	1.5	1.7
	Maximum	10.1	11.1	11.4
LDL cholesterol, mmol/L	N	1635	1592	1685
	Mean	3	3	3
	SD	0.8	0.8	0.8
	Median	3	3	3
	Minimum	0.9	1	1
	Maximum	9.2	11.1	8.9
HDL cholesterol, mmol/L	N	1635	1592	1685
	Mean	1.6	1.6	1.5
	SD	0.5	0.5	0.4
	Median	1.6	1.6	1.6
	Minimum	0.4	0.4	0.4
	Maximum	5.6	5.8	7.5
Systolic Blood Pressure, mmHg	N	1635	1592	1685
	Mean	133.3	130.8	131.7
	SD	16.9	15.9	15.7
	Median	130	130	130
	Minimum	80	66	80
	Maximum	220	210	210
Diastolic Blood Pressure, mmHg	N	1635	1592	1685
	Mean	80.5	78.9	78.8
	SD	9.2	9.8	9.4
	Median	80	80	80
	Minimum	50	30	20
	Maximum	127	120	116

In 2007, Cyclosporine based regimes remained the mainstay of immunosuppressive therapy with 72% of patients receiving it. Tacrolimus based regimes accounted for 21%. There has been continuous increase in the use of Mycophenolate Mofetil as the second immunosuppressive agent in 54% of patients in 2007 compared to 37% of patients in 2004. During the same period, the use of Azathioprine declined from 43% in 2004 to 29% in 2007. Monotherapy of immunosuppresion is mostly not noted except in a small number of patients. Sirolimus was used in 2% of all transplant recipients in 2007.

In terms of non immunosuppressive medications, only 36% of patients were on ACEI or AIIRB's or both and this trend has been relatively static since 2004. Calcium Channel blockers appeared to be the mainstay of antihypertensive therapy in 65% of patients whilst Beta Blockers use was reported in 49% of patients. Other antihypertensives were reported in 8% of patients. The widespread use of Calcium Channel blockers either as monotherapy or combination may be due to the use of the dihydropyridine group to minimise the dose of Cyclosporine, which remains the main immunosuppressive drug.

Table 14.3.3: Medication data, 2005-2007

Medication data	Single drug treatment						Combined drug treatment					
	2005		2006		2007		2005		2006		2007	
	N	%	N	%	N	%	N	%	N	%	N	%
All	1563	100	1480	100	1661	100	1563	100	1480	100	1661	100
(i) Immunosuppressive drug(s) treatment												
Prednisolone	12	1	8	1	9	1	1529	98	1442	97	1607	97
Azathioprine	1	0	0	0	0	0	605	39	496	34	478	29
Cyclosporin A	4	0	5	0	8	0	1221	78	1118	76	1188	72
Tacrolimus (FK506)	0	0	0	0	4	0	225	14	254	17	347	21
Mycophenolate Mofetil (MMF)	0	0	0	0	1	0	683	44	708	48	903	54
Rapamycin	0	0	0	0	0	0	8	1	6	0	33	2
Others	0	0	0	0	0	0	10	1	18	1	4	0
(ii) Non-Immunosuppressive drug(s) treatment												
Beta blocker	105	7	77	5	90	5	667	43	597	40	735	44
Calcium channel blocker	195	12	199	13	183	11	822	53	787	53	903	54
ACE inhibitor	60	4	39	3	38	2	342	22	292	20	384	23
AIIRB	20	1	27	2	18	1	161	10	141	10	210	13
Anti-lipid	67	4	155	10	94	6	602	39	678	46	730	44
Other anti-hypertensive	5	0	11	1	6	0	158	10	159	11	140	8

SECTION 14.4: TRANSPLANT OUTCOMES

14.4.1 Post-transplant complications

Sixty-three percent of patients were hypertensive prior to transplantation whereas 27% developed hypertension post transplantation. Fourteen percent of patients had diabetes mellitus prior to transplant whereas only 7% of patients developed post transplant diabetes mellitus. In terms of cardiovascular and cerebrovascular disease 4% had either or both prior to transplant whereas 3% developed these post transplantation.

Table 14.4.1: Post-transplant complications, 2005-2007

Post transplant complications	Complication developed before transplant (regardless of complication after transplantation)						Complication developed only after transplantation					
	2005		2006		2007		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
All patients	1637	100	1592	100	1685	100	1637	100	1592	100	1685	100
Diabetes (either as Primary Renal Disease or co-morbid)	219	13	215	14	228	14	122	7	125	8	113	7
Cancer	2	0	2	0	3	0	19	1	20	1	21	1
Cardiovascular disease + cerebrovascular disorder	78	5	73	5	72	4	45	3	45	3	54	3
Hypertension	1049	64	1032	65	1059	63	438	27	355	22	453	27

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

14.4.2 Deaths and Graft loss

In 2007, 34 transplant recipients died and 36 lost their grafts. The rates of transplant death and graft loss have remained static for the past 10 years (Table 14.4.2). The main known causes of death have been infection and cardiovascular disease with 33% and 18% respectively. Another 10% of patients died at home, which is usually presumed to be cardiovascular death as well.

Cancer death rates have been significantly high since 2003 contributing to 15% of all deaths in 2003, 18% in 2004 and 15% in 2007. Death due to liver disease has remained relatively static at 5-9% from 2003 to 2006.

In terms of graft loss, 69% were due to rejection with 3% apiece for vascular causes and infections in 2007 and these figures have remained relatively stable for the last 4 years.

Table 14.4.2: Transplant Patients Death Rate and Graft Loss, 1998– 2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
No. at risk	1097	1144	1212	1289	1376	1462	1547	1636	1701	1723
Transplant death	26	25	30	37	32	37	41	43	50	34
Transplant death rate %	2	2	2	3	2	3	3	3	3	2
Graft loss	49	36	32	40	38	41	44	21	36	36
Graft loss rate %	4	3	3	3	3	3	3	1	2	2
Acute rejection	0	0	0	0	0	3	19	14	18	10
Acute rejection rate %	0	0	0	0	0	0	1	1	1	1
All losses	75	61	62	77	70	78	85	64	86	70
All losses rate %	7	5	5	6	5	5	5	4	5	4

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

Figure 14.4.2(a): Transplant Recipient Death Rate, 1976-2007

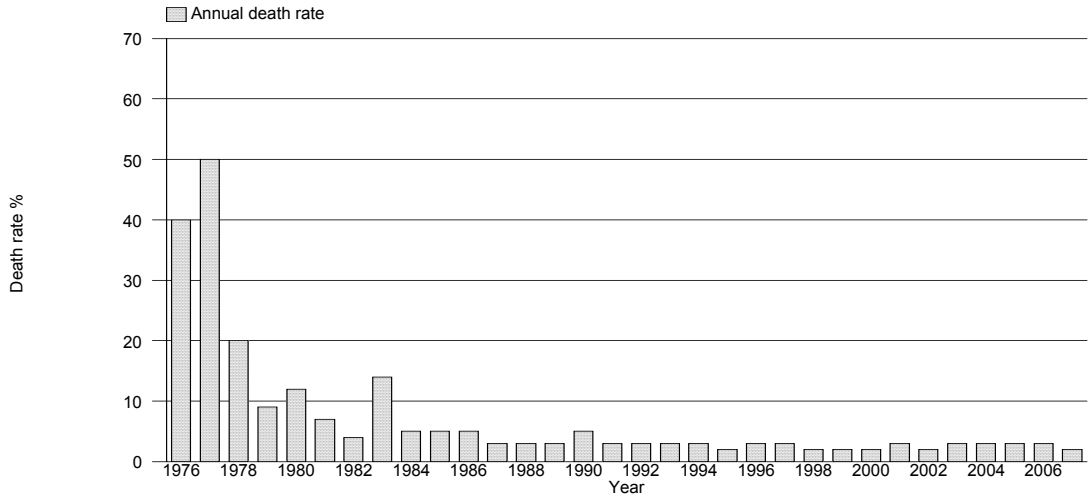


Figure 14.4.2(b): Transplant Recipient Graft Loss Rate, 1976-2007

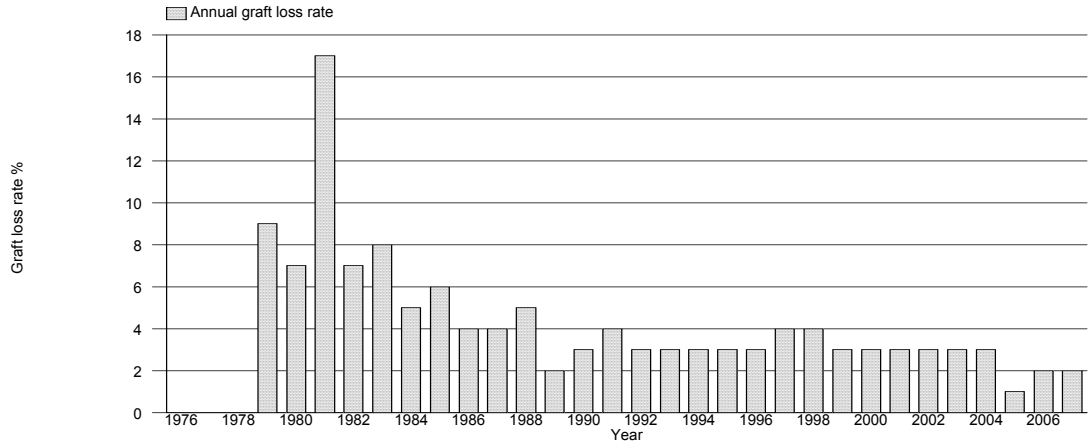


Table 14.4.3: Causes of Death in Transplant Recipients, 1998-2007

Year	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	3	11	4	13	10	29	7	16	5	16
Died at home	4	15	6	19	1	3	5	12	5	16
Infection	10	37	7	23	12	35	20	47	9	28
Graft failure	0	0	0	0	2	6	0	0	0	0
Cancer	3	11	3	10	2	6	6	14	4	13
Liver disease	2	7	3	10	1	3	1	2	3	9
Accidental death	0	0	1	3	1	3	1	2	1	3
Others	2	7	5	16	3	9	2	5	3	9
Unknown	3	11	2	6	2	6	1	2	2	6
TOTAL	27	100	31	100	34	100	43	100	32	100

Year	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	9	23	4	9	5	11	10	18	7	18
Died at home	5	12	6	13	5	11	7	13	4	10
Infection	11	28	11	24	22	50	22	40	13	33
Graft failure	0	0	2	4	0	0	0	0	3	8
Cancer	6	15	8	18	5	11	4	7	6	15
Liver disease	2	5	3	7	3	7	5	9	0	0
Accidental death	0	0	0	0	0	0	0	0	0	0
Others	5	12	10	22	3	7	4	7	2	5
Unknown	2	5	1	2	1	2	3	5	4	10
TOTAL	40	100	45	100	44	100	55	100	39	100

Table 14.4.4: Causes of Graft Failure, 1998-2007

Year	1998		1999		2000		2001		2002	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rejection	28	53	23	64	19	59	25	61	22	55
Calcineurin toxicity	0	0	0	0	0	0	0	0	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0
Infection	1	2	0	0	1	3	2	5	0	0
Vascular causes	3	6	1	3	3	9	1	2	0	0
Recurrent/ de novo renal disease	1	2	0	0	0	0	2	5	2	5
Others	5	9	0	0	2	6	0	0	4	10
Unknown	15	28	12	33	7	22	11	27	12	30
TOTAL	53	100	36	100	32	100	41	100	40	100

Year	2003		2004		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rejection	21	48	33	70	18	75	28	68	25	69
Calcineurin toxicity	0	0	0	0	0	0	1	2	0	0
Other drug toxicity	0	0	1	2	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	1	3
Infection	2	5	1	2	1	4	3	7	1	3
Vascular causes	3	7	4	9	2	8	3	7	1	3
Recurrent/ de novo renal disease	2	5	1	2	0	0	1	2	0	0
Others	1	2	0	0	1	4	3	7	4	11
Unknown	15	34	7	15	2	8	2	5	4	11
TOTAL	44	100	47	100	24	100	41	100	36	100

SECTION 14.5: PATIENT AND GRAFT SURVIVAL

Overall patient survival rates from 1994 to 2007 have been 95%, 91%, 88% and 81% at year 1, 3, 5 and 10 respectively. Overall graft survival rate has been 92%, 85%, 79% and 64% at year 1, 3, 5 and 10 respectively.

Table 14.5.1: Patient survival, 1994-2007

Interval (years)	No.	% Survival	SE
1	1777	95	1
3	1380	91	1
5	993	88	1
10	349	81	1
12	151	76	2

*No.=Number at risk SE=standard error

Figure 14.5.1: Patient survival, 1994-2007

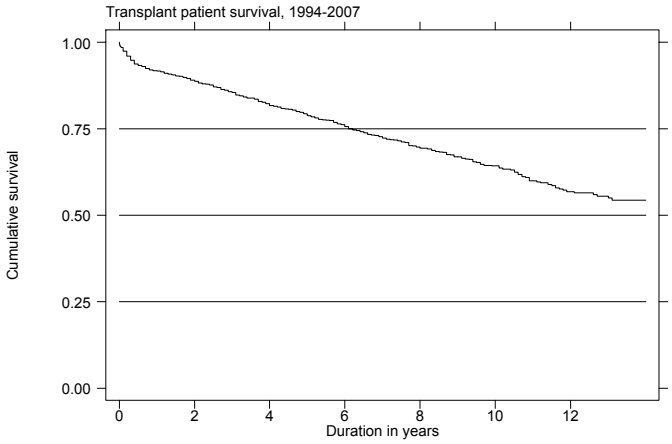
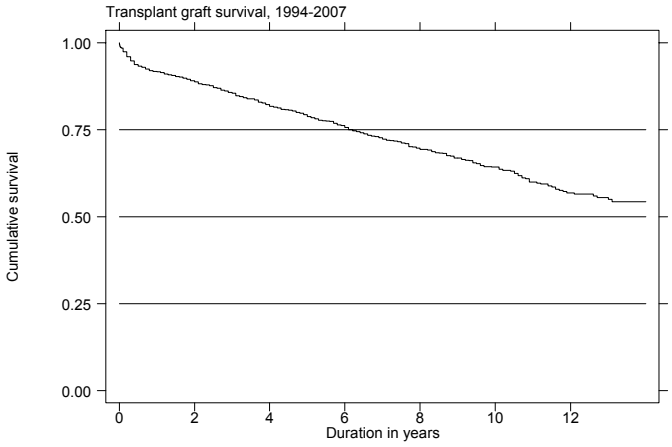


Table 14.5.2: Graft survival, 1994-2007

Interval (years)	No.	% Survival	SE
1	1777	92	1
3	1380	85	1
5	993	79	1
10	349	64	1
12	151	57	2

*No.=Number at risk SE=standard error

Figure 14.5.2: Graft survival, 1994-2007



Outcomes of renal transplantation from the 4 donor groups are shown in respect to patient and graft survival in the Kaplan Meier survival graphs in Figures 14.5.3 and 14.5.4 respectively. In terms of patient survival, live donor grafts maintained the best survival rates with 97%, 95%, 94% and 90% at years 1, 3, 5 and 10 respectively. In terms of graft survival, commercial cadaver grafts performed similarly well with a survival of 94%, 89%, 82% and 70% at year 1, 3, 5 and 10 compared to 92%, 88%, 83% and 69% for the same intervals for live donor grafts.

Table 14.5.3: Patient survival by type of transplant, 1994-2007

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	997	96	1	212	96	1	395	96	1	146	84	3
3	770	92	1	174	90	2	312	95	1	104	79	3
5	500	88	1	144	87	2	254	94	1	80	75	3
10	161	82	2	86	70	4	91	91	2	7	70	4
12	34	77	3	70	65	4	45	87	3	2	-	-

*No.=Number at risk SE=standard error

Figure 14.5.3: Patient survival by type of transplant, 1994-2007

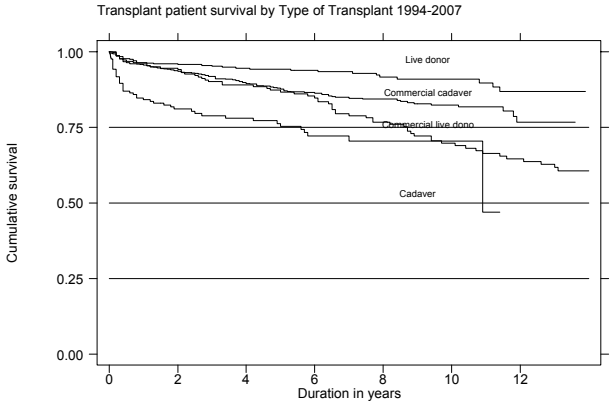


Figure 14.5.4: Graft survival by type of transplants, 1994-2007

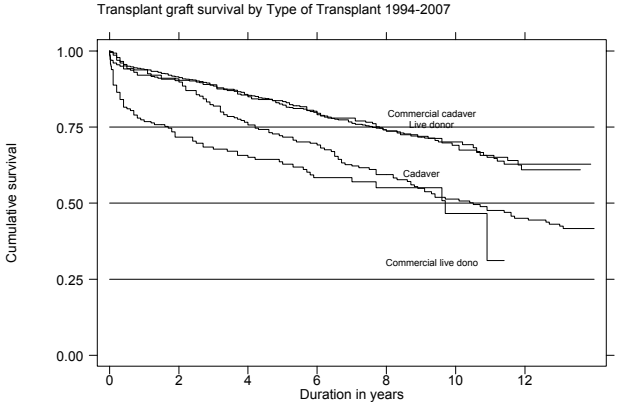


Table 14.5.4: Graft survival by type of transplant, 1994-2007

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	997	94%	1%	212	94%	2%	395	92%	1%	146	77%	3%
3	770	89%	1%	174	82%	3%	312	88%	2%	104	68%	3%
5	500	82%	1%	144	72%	3%	254	83%	2%	80	63%	4%
10	161	70%	2%	86	51%	4%	91	69%	3%	7	47%	7%
12	34	61%	3%	70	45%	4%	45	63%	4%	2	.	.

*No.=Number at risk SE=standard error

Patient and graft survival for living related transplants were compared for two cohorts. The 1994-1999 cohort and the 2000-2007 cohort were compared for patient survival (Figures 14.5.5) but both were comparable and survival remained excellent for both groups.

Graft survival for living related transplants (Figure 14.5.6) however was much better in patients in the 2000-2007 cohort even from the outset probably due to increased usage of newer immunosuppressive agents such as MMF and Tacrolimus.

Table 14.5.5: Patient survival by year of transplant (Living related transplant, 1994-2007)

Year of Transplant	1994-1999			2000-2007		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
1	192	98	1	204	95	1
3	181	96	1	132	94	2
5	169	95	2	86	93	2
7	159	94	2	21	93	2

*No.=Number at risk SE=standard error

Figure 14.5.5: Patient survival by year of transplant (Living related transplant, 1994-2007)

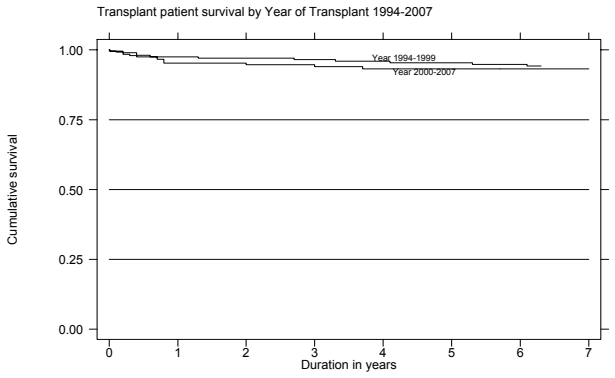


Figure 14.5.6: Graft survival by year of transplant (Living related transplant, 1994-2007)

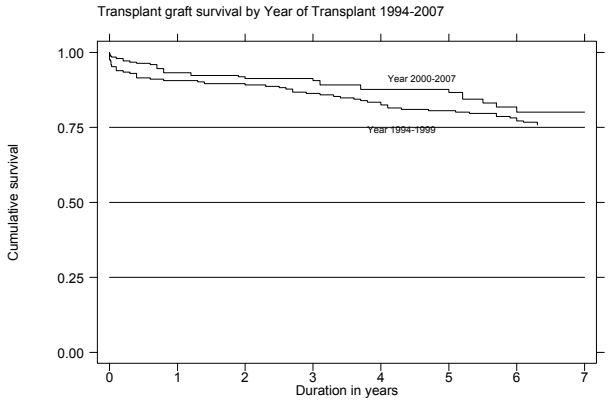


Table14.5.6: Graft survival by year of transplant (Living related transplant, 1994-2007)

Year of Transplant	1994-1999			2000-2007		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
1	192	91	2	204	93	2
3	181	86	2	132	91	2
5	169	81	3	86	87	3
7	159	76	3	21	80	4

In terms of commercial cadaveric transplantation, the comparison between the 1994-1999 cohort and 2000 – 2007 cohort was performed. Both patient and graft survival showed comparable results to living related transplants done within the country.

Table 14.5.7: Patient survival by year of transplant (Commercial cadaver transplant, 1994-2007)

Year of Transplant	1994-1999			2000-2007		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
1	335	95	1	663	96	1
3	317	92	1	453	92	1
5	289	88	2	211	87	2
7	262	85	2	59	85	2

*No.=Number at risk SE=standard error

Figure 14.5.7: Patient survival by year of transplant (Commercial cadaver transplant, 1994-2007)

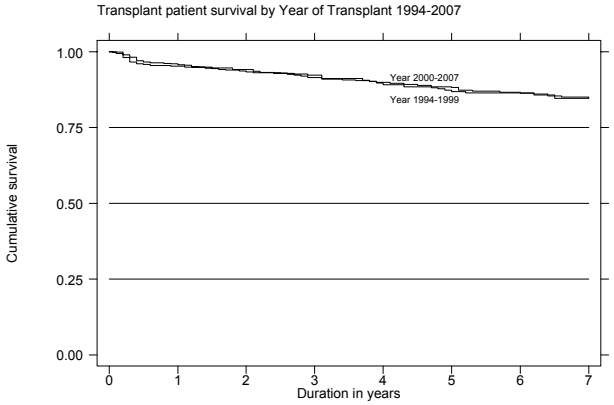


Figure 14.5.8: Graft survival by year of transplant (Commercial cadaver transplant, 1994-2007)

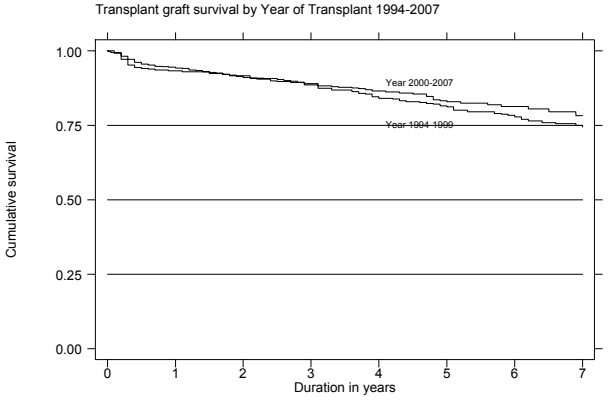


Table 14.5.8: Graft survival by year of transplant (Commercial cadaver transplant, 1994-2007)

Year of Transplant	1994-1999			2000-2007		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
1	335	93	1	663	94	1
3	317	89	2	453	89	1
5	289	81	2	211	83	2
7	262	74	2	59	78	3

*No.=Number at risk SE=standard error

SECTION 14.6: CARDIOVASCULAR RISK IN RENAL TRANSPLANT RECIPIENTS

14.6.1 Risk factors for Ischaemic Heart Disease

In 2007, 89.7% of patients were hypertensive, 21.7% were diabetic and 49.8% had renal insufficiency fulfilling CKD III and above. Forty-five percent of patients had 2 cardiovascular risk factors while 8.3% had all 3 major risk factors.

Table 14.6.1: Risk factors for IHD in renal transplant recipients at year 2005, 2006 and 2007

	2005	2006	2007
Diabetes	19 (1.2)	21 (1.4)	25 (1.6)
Hypertension**	511 (33.4)	456 (31.2)	590 (37.5)
CKD	142 (9.3)	177 (12.1)	126 (8.0)
Diabetes + Hypertension**	160 (10.4)	154 (10.5)	174 (11.1)
Diabetes + CKD	20 (1.3)	18 (1.2)	11 (0.7)
CKD + Hypertension**	538 (35.1)	490 (33.5)	517 (32.8)
Diabetes + CKD + Hypertension**	142 (9.3)	147 (10.0)	131 (8.3)

**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 14.6.1(a); Venn Diagram for Pre and Post Transplant Complications (in %) at year 2005

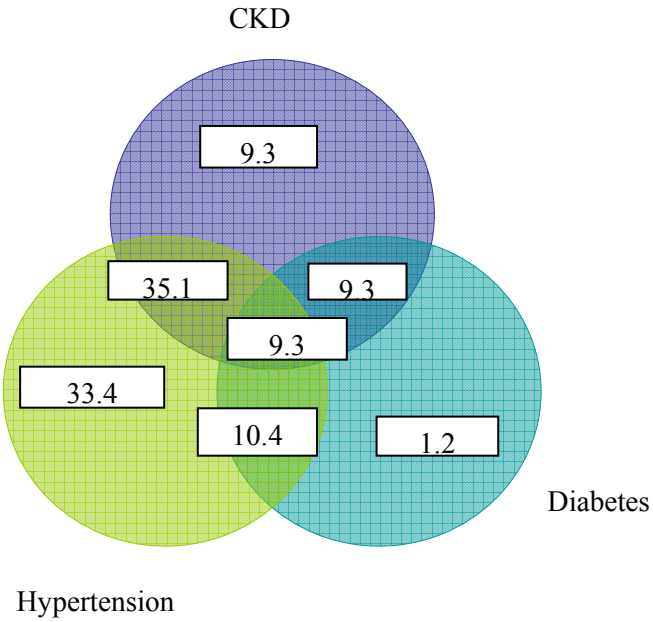


Figure 14.6.1(b); Venn Diagram for Pre and Post Transplant Complications (in %) at year 2006

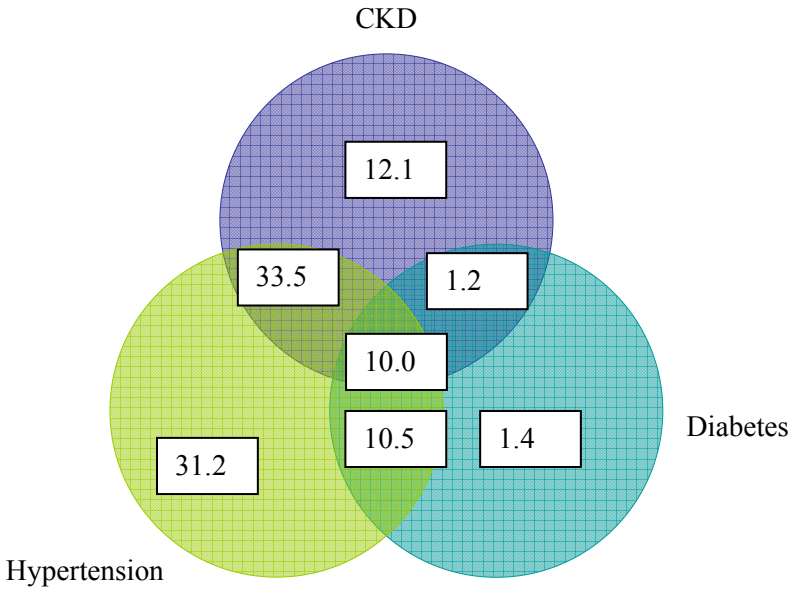
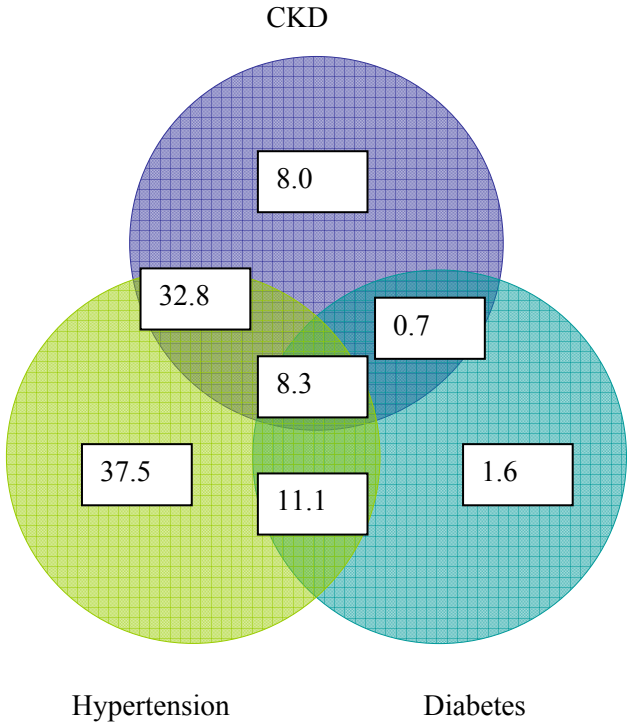


Figure 14.6.1(c); Venn Diagram for Pre and Post Transplant Complications (in %) at year 2007



14.6.2 Blood Pressure classification according to JNC VI criteria, 2005, 2006, and 2007

In 2007, 24.3% of renal transplant recipients had stage I hypertension whereas 5.9% had stage II hypertension and 1% had stage III hypertension despite being on treatment. In terms of diastolic hypertension 15.5% had stage I hypertension, 2.3% of patients had stage II diastolic hypertension and 0.3% of patients had stage III diastolic hypertension despite being on treatment.

Table 14.6.2(a): Systolic BP, 2005-2007

Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
Systolic BP<120	233	(14.25)	249	(15.64)	239	(14.18)
Systolic BP <130	318	(19.45)	395	(24.81)	392	(23.26)
Systolic BP 130-139	475	(29.05)	483	(30.34)	529	(31.39)
Systolic BP 140-159	452	(27.65)	353	(22.17)	409	(24.27)
Systolic BP 160-179	133	(8.13)	93	(5.84)	99	(5.88)
Systolic BP >=180	24	(1.47)	19	(1.19)	17	(1.01)

Figure 14.6.2(a): Systolic BP, 2005-2007

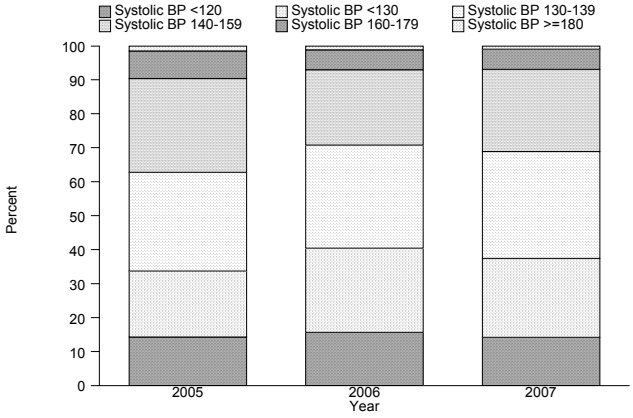


Figure 14.6.2(b): Diastolic BP, 2005-2007

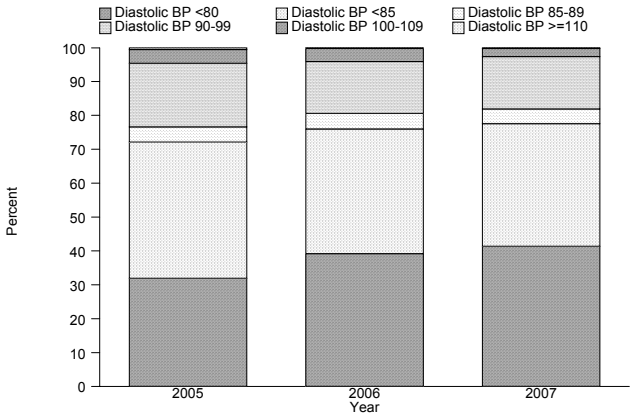


Table 14.6.2(b): Diastolic BP, 2005-2007

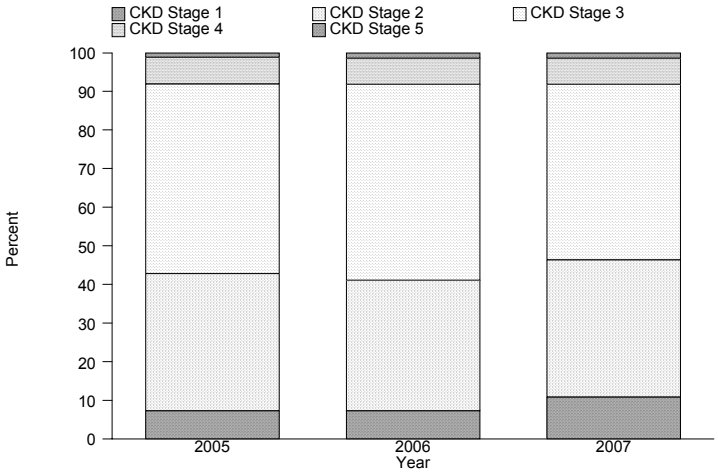
Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
Diastolic BP<80	522	(31.93)	624	(39.20)	697	(41.36)
Diastolic BP <85	657	(40.18)	586	(36.81)	609	(36.14)
Diastolic BP 85-89	73	(4.46)	73	(4.59)	74	(4.39)
Diastolic BP 90-99	308	(18.84)	244	(15.33)	261	(15.49)
Diastolic BP 100-109	65	(3.98)	61	(3.83)	39	(2.31)
Diastolic BP >=110	10	(0.61)	4	(0.25)	5	(0.30)

Table 14.6.3 shows the CKD Stage classification by year and in 2007, 45.5% of renal transplant recipients had CKD Stage III whilst another 6.8% had CKD Stage IV. CKD Stage V (impending renal replacement therapy) was found in 1.4% of renal transplant recipients.

Table 14.6.3: CKD stages, 2005-2007

Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
CKD stage 1	118	(7.25)	116	(7.33)	180	(10.80)
CKD stage 2	579	(35.59)	534	(33.73)	593	(35.57)
CKD stage 3	799	(49.11)	804	(50.79)	758	(45.47)
CKD stage 4	112	(6.88)	107	(6.76)	113	(6.78)
CKD stage 5	19	(1.17)	22	(1.39)	23	(1.38)

Figure 14.6.3: CKD stages by year

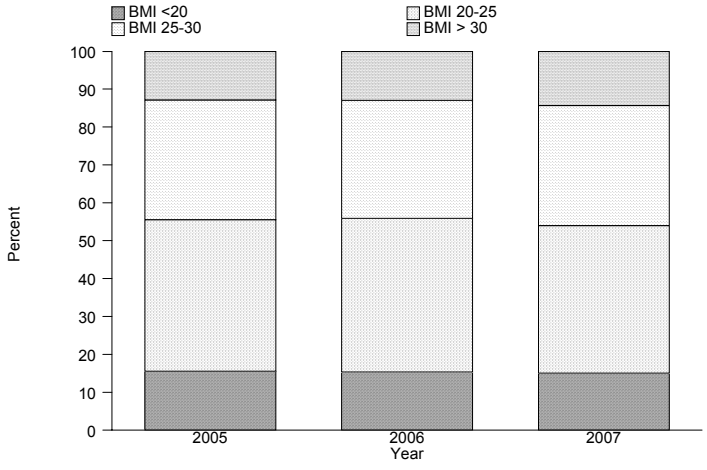


In terms of BMI for 2007, 54% of renal transplant recipients had BMIs of 25 or below. However 31.7% were overweight and 14.3% were obese. There seems to be a slow but steady increase in numbers of obese patients over the last 3 years.

Table 14.6.4: BMI, 2005-2007

Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
BMI <20	254	(15.54)	243	(15.26)	253	(15.01)
BMI 20-25	655	(40.06)	646	(40.58)	657	(38.99)
BMI 25-30	515	(31.50)	497	(31.22)	534	(31.69)
BMI > 30	211	(12.91)	206	(12.94)	241	(14.30)

Figure 14.6.4: BMI by year

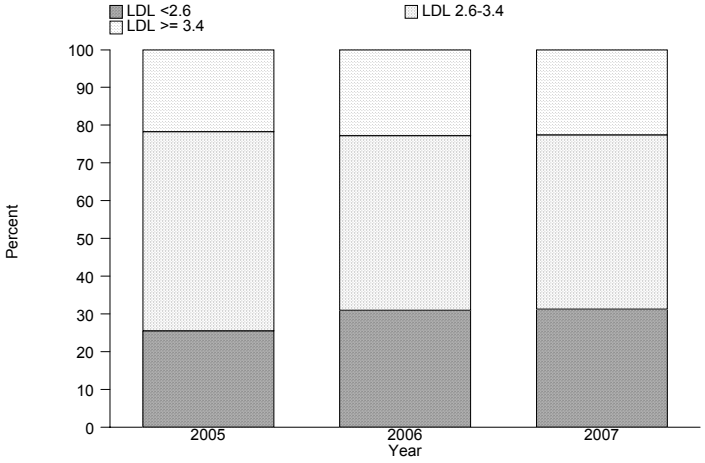


LDL cholesterol has been identified as the primary lipid target for prevention of coronary heart disease by NCEP with a log linear relationship between risk of CHD and level of LDL cholesterol. In terms of renal transplant recipients in 2007 31% have LDL levels below 2.6 mmol/l and this shows an increasing trend from 18.1% in 2004, possibly due to the more widespread use of statins. Whether or not this translates into less cardiovascular mortality in the transplant population is still questionable. Patients with serum LDL >3.4 remained fairly static during the study period at 22.6%.

Table 14.6.5(a): LDL, 2005-2007

Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
LDL < 2.6	418	(25.57)	492	(30.90)	527	(31.28)
LDL 2.6-3.4	862	(52.72)	738	(46.36)	777	(46.11)
LDL >= 3.4	355	(21.71)	362	(22.74)	381	(22.61)

Figure 14.6.5(a): LDL, 2005-2007



In terms of other cholesterol parameters for 2007, 55.6% had total cholesterol levels more than 5.2 and 6.4% had HDL cholesterol levels <1.0.

Table 14.6.5(b): Total Cholesterol, 2005-2007

Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
Total Cholesterol <4.1	159	(9.72)	160	(10.05)	210	(12.46)
Total Cholesterol 4.1-5.1	455	(27.83)	490	(30.78)	539	(31.99)
Total Cholesterol 5.1-6.2	774	(47.34)	700	(43.97)	717	(42.55)
Total Cholesterol 6.2- 7.2	173	(10.58)	173	(10.87)	159	(9.44)
Total Cholesterol > 7.2	74	(4.53)	69	(4.33)	60	(3.56)

Figure 14.6.5(b): Total Cholesterol, 2005-2007

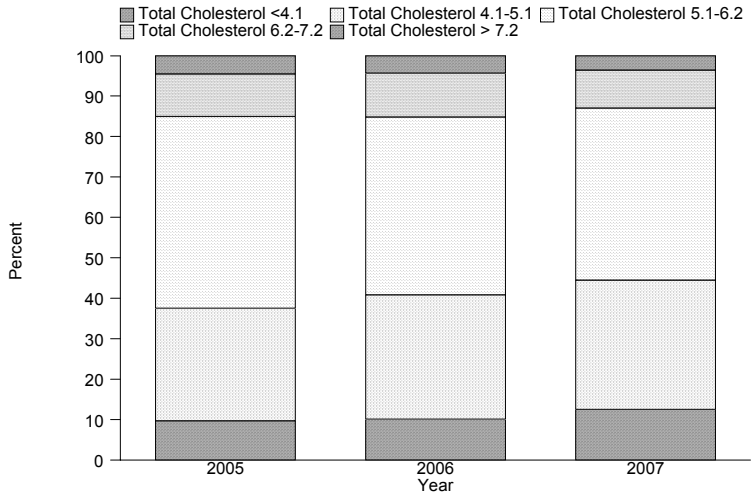
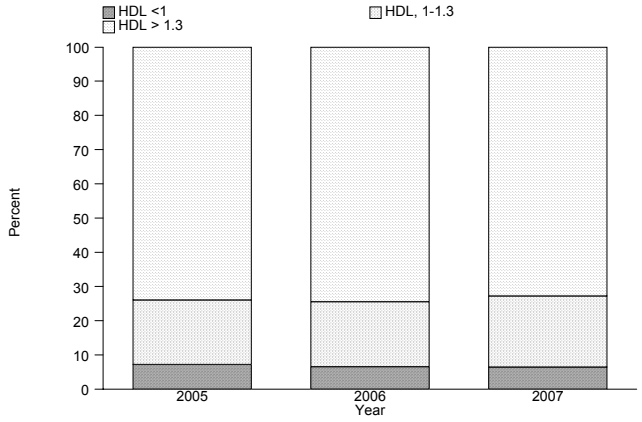


Table 14.6.5(c): HDL, 2005-2007

Year	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
HDL <1	118	7.217125	104	6.532663	108	6.409495
HDL 1-1.3	308	18.83792	302	18.96985	350	20.77151
HDL >1.3	1209	73.94495	1186	74.49749	1227	72.81899

Figure 14.6.5(c): HDL by year



Eighty-five percent of patients in 2007 were on antihypertensives and the majority were on more than 1 antihypertensive drug with 31% on 2 antihypertensives and 21% on 3 antihypertensives. Eight percent of patients still had Systolic BP of > 160 mmHg and 20% had Diastolic BP of > 90 mmHg despite given antihypertensive(s).

Table 14.6.6(a): Treatment for hypertension, 2005-2007

Year	No.	% on anti-hypertensives	% no 1 anti-hypertensive drug	% on 2 anti-hypertensives	% on 3 anti-hypertensives
2005	1635	85	28	30	19
2006	1592	86	34	26	17
2007	1685	85	25	31	21

Table 14.6.6(b): Distribution of Systolic BP without anti-hypertensives, 2005-2007

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2005	229	126.9	15	130	120	137	3
2006	189	123.8	14.4	120	117	130	4
2007	195	125.3	16.5	120	114	134	4

Table 14.6.6(c): Distribution of Diastolic BP without anti-hypertensives, 2005-2007

Year	No.	Mean	SD	Median	LQ	UQ	% patients ≥ 90mmHg
2005	229	79	9	80	70	80	18
2006	189	76.4	10.3	80	70	80	11
2007	195	76.6	10	80	70	80	12

Table 14.6.6(d): Distribution of Systolic BP on anti-hypertensives, 2005-2007

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2005	1350	134.5	17.3	130	120	143	11
2006	1334	131.7	16.3	130	120	140	8
2007	1388	132.6	16	130	120	140	8

Table 14.6.6(e): Distribution of Diastolic BP on anti-hypertensives, 2005-2007

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 90 mmHg
2005	1350	80.8	9.4	80	76	90	25
2006	1334	79.2	9.9	80	70	86	22
2007	1387	79.1	9.6	80	70	85	20

APPENDIX

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 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. RRT centres which have expressed interest in participating will be recruited as SDP.

In the year 2007, there were 44 new haemodilaysis centres participated in NRR. Thus, this is an average of 3.6 new centres per month. Within the same year 3 centres had ceased operation. The number of RRT centres is shown in the table below. The participating rate for government centres was 100%. The overall data submission rate has improved from 80.9% in 2006 to 88.8% and with 100% data submission for PD. We hope to see a better participation in the annual treatment return for the coming years.

	At December 2007 Known centres (N)	Agreed to Participate (N)	Submitting data in 2007 (N)	Submitting annual returns (N)	Submitted data (%)
Haemodialysis	453	450	413	357	91.8
Peritoneal Dialysis	32	32	32	30	100
Transplant	70	70	45	45	64.2
All modality	555	552	490	432	88.8

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.
Six analysis sets were defined:

1. Dialysis patients notification between 1998 and 2007
This analysis set consists of patients commencing dialysis between 1998 and 2007. This analysis set was used for the analysis in Chapter 1, 2 and 4.

This analysis set consists of patients with age commencing dialysis less than 20 years old between 1998 and 2007. This analysis set was used for the analysis in Chapter 6.

Since 1993, the MDTR collected annual returns 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. This analysis set was used for the analysis in Chapters 7 to 13.

2. *Rehabilitation outcomes*
Analysis is confined to the relevant population. Hence we exclude the following groups.
- Age less than or equal to 21 years
- Age more than or equal to 55 years
- Homemaker
- Full time student
- Retired

This analysis set was used for the analysis in Chapter 5.

3. *Centre Survey data*
Section 2.2 in the report was based on annual centre survey data between 1998 to 2007 rather than individual patient data reported to the Registry.

4. *Peritonitis data*
Analysis was confined to CAPD patients who were on peritoneal dialysis from 31st Dec 1999. This analysis set was used for the analysis in Section 13.4.

5. Economics of Dialysis data
This analysis used data from on dialysis provision were from the Malaysian Dialysis and Transplant Registry (1980-2005) and international renal provision data from the Annual Data Report of the US Renal Data Service (2005). Published population and economic data was obtained the Department of Statistics, Malaysia Plan reports (1997-2004), World Economic Outlook Database of the International Monetary Fund (1980-2005), World Development Indicators and HNP Stats from the World Bank (1980-2005).

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 ratio 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 one is 1 and group two is 2, then the odds ratio is 1/2. 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.

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

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

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

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

published clinical practice guidelines, for example, the DOQI guideline; or otherwise they represent consensus of the local dialysis community.

Centre survey data
In contrast to other results reported in this report, Section 2.2 was based on centre survey data rather than individual patient data reported to the Registry. This is to provide an up-to-date information on patient and centre census in the country and thus overcome the inevitable time lag between processing individual patient data and subsequent reporting of results. The survey was conducted in the month of December 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 (Kedah and Perlis) based on geographical considerations. HD treatment capacity is derived by assuming on average patients underwent 3 HD sessions per week and a centre can maximally operate 2.5 shifts per day. A single HD machine can therefore support 5 patients' treatment. Obviously HD treatment capacity is calculated only for centre HD. The ratio of the number of centre HD capacity to number of centre HD patient is a useful measure of utilization of available capacity.

Centre variation
To compare the variation of the intermediate results between centres, graph describing intermediate results in each centre are presented. The 95% confidence intervals have been calculated using the normal approximation of the Poisson to show the variation of proportion in centres. Lower quartile and upper quartile are instead plotted in comparison of variation in median among centres. In the analysis, centres with less than ten patients were combined in a pooled centre. An accompanying table gives the summary statistics like minimum, 5^{th} percentile, lower quartile, median, upper quartile, 95^{th} percentile and maximum value among centres over year.
Centres with intermediate results for <10 patients were combined into one composite centre.

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

Funnel plot
Analysis confined to new dialysis patients from year 2000-2007. 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 were excluded from the analysis.